Full draft of the pan-European environmental assessment

as of 14 February 2022

Note by the Secretariat and UNEP

Summary

The United Nations Economic Commission for Europe (ECE) Working Group on Environmental Monitoring and Assessment has been tasked by the Committee on Environmental Policy with leading a process of consultation on the regular pan-European environmental assessment (ECE/CEP/2017/2, annex II, para. 2 (b)) for consideration by the Committee and leading up to the next Environment for Europe Ministerial Conference.

At its twenty-fifth session (Geneva, 13–15 November 2019), the Committee welcomed the information provided by the secretariat and the United Nations Environment Programme (UNEP) on the next pan-European environmental assessment. Furthermore, it requested the secretariat and UNEP, working in close cooperation with the European Environment Agency, to prepare a limited indicator-based and thematic assessment, and to regularly inform the Bureau of progress made (ECE/CEP/2019/15, para. 37 (k)). At its twenty-sixth session (Geneva, 9 and 10 November 2020), the Committee rescheduled the next Ministerial Conference, to be held in Nicosia, for 5–7 October 2022 (ECE/CEP/2019/15, para. 19 (a)).

At its twenty-seventh session (Geneva, 3–5 November 2021), the Committee welcomed the draft elements of the assessment and took note of the progress made, timeline and next steps for its completion, requested the secretariat to submit the full draft of the pan-European assessment and the draft summary for policymakers for consultation with ECE member States, at the latest by 15 February 2022, and decided to provide comments to the secretariat within one month of receipt.

Foreword & Preface

To be added.

Acknowledgements

This report was produced with financial support from Austria, Germany, the Netherlands, Norway, Serbia and Switzerland. Additional resources were provided by the regular budget of the United Nations.

Sections of the report were drafted by the following experts:

Cornelius Braams	section III.A on atmospheric air
Olivera Kujundzic (Ministry of Ecology, Spatial Planning and Urbanism of Montenegro)	section III.B on climate change
António Guerreiro de Brito, Sergio Costa and Vanessa Ramos (University of Lisbon)	section III.C on freshwater
Claudette Spiteri	section III.D on coastal waters, marine ecosystems and seas
Tobias Garstecki	section III.E on biodiversity and ecosystems
Nikolai Dronin (Moscow State University)	section III.F on land and soil
Sigrid Kusch-Brandt (University of Southampton and Ulm University of Applied Sciences)	section III.G on chemicals and waste
Saraly Andrade De Sa (University of Geneva)	section III.H on environmental financing
Cristina Contreras (Harvard University)	section IV.A on greening the economy in the pan-European region: working towards sustainable infrastructure
Jos van der Sterren, Paul Peeters, Eke Eijgelaar and Tamina Reinecke (Breda University of Applied Sciences)	section IV.B on applying principles of circular economy to sustainable tourism

José de Bettencourt supported the harmonization of the report sections.

The following organizations, bodies and individuals provided inputs to and reviews of the report, with individuals' names being listed alphabetically by surname for each organization:

United Nations Economic Commission for Europe (ECE)	Tea Aulavuo, Ella Behlyarova, Amy Choi, Kristof Douçot, Apolline Louvert, Jose Palacin Lucio, Roman Michalak, Elena Santer, Carolin Sanz Noriega, Angela Sochirca, Sarah Tiefenauer-Linardon, Maryna Yanush and Indira Urazova
United Nations Environment Programme (UNEP)	Matthew Billot, Dominic MacCormack, Tomas Marques, Rowan Palmer, Marika Palosaari, Helena Rey De Assis and Rie Tsutsumi, plus Emily Howland of UNEP World Conservation Monitoring Centre
Organisation for Economic Co-operation and Development (OECD)	Matthew Griffiths, Douglas Herrick, Takayoshi Kato, Kumi Kitamori, Jean-Francois Lengelle,

	Virginie Marchal and Krzysztof Michalak
United Nations World Tourism Organization (UNWTO)	Virginia Fernandez-Trapa
European Environment Agency	Cécile Roddier-Quefelec, Stefan Ulrich Speck and Nihat Zal
members of the ECE Working Group on Environmental Monitoring and Assessment and the ECE Joint Task Force on Environmental Statistics and Indicators	in particular Nicolas Perritaz (Switzerland) and Yuri Tsaturov (Russian Federation)
members of the ECE Committee on Environmental Policy	
individuals	Joana Mira Veiga

Maps were provided by: ISRIC–World Soil Information (Laura Poggio and Rik van den Bosch); Conservation International (Gabriel Daldegan and Alex Zvoleff); and the Secretariat of the United Nations Convention to Combat Desertification (Sara Minelli). The assessment also benefitted from the work of the European Environment Agency and, in particular, cooperation with Adriana Gheorghe and Galina Georgieva.

Preparation of the report was led by ECE staff: Nicholas Bonvoisin and Christine Kitzler, supported by Anelia Rambosson.

Photo credits: depositphotos.com.

Contents

Foreword & preface 2
Acknowledgements 3
Abbreviations 6
Summary for policymakers 8
Chapter I – Setting the scene 22
A. Regular assessment of the state of the environment 22
B. State of knowledge and the Shared Environmental Information System 25
C. Environmental policies in the region 32
Chapter II – Regional context and developments as drivers of environmental change 38
Chapter III – Environmental state and trends 50
A. Atmospheric air 51
B. Climate change 61
C. Fresh water 68
D. Coastal waters, marine ecosystems and seas 80
E. Biodiversity and ecosystems 91
F. Land and soil 99
G. Chemicals and waste 108
H. Environmental financing 118
Chapter IV – Themes for the Ninth Environment for Europe Ministerial Conference 128
A. Greening the economy in the pan-European region: working towards sustainable infrastructure 128
B. Applying principles of circular economy to sustainable tourism 147
Chapter V – Strengthening environmental governance 167
Chapter VI – Way forward 181
Glossary 185

Abbreviations

BACA	Batumi Action for Cleaner Air
BIG-E	Batumi Initiative on Green Economy
BOD	Biochemical oxygen demand
DMC	Domestic Material Consumption
DRR	Disaster risk reduction
ECE	United Nations Economic Commission for Europe
EF	Ecological footprint
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EPEEF	Environmental Protection and Energy Efficiency Fund
EPR	Environmental performance review
ESD	Education for sustainable development
ETS	Emissions Trading Scheme
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GES	Good Environmental Status
GHG	Greenhouse gas
HDI	Human Development Index
IEA	International Energy Agency
IFC	International Financial Corporation
ILO	International Labour Organization
IMF	International Monetary Fund
IOM	International Organization for Migration
ITF	International Transport Forum
IWRM	Integrated water resources management
KBA	Key biodiversity area
LDN	Land Degradation Neutrality
MDB	Multilateral Development Bank
MF	Material Footprint
MPA	Marine protected area
NbS	Nature-based Solutions
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
ODP	Ozone-depleting potential
ODS	Ozone depleting substance
OECD	Organisation for Economic Co-operation and Development
PA	Protected area
PM	Particulate matter

POP	Persistent organic pollutant
PRTR	Pollutant release and transfer register
R&D	Research and development
SEA	Strategic environmental assessment
SF-MST	Statistical Framework for Measuring the Sustainability of Tourism
SOC	Soil organic carbon
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNWTO	United Nations World Tourism Organization
VOC	Volatile organic compound
WHO	World Health Organization

Summary for policymakers

The secretariat of the United Nations Economic Commission for Europe (ECE) and the United Nations Environment Programme (UNEP) have prepared this limited indicator-based and thematic pan-European environmental assessment upon the request of the ECE Committee on Environmental Policy, as input to the Ninth Environment for Europe Ministerial Conference (Nicosia, 5–7 October 2022).

This seventh pan-European environmental assessment reports that progress has been achieved in environmental protection in certain areas, but significant shortcomings remain and pose a threat to the health of both people and the environment in the pan-European region. This summary for policymakers picks out a series of key issues and recommendations from the body of the assessment report. The reader is encouraged to turn to the thematic assessments to learn more.

Note

Throughout the assessment, where feasible and relevant, the following subregions are referred to:

(a) European Union, comprising 27 member States;

(b) Western Europe, comprising Andorra, Iceland, Israel, Liechtenstein, Monaco, Norway, San Marino, Switzerland and the United Kingdom of Great Britain and Northern Ireland;

(c) Central Asia, comprising Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan;

(d) Eastern Europe, comprising Armenia, Azerbaijan, Belarus, Georgia, the Republic of Moldova, the Russian Federation and Ukraine;

(e) South-Eastern Europe, comprising Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia and Turkey.

1. Air quality

Countries in the pan-European region are expanding policies to tackle air pollution. **Some progress has been achieved, but increased effort is needed.** The health impact of long-time exposure to fine particulate matter with a diameter less than 2.5 µm ($PM_{2.5}$) in 41 European countries was reduced by 13 per cent in the period 2009–2018 and that of nitrogen oxides (NO_x) by 54 per cent. However, the number of premature deaths due to ground-level ozone exposure increased in that period by an estimated 24 per cent, possibly caused by higher mean temperatures. **The phasing out of hydrochlorofluorocarbons present as coolant in refrigerators and air conditioning systems remains incomplete**, especially in countries with economies in transition.

Recommendation: Governments in the pan-European region should develop additional technical and organizational measures to achieve target 3.9 of the Sustainable Development Goals, especially for fine particulate matter and ground-level ozone. Key responses are the sharpening and application of best available techniques to prevent emissions of particulate matter, NO_x and hydrocarbons by industry and emission reduction from traffic (by implementing Euro-6 and 7 measures). All countries should update ambient air quality standards to align them with WHO guidelines. Governments should contribute to the adequate replenishment of the Multilateral Fund for the implementation of the Montreal Protocol in order to accelerate the phasing out of hydrochlorofluorocarbons globally.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Ambient fine particulate matter ($PM_{2.5}$) (mg/m^3 in 2016)	☹ (13)	☹ (11)	☹ (25)	☹ (12)	☹ (35)	☹ (16)
Emissions of SOx, NOx and $PM_{2.5}$ (2015–2019)	↗↗↗	↗↗↗	→↘→	↗↗↘	↘↗↘	↗↗→
Consumption of hydrochlorofluoro-carbons, ODP g per capita (2010–2019)	☺ →	☺ →	😐 ↗	😐 ↗	😐 ↗	😐 ↗

Note: trend is ↗ improving (emissions falling), → stable or ↘ worsening; status of $PM_{2.5}$ concentration is ☹ (exceeds WHO air quality guideline of 5 mg/m^3); status of consumption of hydrochlorofluorocarbons is ☺ (phased out) or 😐 (below but close to target). European Union net consumption of hydrochlorofluorocarbons has been below zero since 2010; Western Europe except Israel has zero consumption since 2015, Azerbaijan and Belarus achieved zero consumption in 2019, Kyrgyzstan in 2020.

2. Greenhouse gas emissions

All pan-European countries commit to reduce greenhouse gas (GHG) emissions, but net emissions in the region are still rising. Efforts and achievements are unevenly distributed throughout the region. Reductions, which are mostly achieved in the western part of Europe (2014–2019), are offset by the increase in emissions in the rest of the region. National commitments under the Paris Agreement were renewed by 35 countries in the region with more ambitious targets. However, some countries still do not have firm, quantifiable commitments or mechanisms to follow the progress towards them, which results in significant data gaps.

Recommendation: Governments in the pan-European region should establish the conditions for medium- and long-term sustainable mobilization of funds for climate action both by accelerating the use of available regional and global funds and mechanisms and by creating national financial instruments.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Greenhouse gas emissions (2014–2019) (percentage change)	↗ (-4.3%)	↗ (-10.8%)	–	↘ (+2.0%)	↘ (+10.2%)	↗ (-1.2%)

Note: trend is ↗ improving (emissions falling), → stable or ↘ worsening. Insufficient data for Central Asia, where emissions are rising.

3. Decarbonization

Decarbonization is becoming a strong narrative across the pan-European region, but action lags behind. The use of renewables was increased in 29 countries in the pan-European region in the period 2013–2017, but the region still largely relies on fossil fuels – some 78 per cent of the total final energy consumption in average comes from fossil fuels. The penetration of renewables in the energy mix rises more slowly than the increase in the total final energy consumption in the region.

Recommendation: Governments in the pan-European region should eliminate or reform harmful subsidies and incentives, and develop effective positive incentives to deepen decarbonization, by shifting promotion of investments towards renewable energy.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Renewable energy share in total energy consumption (2014–2018) (latest rate)	→ (18%)	↗ (18%)	↗ (4%)	→ (4%)	→ (14%)	→ (13%)

Note: trend is ↗ improving, → stable or ↘ worsening.

4. Fresh water quantity and quality

Water quantity has an asymmetric space and time distribution in the pan-European region and climate change is delivering additional challenges with impacts on human health through various water-related phenomena such as floods, droughts, water-borne diseases and biodiversity changes in aquatic ecosystems. **Anthropogenic pressures amplify water asymmetry by constraining fresh-water quality and aquatic biodiversity.** River basins, lakes and aquifers are subject to multiple stressors. Diffuse pollution and urban and industrial wastewater discharges remain significant in many locations and persistent organic contaminants are of greater public health concern. Science is advancing to provide solutions and foster new processes and technologies to face these negative impacts.

Recommendation: Whenever fresh waters and aquatic ecosystems are at risk, the best available technology should be applied. Some examples of high readiness solutions include water conservation measures and conventional mitigation approaches, plus measures for resource protection and more efficient water use, such as digitalization and precision agriculture, nature-based solutions for water retention basins or in riparian zone restoration, and the use of new methods for environmental flow regimes. Non-conventional water sources deserve proof of concept opportunities.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Proportion of bodies of water with good ambient water quality, for countries having data available (national value ranges by subregions):						
(2017)	(34–100%)	(80–100%)	-	(96%)	(6–94%)	(6–100%)
(2020)	(41–99%)	(61–100%)	(64%)	(89–96%)	(31–88%)	(31–100%)

Note: Based on the available information, with no data produced for several countries in 2017 and 2020 and different countries having data in each year. Insufficient data for Central Asia in 2017.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Proportion of population using safely managed drinking water or sanitation services:						
Drinking water, 2016–2020 (latest rate)	↗ (97.8%)	→ (99.3%)	↗ (69.6%)	↗ (79.9%)	↘ (78.0%)	↗ (90.4%)
Sanitation, 2016–2020 (latest rate)	↗ (90.5%)	↗ (95.9%)		↗ (61.5%)	↗ (70.0%)	↗ (81.4%)

Note: trend is ↗ improving, → stable or ↘ worsening. No data for some countries. Insufficient sanitation data for Central Asia.

5. Fresh water – financing

Financing of water-related projects under the international climate agenda has been limited and setting up bankable projects is difficult. Financing models are highly susceptible to technical and governance insufficiencies and have been restrained by local and regional crises during the past decade.

Recommendation: Economic sustainability in water resources management should be pursued and innovative financing mechanisms are still required. Natural and man-made infrastructure development may use several financing tools (for example, fair water pricing, ecological payments, cost recovery and incentives) but a clear legal framework is vital for success.

6. Integrated water resources management and transboundary water cooperation

Increasing water resources management challenges indicate that fragmented governance practices are unlikely to succeed in the long term. Granularity of information is important for better knowledge and involving public and private actors is becoming fundamental to successful water policy and good decision-making. **Transboundary management of shared rivers, lakes and aquifers remains a challenge.** The problem is acute when upstream water abstraction or retention is significant and downstream countries lack alternative water sources. Despite some good examples, cooperation and participatory processes for water protection, allocation and other practical achievements are not implemented as in depth as they could be in the pan-European region.

Recommendation: Integrated water resources management should be pursued, involving a balance between human water needs and water's availability for nature. Water policy should enhance its interdisciplinarity and transdisciplinary character to maximize societal impact. Therefore, the water-food-energy-ecosystems nexus should strengthen an anticipatory policy approach to combining short-term projects with a long-term vision for the pan-European region. Water resources management is more efficient at the basin level and good governance is required to bring success to technology and financing. This integrated approach is even more critical in international rivers, lakes or aquifers where floods or droughts are likely to occur. Co-management should be pursued towards environmental protection and benefit-sharing within an efficient and resilient transboundary cooperation framework in the subregions, as envisaged by the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Proportion of transboundary basin area with an operational arrangement (2017 and 2020):						
For rivers and lakes (percentage change)	↘ (-1%)	↗ (+20%)	↘ (-7%)	↗ (+19%)	↘ (-1%)	↘ (-0.6%)
For aquifers (percentage change)	↘ (-2%)	↗ (+49%)	no data	↘ (-19%)	↘ (-17%)	↗ (+4.5%)

Note: trend is ↗ improving or ↘ worsening. Based on the available information, with no data produced for several countries in 2017 and 2020. No reported arrangements for aquifers in Central Asia.

7. Ecosystems

The status of ecosystems remains a cause for concern, with no evidence of a clear positive trend. Only a minority of the habitats assessed at the European Union level have a good conservation status, and the overall picture is likely to be similar in the remaining region. The relative share of the particularly biodiversity-rich primary and intact forests has been stable at a very low level over the same period. Forest fragmentation remains an important pressure. **There are significant variations in the proportion of sustainable fish stocks.** The Mediterranean Sea and Black Sea remain highly overfished, whereas signs of recovery of fish stocks can be observed in the North-East Atlantic Ocean and the Baltic Sea as a result of improved management decisions (see also point 10 below). **Land continues to be taken for infrastructure development** in the pan-European region, but the rate of land take has decreased in most European Environment Agency member countries and even reversed in Eastern Europe (see also point 9 below)

Recommendation: Governments in the pan-European region should establish the conditions for medium- and long-term sustainable mobilization of funds for biodiversity and other environmental components both by accelerating the use of available regional and global funds and mechanisms and by creating national financial instruments. Governments should also eliminate or reform subsidies and incentives for products and activities that lead to biodiversity loss, and develop effective positive incentives to mainstream biodiversity conservation across sectors and policies, promoting biodiversity conservation and sustainable use of resources. Further, Governments should ensure that trends in forest area remain positive and take additional measures to safeguard the remaining primary and intact forests and their ecological functionality, for example, by promoting management standards aimed at preserving high-conservation value forest and by preventing forest fragmentation and thus enhancing forest connectivity.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Land take (2012–2018), as proportion of total land area	↘	↘	↘	↗	↘	↘
Rate 2012–2018 compared with 2006–2012	↗	↘	↗	↗	↘	↗

Note: trend is ↗ improving, → stable or ↘ worsening.

8. Protected areas

The protected area estate in the pan-European region has almost tripled, and the overall forest area in the ECE region has increased by 33.5 million ha over the past 30 years. The coverages of terrestrial and marine protected areas increased over the period since 2000 and are 13.6 and 9.2 per cent, respectively, for the overall pan-European area (below the 17 and 10 per cent goals in Aichi target 11). Marine protected areas have grown in area by 66 per cent and terrestrial ones by 22 per cent over the past five years. Despite progress in terrestrial and marine protected areas, overall biodiversity loss continues to occur.

Recommendation: Governments in the pan-European region should consolidate and improve the extended protected area network in the region through investment in management effectiveness, ecological representativeness and connectivity, i.e. making sure that protected areas are connected to each other to foster movement of fauna and that they represent the variety of ecosystems in the country. Further efforts are needed, in particular in Eastern and South-Eastern Europe, to achieve the target of conservation of 10 per cent of coastal and marine areas in the pan-European area.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Proportion of terrestrial area protected (2021)	↗ ☺ (26.1%)	↗ ☺ (27.0%)	↗ ☹ (9.0%)	↗ ☺ (11.5%)	↗ ☹ (7.4%)	↗ ☹ (13.6%)
Proportion of marine area protected (2021)	↗ ☺ (15.2%)	↗ ☺ (17.1%)	↗ ☺ (31.9%)	↘ ☹ (2.3%)	↗ ☹ (1.8%)	↗ 😐 (9.2%)

Notes: trend is ↗ improving, or ↘ worsening; status is ☺ (area nominally meets the Aichi target 11 of 17 per cent of terrestrial and inland water, 10 per cent of marine areas) or ☹ (does not meet) or 😐 (below but close to target).

9. Land use and soil

Land use and land-use change dynamics in the pan-European region continue to be mainly driven by agriculture. Erosion can be further reduced in most affected areas by

implementing conservation agriculture.[1] Conservation agriculture practices in the pan-European region may also play an important role in carbon sequestration and raising soil productivity by increasing soil organic carbon content. In Eastern Europe the average rate of soil erosion decreased over the last 30 years following massive cropland abandonment and climate change. In the Russian Federation, the total amount of washed soil and the rate of erosion have been reduced by 56.1 and 15 per cent respectively in the last 30 years due to the widespread abandonment of cropland and lower spring runoff. Land continues to be taken for infrastructure development in the pan-European region, but land take has decreased in most member countries of the European Environment Agency.

Recommendation: Governments in the pan-European region should provide better guidance to farmers on using soil conservation methods in areas of degraded (eroded) soils. Policies should also maintain a judicious balance between soil organic carbon accumulation for higher crop productivity and soil organic carbon storage for climate change mitigation, in line with initiatives that aim, for example, to boost carbon storage in agricultural soils by 0.4 per cent each year. Measures should also address the conversion of natural to agricultural ecosystems and the degradation of habitat quality due to biodiversity-unfriendly agricultural practices, for example, by using more targeted use of subsidies and other incentives for sustainable agriculture. Further, Governments should take measures to reduce land take further and consistently.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Land take rate (in 2012–2018)	↗ ☹ (0.05%)	↘ ☹ (0.06%)	↗ ☹ (0.15%)	↗ ☺ (-0.23%)	↘ ☹ (0.15%)	↗ ☹ (0.08%)
Proportion of land that is degraded (2005–2019) (net land with improvement)	↗ (39%)	↗ (31%)	↗ (18%)	↗ (26%)	↗ (51%)	↗ (28%)
Soil organic carbon content (2005–2019) (net land with improvement)	↘ (-0.2%)	→ (0%)	↗ (+0.7%)	↗ (+0.7%)	↗ (+0.4%)	↗ (+0.5%)

Notes: trend is ↗ improving (for land take, rate is improving if 2012–2018 rate was lower than 2006–2012 rate), → stable or ↘ worsening; status of land take rate in 2012–2018 is ☺ (negative) or ☹ (positive). Land may be improving but still degraded.

10. Marine protection

Marine pollution, from both land-based (for example, nutrients, plastic and chemicals) and sea-based (for example, plastic and oil) sources, continues to be an urgent problem in most sea regions. Beach and marine litter, dominated by plastic, is recognized as a major global threat to coastal and marine ecosystems in most areas, including remote and less populated areas such as the Barents Sea. At the same time, climate-induced changes in coastal and marine ecosystems are occurring with as yet unknown impact, such as increasing sea surface temperatures by about 0.2 °C per decade in the North Atlantic and 0.5 °C per decade in the Black Sea (since 1981) and observed acidification of surface water, at a rate of approximately 0.02 pH units per decade, in the sea regions surrounding the European Union (and across the global ocean). **A holistic and ecosystem-based approach to the management of coastal waters and marine ecosystems that addresses the combined effects of multiple pressures is progressively integrating social, economic and**

[1] According to the Food and Agriculture Organization of the United Nations, conservation agriculture is a farming system that promotes minimum soil disturbance (i.e. no tillage), maintenance of a permanent soil cover, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency and to improved and sustained crop production.

governance aspects. Such an approach applies equally to the use of nature-based solutions in sustainable infrastructure for enhancing coastal resilience and able to withstand the effects of climate change, and to the transition to sustainable coastal and maritime tourism as part of the recovery after the coronavirus pandemic (COVID-19) situation. The Mediterranean and Black Seas remain highly overfished, whereas signs of recovery of fish stocks can be observed in the North-East Atlantic Ocean and the Baltic Sea as a result of improved management decisions.

Recommendation: Governments in the pan-European region should take urgent action to reduce key pressures to halt and reverse the degradation of coastal waters, marine ecosystems and seas (see also points 7 and 8 above). They should also increase efforts to complement inventories of the number of items of beach and marine litter with information on composition and sources of litter to be able to design more effective measures, in particular where subregional measures are deemed necessary.

	Baltic Sea	Black Sea	Mediterranean Sea	North-East Atlantic
Number of items on beach per 100 m of shoreline, median (2014 –2019)	78	652	428	105
Proportion of assessed marine fish stocks of Good Environmental Status (2018)	13%	0%	0%	44%

11. Waste management

While the waste management hierarchy assigns highest priority to waste prevention, waste generation continues to rise across the region. Even where a strong political commitment for a circular economy exists, such as in the European Union and other western European countries, the generated waste quantities are growing. Recycling rates differ significantly among the countries and are particularly low in Eastern Europe and Central Asia. Municipal waste recycling rates above 45 per cent exist only in a few European Union countries and Switzerland. Progress is being achieved in all subregions, but slowly. Average electrical and electronic equipment waste (e-waste), which contains both hazardous and precious components, is stabilizing in the region as a whole, but continues to increase rapidly in the economically less mature subregions. E-waste collection and recycling are highly deficient across all subregions; the recovery rates are low.

Recommendation: Governments in the pan-European region should support waste prevention in production and consumption and repair, refurbishment and remanufacturing, including through financial incentives such as tax reliefs, in order to reduce waste. These waste prevention efforts would improve resource efficiency. Governments should also equip public administrations with a skilled work force, ready to engage with all sectors of society, and to increase broad access to reliable and detailed information, in order to achieve sound management of chemicals and waste. The countries of the region should establish a resource-oriented, pan-European e-waste management partnership, which would aim at the effective collection and sound handling of recyclables to enable the recovery of valuable resources. An urgent priority is the recovery of secondary resources from e-waste, especially in view of the rapidly growing quantities across Eastern Europe, South-Eastern Europe and Central Asia.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
e-waste generation per capita (kg in 2019)	↗ ☹ (18)	↗ ☹ (23)	↘ 😐 (7.0)	↘ ☹ (10)	↘ ☹ (9.9)	→ ☹ (15)
Total waste per capita (2018)	↘	↘	↘	↘	↘	↘

Note: trend is ↗ improving, → stable or ↘ worsening; status of e-waste generation is 😐 (at the global average of 6.95 kg per capita in 2019) or ☹ (above the global average rate).

12. Chemicals

Chemicals play a vital role in the economy and are essential in paving the way towards a green economy, but it remains difficult to capture what is our full exposure to hazardous chemicals. Chemicals and waste management are at the heart of many solutions to the current challenges that countries face in their transition to a net zero GHG emission and sustainable economy.

Recommendation: Governments in the pan-European region should strengthen their waste and chemicals management systems. Governments should strive to further advance full and coherent implementation of multilateral environmental agreements, including the Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (see also point 18 below).

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Reporting under Basel, Rotterdam and Stockholm Conventions (average for 2015–2019)	↘ (82%)	↘ (51%)	↘ (33%)	↘ (57%)	↗ (75%)	↘ (68%)

Note: trend is ↗ improving or ↘ worsening.

13. Minerals

Minerals too are critical for the transition to a net zero GHG emission and sustainable economy, in particular those used in electric and electronic gear and batteries. An important opportunity to harness economic value for the region and to reduce the region's dependency regarding the sourcing of critical raw materials, which are bottlenecks in the shift towards resilient future economies, exists but it is not yet being tackled.

Recommendation: Governments in the pan-European region should adopt a circular – or resource efficient – economy approach and strengthen management of raw materials.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Material footprint, tons per capita, trend since 2000 (2017)	↘ (23.3)	↗ (24.6)	↘ (10.4)	↘ (9.8)	↘ (16.2)	↘ (18.5)

Note: trend is ↗ improving or ↘ worsening.

14. Disaster risk reduction

About 65 per cent of the population in the pan-European region is covered by local disaster risk reduction strategies.[2] Only 15 countries in the region reported that all their local authorities are implementing such strategies under the Sustainable Development Goal target 13.1, while 23 countries, which jointly represent a quarter of the region's population, do not report on that target.

Recommendation: Governments in the pan-European region should strengthen awareness of climate hazards, especially among poorer communities, and establish conditions to report regularly on the Sustainable Development Goal target 13.1 and under the Sendai Framework for Disaster Risk Reduction 2015–2030.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Countries having local disaster risk reduction strategies	→ ☺	↗ 😐	↗ 😐	↗ 😐	→ ☹	↗ 😐
Countries reporting under target 13.1	😐	☹	😐	😐	😐	😐

Note: trend is ↗ improving, or → stable (or no trend information); status of countries having local disaster risk reduction strategies is ☺ (majority of countries reporting report 100 per cent of local governments implementing DRR strategies), 😐 or ☹ (majority of countries reporting report less than 5 per cent of local governments); status of reporting is ☺ (all countries reporting), 😐 or ☹ (less than half of countries reporting).

15. Finance

In all countries across the pan-European region for which data are available, environmental tax revenues and government expenditures on environmental protection, closely following GDP growth, have increased since 2000. However, in terms of percentage of GDP, public expenditure for environmental protection (with a maxi mum of around 0.8 per cent) is much lower than environmental tax revenues, implying that revenues from environmental taxes are not necessarily earmarked for reducing environmental damage. Nonetheless, environmental expenditures for environmental protection made by Governments are only a subset of total environmental protection expenditures in each country. Green bonds have emerged as a tool for financing environmental-friendly projects, by both the private sector and Governments. Despite their negative impacts on the environment, all countries continue to implement fossil fuel subsidies to varying degrees. International Monetary Fund projections suggest that these subsidies will remain in place at least until 2025, with implicit subsidies increasing until that time.

Recommendation: Governments should favour the development of green finance and consider spending on environmental protection in the wider context of environmental and public finance. Environmental taxes should be used to decrease different kinds of pollution, and the income generated should be primordially used to finance environmental protection public expenditures. Governments should use subsidies only when they are really necessary, as they always distort markets and increase public sector deficit. They should also periodically reconsider environmental subsidized finance in the light of the polluter pays principle. and regularly perform impact assessment analysis of such funding, so that the funds can bring a genuine value added. Besides, Governments should envisage green bonds, in particular, through a series of policies including demonstration issuance, dissemination of clear guidelines for green bonds issuance and implementation of favourable regulatory policies, as complementary tools for environmental financing along more traditional ones

[2] Local governments are determined by the reporting country for the corresponding Sustainable Development Goal indicator (11.b.2), considering sub-national public administrations with responsibility to develop local disaster risk reduction strategies.

such as taxes and fees. National environmental policies across the pan-European region should aim at phasing out harmful subsidies and transitioning towards greener energy sources quickly.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Government environmental protection expenditures, as percentage of GDP, 2015–2019 (latest rate)	↘ (0.73%)	↘ (0.67%)	↗ (0.17%)	↗ (0.22%)	↗ (0.45%)	↘ (0.58%)
Total fossil fuel subsidies, 2015–2020 (per cent change)	↗ (-19%)	↗ (-32%)	↘ (+37%)	↗ (-1.2%)	↘ (+32%)	↗ (-3.2%)

Note: trend is ↗ improving (increasing percentage of GDP spent on governmental environmental protection, or declining fossil fuel subsidies) or ↘ worsening. The subregional Government environmental protection expenditures are simple unweighted averages across the countries.

16. Sustainable infrastructure

Sustainable infrastructure investment has been recognized as one of the most impactful strategies to build back better in the post-COVID recovery. There is a recent common understanding that sustainability solutions should be incorporated as early as possible in the strategic planning phase. However, most pan-European countries have yet to develop mechanisms to incorporate sustainability considerations (such as climate risk) and externality accounting (like the cost of pollution, ecosystem services, or biodiversity protection) in the cost-benefit analysis of large infrastructure projects, while this analysis is not a legal requirement in many countries. Access to basic drinking water services is consistently above 90 per cent across the pan-European subregions, except in rural Tajikistan where access is below 75 per cent. Sanitation access ranges, for example, from 82.3 per cent in rural Eastern Europe to 99.5 percent in urban South-Eastern Europe and Western Europe, the average being 96.3 per cent. The pan-European region shows full access to electricity, and countries have at least over 83.8 percent coverage of 3G telecommunications. The challenges are currently to guarantee that there is an increase in sustainable infrastructure, using nature-based solutions, resource efficiency, recycling and reuse, in an environmentally responsible, socially inclusive and economically viable way. It is important to guarantee that the needs of all stakeholders are identified and addressed, and that infrastructure is conceived to be flexible in its use, interconnected and able to employ real-time information to adapt to the changing conditions (including climate risk, changes in service demand and migration patterns, among others).

Recommendation: Governments should participate in a pan-European effort to create a common understanding of what sustainable infrastructure means and define a common strategy to quantify progress across nations. Governments should make use of existing tools to promote sustainable infrastructure development, including the ECE Protocol on Strategic Environmental Assessment, and devote additional resources to achieve the institutional and technical capacity necessary for the planning, design, execution, operation and decommissioning of sustainable infrastructure projects. Governments should also deploy economic and financial incentives – in the short and medium terms – to support the implementation by the private sector of nature-based solutions into infrastructure projects. Besides, Governments should establish favourable conditions to implement a life-cycle approach and circular economy strategies aligned with or similar to the Pan-European Strategic Framework for Greening the Economy in sustainable consumption and production patterns, or other initiatives such as the European Union taxonomy.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Corruption Perceptions Index (2020)	↗ (64)	↘ (76)	↗ (28)	↗ (40)	↘ (38)	↗ (55)

Note: trend is ↗ improving or ↘ worsening over period 2012–2020, with 0 being the highest and 100 being the lowest level of corruption. Simple average of national values per subregion.

17. Sustainable tourism and circular economy

A pan-European circular tourism economy will be more resilient to and better equipped to cope with future crises, be they economic, health-related, or derived from the environmental challenges that the region faces. It is essential for the sustainable development of tourism and can contribute to the achievement of the Sustainable Development Goals. With the rapid growth of tourism, its impacts are growing despite efficiency improvements, increasingly contributing to environmental crises and social issues. The application of circular principles in tourism is still in its infancy, apart from individual cases. Many sharing economy initiatives currently have too many non-circular counter effects. Key areas in tourism with a strong relation to both Sustainable Development Goals and the circular economy are energy use and emissions in transport, accommodation and restaurants, waste management of accommodation and restaurants (including food waste), water consumption and generation of wastewater in general, and resource usage in building, for interiors, and in amenities. Opportunities may be most straightforward in construction and operations, including (food) waste management, of accommodations and restaurants. Tourism, under the condition of its sustainable development, has the potential for long-lasting positive impacts beyond the sector itself, due to its interlinkages with other economic activities and the direct producer-consumer interaction. Indicator development for the monitoring of circularity in tourism is hampered by data availability and definitional issues.

Recommendation: Governments should increase efforts together with entrepreneurs to apply circular economy principles across the tourism value chain, and promote knowledge creation and the sharing of good practices. Direct investment in the wake of the COVID-19 pandemic and in preparation of recovery plans might include the promotion of domestic and nearby country tourism, with the scaling-up of international, long-distance rail infrastructure, and electric charging infrastructure in tourism destinations, facilitating the transition towards renewable energy use by accommodation. Governments should work together to promote tighter product loops, which are easier to make circular, and establish incentives to promote resource efficiency and sustainable consumption. ECE member States need to select a number of specific key-impact tourism indicators to be included in ECE statistical databases. Indicators for circular economy in tourism should be aligned with those being developed for the monitoring of sustainable development in tourism and be compatible with Sustainable Development Goals.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Renewable energy share in total energy consumption (2014–2018) (latest rate)	→ (18%)	↗ (18%)	↗ (4%)	→ (4%)	→ (14%)	→ (13%)
Percentage domestic tourism of total trips by nationals (2019)	73%	54%	90%	79%	89%	73%
Percentage air transport of all inbound trips (2019)	47%	79%	13%	21%	56%	49%

Note: trend is ↗ on average improving, or → on average stable; limited data for domestic trips (all of the European Union, but only Norway and Switzerland in Western Europe, Tajikistan in

Central Asia, Armenia, Azerbaijan and Georgia in Eastern Europe, and North Macedonia and Turkey in South-Eastern Europe) and inbound trips by air (only 14 European Union Member States, Iceland and the United Kingdom in Western Europe, Kyrgyzstan and Uzbekistan in Central Asia, not the Republic of Moldova or the Russian Federation in Eastern Europe, and only Albania, Bosnia and Herzegovina and Turkey in South-Eastern Europe).

18. Environmental governance

The environmental governance system in the pan-European region remains partly fragmented in terms of applied policies, institutions, the harmonization of legislation and the participation of the 54 countries in multilateral environmental agreements (MEAs), which is incomplete. The assessment of state and trends and policy recommendations in the thematic chapters of this report indicate the need to strengthen the environmental governance system and existing policies in the region and to make adjustments to address substantive gaps. Gaps remain also in the implementation good environmental governance including in relation to public participation, transparency, responsiveness, effectiveness and efficiency, with implications for the environment and health of the region.

Recommendations: Governments, the private sector, academia and citizens must work together to achieve the Sustainable Development Goals, including in a transboundary context. They should explore new partnerships on topics such as circular economy, sustainable infrastructure, resource efficiency and waste management. Governments should consider joining MEAs to which they are not yet party so as to enhance the coherency and harmonization of policies and legislation. They can also use the Pan-European Strategic Framework for Greening the Economy as a framework for commitments on circular economy, resource efficiency and sustainable infrastructure development including through promoting nature-based solutions. Finance should be redirected to these areas in support of a just transition. The effectiveness of such investments needs to be monitored and evaluated. Successful outcomes are more likely when public participation in planning and implementation of actions is assured, gender is mainstreamed and public access to reliable and timely information is guaranteed. Governments should seek to enhance science-policy linkages and the rapid deployment of innovative solutions, while investing in digitalization. Other recommendations in the summary and the assessment provide further details on steps to be taken to improve governance in the future.

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Proportion of 12 MEAs to which countries are party	93%	47%	40%	68%	81%	76%
Proportion of countries with legislation or regulations on mandatory corporate sustainability reporting	100%	56%	20%	29%	50%	70%

Note: The MEAs are eight ECE environmental treaties, plus three global chemicals conventions and the Convention on the Conservation of Migratory Species of Wild Animals.

19. Monitoring and information management

Availability and access to information and knowledge to support Government decision-makers, industry and the public taking impact-oriented choices is improving but continues to be challenging in some sectors more than in others. It constitutes a challenge for measuring progress towards policy targets in the pan-European region including for emerging policy developments such as circular economy or sustainable infrastructure as revealed during this assessment. **This assessment reveals various data gaps across the region in almost all areas**, with data available for some countries but not others, or no recent data available. Data for some indicators needed for this assessment are not routinely collected, in particular for emerging policies including the two conference themes.

While, according to the final review report on the establishment of a Shared Environmental Information System (ECE/CEP/AC.10/2021/6), such national systems have been successfully established in all countries in Europe and Central Asia, the systems vary in form and regularity regarding their updates and content. Gaps remain that need to be addressed including regarding compliance with all principles and pillars of the Shared Environmental Information System and the full production and sharing of all data flows associated with the ECE environmental indicators. Monitoring gaps, both in terms of data availability and quality, have been identified during the assessment for the region. Examples include:

(a) Air and climate change: Gaps remain for the measurement and analysis of fine particulate matter and the quality of data varies widely for emissions. Data sets on greenhouse gas emissions remain incomplete for some countries.;

(b) Fresh water: The use of geographic information systems needs to be strengthened, in particular at transboundary level, and there is a need for enhancing water statistics. Ecological water quality assessment and the identification of hydromorphological pressures requires knowledge that is not yet available everywhere in the region. The monitoring of emerging contaminants requires more attention throughout the pan-European region. Monitoring and data are incomplete for production of certain indicators;

(c) Coastal waters, marine ecosystems and seas: Challenges remain regarding the spatial and temporal data coverage. and data gaps remain for example for the amounts, composition and sources of beach and marine litter in parts of the region;

(d) Biodiversity and ecosystems: Data gaps remain for the production of certain indicators including the ECE indicators "Terrestrial protected areas" and "Land uptake", in particular for countries outside the European Union. Comparability of data is another issue that was noted;

(e) Land and Soil: Data gaps were identified for the indicator "Prevalence of stunting among children aged under 5 years, per cent";

(f) Chemicals and waste: No set of impact-oriented chemical indicators is regularly monitored across the region. There is also a lack of information regarding the impact of chemicals on the efficiency and economic viability of circular economy schemes. Gaps remain regarding capacities and data availability for certain indicators including "Total waste generation per capita", "E-waste generation per capita" and "Recycling rate of municipal solid waste";

(g) Environmental financing: There is a severe lack of quantitative data on environmental financing for countries in Central Asia and South-Eastern Europe and there is an urgent need for improving data collection systems;

(h) Sustainable infrastructure: Significant data gaps have been identified both in the social, environmental, institutional, economic and financial indicators proposed and when quantifying the contribution (positive or negative) of infrastructure development based on the indicators. A common definition of sustainable infrastructure is missing with implications for quantifying progress in the region;

(i) Circular economy and sustainable tourism: Indicator development for sustainable tourism, let alone for monitoring circularity, is still evolving. There are currently no indicators across the region that give explicit information on tourism's circular state and for several general circularity aspects, classification definitions differ between States. Even mainstream tourism statistics tend to be incomplete and suffer from varying definitions, while detailed statistics needed for accurate circularity monitoring are absent;

(j) While a Shared Environmental Information System has been established, national Systems vary in form and regularity regarding their updates and content. Gaps remain that need to be addressed including regarding the full establishment of the system in line with all principles and pillars the System. The gaps identified indicate that countries still need assistance to fully implement the System's pillars and principles and for the full production and sharing of all data flows associated with the ECE environmental indicators.

Recommendations: Governments in the pan-European region should:

(a) Bring policy and science together to develop and implement appropriate and standardized pan-European methods and systems for monitoring and information management, including through the application of new technologies, to fill data gaps for improved decision-making and ensure timely availability of the information for the public;

(b) Employ the revised ECE Guidelines for the Application of Environmental Indicators, provide the ECE set of environmental indicators in accordance with the principles and pillars of the Shared Environmental Information System and adopt indicators to cover emerging policymaking themes of importance;

(c) Promote the use of appropriate and standardized methods for monitoring air pollution emissions and the public availability of monitoring data in the pan-European region, while also strengthening cooperation and national investment to fill monitoring gaps in countries with economies in transition;

(d) Invest in data collection and information processing as knowledge is instrumental for decision-making and water policy design (for example, water accounts, ecosystem assessment and indicators). The continuous improvement of monitoring and communication technologies is a top priority in terms of a water information system for the pan-European region;

(e) Increase efforts to complement inventories of the number of items of beach and marine litter with information on composition and sources of litter to be able to design more effective measures. Joint efforts should be taken where subregional monitoring measures are deemed necessary;

(f) Establish a region-wide chemicals and waste impact-oriented monitoring scheme, as a cooperation between science and policy, to achieve a better picture of the adverse impacts of chemicals on human health and the environment, and to address them;

(g) Improve data collection systems on environmental financing, for example on environmental expenditures, throughout the region to clarify and report which entities spend money on the environment, how much, with what objectives and who finances these expenditures;

(h) Develop a common definition of sustainable infrastructure in the pan-European region. This would allow reporting on and quantifying of progress across countries and subregions (see also point 16 above);

(i) Select some specific key-impact tourism indicators to be included in ECE statistical databases. Indicators for circular economy in tourism should be aligned with those being developed for the monitoring of sustainable development in tourism (particularly with those that are most promising) and be compatible with Sustainable Development Goals. Circular economy indicator development could follow the approach adopted by the initiative of the United Nations World Tourism Organization (UNWTO) towards a Statistical Framework for Measuring the Sustainability of Tourism;

(j) Assist countries to fully implement the Shared Environmental Information System's pillars and principles and the full production and sharing of all data flows associated with the ECE environmental indicators;

(k) Continue digitalization of environmental monitoring systems and use of new technologies for enhanced high-quality data production in support of regular assessments and policymaking.

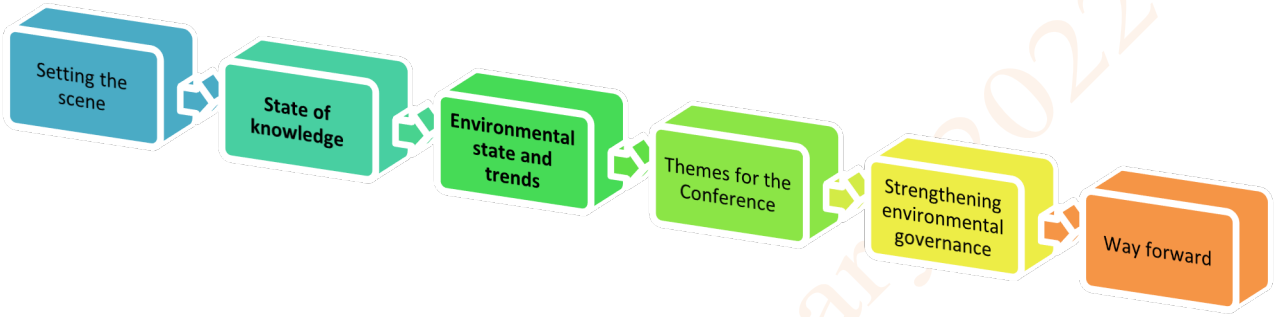
	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Shared Environmental Information System established (2011–2021)	😐 ↗	😐 ↗	😐 ↗	😐 ↗	😐 ↗	😐 ↗

Note: trend is ↗ on average improving; Shared Environmental Information System established but with gaps in the alignment with the pillars and principles 😐.

I. Setting the scene

1. The present pan-European environmental assessment is structured as shown in figure I. This first chapter provides an overview of the regular assessment of the state of the environment in the pan-European region, together with the mandate for the present assessment. It also summarizes national reporting and progress in establishing a Shared Environmental Information System. The chapter concludes with an overview of environmental policies in the region.

Figure I
Structure of the assessment



Note

2. Throughout the assessment, where feasible and relevant, the following subregions are referred to:

(a) European Union, comprising 27 member States;

(b) Western Europe, comprising Andorra, Iceland, Israel, Liechtenstein, Monaco, Norway, San Marino, Switzerland and the United Kingdom of Great Britain and Northern Ireland;

(c) Central Asia, comprising Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan;

(d) Eastern Europe, comprising Armenia, Azerbaijan, Belarus, Georgia, the Republic of Moldova, the Russian Federation and Ukraine;

(e) South-Eastern Europe, comprising Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia and Turkey.

A. Regular assessment of the state of the environment

3. This section begins by looking at the past Environment for Europe Ministerial Conferences and associated pan-European environmental assessments (see figure II below). It then presents the mandate for this assessment, explains the selection of the themes for the next Conference and describes the use of the Shared Environmental Information System as a basis for this assessment.

1. History of the state-of-the-environment assessments

Figure II
Timeline of state-of-the-environment assessments

4. The First Ministerial Conference within the Environment for Europe process was held in 1991 at Dobris Castle in the then Czechoslovakia. It was the first all-European conference of ministers responsible for the environment and international organizations working in Europe, building upon the Stockholm Conference of 1972 but also the accelerating political transition in 1990–1991. The Conference discussed ways of strengthening cooperation to protect and improve the environment and called on the Commission of European Communities to prepare, in cooperation with the United Nations Economic Commission for Europe (ECE), a report describing the state of the environment in Europe. The requested report was to become the first pan-European environmental assessment – *Europe's Environment: the Dobris Assessment*, of 1995 – though the geographical scope was focused on central and eastern Europe.

5. The Second Environment for Europe Ministerial Conference was held in 1993 in Lucerne, Switzerland. Though the first report on the state of the environment had yet to be produced, the environmental programme for Europe had been developed and the broad strategy contained in the Environmental Action Programme for Central and Eastern Europe was endorsed by the Conference, as was an ECE report on Elements for a Long-term Environmental Programme for Europe.

6. The Third Environment for Europe Ministerial Conference was held in Sofia in 1995. The Sofia Conference saw the publication of the *Europe's Environment: The Dobris Assessment* report, which assessed for the first time Europe's environment as a whole. The report's findings were of immediate concern to the Conference, since they demonstrated the need for far-reaching action in a number of environmental sectors.

7. The Fourth Ministerial Conference took place in Aarhus (Denmark) in 1998. This might be termed the first pan-European conference. *Europe's Environment: The Second Assessment* set the scene for the Conference, identifying the main areas of achievement and concern in the state of the European environment. Based on its findings, Ministers decided to strengthen support within the Environment for Europe process for the newly independent States and those countries of central and eastern Europe that were not part of the European Union's accession process. *Europe's Environment: The Second Assessment* did not cover Central Asia, for which the report *Sub-regional integrated environment assessment: Central Asia*[3] was prepared by the countries in the subregion.

8. The Fifth Ministerial Conference took place Kyiv in 2003. It concluded with the adoption of the Ministerial Declaration, which underlined the importance of the Environment for Europe process as a tool to promote environmental protection and sustainable development in the region, thus contributing to wider peace and security. *Europe's Environment: The Third Assessment*[4] for the first time covered all countries of the Caucasus,

[3] International Fund for saving the Aral Sea, the Interstate Commission on Sustainable Development and the United Nations Environment Programme (UNEP), 2007. Available at http://wedocs.unep.org/bitstream/handle/20.500.11822/9850/-Sub-regional_integrated_environment_assessment_Central_Asia-2007Sub_regional_integrated_environment_assessment_central_asia.pdf.pdf?sequence=3&isAllowed=y.

[4] Prepared by the European Environment Agency with the support of countries and ECE and in cooperation with UNEP and other international organizations.

Central Asia and Eastern Europe. Ministers noted that the three assessment reports on the state of the environment produced by the European Environment Agency had helped to identify major threats and challenges for the development of regional environmental policies and laid the ground for the preparation of the Environmental Programme for Europe.

9. The Sixth Ministerial Conference took place in Belgrade in 2007. The Conference noted the fourth assessment report on the state of the environment (*Belgrade Assessment*)[5] and some improvements in the state of the environment at the pan-European level and in some subregions and countries but were particularly concerned by the report's negative findings. Two further assessments were presented to the Conference: *First assessment of transboundary rivers, lakes and groundwaters*[6] and *Policies for a Better Environment: Progress in Eastern Europe, Caucasus and Central Asia*.[7]

10. The Seventh Ministerial Conference took place in Nur-Sultan (then Astana) in 2011. It welcomed the *Europe's Environment: An Assessment of Assessments* report,[8] which was an assessment of all environmental assessments produced in the region. To keep the pan-European environment under review, Ministers decided to establish a regular process of environmental assessment and to develop the Shared Environmental Information System across the region. These would serve multiple policy processes, including multilateral environmental agreements, and include capacity-building of countries in the Caucasus, Central Asia and Eastern and South-Eastern Europe to monitor and assess their environment. They invited the European Environment Agency and its partners to develop an outline for how these actions could be performed. In addition, the *Second Assessment of Transboundary Rivers, Lakes and Groundwaters in the ECE region*[9] was presented to the Conference.

11. The latest conference, the Eighth Environment for Europe Ministerial Conference took place in Batumi, Georgia, in June 2016. Ministers welcomed the launch of the European regional assessment of the Global Environment Outlook, as the regular pan-European environmental assessment. The *GEO-6: Global Environment Outlook: Regional assessment for the Pan-European Region*[10] was built on existing national, subregional and thematic assessments, including *The European environment - state and outlook 2015* report.[11]

2. Mandate for this assessment

12. The series of assessments of the state of the environment in the pan-European region provide up-to-date and policy-relevant information on interactions between the environment and society. The assessments were a consistent feature of the Environment for Europe process from 1995 to 2016. The 2009 reform of that process identified the pan-European assessment as one of the three substantive documents to be prepared for each ministerial conference, together with up to two theme-specific reports.[12]

13. Following the Seventh Environment for Europe Ministerial Conference (Nur-Sultan, 21–23 September 2011), responsibility for drafting the assessment shifted from the European Environment Agency to the United Nations Environment Programme (UNEP) and ECE.

---

[5] Prepared by the European Environment Agency with the support of countries, the European Commission and ECE, and in cooperation with other partners.

[6] ECE, 2007.

[7] Organisation for Economic Co-operation and Development (OECD), 2007. Summary for policymakers, available at https://www.oecd.org/env/outreach/39271802.pdf.

[8] Coordinated and produced by the European Environment Agency in cooperation with the countries, the Regional Environmental Centres (RECs), multilateral environmental agreement (MEA) secretariats, ECE and international organizations.

[9] ECE, 2011.

[10] UNEP and ECE, 2016.

[11] European Environment Agency, 2015.

[12] ECE/CEP/S/152, annex I, para. 12 (a) and (d)

14. During the Eighth Environment for Europe Ministerial Conference (Batumi, Georgia, 8–10 June 2016), the launch of the European regional assessment of the Global Environment Outlook as the regular pan-European environmental assessment was welcomed.

15. Following the Eighth Environment for Europe Ministerial Conference, the ECE Committee on Environmental Policy adopted the revised mandate and terms of reference of the Working Group on Environmental Monitoring and Assessment for the period 2017–2021. The Working Group was tasked by the Committee with leading a process of consultation on the regular pan-European environmental assessment for consideration by the Committee and leading up to the next Environment for Europe Ministerial Conference.

16. At its twenty-fifth session (Geneva, 13–15 November 2019), the Committee on Environmental Policy: welcomed the information provided by the secretariat and UNEP on the next pan-European environmental assessment; selected option 3 from among the options for the next pan-European environmental assessment set out in document ECE/CEP/AC.10/2019/6, subject to availability of resources; requested the secretariat and UNEP, working in close cooperation with the European Environment Agency, to prepare a limited indicator-based and thematic assessment and to regularly inform the Bureau of progress made; and encouraged all member States to provide the necessary funding to enable the preparation of the assessment. The Committee selected the two following specific themes for the ministerial conference and, consequently, the assessment: (a) greening the economy in the pan-European region: working towards sustainable infrastructure; and (b) applying principles of circular economy to sustainable tourism.

B. State of knowledge and the Shared Environmental Information System

17. Access to reliable, robust, comparable and timely data is crucial to monitor progress towards policy targets in the pan-European region and to help policymakers to make informed decisions for the benefit of people in the region. The COVID-19 pandemic has amplified the need for timely, reliable and comparable data throughout the region. Regular national reporting on the state of the environment and the establishment of a Shared Environmental Information System in Europe and Central Asia are important contributions to making use of the available data to help policymaking and are described in the following section.

1. Reporting on the state of the environment

18. Regular reporting on the state of the environment in the countries of the pan-European region provides comprehensive and targeted information about environmental conditions, trends and pressures in each of the countries. Such reports provide a strategic view to shape policy and action. National state-of-the-environment reports, having a sound evidence base, inform and provide knowledge for decision-makers and the public and to engage readers to influence their behaviour.

19. Most of the countries in the pan-European region review the state of the environment on a regular basis and prepare integrated reports covering several thematic areas and/or indicator-based national state-of-the-environment reports.

20. Within the framework of the final review of the establishment of a Shared Environmental Information System in Europe and Central Asia, ECE member States in the pan-European region were asked to provide information on the regularity and type of reports they produce. The reports vary in regularity, content and form but all of them support the transition to a more sustainable use of resources and the protection of the environment for the wellbeing of human life. Table 1 below provides an overview of whether national state-of-the-environment reports or indicator-based state-of-the-environment reports are produced on a regular basis.

Table 1
Overview on national state-of-the-environment reporting

	Integrated state-of-the-environment reports		Indicator-based state-of-the-environment reports	
Country	**Regular production of reports?**	**Year of latest report**	**Regular production of reports?**	**Year of latest report**
Albania	Yes	2019	No	2018
Andorra	to be confirmed	to be confirmed	Yes	2019
Armenia	No	2011	Yes	2020
Austria	Yes	2019	Yes	2019
Azerbaijan	No	2019	No	to be confirmed
Belarus	Yes	2019	Yes	2019
Belgium (regions)	Yes	2019	No	2012
Bosnia and Herzegovina	Yes	2012	No	to be confirmed
Bulgaria	Yes	2020	No	2020
Croatia	No	to be confirmed	Yes	2019
Cyprus	No	2015	No	to be confirmed
Czechia	Yes	2018	Yes	2020
Denmark	Yes	2014	Yes	to be confirmed
Estonia	Yes	2013	Yes	2019
Finland	Yes	2018	Yes	2020
France	Yes	2019	Yes	2020
Georgia	Yes	2017	Yes	2017
Germany	Yes	2019	Yes	2020
Greece	Yes	2019	Yes	to be confirmed
Hungary	Yes	2017	Yes	2020
Iceland	Yes	2019	Yes	2019
Ireland	Yes	2020	Yes	2020
Israel	Yes	2019	to be confirmed	2010
Italy	Yes	2019	Yes	2019
Kazakhstan	Yes	2019	Yes	2018
Kyrgyzstan	No	2012	to be confirmed	to be confirmed
Latvia	Yes	2016	Yes	2019
Liechtenstein	No	2021	Yes	2015
Lithuania	Yes	2020	Yes	2020
Luxembourg	No	2003	to be confirmed	2018
Malta	Yes	2018	Yes	2011
Monaco	Yes	2018	Yes	2018
Montenegro	Yes	2019	Yes	2017
Netherlands	Yes	2020	Yes	2019
North Macedonia	Yes	2020	Yes	2018
Norway	Yes	2020	Yes	2020
Poland	Yes	2018	No	2001
Portugal	Yes	2019	Yes	2019
Republic of Moldova	Yes	2011	No	2014
Romania	Yes	2019	Yes	2018

Country	Integrated state-of-the-environment reports		Indicator-based state-of-the-environment reports	
	Regular production of reports?	Year of latest report	Regular production of reports?	Year of latest report
Russian Federation	Yes	2019	Yes	2019
San Marino	to be confirmed	to be confirmed	Yes	2020
Serbia	Yes	2019	No	2016
Slovakia	Yes	2018	Yes	2020
Slovenia	No	2010	Yes	2020
Spain	Yes	2019	Yes	2019
Sweden	Yes	2020	Yes	2020
Switzerland	Yes	2018	Yes	2018
Tajikistan	No	to be confirmed	to be confirmed	to be confirmed
Turkey	Yes	2016	Yes	2017
Turkmenistan	No	to be confirmed	No	to be confirmed
Ukraine	Yes	2015	No	to be confirmed
United Kingdom of Great Britain and Northern Ireland	Yes	2020	Yes	to be confirmed
Uzbekistan	No	to be confirmed	No	to be confirmed

Key: 2019–2021 2016–2018 2013–2015. *Note*: Countries are invited to verify data.

21. This assessment has used available information and reports to the extent possible including the above-mentioned national reports on the state of the environment. Another source of information was the "The European environment —state and outlook 2020" report by the European Environment Agency and the Global Sustainable Development Goal Indicators Database.

2. Progress achieved in establishing a Shared Environmental Information System in Europe and Central Asia

22. At the Seventh Environment for Europe Ministerial Conference (2011), ministers requested that a Shared Environmental Information System be developed to underpin a regular environment assessment process across the pan-European region. This was reiterated by ministers at the Eighth Environment for Europe Ministerial Conference (2016).

23. Since then, overall, a Shared Environmental Information System has been successfully established in Europe and Central Asia. All member States have, to varying degrees, made progress regarding the establishment of a national system during the past years and in making environmental information available and accessible including for the use in regular assessments such as the seventh pan-European environmental assessment (see figure III on availability and accessibility of data flows on national systems as reported in the final review report on the establishment of the Shared Environmental Information System).

24. According to the final review report on the establishment of the Shared Environmental Information System (ECE/CEP/AC.10/2021/6), national Shared Environmental Information Systems vary in form and regularity regarding their updates and content, and gaps remain that need to be addressed including regarding the full establishment of the system in line with all Shared Environmental Information System principles and pillars. The gaps identified indicate that countries still need assistance to fully implement the Shared Environmental Information System's pillars and principles and for the full production and sharing of all data flows associated with the ECE environmental indicators also beyond 2021.

25. Further reviews of the implementation of the Shared Environmental Information System according to its principles would help to address gaps and, by doing so, ensure that it supports regular assessments and reporting in the region.

26. The final review report also recommends that the establishment of the System and the production of relevant data flows that underpin the ECE environmental indicators be harmonized and aligned with the revised ECE environmental indicators. They should also be aligned with the United Nations Framework for the Development of Environmental Statistics and monitoring and assessment processes at the regional and global levels, including in the context of the 2030 Agenda for Sustainable Development and a green and circular economy, to enhance their policy relevance. The present assessment also recommends that the list of ECE indicators to be expanded and to include other relevant themes such as "Coastal waters, marine ecosystems and seas".

27. Based on the countries' replies during the final review of the establishment of the Shared Environmental Information System, for each data flow, limitations in comparing the data flow across countries and the region were assessed. The results from the submissions show limitations in 44 per cent of cases due also to the fact that several countries did not provide links to the data flows or information on the time series. The current assessment confirmed these challenges and noted comparability issues for example between data on "Land uptake and land take data from European Environment Agency member and cooperating countries" and data from other countries in the pan-European region. It is therefore recommended to continue investing in comparable data and indicators including for consistent land-cover classifications and monitoring capacity and to agree on consistent national information to be fed into the Shared Environmental Information System, and carefully retrofit actual land-cover categories to past data, to obtain reliable trend information.

28. Furthermore, the final review report recommends continuation of digitalization of environmental monitoring systems and use of new technologies for enhanced high-quality data production in support of regular assessments and policymaking. This was also confirmed throughout the development of the pan-European assessment.

29. The efforts to establish a Shared Environmental Information System including the strengthening of content, infrastructure or cooperation between authorities to ensure the flow of data, contributed also to the implementation of the Aarhus Convention, in particular the pillar on access to information, as noted during a reporting exercise under the Aarhus Convention by Parties. Parties reported that while obstacles remain (e.g. lack of interoperability of databases, and incomplete and fragmented data that lead to providing incomplete information), significant progress in ensuring that environmental information is available in electronic databases that are easily accessible to the public through public telecommunication networks has been achieved. Numerous effective electronic tools are being further developed in this area, such as electronic databases, publicly accessible governmental electronic services, websites and information portals, which are routinely updated and improved. Additional steps are however needed throughout the region, in particular when it comes to pollution and emissions registers.

30. The development of the pan-European assessment revealed additional data and knowledge gaps for core environmental issues throughout the pan-European region. The availability of and access to information and knowledge to support Government decision-makers, industry and the public taking impact-oriented choices is improving but continues to be challenging in some sectors more than in others. It constitutes a challenge for measuring progress towards policy targets in the pan-European region (see table 2) including for emerging policy developments such as circular economy or sustainable infrastructure as revealed during this assessment.

31. Monitoring gaps, both in terms of data availability and quality, have been identified during the assessment for the region. Examples include (with further details in chapters III and IV):

(a) Air and climate change: Gaps remain especially for the measurement and analysis of fine particulate matter. Quality of data varies widely for emissions. There are also gaps in data availability because not all countries in Eastern, South-Eastern and Western Europe and Central Asia submitted emission inventories. Data sets on greenhouse gas emissions remain incomplete for some countries in the region;

(b) Fresh water: There are gaps in geographic information systems, in particular at transboundary level and there is a need for enhancing water statistics. Ecological water quality assessment or the identification of hydromorphological pressures requires knowledge that is not yet available everywhere in the region and the monitoring of emerging contaminants is an issue. Monitoring and data are incomplete for production of certain indicators;

(c) Coastal waters, marine ecosystems and seas: New developments and technologies related to monitoring and data production (are not yet sufficiently applied and challenges remain regarding the spatial and temporal data coverage. Data gaps for example related to the amounts, composition and sources of beach and marine litter in parts of the region were noted;

(d) Biodiversity and ecosystems: Data gaps remain for the production of certain indicators including the ECE indicator "Land uptake" in particular for countries outside the European Union. Comparability of data is another issue that was noted;

(e) Land and Soil: Data gaps were identified for the indicator "Prevalence of stunting among children aged under 5 years, per cent";

(f) Chemicals and waste: No set of chemicals' impact-oriented indicators is regularly monitored across the region. Gaps remain regarding data availability from a number of countries for certain indicators including "Total waste generation per capita", "E-waste generation per capita" or "Recycling rate of municipal solid waste";

(g) Environmental Financing: There is a severe lack of quantitative data on environmental financing for countries of Central Asia and South-Eastern Europe. This hinders attempts to evaluate progress in environmental protection and environmental financing. The lack of reliable data also implies that investment and operational costs of meeting environmental objectives cannot be calculated in a robust way and used in policy development. There is an urgent need for improving data collection systems, for example for data on environmental expenditures;

(h) Sustainable Infrastructure: Significant data gaps have been identified both in the social, environmental, institutional, economic and financial indicators proposed and when quantifying the contribution (positive or negative) of infrastructure development and the achievement of the indicators proposed in this assessment. Furthermore, a common definition of sustainable infrastructure is missing in the pan-European region thus reporting on and quantifying of progress across countries and subregions is a challenge;

(i) Circular economy and sustainable tourism: Indicator development for sustainable tourism, let alone for monitoring circularity, is still evolving but hampered by various issues. There are currently no indicators across UNECE countries that give explicit information on tourism's circular state. On several general circularity aspects, classification definitions differ between states. Finally, even mainstream tourism statistics tend to be incomplete and suffer from varying definitions, while detailed statistics needed for accurate circularity monitoring are absent. Digitalization holds promise for better and more uniform measurement and monitoring, but depends on availability of uniform and relevant data on circular economy in tourism.

32. Accordingly, Governments in the pan-European region are recommended to:

(a) Bring policy and science together to develop and implement appropriate and standardized pan-European methods and systems for monitoring and information management, including through the application of new technologies, to fill data gaps for improved decision-making and ensure timely availability of the information for the public;

(b) Employ the revised ECE Guidelines for the Application of Environmental Indicators, provide the ECE set of environmental indicators in accordance with the principles and pillars of the Shared Environmental Information System and adopt indicators to cover emerging policymaking themes of importance.

(c) Assist countries to fully implement the Shared Environmental Information System's pillars and principles and the full production and sharing of all data flows associated with the ECE environmental indicators.

(d) Continue digitalization of environmental monitoring systems and use of new technologies for enhanced high-quality data production in support of regular assessments and policymaking.

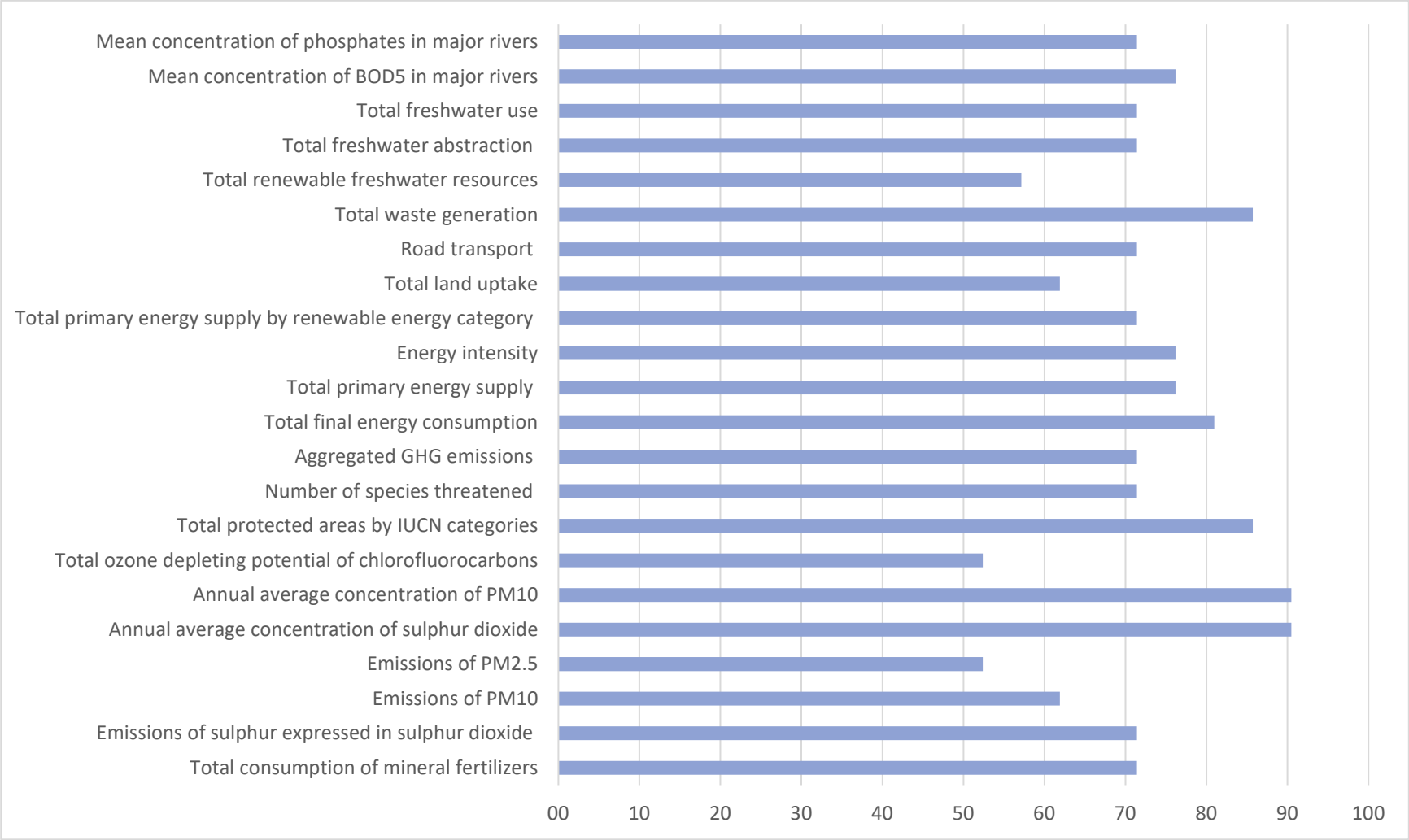
Further recommendations related to monitoring and information management on the specific environmental themes are provided under chapter III and IV.

Table 2
Implications of monitoring and data gaps for measuring progress towards policy targets

Topic having monitoring and data gaps	*Examples of policies and targets, the measuring of which is impacted*
Air	Convention on Long-range Transboundary Air Pollution, United Nations Framework Convention on Climate Change Vienna Convention for the Protection of the Ozone Layer, and Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention)
	Sustainable Development Goal targets related to air quality and health and climate change
Fresh water	Water Convention
	Sustainable Development Goal targets related to freshwater quantity, quality and health and climate change
Coastal waters, marine ecosystems and seas	Convention on Biological Diversity
	Sustainable Development Goal targets related coastal waters, marine ecosystems and seas.
Biodiversity and ecosystems	Convention on Biological Diversity
	Sustainable Development Goal targets related coastal waters, marine ecosystems and seas.
Land and soils	Convention on Biological Diversity, and United Nations Convention to Combat Desertification
	Sustainable Development Goal targets related to land and soil,
Chemicals and waste	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Minamata Convention on Mercury, Convention on Long-range Transboundary Air Pollution, and its Protocols, Protocol on Water and Health, and Convention on the Transboundary Effects of Industrial Accidents
	Sustainable Development Goal targets related to waste and chemicals,
Sustainable infrastructure	Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and its Protocol on Strategic Environmental Assessment, and Convention on the Transboundary Effects of Industrial Accidents
	Sustainable Development Goal targets related to sustainable infrastructure
Circular economy and sustainable tourism	Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and its Protocol on Strategic Environmental Assessment, Air Convention, and Convention on Biological Diversity

Figure III

Ready online availability and accessibility of data flows on a national platform, per cent of data flows with reply "yes"



C. Environmental policies in the region

33. This section explores global, regional and subregional policy frameworks that are at play at the level of the pan-European region. The policies, but also their objectives, goals, targets and indicators, all play a role in driving action by countries. Among the most relevant global level instruments are the multilateral environmental agreements (MEAs; see Table 3), the United Nations Environment Assembly and the 2030 Agenda for Sustainable Development. Notable regional level frameworks are the Environment for Europe Ministerial process, the European Environment and Health Process and regional MEAs. Major elements at the subregional level include the European Union's environmental policy and legislation, the European Union accession process and environmental and sustainable development policies emanating from the Commonwealth of Independent States.

Global policy frameworks

34. The 2030 Agenda for Sustainable Development provides the overarching policy framework for sustainable development and integrated environmental policy. The 2030 Agenda's 17 universal Sustainable Development Goals and 169 targets[13] provide policy objectives at all levels with the overall aim to eradicate poverty along with the economic, social and environmental dimensions of sustainability. It addresses underlying issues related to governance, institutions, peace and international collaboration. There are dedicated targets to progress on core environmental issues, including under Goal 6 on water, Goal 7 on energy, Goal 12 on consumption and production patterns and Goal 13 on climate action, and more than 90 environment-related indicators to measure progress in the implementation of the agenda. Governments have also adopted national targets and indicators.

35. The Sendai Framework for Disaster Risk Reduction 2015–2030 aims for the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of people, businesses, communities and countries. It includes a set of seven global targets, which are indirectly related to the environment, and sets four priority actions, each of which has an environmental dimension. Besides, it includes activities at local, national, regional and global levels.

36. The Strategic Plan for Biodiversity 2011–2020, including Aichi Biodiversity Targets, has set the global framework for action to preserve biodiversity for the past decade. The Plan identifies five strategic goals, with each having between three and six targets. The post-2020 global biodiversity framework was due to be adopted in 2022. The Sustainable Development Goals also include targets and indicators related to biodiversity.

37. The global MEAs, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, the Convention on Biological Diversity, the Convention to Combat Desertification, and those on specific pollutants (such as persistent organic pollutants (POPs), mercury and ozone-depleting substances (ODSs)) and waste, also drive environmental policy within the ECE region, including through the setting of legally binding limits. The rapid take up of the global agreements emphasizes their political importance at the international level.

[13] UNEP has determined that over 86 of the 169 targets directly concern the environment.

Table 3
Key multilateral environmental agreements[14]

Treaty	*Categories*	*Number of Parties in region (globally)*
Vienna Convention for the Protection of the Ozone Layer		… (198)
Montreal Protocol on Substances that Deplete the Ozone Layer	Climate and Atmosphere	… (198)
London, Copenhagen, Montreal, Beijing and Kigali Amendments		
United Nations Framework Convention on Climate Change	Climate and Atmosphere	… (197)
Kyoto Protocol	Climate and Atmosphere	… (193)
Paris Agreement	Climate and Atmosphere	… (191)
United Nations Convention to Combat Desertification	Biological Diversity, Land and Agriculture, Drylands	… (197)
Convention on Biological Diversity	Biological Diversity	… (196)
Cartagena Protocol on Biosafety to the Convention on Biological Diversity	Biological Diversity, Land and Agriculture	… (173)
Nagoya – Kuala Lumpur Supplementary Protocol	Biological Diversity, Land and Agriculture	… (49)
Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization	Biological Diversity, Land and Agriculture	… (132)
Convention concerning the Protection of the World Cultural and Natural Heritage	Biological Diversity, Marine and Freshwater, Land and Agriculture	… (194)
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	Chemicals and Waste	… (188)
Basel Protocol on Liability and Compensation	Environmental Governance, Chemicals and Waste	… (12)
Stockholm Convention on Persistent Organic Pollutants	Chemicals and Waste	… (184)
International Plant Protection Convention	Biological Diversity, Land and Agriculture	… (184)
Convention on International Trade in Endangered Species of Wild Fauna and Flora	Biological Diversity	… (183)
Convention on Wetlands of International Importance (Ramsar Convention)	Biological Diversity, Land and Agriculture, Marine and Freshwater	… (170)
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Chemicals and Waste	… (164)

[14] The number of Parties to each agreement in the pan-European region will be added to this table.

Treaty	*Categories*	*Number of Parties in region (globally)*
International Convention for the Prevention of Pollution from Ships	Marine and Freshwater	… (160)
International Treaty on Plant Genetic Resources for Food and Agriculture	Biological Diversity, Land and Agriculture	…. (148)
Minamata Convention on Mercury	Chemicals and Waste	… (132)
Convention on the Conservation of Migratory Species of Wild Animals	Biological Diversity	… (132)
Agreement on the Conservation of African-Eurasian Migratory Waterbirds	Biological Diversity	… (82)
Convention on Long-range Transboundary Air Pollution, and its Protocols, including:	Chemicals and Waste, Climate and Atmosphere	49 (51)
Protocols on Heavy Metals	Chemicals and Waste, Climate and Atmosphere	33 (35)
Protocols on Persistent Organic Pollutants	Chemicals and Waste, Land and Agriculture	33 (34)
Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention)	Environmental Governance	47 (47)
Protocol on Pollutant Release and Transfer Registers	Environmental Governance, Chemicals and Waste	38 (38)
Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)	Environmental Governance	44 (45)
Protocol on Strategic Environmental Assessment	Environmental Governance	33 (33)
Convention on the Protection and Use of Transboundary Watercourses and International Lakes	Biological Diversity, Marine and Freshwater	41 (46)
Protocol on Water and Health	Chemicals and Waste, Biological Diversity, Marine and Freshwater	27 (27)
Convention on the Transboundary Effects of Industrial Accidents	Chemicals and Waste, Climate and Atmosphere, Biological Diversity, Marine and Freshwater, Land and Agriculture	41 (41)
Barcelona Convention, and its Protocols	Chemicals and Waste, Biological Diversity, Marine and Freshwater	15 (22)
Agreement on the Conservation of Small Cetaceans of the Baltic, North-East Atlantic, Irish and North Seas	Biological Diversity	10 (10)
Framework Convention on the Protection and Sustainable Development of the Carpathians, and its Protocols	Biological Diversity, Land and Agriculture	7 (7)

Note: Categories are according to www.InforMEA.org (accessed on 8 September 2021). The specified number of Parties is to the parent treaty if protocols are referred to but not listed separately. Agreements adopted within the Environment for Europe process are indicated in bold.

38. The United Nations Environment Assembly provides an overarching, global structure for environmental governance, bringing emerging issues to the attention of the global community. It sets priorities for global environmental policies and develops international environmental law. Through its ministerial declaration and resolutions, the Assembly also provides leadership, catalyses intergovernmental action on the environment and contributes to the implementation of the 2030 Agenda.

Regional policy frameworks

Environment for Europe ministerial process

39. At the regional level, the Environment for Europe process and its Ministerial Conferences, which aim at harmonizing environmental quality and policies in the pan-European region, and securing its peace, stability and sustainable development, have provided the primary policy framework over the past three decades. The Lucerne Declaration adopted by Ministers of Environment in 1993 sets out the political dimension of the Environment for Europe process. The 1995 Sofia Declaration underlined the urgent need for further integration of environmental considerations into all sectorial policies, so that economic growth takes place in accordance with principles of sustainable development.

40. At the 2011 Ministerial Conference in Nur-Sultan, a series of policy commitments were decided, such as to: improve environmental protection and to promote sustainable development in the ECE region; reiterate the importance of the involvement of civil society, including business, women, non-governmental organizations and other groups, in decision-making to improve the environment; pursue implementation of the principles of integrated water resources management, an ecosystem approach and the integration of ecosystem values in economic accounting; improve water management and strengthening transboundary cooperation; and pursue completion and implementation of a 10-Year Framework of Programmes on Sustainable Consumption and Production.[15]

41. Outcomes of the Conference in Nur-Sultan were reviewed in Batumi, Georgia in 2016, including through the consideration of a final report on the implementation of the Astana Water Action, a report on progress in establishing the Shared Environmental Information System and a report on 20 years of Environmental Performance Reviews.[16] The Batumi Conference also:

- Endorsed the voluntary Pan-European Strategic Framework for Greening the Economy and invited ECE member States and other stakeholders to implement it;
- Welcomed the Batumi Initiative on Green Economy (BIG-E), which consists of voluntary commitments to operationalize the Strategic Framework;
- Endorsed the voluntary Batumi Action for Cleaner Air (BACA) and welcomed the initiatives launched by interested countries and other stakeholders aimed at improving air quality and protecting public health and ecosystems.

42. The Conference also committed to: improve environmental protection, advancing sustainable development, implementing the Sustainable Development Goals and providing access to essential services; enhance ecosystems and ecosystem services as part of ecological infrastructure and improving the sustainable use of natural resources; lead the transition to a green economy, direct investments and trade to support a green and inclusive economy and work towards the full internalization of externalities that cause the loss of or damage to natural capital; fostering a circular economy, transparent and responsible business practice and eco-innovation, and further work towards cleaner and more resource-efficient production processes; develop the human capital for green and decent jobs and increase the availability of such jobs; improve air quality for a better environment and human health, strengthen the role of civil society in addressing air pollution and its impacts and ensure adequate monitoring of and public access to relevant information on air pollution; strengthen and scale-

[15] Declaration: "Save water, grow green!" (ECE/ASTANA.CONF/2011/2/Add.1).

[16] ECE/BATUMI.CONF/2016/10, ECE/BATUMI.CONF/2016/8 and ECE/BATUMI.CONF/2016/INF/5, respectively.

up education for sustainable development; promote effective public participation; civil society participation in decision-making to improve the environment and promote sustainable development; and develop partnerships with civil society organizations in the region and create favourable conditions for their operation.[17]

43. The fulfilment of commitments made under BIG-E and BACA, both at the Conference and subsequently, have been monitored, notably through a mid-term review carried out by the Committee on Environmental Policy in January 2019. The evaluation was based upon reports on the implementation of each of the three Batumi instruments and MEAs in support of the 2030 Agenda, and on activities to support countries in their efforts to green their economies, establishment of the Shared Environmental Information System and the third cycle of environmental performance reviews.[18] The evaluation demonstrated harmonization and improvement of relevant data flows and the quality of selected environmental indicators and use of data flows for multiple purposes. The evaluation has also highlighted the progress achieved in implementing voluntary commitments by the member States and organizations participating in BIG-E and BACA. It noted that since 2017, the Sustainable Development Goals and targets were being included in environmental performance reviews. The Committee welcomed the commencement of activities to assist reviewed countries in the implementation of recommendations emerging from their reviews.

44. The Committee noted that countries still need assistance in fully implementing the pillars and principles of the Shared Environmental Information System and in the regular production and sharing of relevant data flows associated with the ECE environmental indicators by 2021. The Committee also recognized the need to allocate sufficient resources for multilateral environmental agreements to assist Governments to achieve Sustainable Development Goals.

European Environment and Health Process

45. The European Environment and Health Process started in Frankfurt, Germany in 1989. The Second Conference, in Helsinki in 1994, was followed in 1995 by the publication *Concern for Europe's tomorrow. Health and the environment in the WHO European Region*,[19] a comprehensive survey on environmental health in Europe. In 1999, the Third Conference adopted the Protocol on Water and Health to the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes. At the Fifth Conference, held in Parma, Italy in 2010, Governments of the 53 member States of the WHO European Region set clear targets to reduce the adverse health impact of environmental threats in the next decade. At the most recent, Sixth Conference in Ostrava, Czechia in 2017, member States committed to develop national portfolios for action that should address the need to accelerate progress on health and environment and, in particular, the environment-related health goals and targets of the 2030 Agenda. A next ministerial conference is planned for 2023.

Other regional processes

46. Other important processes and instruments include the ECE Steering Committee on Education for Sustainable Development, the Transport, Health and Environment Pan-European Programme and the ECE Environmental Performance Review programme.

Subregional policy frameworks

47. Among the frameworks below the regional level, the policies of the European Union, including its accession process, have been among the strongest drivers of policy change. Subregional environmental agreements also play a significant role because of their binding provisions for their parties; these include the Alpine Convention, the Framework Convention

[17] Declaration: "Greener, cleaner, smarter!" (ECE/BATUMI.CONF/2016/2/Add.1).

[18] For details, see the report of the Committee on Environmental Policy on its twenty-fourth session (ECE/CEP/2019/2).

[19] Available at https://www.euro.who.int/en/publications/abstracts/concern-for-europes-tomorrow.-health-and-the-environment-in-the-who-european-region.

on the Protection and Sustainable Development of the Carpathians, the Framework Convention on Environmental Protection for Sustainable Development in Central Asia and a whole series of regional seas agreements, such as the Barcelona Convention for the Mediterranean.

48. At the European Union level, the European Green Deal promotes a holistic approach and sets out a roadmap for climate neutrality by 2050 and setting sustainability as the new standard for all policies. It includes a Biodiversity Strategy 2030, Zero Pollution Action Plan, "Farm-to-Fork" and Transition to a circular economy as ambitious directions for the European Union and beyond, acknowledging the ecological continuity and inclusion of its immediate neighbourhood. The Biodiversity Strategy provides a plan to protect nature and reverse the degradation of ecosystems and is instrumental for measuring ecosystem health and halting biodiversity loss across ecosystems including marine ecosystems. It runs concurrently with the global process under the Convention on Biological Diversity for the elaboration of the post-2020 Global Biodiversity Framework.

II. Regional context and developments as drivers of environmental change

1. The period since 1990 has seen dramatic socioeconomic and political changes in the pan-European region that have increased pressure on the natural environment and are driving environmental change. This section looks at four clusters of drivers:[20]

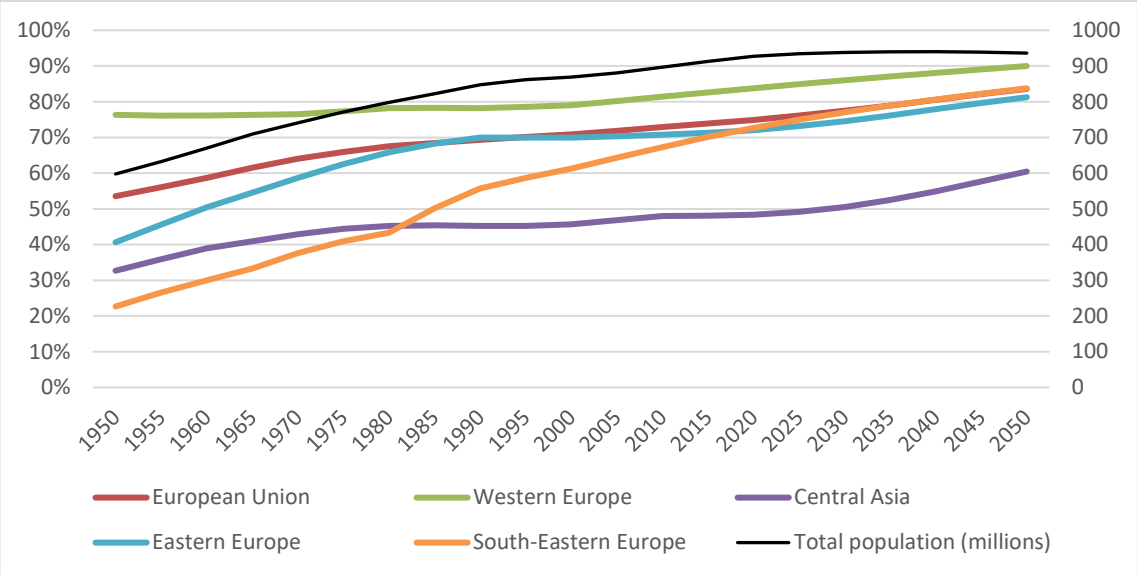
- An urbanizing and more coastal population
- A more prosperous society with increased use of resources
- Shifting energy production and use
- An increasingly mobile society

2. The final cluster also addresses tourism in detail.

1. An urbanizing and more coastal population

3. The region's population has grown slowly by about 6.5 per cent between 1990 and 2015 (compared with about 38 per cent globally), from 784.8 million in 2000 to 829.9 million in 2015,[21] and is expected to rise by only 2.7 per cent relative to 2015, before declining after 2040. The region is becoming more urban, with forecasts indicating 50 to 80 per cent of the population living in urban areas by 2050 (figure I).

Figure I
Proportion of the population living in urban areas, by subregion, per cent (left axis), and total population, millions (right axis), forecast from 2020 (1950–2050)



Source: United Nations, Department of Economic and Social Affairs, Population Division (2018). *World Urbanization Prospects: The 2018 Revision*, Online Edition.

4. Currently, the high concentration of human activities in urban territory causes 70 per cent of the global GHG emissions and growing air, water and soil pollution and nuisance by noise and congestion. Besides, the impacts of rapid and unplanned urbanization could affect the likelihood of conflict over limited resources. This situation has sparked the development of sustainable infrastructure, and innovative approaches to spatial planning, mobility and

[20] Other clusters of drivers are presented in the European Environment Agency (EEA) publication *Drivers of change of relevance for Europe's environment and sustainability,* Report No. 25/2019 (Luxembourg, Publications Office of the European Union, 2020); and Paul Ekins, Joyeeta Gupta and Pierre Boileau, eds., *Global Environment Outlook: Geo-6 – healthy planet, healthy people* (Cambridge, Cambridge University Press, 2019), chap. 2.

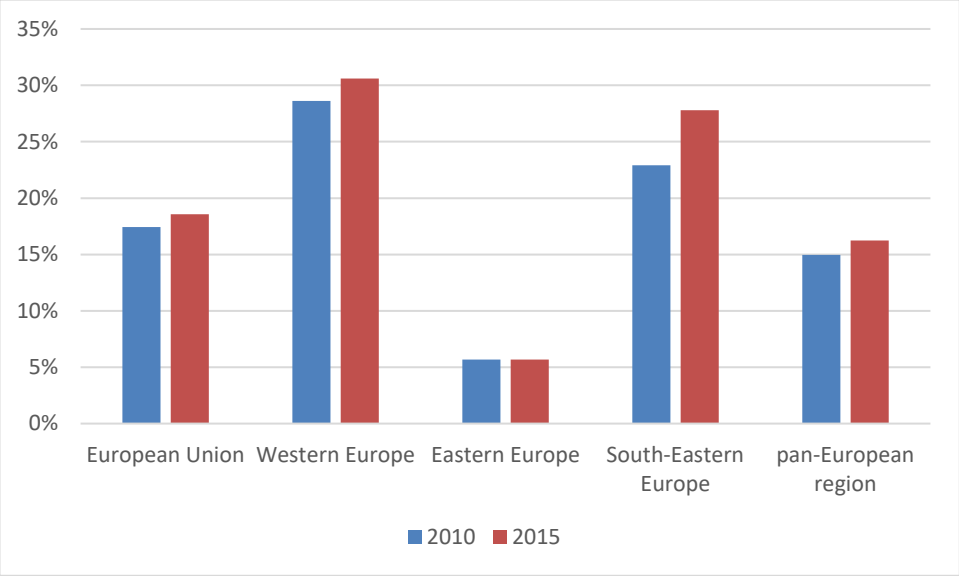
[21] UN DESA. 2021. "World Population Prospects - Population Division - United Nations." 2021. https://population.un.org/wpp/Download/Standard/Population/.

energy consumption (for example, smart cities and smart grids or networks). Sustainable infrastructure is strongly promoted by climate policies in order to enable greater resilience to extreme weather events. The New Urban Agenda promotes a smart-city approach that makes use of opportunities from digitalization, clean energy and technologies, as well as innovative transport technologies, thus providing options for inhabitants to make more environmentally friendly choices.

5. The population living within 10 km of the coast in the coastal countries of the pan-European region has increased by 10 per cent between 2000 to 2015, at a faster rate than the overall population, from 133.6 to 147.7 million.[22] Projections indicate that, by 2050, 71 per cent of the global population will live in coastal zones.[23]

6. High-density populated coastal areas are characterized by elevated urban footprints, associated with an increased strain on infrastructure, where environmental pressures such as wastewater discharges or sewage overflows and waste generation, are exacerbated. Coastal urbanization results in land consumption, degradation of landscapes, coastlines, and habitats, and increased pressure on coastal ecosystems. These pressures are further amplified by the development of tourism, often concentrated in coastal areas and in the summer months, as is the case of the Mediterranean region.[24] Coastal countries face increased challenges in achieving sustainable development and the conservation of coastal and marine areas, more so in view of climate change. Several regions and cities in the region are experiencing rapid population growth and currently lack the capacity to face these mounting pressures.

Figure II
Proportion of population living within 10 km of the coast, by subregion (2010, 2015)



Source: OECD.Stat (coastal population) and UNECE Statistical Database (total population)

Notes: Population of Monaco figures for 2010 and 2015 replaced by 2008 and 2016, respectively; Turkmenistan, 2009 figures; and Russian Federation, 2013 instead of 2015.

2. A more prosperous society with increased use of resources

7. Growing populations with higher incomes in the coming decades will drive a strong increase in global demand for goods and services, as noted in the Organisation for Economic

[22] OECD. 2020. "OECD.Stat – Sustainable Ocean Economy Indicators." 2020. https://stats.oecd.org/.

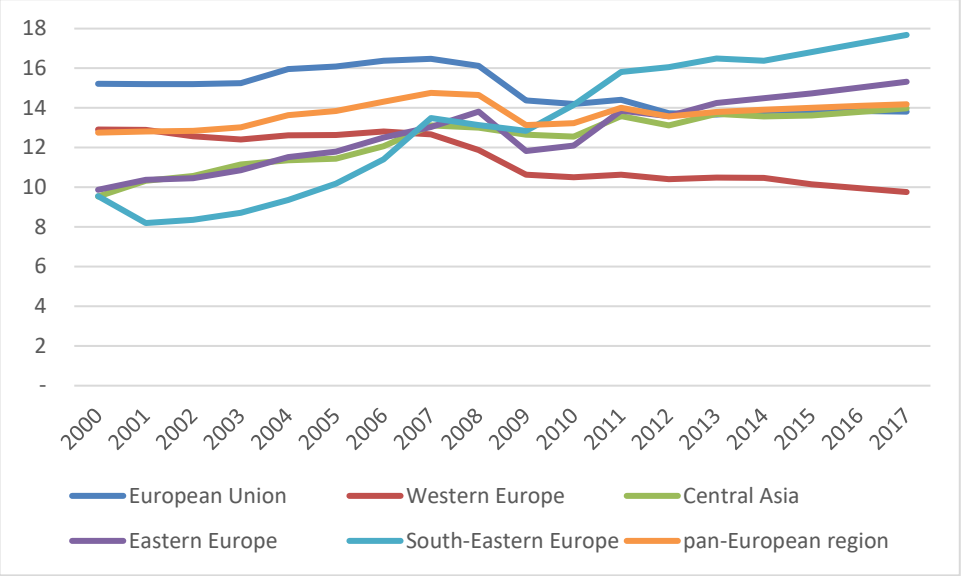
[23] Merkens, Jan-Ludolf, Lena Reimann, Jochen Hinkel, and Athanasios T. Vafeidis. 2016. "Gridded Population Projections for the Coastal Zone under the Shared Socioeconomic Pathways." Global and Planetary Change 145 (October): 57–66. https://doi.org/10.1016/j.gloplacha.2016.08.009.

[24] UNEP/MAP and Plan Bleu. 2020. "State of Environment and Development in Mediterranean." Plan Bleu. https://planbleu.org/en/soed-2020-state-of-environment-and-development-in-mediterranean/.

Co-operation and Development (OECD) *Global Material Resources Outlook to 2060.*[25] The Outlook concludes that technological developments will help decouple growth in production levels from material inputs, and the greatest opportunities may lie in countries with less-developed technology at present. However, the decrease in resource intensity may be slower than growth in GDP, thus driving up resource use. OECD forecasts, for the period 2011–2060, material use and GDP increases of respectively 1.5 and 2.5 times in Eurasia,[26] and 1.8 and 2.5 times in Europe, while material intensity is expected to drop from 0.9 tons/$ to 0.5 tons/$ in Eurasia, and from 0.4 tons/$ to 0.3 tons/$ in Europe.

8. The Material Footprint (MF), i.e. the amount of materials extracted from the environment used to reply to final demand of an economy, and the Domestic Material Consumption (DMC), i.e. the amount of materials produced or processed in a country, show that, although countries with higher populations use more resources, on a per capita basis wealthier countries stand out as the largest relative consumers.

Figure III
Domestic material consumption, tons per capita (2000–2017)



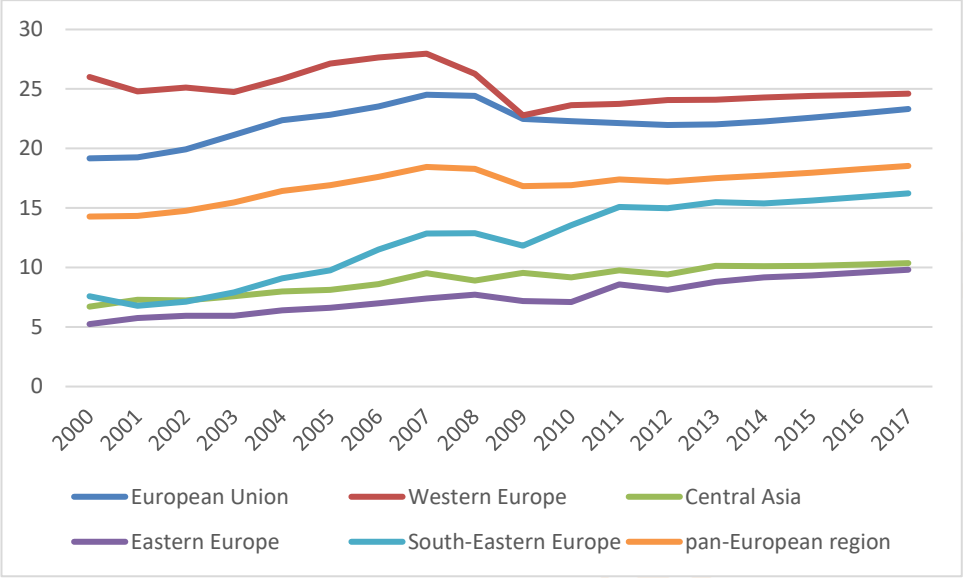
Sources: United Nations Statistics Sustainable Development Goal Indicator Database for indicator 12.2.2 (total figures). Population data from ECE Statistical Database. Latest data. Accessed 1 February 2022.

Notes: No data for Andorra, Liechtenstein, Monaco, San Marino, nor for Montenegro and Serbia in the period 2000–2005. Population of Turkmenistan 2010–2017 uses figure for 2009; for Russian Federation 2014–2017, uses 2013.

[25] OECD (2019), *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*, OECD Publishing, Paris, https://doi.org/10.1787/9789264307452-en.

[26] Central Asia, the Caucasus, Eastern Europe, South-Eastern Europe and Andorra, Bulgaria, Croatia, Cyprus, Latvia, Lithuania (though it became an OECD member in 2018), Malta, Romania, the Russian Federation and San Marino.

Figure IV
Material footprint, tons per capita (2000–2017)



Sources: UNEP World Environment Situation Room, https://wesr.unep.org/downloader and ECE Statistical Database for populations.

Notes: No data for Andorra, Liechtenstein, Monaco, or San Marino. Population of Turkmenistan 2010–2017 uses figure for 2009; for Russian Federation 2014–2017, uses 2013.

9. The Ecological Footprint (EF)[27], an indicator that compares demand for nature to available biocapacity, indicates that larger countries with less intensive industry tend to still have a positive balance, but many countries of the world are in deficit, either by consumption or due to production. Across the pan-European region, national footprints far exceed global biocapacity (about 1.7 tons per person) in all countries except Tajikistan.

10. Prosperity in the region has led to vastly developed infrastructure, continuing extraction of natural resources and the expansion and intensification of agriculture (including in countries outside the region but feeding the pan-European region), which have increased pressure on land.

11. Besides, about 40,000 to 60,000 industrial chemicals are commercially traded worldwide and are expected to significantly grow in the future.[28] Chemicals are used for example in agriculture, healthcare and the manufacturing of items such as electronics, textiles, furniture and toys, and a high proportion are hazardous, for example, in the European Union in 2016, 62 per cent belonged to categories classified as hazardous to human health and 35 per cent were hazardous to the environment.[29] Occurrence of large amounts of waste is also linked to inefficient use of resources as part of unsustainable consumption and production practices in current societies. Besides the problems caused by hazardous waste, other waste streams cause losses of materials and energy and aggravate pressures on the environment, for example, by the introduction of micro-plastics into food chains, affecting biodiversity and human health.

[27] https://www.footprintnetwork.org/our-work/ecological-footprint/

[28] UNEP. 2019. "Global Environment Outlook 6." http://www.unep.org/resources/global-environment-outlook-6.

[29] European Environment Agency, "Consumption of hazardous chemicals", briefing, 26 November 2019, available at www.eea.europa.eu/airs/2018/environment-and-health/production-of-hazardous-chemicals.

12. Single-occupancy housing is an indicator of a more prosperous society, with resulting increase in material and energy use per capita. Between 2000–2019 this indicator grew in the region, though especially since 2010 there has been a decline in a few countries (see Table 1).

13. A general increase in personal wealth is also a main driver for the development of coastal tourism, including the construction of luxury resorts and hotels, other facilities and infrastructure.

Table 1
One-person households (thousands), selected countries, ordered by decreasing percentage change (2000–2019).

Country	2000	2005	2010	2015	2019	Percentage increase from 2000 to 2019
Ireland	289	319	382	390	526	82%
Israel	301	333	387	439	530	76%
Italy	5,037	5,937	6,997	7,910	8,308	65%
Austria	977	1,199	1,300	1,418	1,480	51%
Finland	857	965	1,040	1,112	1,221	42%
Netherlands	2,272	2,449	2,670	2,868	3,038	34%
Switzerland	1,121	no data	1,275	1,276	1,371	33%
Estonia	195	180	201	211	258	32%
Germany	13,750	14,695	16,195	16,875	17,557	28%
Azerbaijan	117	123	131	140	145	24%
United Kingdom	6,954	7,230	7,591	7,743	8,197	18%
Denmark	905	950	993	1,011	1,034	14%
Georgia	144	139	144	139	163	13%
Sweden	2,029	2,057	2,264	1,753	1,879	-7%
Uzbekistan	184	226	155	136	158	-14%
Ukraine	3,698	3,896	4,006	3,022	2,897	-22%

Source: ECE Statistical Database. Accessed 1 February 2022.

3. Shifting energy production and use

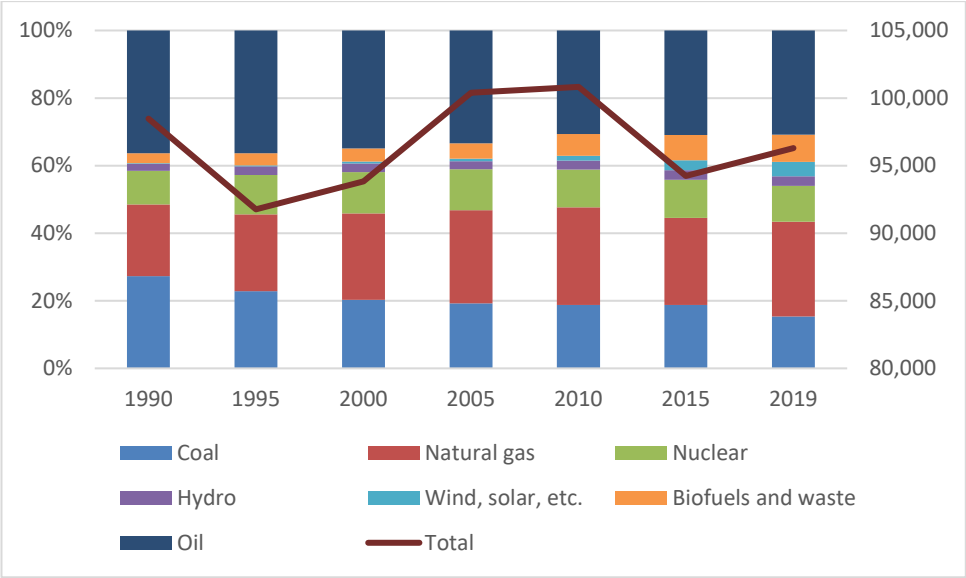
14. Despite industrial production increasing by 25 per cent from 2000 to 2010 and by 20 per cent from 2010 to 2018, total energy sources have hardly shifted since 1990 (a 3 per cent drop to 2017). This indicates an increase in energy efficiency. In parallel, the energy mix has changed but fossil fuels, such as coal, oil and natural gas still have only decreased from 84 per cent in 1990 to 74 per cent of net energy production, while hydro, wind, solar, biofuels and waste grew from 5 to 14 per cent. Figures point to 44 per cent less coal, and 9 per cent less crude oil, but 21 per cent more gas, and total consumption of fossil fuels increased by 2.4 per cent in 2015–2017. Besides, the relative use of nuclear power increased by 5 per cent, hydropower increased by 17 per cent, wind and solar increased by 11 times and biofuels and waste doubled.

15. The change in energy mix has also led to a stabilization in CO_2 emissions from the region, though with significant geographical variations (see figure VI). However, the reductions in greenhouse gas emissions necessary to limit global temperature rise to 2ºC, let alone 1.5ºC, are still not in the horizon.

16. New trends are expected in electricity consumption. The European Union aims to have at least three million electric vehicle chargers by 2030, a three-fold increase in comparison with today. This trend will however promote material pressure such as on lithium for batteries. Hydrogen fuel cells are an emerging industry.

Figure V

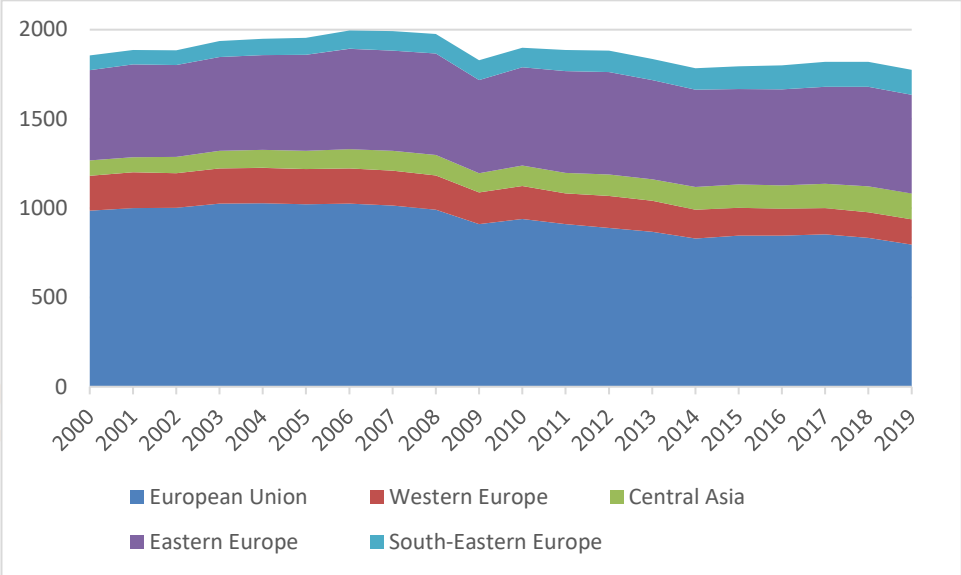
Energy sources, net of imports and exports, pan-European region, proportion by source (left axis) and total in petajoules (right axis) (1990–2019)



Source: International Energy Agency (IEA) Data and Statistics. All rights reserved. *Note*: No data for Andorra, Liechtenstein, Monaco and San Marino.

Figure VI

Territorial fossil CO_2 emissions by subregion, million tons of CO_2 (2000–2019)



Source: Global Carbon Budget, 2020.[30] *Note:* Monaco included with France and San Marino with Italy.

[30] Pierre Friedlingstein, Michael O'Sullivan, Matthew W. Jones, Robbie M. Andrew, Judith Hauck, Are Olsen, Glen P. Peters, Wouter Peters, Julia Pongratz, Stephen Sitch, Corinne Le Quéré, Josep G. Canadell, Philippe Ciais, Rob Jackson,Simone Alin, Luiz E.O.C. Aragão, Almut Arneth, Vivek Arora, Nicholas R. Bates, Meike Becker, Alice Benoit-Cattin, Henry C. Bittig, Laurent Bopp, Selma Bultan, Naveen Chandra, Frédéric Chevallier, Louise P. Chini, Wiley Evans, Liesbeth Florentie, Piers M Forster, Thomas Gasser, Marion Gehlen, Dennis Gilfillan, Thanos Gkritzalis, Luke Gregor, Nicolas Gruber, Ian Harris, Kerstin Hartung, Vanessa Haverd, Richard A. Houghton, Tatiana Ilyina, Atul Jain, Emilie Joetzjer, Koji Kadono, Etsushi Kato, Vassilis Kitidis, Jan Ivar Korsbakken, Peter Landschützer, Nathalie Lefèvre, Andrew Lenton, Sebastian Lienert, Zhu Liu, Danica Lombardozzi,

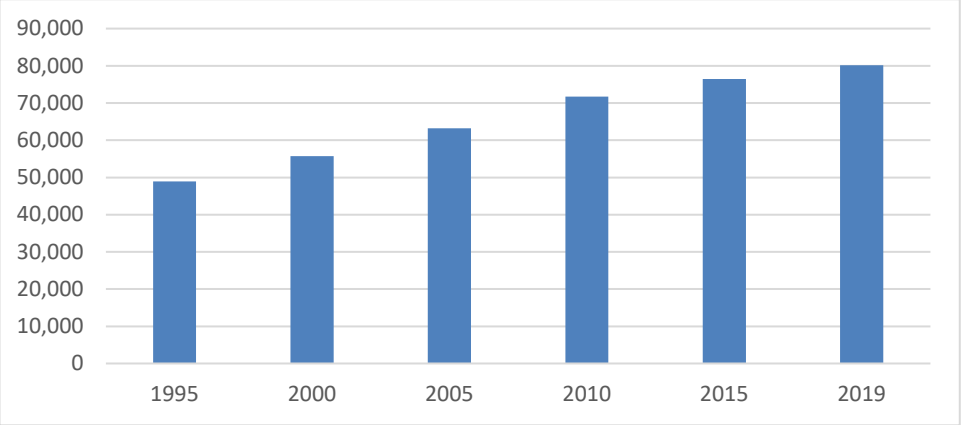
4. An increasingly mobile society

17. The transport of persons and goods is among the most important drivers for the environment, with effects ranging from GHG emissions to material consumption and pollution, to issues related to the ocean and atmosphere.

18. Infrastructure including for transport has seen continued growth. For example, the length of motorways has continued to grow, though at a slower rate (figure VII). At the same time, motor transport has continued to see growth, which has accelerated in some countries. However, Finland has been able to see a decrease in motor vehicle movements between 2010 and 2017, since when it has remained stable; Norway and Sweden have also seen zero growth since 2017 (see Table 2). Land public transportation has been rising, railway passenger traffic has grown (figure VIII). However, this trend – among others – has likely been reversed by the effects of the COVID-19 pandemic.

Figure VII

Motorway length, pan-European region excluding Central Asia and Eastern Europe, km (1995–2019)



Source: ECE Transport Division Database. No data for Albania, Belgium, Bosnia and Herzegovina, Bulgaria, Greece, Iceland, Malta, Montenegro, San Marino and Serbia. Interpolation used to fill gaps in data for Andorra, Denmark, Israel, Italy, Latvia, Liechtenstein, Monaco, Norway, Spain, Switzerland and the United Kingdom.

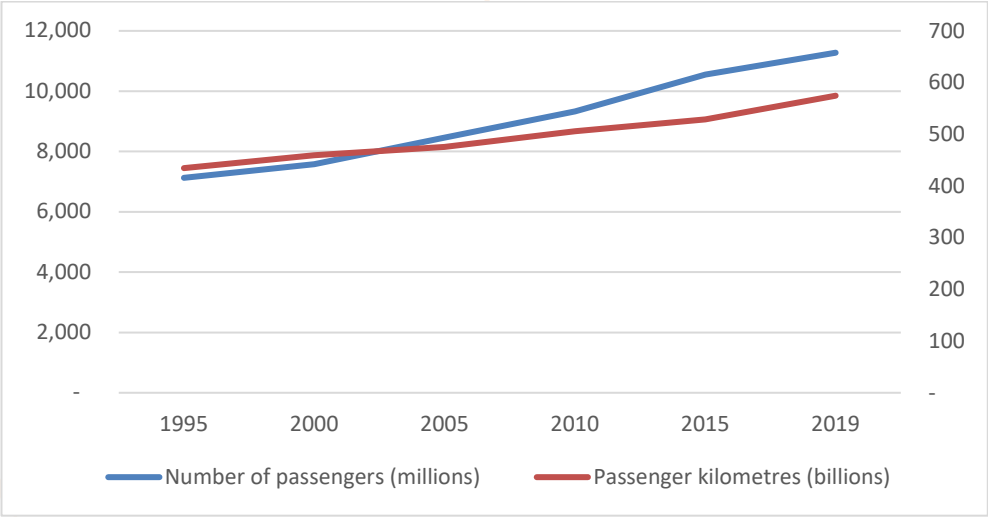
Gregg Marland, Nicolas Metzl, David R. Munro, Julia E.M.S Nabel, Shin-Ichiro Nakaoka, Yosuke Niwa, Kevin O´Brien, Tsuneo Ono, Paul I. Palmer, Denis Pierrot, Benjamin Poulter, Laure Resplandy, Eddy Robertson, Christian Rödenbeck, Jörg Schwinger, Roland Séférian, Ingunn Skjelvan, Adam JP Smith, Adrienne J. Sutton, Toste Tanhua, Pieter P. Tans, Hanqin Tian, Bronte Tilbrook, Guido van der Werf, Nicolas Vuichard, Anthony P. Walker, Rik Wanninkhof,Andrew J. Watson, David Willis, Andrew J. Wiltshire, Wenping Yuan, Xu Yue, Sönke Zaehle. Global Carbon Budget 2020, Earth Syst. Sci. Data, 2020. Available at https://www.icos-cp.eu/science-and-impact/global-carbon-budget/2020.

Table 2
Motor vehicle movements on national territory by vehicle-kilometres (millions), irrespective of country of registration, selected countries, ordered by decreasing percentage change (2000–2019)

	2000	2010	2017	2019	Percentage increase from 2000 to latest
Turkey	56,151	80,124	127,997		128%
Estonia	6,441	8,355	10,811	11,659	81%
Slovenia	13,346	17,826	21,346	21,886	64%
Norway	32,669	43,847	46,791	47,065	44%
Austria	65,143	75,957	86,854		33%
Czechia	40,490	46,381	54,558	56,401	39%
Hungary	32,974	no data	43,016	46,416	41%
Switzerland	52,873	60,036	67,822	69,265	31%
Sweden	69,667	76,836	83,896	83,723	20%
Spain	208,508	241,131	244,661	252,055	21%
France	525,787	560,429	606,042	622,988	18%
Netherlands	126,660	130,192	139,850	142,259	12%
Finland	46,710	54,715	51,386	51,548	10%
United Kingdom	478,376	495,917	526,423		10%

Source: ECE Transport Division.
Note: Latest data for Czechia and Slovenia are from 2018.

Figure VIII
Railway passenger traffic, national and international, millions of passengers (left axis) and billions of passenger kilometres (right axis) (1995–2019)

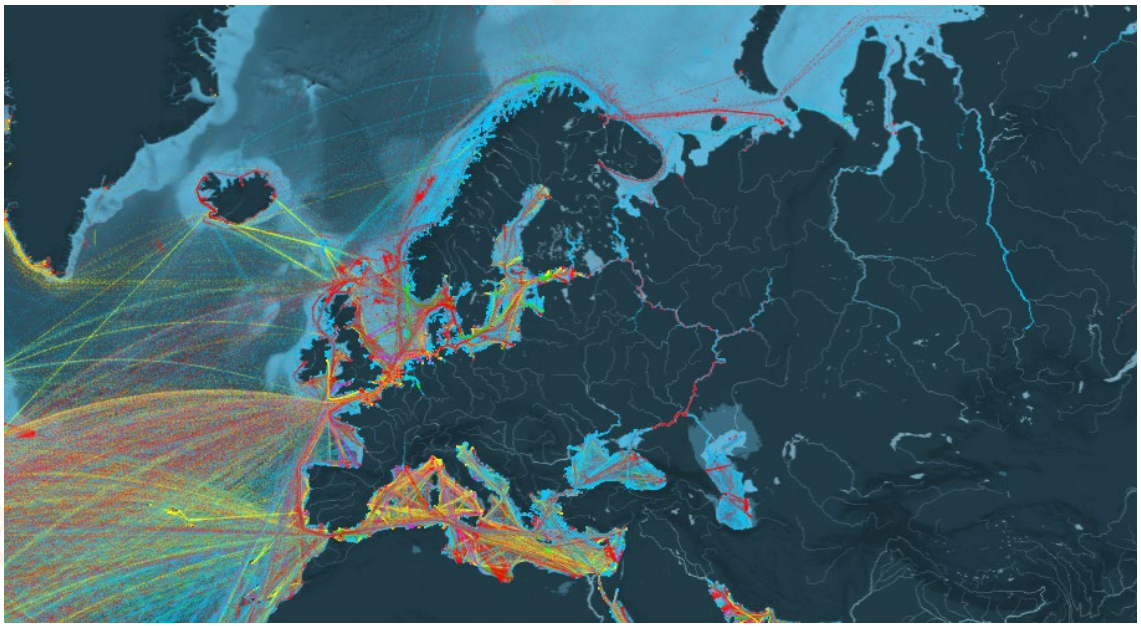


Source: ECE Transport Division Database. Interpolation used to fill gaps in data for numbers of passengers in Belarus, Denmark, Germany, Greece, Israel, Luxembourg, Norway, Portugal, United Kingdom and Uzbekistan. Insufficient or no data on numbers of passengers for Albania, Andorra, Armenia, Belgium, Georgia, Kyrgyzstan, Liechtenstein, Monaco, Montenegro, Russian Federation, San Marino, Serbia, Tajikistan and Turkmenistan, which together accounted for approximately 2,000 million passengers in 1995 and 1,100 million passengers in 2019. Interpolation used to fill gaps in data for passenger kilometres in Azerbaijan, Belarus, Bosnia and Herzegovina, Denmark, Germany, Greece, Israel, Kazakhstan, Netherlands, Norway, Republic of Moldova, Ukraine, United Kingdom and Uzbekistan. Insufficient or no data on passenger kilometres for Andorra, Armenia, Belgium, Georgia, Kyrgyzstan, Liechtenstein, Luxembourg, Monaco, Montenegro, Russian Federation, San Marino, Serbia, Tajikistan and Turkmenistan, which together account for together accounted for approximately 200 billion passenger kilometres in 1995 and 150 billion passenger kilometres in 2019.

19. According to the International Energy Agency (IEA)[31] (2020), aviation CO_2-equivalent emissions rose rapidly, at an average annual rate of 2 per cent during 2000–2019, with commercial passenger flight activity since 2000 rising 5 per cent yearly. The energy intensity of commercial passenger aviation has decreased 2.8 per cent per year on average, but improvements have slackened over time. This is due to operational and technical efficiency measures adopted by commercial airlines, including new aircraft purchases. But most (over 99.5 per cent) aviation relies on jet kerosene, and sustainable alternatives will need many years to be developed on a mass-scale.[32]

20. Maritime transport remains the main gateway to the global marketplace, with around 90 per cent of all goods moved across the world by ships (OECD website[33]). The figure below shows the vast scale of the shipping sector globally, with a focus on the pan-European region, highlighting the most important and busiest ports and the most used shipping routes. Transport of oil and chemicals predominates in the North Sea, the southern parts of the Caspian Sea and inland transport from Azov Sea. The Mediterranean Sea also hosts major oil transportation lanes, notably with oil shipments through two of the six major oil chokepoints worldwide, the Suez Canal/SUMED Pipeline and the Turkish straits which together accounted for 13.24 per cent of the world's seaborne oil trade in 2015.[34] The increasing container volumes and ship sizes have exacerbated the need to improve port infrastructure and move towards deep-water terminals able to better process larger and more efficient ships.

Figure IX
Map showing the movements of ships in the global merchant fleet during 2012, the most recent year with complete data



Source: www.shipmap.org, courtesy of https://www.kiln.digital/.

Notes: Colour code: Yellow: Container (e.g., manufactured goods); Blue: Dry bulk (e.g., coal, aggregates); Red: Tanker (e.g., oil, chemicals); Green: Gas bulk (e.g., liquefied natural gas); Purple: Vehicles (e.g., cars).

[31] https://www.iea.org/reports/tracking-transport-2020/aviation

[32] According to the same report near to mid-term priorities include implementing fiscal and regulatory measures that promote exploitation of operational and technical efficiency and managing the investment risks derived from developing and deploying clean sheet airframes, new engines and propulsion systems, and for production low-lifecycle GHG-emissions Sustainable Aviation Fuels.

[33] https://www.oecd.org/ocean/topics/ocean-shipping/

[34] UNEP/MAP and Plan Bleu. 2020. "State of Environment and Development in Mediterranean.".

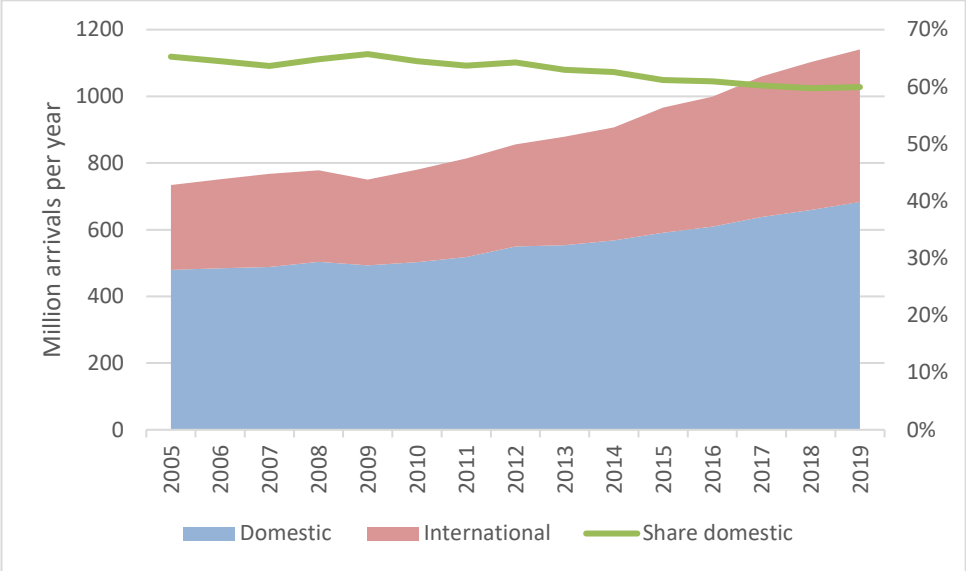
21. Tourism is a vital economic sector for certain Mediterranean countries, the region that hosted around 27 per cent of global international tourism in 2017, as well as other coastal tourism hotspots. The contribution of tourism to climate change is estimated to be 8 per cent,[35] and transport is responsible for the majority (75 per cent) of tourism emissions. Travel distance and modal choice are the key determining factors in tourism transport emissions. The combination of strong increases of transport speed and low fares through the development of air transport were the main drivers of overconsumption of travelled distances.[36] Aviation has become a key driver of overall tourism emissions.

22. Figure X shows the development of both domestic and international tourism arrivals at all accommodation types for the European Union countries (latest data from 2019 and for the 28 European Union countries at that time). This has grown continuously between 2005 and 2019, except for the year 2009 as a response to the 2008 economic crisis. Also, the figure shows the share of domestic arrivals to be consistently above 60 per cent but slowly declining. Only during the economic crisis in 2008 did the share of domestic tourism increase.

23. The participation of European Union citizens in tourism shows a slowly downward trend. This means that the increased consumption of tourism by the European Union is being done by a slightly decreasing number of people. Both the benefits and the impacts of tourism are becoming less equally distributed over the population.

Figure X

Growth of the domestic and international arrivals at European Union accommodation (all types) between 2005 and 2019.



Source: Eurostat (2022). Arrivals at tourist accommodation establishments [TOUR_OCC_ARNAT], 28 countries, including the United Kingdom of Great Britain and Northern Ireland. *Note:* In this section we discuss drivers and pressures on the natural environment based on the development of tourism in the European Union. No comparable data from other subregions of the pan-European region could be found.

24. Currently, the environmental impacts of tourism are not systematically measured. This failure to measure affects every indicator relevant for the circular economy. The tourism system consists of accommodation, activities, transport at the destination and transport between the source markets and the destinations. For many circular economy indicators, like waste and water treatment, tourism will not deviate too much from the national performance, simply because a 100 per cent circular country will also provide a 100 per cent circular tourism destination. However, the role of tourism is important as long as a country is not yet

[35] Manfred Lenzen and others, "The carbon footprint of global tourism".

[36] P.M. Peeters, "Tourism's impact on climate change and its mitigation challenges: How can tourism become 'climatically sustainable'?", doctoral thesis, Delft University of Technology, 2017.

100 per cent circular. Also, the larger the resource requirements (energy, water, land-use, food), the more difficult it will be to reach full circularity.

25. At the global level, a few studies show the shares of tourism impacts and the trends. For instance, one paper[37] shows the projected trends between 1900 and 2050 for energy use, water use, land area, food, and CO_2 emissions. The paper states that in 2010 the global tourism system required: "c.16,700 PJ of energy, 138 km3 of fresh water, 62,000 km2 of land, and 39.4 Mt of food, also causing emissions of 1.12 Gt CO2. Despite efforts to implement more sustainable forms of tourism, analysis indicates that tourism's overall resource consumption may grow by between 92 per cent (water) and 189 per cent (land use) in the period 2010–2050. To maintain the global tourism system consequently requires rapidly growing resource inputs, while the system is simultaneously becoming increasingly vulnerable to disruptions in resource flows."

26. The above figures are for the global domestic plus international tourism system, but it is likely that tourism in the pan-European region takes a share proportionate to the number of trips in the pan-European region of global trips.

27. The situation is different for climate change. The impact of tourism on climate is mainly (75–80 per cent) caused by transport between home and destination, and the largest share is from air transport, even though only some 20–25 per cent of all trips are by air. An important gap in tourism measurement is measuring the distances tourists travel per transport mode. The most recent study on the subject is from 2004.[38] Air transport statistics are more detailed, but only in terms of number of passengers, not passenger-kilometres. The number of passengers carried per year for the European Union increased between 2009 and 2019 by 52–56 per cent, but fell back to 40 per cent of the 2009 value in 2020, and 28 per cent of the 2019 level due to the pandemic. Taking the United Nations World Tourism Organization (UNWTO) definition of a tourist and thus including leisure, visiting family and friends and business trips that comprise at least on night overstay, most air transport (over 90 per cent) is tourism related. Tourism takes around 10 per cent of other transport modes. As transport statistics use rather different trip purpose definitions, data using the UNWTO tourism definition are very difficult to extract.

28. The main drivers of the tourism system are GDP per capita levels, and cost and speed of transport. The average number of trips per capita in a country, region or city follows a surprisingly linear relationship with GDP per capita, but with a cap at about five trips per year per capita.[39] So the total number of trips in the pan-European region will develop proportionally to the population size and the differentiated GDP per capita.

29. However, destination choices and transport modes and distances travelled not only depend on GDP per capita, but also by the cost and travel times of the supplied transport systems.[40] These choice processes are very complex because people do not only react to the speed and cost of the transport mode of their choice, but are also affected by the perceived cost and speed of other transport modes. Furthermore, the destination choice and particularly the distance a tourist is prepared to travel, depends highly on the speed and cost of the transport system provided. Therefore, the main drivers of how tourism is shaped and what its impacts are on circularity are the speed and cost of the whole complex of infrastructure (infrastructure, software, marketing, etc.) of car, bus, train, ferries and air transport and their relationships and connectedness.

[37] S. Gössling and P. M. Peeters, Assessing tourism's global environmental impact 1900–2050, Journal of Sustainable Tourism 2015 Vol. 23 Issue 5 Pages 639-659, DOI: 10.1080/09669582.2015.1008500.

[38] P. M. Peeters, T. van Egmond and N. Visser, European tourism, transport and environment. Final Version, NHTV CSTT 19-08-2004 Breda.

[39] P. M. Peeters and M. Landré, The emerging global tourism geography – an environmental sustainability perspective, Sustainability 2012 Vol. 4 Issue 1 Pages 42-71, DOI: 10.3390/su4010042.

[40] The statements in this paragraph bare all based on P. M. Peeters, 'Tourism's impact on climate change and its mitigation challenges. How can tourism become 'climatically sustainable?', Delft University of Technology.

30. Legislative drivers with respect to the environment are diverse and sometimes complex. The main drivers for infrastructure are resource and energy use and emissions of NO_x and particulate matter (PM). Climate policies can also have a strong impact on cost and even speed of transport systems. Both shipping and air transport are hard-to-abate sectors,[41] meaning these sectors do not have many options to mitigate and have not implemented any at scale. For tourism, zero emissions are achievable for buildings, surface transport and short distance ferries. Particularly railways have several national systems that are already (almost) fully running on renewables at zero-emissions (for example, Austria, Netherlands, Sweden and Switzerland,). Electric cars potentially become zero-emission as soon as electricity production reaches that goal. The resources for batteries are still a potential barrier, as despite increasing attempts for recycling, the total battery capacity needed is challenging for circular resource use,[42] which is not a problem with rail transport. Therefore, environmentally, efforts to get more tourists travelling by train, rather than by car or air, should have the highest priority in Europe.

31. For aviation, decarbonization is still in the initial development phase. Apart from the less than 0.5 per cent mixing alternative (bio-)fuels, only business-as-usual improvements of aircraft efficiency have been achieved. Currently, developments in advanced waste-based fuels and synthetic e-fuels are picking up speed in several countries. E-fuels potentially reach zero-emissions for flights using 100 per cent of these fuels. However, the renewable energy input for producing such fuels is very high. Current processes run at some 20 per cent efficiency,[43] which means that the energy use of flight-based tourism will increase by a factor five if this is not improved. But even with large-scale efficiencies expected by experts of up to 60 per cent,[44] the e-fuel-aviation system might consume about 20 per cent of all renewables expected up to 2050. Clearly, such a share of renewable energy of 20–25 per cent for tourism alone might not be societally justifiable. This limitation is a substantial one to the growth of aviation and an additional argument to shift as much as possible towards trains and electric cars. Such a move will not affect the size of the tourism sector because the number of trips (and guest-nights) is a function of GDP per capita. But it will change the geographical spread of tourism towards more domestic, more short-haul and a smaller share of long-haul travel, and a more circular operating industry.

[41] Energy Transitions Commission (ETC), Mission possible. Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century, Energy Transitions Commission (ETC) 2018, London.

[42] See e.g. C. M. Costa, J. C. Barbosa, R. Gonçalves, H. Castro, F. J. D. Campo and S. Lanceros-Méndez, Recycling and environmental issues of lithium-ion batteries: Advances, challenges and opportunities, Energy Storage Materials 2021 Vol. 37 Pages 433-465, DOI: https://doi.org/10.1016/j.ensm.2021.02.032

[43] Private information in extension to the information given on https://www.atmosfair.de/en/air_travel_and_climate/flugverkehr_und_klima/sorgenfrei-fliegen-mit-e-kerosin/.

[44] See for instance P. Schmidt, V. Batteiger, A. Roth, W. Weindorf and T. Raksha, Power-to-Liquids as Renewable Fuel Option for Aviation: A Review, Chemie Ingenieur Technik 2018 Vol. 90 Issue 1-2 Pages 127-140, DOI: 10.1002/cite.201700129

III. Environmental state and trends

Introduction

1. This chapter discusses the environmental state, trends and policy responses, using the ECE set of environmental indicators,[45] Sustainable Development Goal indicators and other indicator frameworks as appropriate. The indicators used have been selected based on the following criteria: policy relevance; soundness of the methodology, preferably based on national sources; data availability; and coverage of pressures, state and impacts. The chapter addresses eight environmental themes:

- Atmospheric air
- Climate change
- Fresh water
- Coastal waters, marine ecosystems and seas
- Biodiversity and ecosystems
- Land and soil
- Chemicals and waste
- Environmental financing

2. For each theme, key messages and policy recommendations are presented based on an assessment of the state, trends and outlook towards meeting policy objectives. Key messages and recommendations are derived from the assessment that follows and not necessarily repeated in the assessment. Links are provided to circular and green economy, sustainable development and the two conference themes.

[45] For a list and guidance on application of United Nations Economic Commission for Europe (ECE) environmental indicators, see https://unece.org/guidelines-application-environmental-indicators.

A. Atmospheric air

1. Key messages and recommendations

Key messages

3. The health impact of long-term exposure to fine particulate matter with a diameter less than 2.5 µm ($PM_{2.5}$) in 41 European countries was reduced by 13 per cent in the period 2009–2018 and that of nitrogen oxides (NO_x) by 54 per cent. However, the number of premature deaths due to ground-level ozone exposure increased in that period by an estimated 24 per cent, possibly caused by higher mean temperatures.[46]

4. The Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) has had positive effects on human health and the environment. The phasing out of hydrochlorofluorocarbons present as coolant in refrigerators and air conditioning systems remains incomplete, especially in countries with economies in transition.

5. Emissions measurement and ambient air pollution monitoring have improved in the past decade, with more appropriate equipment, advanced portable sensors and network strategies leading to greater efficiency and lower costs of ground-level monitoring stations, and are increasingly available.[47] In the pan-European region, there are still monitoring gaps, especially in the measurement and analysis of fine PM.

6. Countries in the region are expanding policies to tackle air pollution. The evaluation and fitness check of existing European Union air quality legislation in 2019[48] led to proposals to strengthen provisions on monitoring, modelling and air quality plans to achieve cleaner air. The European Union air quality standards will be revised to align them more closely with the World Health Organization (WHO) Air Quality Guidelines, which were updated in 2021.[49] The Russian Federation is implementing the "Clean Air" project,[50] which provides for significant reduction of pollutants in 12 large industrial centres by 2024, as well as a radical modernization of the State system for monitoring air pollution in these cities.

Recommendations

7. Cooperation should be enhanced so that non-European Union countries in the region could have the possibility to benefit from the experience on the European Union zero-pollution action plan.[51]

8. Governments should develop additional technical and organizational measures to achieve target 3.9 of the Sustainable Development Goals, especially for fine particulate matter and ground-level ozone. Key responses are the sharpening and application of best

---

[46] European Environment Agency (EEA), *Air Quality in Europe – 2020 report*, EEA Report No. 9/2020 (Luxembourg, Publications Office of the European Union, 2020), available at www.eea.europa.eu/publications/air-quality-in-europe-2020-report/at_download/file.

[47] Real-time air polluting concentrations and air pollution indices are available and are published on maps by different providers (for example, http://iqair.com). Since 2015, the European Copernicus Atmosphere Monitoring Service (http://atmosphere.copernicus.eu) has provided continuous satellite data and information on atmospheric composition. The Service tracks air pollution, solar energy, greenhouse gases and climate forcing globally.

[48] European Commission, *Fitness Check of the Ambient Air Quality Directives*, Commission Staff Working Document (Brussels, 2019), available at https://ec.europa.eu/info/publications/fitness-check-eu-ambient-air-quality-directives_en.

[49] World Health Organization. (2021). WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. World Health Organization. https://apps.who.int/iris/handle/10665/345329.

[50] Full information on the project is available (in Russian) at https://rpn.gov.ru/activity/fresh-air/info/.

[51] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Pathway to a Healthy Planet for All EU Action Plan: "Towards Zero Pollution for Air, Water and Soil", COM(2021) 400 final.

available techniques to prevent emissions of particulate matter, nitrogen oxides (NO_x) and hydrocarbons by industry and emission reduction from traffic (by implementing measures for Euro-6 and 7 emissions standards).

9. Governments should contribute or urge donors to contribute to the adequate replenishment of the Multilateral Fund for the implementation of the Montreal Protocol in order to accelerate the phasing out of hydrochlorofluorocarbons globally.

10. Governments should promote the use of appropriate and standardized methods for monitoring air pollution emissions[52] and the public availability of monitoring data in the pan-European region, while also strengthening cooperation and national investment to fill monitoring gaps in countries with economies in transition.

2. Context

11. Emissions of substances such as sulfur dioxide (SO_2), carbon monoxide (CO) and lead (Pb), which were problematic in the second half of the twentieth century, have been reduced worldwide. Others, such as PM, NO_x and ammonia (NH_3), have increased in many areas. In the past 40–50 years, policy measures to reduce air pollution have been developed at the national level and through successful international cooperation, such as the ECE multilateral environmental agreements[53] or European Union directives and guidelines. Since 2016, 27 countries and various organizations have submitted commitments to the Batumi Action for Cleaner Air.[54]

12. For the pan-European region, the Convention on Long-range Transboundary Air Pollution (Air Convention), with its 51 Parties and its various protocols, has initiated actions, founded on scientific arguments, to deal with the long-term challenges of air pollution. The Convention's 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, as amended in 2012, is the leading instrument for setting national emission ceilings for SO_2, NO_x, NH_3, volatile organic compounds (VOCs) and $PM_{2.5}$ to be achieved by 2020 and beyond. As black carbon (soot, a short-lived climate pollutant) is included in the PM fraction, climate co-benefits are also achieved. Other key protocols of the Convention are the Protocol on Heavy Metals and the Protocol on Persistent Organic Pollutants.

13. Air quality in the pan-European region remains moderate and unhealthy for sensitive groups in many regions, particularly in urban and industrial areas, despite some sizable reductions in ambient concentrations, and air pollution is still considered as the most important environmental risk to human health. At present, PM, nitrogen dioxide (NO_2) and ground-level ozone (O_3) are the substances that most seriously influence human health, even when concentrations do not exceed current established limit values.

3. Status, main trends and recent developments

14. Air pollution in Europe has in general decreased in European Union and Western Europe countries in recent decades and, mainly through economic growth, increased in the countries of Central Asia and Eastern Europe. Joint efforts of national and regional authorities have not yet led to all desired results as some air quality standards are still exceeded, especially in urban areas.

15. The health impact of long-time exposure to $PM_{2.5}$ in 41 European countries was reduced by 13 per cent in the period 2009–2018 to 417,000 premature deaths (4.8 million years of life lost). For NO_x, the health impact was reduced by 54 per cent to 55,000 premature deaths (624,000 years of life lost) in the same period. However, the number of premature deaths due to ground-level ozone exposure increased in this period by an estimated 24 per cent to 20,600 (247,000 years of life lost), possibly caused by higher mean temperatures.[55]

---

[52] For example, as described in European Union Best Available Techniques reference documents and their equivalents in the Russian Federation.

[53] As described in Chapter I.

[54] Available at https://unece.org/baca.

[55] European Environment Agency, *Air Quality in Europe – 2020 report*.

16. In the Russian Federation, the number of cities with high and very high air pollution decreased by 70 per cent in the period 2010–2019 (based on air pollution indices). The Government of the Russian Federation has instructed the authorities in big cities like Moscow and St. Petersburg to develop a road map to set up restrictions for heavily polluting traffic (under Euro-3).[56] In other countries of Central Asia and Eastern Europe, there have been similar developments in the field of fuel quality. In Uzbekistan, over 50 per cent of private cars and trucks use cleaner natural gas as fuel.[57]

17. The global BreatheLife campaign,[58] led by WHO, UNEP and the Climate and Clean Air Coalition, calls on Governments to commit to achieving the WHO Air Quality Guidelines targets in 2030. The aim is to halve the number of air pollution-related deaths by 2030, while helping to slow the pace of climate change. Within the Coalition, over 70 States have founded a voluntary partnership together with intergovernmental organizations, non-governmental organizations, cities and financial and business institutions, aimed at reducing emissions of short-lived climate pollutants (black carbon, methane, hydrofluorocarbons and tropospheric ozone).

18. The Second European Union Clean Air Forum (2019) discussed differences between the European Union air quality guidelines and their mostly more stringent WHO equivalents and ways to close this gap. The European Union clean air policy framework to abate air pollution includes three pillars: air quality standards, national emission ceilings for key pollutants and emission limit values for key sources of pollution. The 2019 fitness check of the European Union Ambient Air Quality Directive[59] showed that not all the Directive's targets have been met and that the gap to achieve air quality standards is wide in some cases, thus requiring improvement of existing legislation. In specific cases, stricter emission ceilings in the National Emission Ceilings Directive[60] or more stringent emission limit values in the Industrial Emissions Directive[61] and for mobile sources could be necessary to meet the policy challenge to achieve all European Union air quality standards as a first step to achieving their WHO equivalents in 2030. In 2021, the European Commission adopted a Zero Pollution Action Plan.

19. The European Environment Agency and the European Commission launched the European Air Quality Index in 2017, which provides on-line information on the air quality situation, based on measurements from more than 2,000 air quality monitoring stations across Europe. An interactive map shows the local air quality situation at station level, based on five key pollutants: $PM_{2.5}$, PM_{10}, ground-level ozone, NO_2, and SO_2.

20. At the global level, the General Assembly adopted resolution A/RES/74/212 on the International Day of Clean Air for blue skies (first held on 7 September 2020). UNEP, in collaboration with the Climate and Clean Air Coalition and WHO, coordinated activities for the International Day, to raise public awareness, demonstrate the connection with the Sustainable Development Goals and promote and facilitate solutions for air protection.

---

[56] Konstantin Fomin, "How Russian cities are cleaning up their air", Greenpeace, 30 April 2019.

[57] *Environmental Performance Reviews: Uzbekistan – Third Review* (United Nations publication, Sales No. E.20.II.E.26).

[58] See https://breathelife2030.org.

[59] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, *Official Journal of the European Union*, L 152 (2008), pp. 1–44.

[60] European Union Directive 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, *Official Journal of the European Union*, L 344 (2016), pp. 1–31.

[61] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control), *Official Journal of the European Union*, L 334 (2010), pp. 17–119.

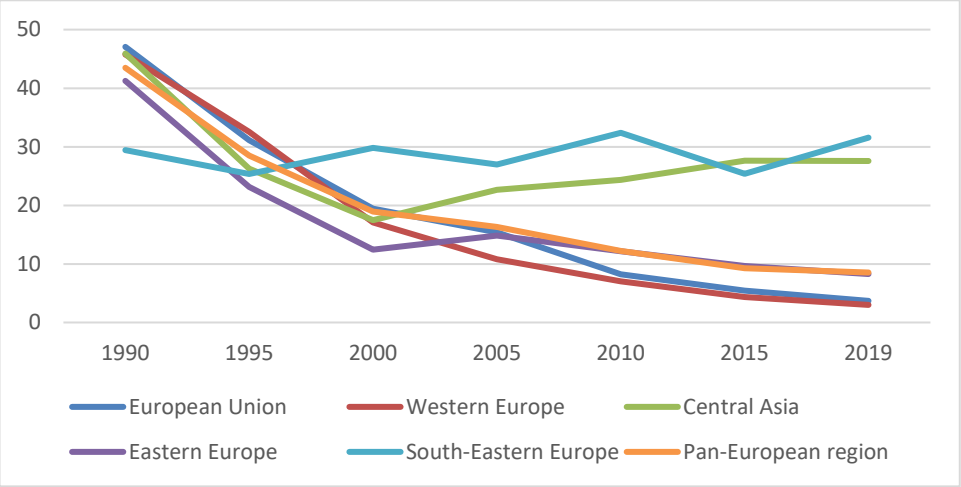
4. Indicators

Emission of pollutants into the atmospheric air (ECE, pressure indicator)

21. Within the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), 43 out of 51 Parties to the Air Convention submitted their emission inventories in 2020. Nevertheless, the quality of data varies widely, generating uncertainty. Experts and modellers are working on a solution towards a harmonized emission methodology.

22. In the period 2000–2018, emissions of the main pollutants (SO_2, NO_x, NH_3, non-methane VOCs, PM_{10}, $PM_{2.5}$, PM_{coarse} and black carbon) have shown a major decoupling from economic growth and an absolute decrease in the western part of the region. In the countries of Central Asia and Eastern Europe, emissions have increased since 2000, but these emissions are often based on expert estimates extrapolated from gross domestic product growth trends, due to the lack of plausible reporting. Figures I (below) and II and III (overleaf) show strong decreases in emissions of SO_2 and NO_x, while decreases for $PM_{2.5}$ are much smaller.

Figure I
Emission trends for SO_2, kg per annum per capita (1990–2018)

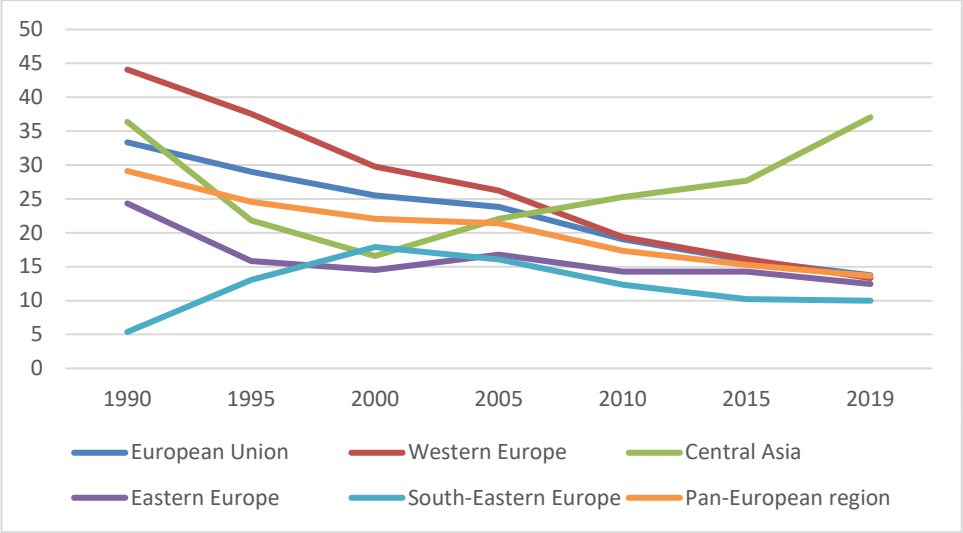


Source: EMEP Centre on Emission Inventories and Projections, 2021, Officially reported emission data, available at www.ceip.at/webdab-emissions-database/reported-emissiondata. Population data from ECE Statistics Database, 2019 or latest.

Notes: No data for Andorra, Bosnia and Herzegovina (except 1992), Israel or San Marino; data only for Kazakhstan and Kyrgyzstan in Central Asia; gaps for Armenia, Azerbaijan, Belarus and Ukraine; 2017 instead of 2019 data for Azerbaijan and Kyrgyzstan.

23. The largest decoupling between economic growth and production and air polluting emissions in recent decades has occurred in the energy-producing sector and manufacturing industry. Emissions from the road and non-road transport sector also decreased considerably by stringent emission standards set at the European Union level and, with some delay, also in the pan-European region. The agriculture and waste sectors had significantly less reductions in emissions. The residential, commercial and institutional sector did not reduce its emissions very much except for SO_2 emissions.

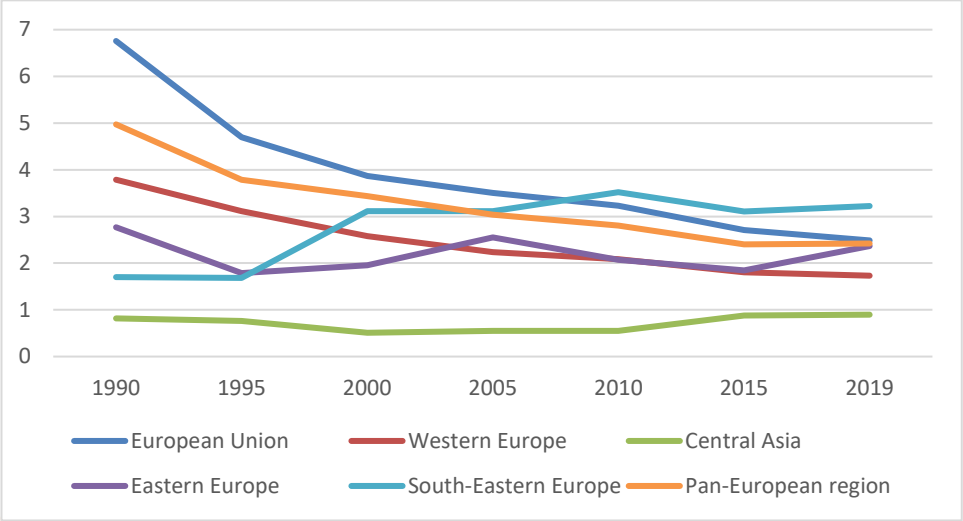
Figure II
Emission trends for NO_x, kg per annum per capita (1990–2018)



Source: EMEP Centre on Emission Inventories and Projections, 2021, Officially reported emission data, available at www.ceip.at/webdab-emissions-database/reported-emissiondata.

Notes: No data for Andorra, Bosnia and Herzegovina, Israel or San Marino; data only for Kazakhstan and Kyrgyzstan in Central Asia; gaps for Armenia; 2017 instead of 2019 data for Azerbaijan and Kyrgyzstan.

Figure III
Emission trends for $PM_{2.}$, kg per annum per capita (1990–2018)



Source: EMEP Centre on Emission Inventories and Projections, 2021, Officially reported emission data, available at www.ceip.at/webdab-emissions-database/reported-emissiondata.

Notes: No data for Andorra, Bosnia and Herzegovina, Israel or San Marino; no data for 1992 and 1995 for Estonia, Hungary, Slovenia and Spain; data only for Kazakhstan and Kyrgyzstan in Central Asia; gaps for Armenia, Belarus, the Russian Federation and Ukraine; 2017 instead of 2019 data for Azerbaijan and Kyrgyzstan.

Ambient air quality in urban areas (ECE, state indicator)

24. Improvements in air quality monitoring and reporting in the past 15–20 years make it possible to assess and report air quality trends in a qualitative, good statistical way. Long-term records of concentrations of the limited number of air polluting substances regulated in the European Union Ambient Air Quality Directive are available for European Union Member States, Iceland, Norway, Switzerland and the United Kingdom of Great Britain and

Northern Ireland.[62] Countries in Central Asia and some Eastern European countries perform reporting of air quality by a different method in the form of air pollution indices, in which three different indicators are used to assess air quality. These indicators make it possible to characterize both short-term air pollution and the chronic impact of air pollution on public health and the environment. The assessment of the air quality in the countries of Central Asia and Eastern Europe also includes specific pollutants for which hygienic standards have been established (more than 700 substances, for 160 of which State regulation measures are applied). The air quality category established by a set of indicators considers the main pollutants for each city, as assessed relative to standards. Assessments for specific pollutants that make the greatest contribution to air pollution levels in cities are regularly published online.[63]

25. SO_2 concentrations show the largest decrease of the main pollutants in the pan-European region over the past 20 years, with mean European Union values showing a 70 per cent reduction at traffic monitoring stations and 85 per cent at monitoring stations in urban background and industrial areas. In the past few years, the decrease of SO_2 concentrations has slowed. For ambient NO_x concentrations in the European Union, the mean reduction of 25–35 per cent over the past 20 years is similar for all station types, with rural stations having the largest decrease. The phasing out of combustion engines in automobiles is expected to accelerate the decrease of NO_x concentrations in urban and suburban stations in the next 10 years. Annual mean ground-level ozone trends in Europe over the past 20 years did not show significant trends or increased around 20 per cent for traffic stations, with 25 per cent of these sites showing increases of 40 per cent or more, while high ozone peaks have decreased by about 10 per cent except at traffic stations. The increase of mean ozone concentrations is coupled with the reduction of NO_x and VOC emissions. From 2000, annual mean PM_{10} concentrations in Europe have decreased by 40–50 per cent for all stations, with the largest reduction at industrial monitoring stations, while the reduction of $PM_{2.5}$ was around 30 per cent (measured relative to 2008). Regional differences occur with seasonal peaks of PM concentrations in areas where mostly wood is used for domestic heating, such as South-Eastern Europe, Eastern Europe and Central Asia. Figure IV overleaf illustrates the changes in the period 2010–2016.

Consumption of ozone-depleting substances (ECE, response indicator)

26. Ozone-depleting substances (ODS) are being phased out, although certain limited essential uses are still allowed, such as laboratory use and firefighting in special cases. Consumption of ozone-depleting substances in the 27 Member States of the European Union (production, plus imports, minus exports and destruction) has been negative since 2012, falling from 343,000 ozone-depleting potential (ODP) tons in 1986.[64] In the countries of Central Asia and Eastern Europe, the consumption of ozone-depleting substances fell from 243 to 34 tons and in the Russian Federation from 684 to 287 tons in the period 2014–2019.[65] Figure V overleaf provides an overview hydrochlorofluorocarbon consumption per capita in the period 2010–2019.

27. The emission of ODS today has been reduced by 98 per cent compared to 1990 levels. Obligations for parties to the Montreal Protocol are the gradual phase-out of production and consumption of the controlled substances according to specific timelines, reporting of data

[62] Augustin Colette and Laurence Rouïl, *Air Quality Trends in Europe: 2000–2017: Assessment for surface SO_2, NO_2, Ozone, PM_{10} and $PM_{2.5}$*, European Environment Information and Observation Network Report ETC/ATNI 2019/16 (Kjeller, Norway, European Topic Centre on Air pollution, Transport, Noise and Industrial Pollution, 2020)

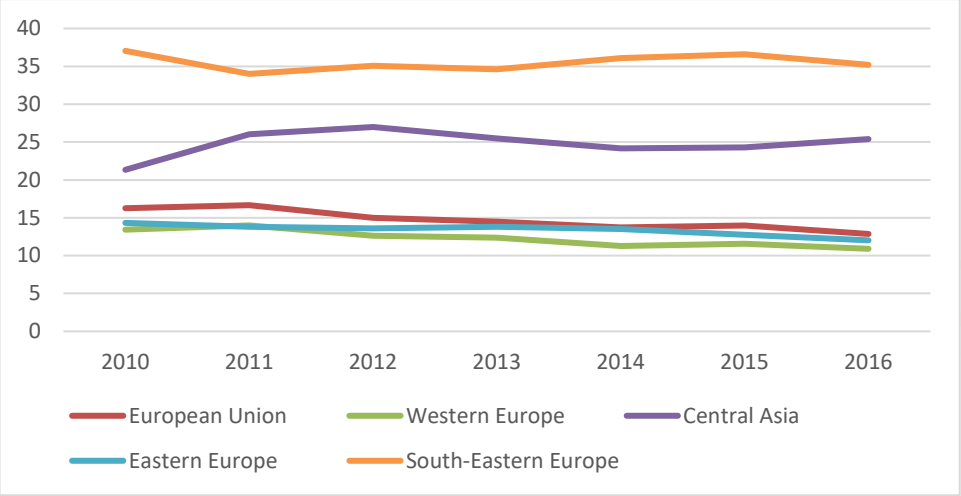
[63] Russian Federation, Sanitary Rules and Norms, State standards for air pollution.

[64] European Commission, *Evaluation of Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009 on substances that deplete the ozone layer*, Commission Staff Working Document (Brussels, 2020), available at https://ec.europa.eu/clima/sites/default/files/ozone/docs/swd_2019_406_en.pdf.

[65] See http://ozone.unep.org.

on the production, use, import and export to the Ozone Secretariat and establishing an import- and export licensing system.

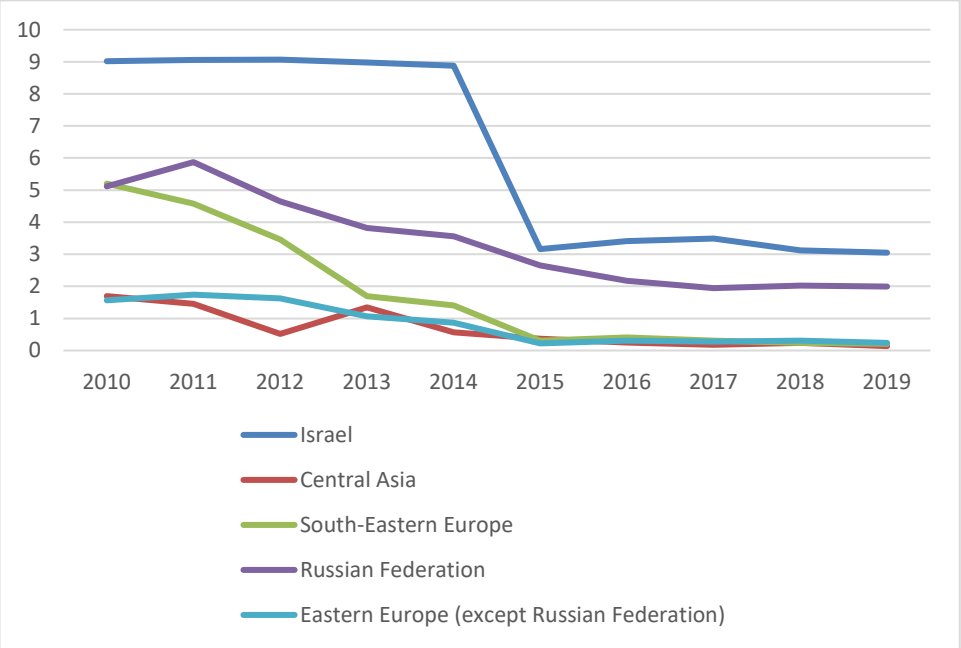
Figure IV
Concentrations of fine particulate matter ($PM_{2.5}$), all areas, mg/m3 (2010–2016)



Source: WHO Global Health Observatory, www.who.int/data/gho/data/indicators/indicator-details/GHO/concentrations-of-fine-particulate-matter-(pm2-5), last update 7 May 2021.

Notes: Regional values are population weighted. No data for Liechtenstein. Corresponds to Sustainable Development Goal indicator 11.6.2.

Figure V
Consumption of hydrochlorofluorocarbons, ozone-depleting potential g per capita (2010–2019)



Source: UNEP Ozone Secretariat, http://ozone.unep.org. *Notes*: European Union net consumption below zero since 2010; Western Europe except Israel has zero consumption since 2015, Azerbaijan and Belarus achieved zero consumption in 2019, Kyrgyzstan in 2020.

28. In the countries of Central Asia and South-Eastern and Eastern Europe, the consumption of chlorofluorocarbons has been phased out completely in the period 2005–2010. Consumption of hydrochlorofluorocarbons has been reduced in the period 2014–2019 from 90 to 27.5 tons ODP (Central Asia and Eastern Europe), from 14.5 to 12 tons ODP

(South-Eastern Europe excluding Turkey) and from 124 to 8.5 tons ODP (Turkey). For the implementation of the Kigali amendment to the Protocol, Belarus, Kazakhstan, Tajikistan and Uzbekistan follow the same rules as the Russian Federation.

5. Case studies

29. Three possible sources for case studies are suggested. The first is the recently published "Measures to Green the Post-Pandemic recovery", by the Issue-based Coalition on Environment and Climate Change, which includes interesting examples under the categories "Transport and Mobility, Climate Action" measure 10 (Chisinau), "Transport, Air Quality, Climate Action" measure 11 (Milan (Italy), Amsterdam, Ukraine and Belarus) and "Transport and Mobility, Air Quality, Biodiversity action" measure 13 (Barcelona (Spain)).[66] The second and third sources are the City of London's Air Quality Strategy 2019–2024[67] and a case study from South-East Europe under the UNEP regional air quality policy update report for the pan-European region (forthcoming).

[66] Available at https://unece.org/sites/default/files/2021-02/IBC%20Env%20Green%20post-pandemic%20measures%2031.1.21.pdf.

[67] Available at https://www.cityoflondon.gov.uk/services/environmental-health/air-quality/air-quality-strategy.

B. Climate change

1. Key messages and recommendations

Key messages

30. In spite of the commitments related to the reduction of greenhouse gas emissions, expressed by all countries in the pan-European region, net greenhouse gas emissions in the region are still rising.

31. Efforts and achievements are unevenly distributed throughout the region. Reductions, which are mostly achieved in the western part of Europe (2014–2018), are three times less than the increase in emissions in the rest of the region.

32. National commitments under the Paris Agreement were renewed by 35 countries in the region with more ambitious targets. However, some countries still do not have firm, quantifiable commitments or mechanisms to follow the progress towards them, which results in significant data gaps.

33. While decarbonization becomes a new narrative for Europe, there is a widening gap between rhetoric and action. The use of renewables was increased in 29 countries in the pan-European region in the period 2013–2017, but the region still largely relies on fossil fuels – some 78 per cent of the total final energy consumption on average comes from fossil fuels. The penetration of renewables in the energy mix rises more slowly than the increase in the total final energy consumption in the region.

34. The estimated population covered by local disaster risk reduction (DRR) strategies in the pan-European region is about 65 per cent. Only 15 countries in the region reported that all their local authorities are implementing DRR strategies under the Sustainable Development Goal target 13.1, while 23 countries, which jointly represent a quarter of the region's population, do not report on that target.

Recommendations

35. The principle of "common but differentiated responsibilities" should be followed, but not necessarily when it comes to reporting obligations.

36. Governments should establish the conditions for medium- and long-term sustainable mobilization of funds for climate action, both by accelerating the use of available regional and global funds and mechanisms and by creating national financial instruments.

37. Governments should deepen decarbonization by shifting promotion of investments towards renewable energy.

38. Governments should strengthen awareness of climate hazards, especially among poorer communities, and establish conditions to report regularly on the Sustainable Development Goal target 13.1 and under the Sendai Framework for Disaster Risk Reduction 2015–2030.

2. Context

39. Within the scope of global climate action, all countries of the pan-European region have committed to cut their greenhouse gas emissions to limit the increase in global temperature to 1.5 °C, as stated in the Paris Agreement.

40. According to the International Energy Agency (IEA),[68] despite a slowing trend, global energy demand may still expand by 30 per cent between 2017 and 2040. Energy use is expected to continue to be the main cause of anthropogenic greenhouse gas emissions. The European Union has defined its pathway to decarbonization, with the long-term vision to reduce its greenhouse gas emissions by 80–95 per cent by 2050 compared to 1990. In that context, several European Union Member States have already stated their intention to phase

[68] International Energy Agency (OECD/IEA), *The World Energy Outlook 2018* (OECD/IEA, 2018), available at https://www.iea.org/reports/world-energy-outlook-2018.

out coal and lignite completely between 2025 and 2035. Such an objective may be too ambitious and difficult for countries that rely heavily on coal. The countries in the region are in very different situations in terms of their fossil fuel reserves and renewable energy potentials, technological capacities, energy demand patterns, infrastructure and labour and capital markets. While the decarbonization process brings an impetus for development of new low- and zero-carbon technologies, it is necessary to address energy poverty and a just transition.

41. Urgent adaptation approaches that are systemic, multidimensional and transformative are required to address the impacts of climate change, especially on the most vulnerable communities. The development of local adaptation strategies is increasing throughout Europe. As of April 2019, over 1,900 local authorities in the European Environment Agency member and collaborating countries have made commitments related to adaptation within the Covenant of Mayors for Climate and Energy.[69] A further challenge is to implement those strategies.

3. State, main trends and recent developments

42. Emissions of greenhouse gases in the pan-European region increased by 1 per cent in the period 2014–2018, while the average carbon footprint per person rose by 0.2 per cent. The Climate Action Progress Report of the European Union "Kick-Starting the Journey Towards A Climate Neutral Europe" states that in 2019 greenhouse gas emissions were down by 24 per cent from 1990 levels[70] and that the European Union remains on track to achieve its target of reducing greenhouse gas emissions by 20 per cent by 2020.

43. According to IEA most recent data[71] the coronavirus pandemic (COVID-19) situation generated a 6 per cent overall decline in global energy-related greenhouse gas emissions in 2020, hitting a low in April that year. However, in December 2020, global emissions were 2 per cent, or 60 million tons, higher than they were in the same month a year earlier. Globally, financing for climate action has increased substantially, but it continues to be surpassed by investments in fossil fuels.

44. While renewables are increasing, so is energy demand. The share of modern renewable energy in global final energy consumption has stayed around 10 per cent since 2010. Adding traditional uses of bioenergy, the share of all renewable energy in total final energy is 18 per cent.[72] The IEA *Net Zero by 2050: a Roadmap for the Global Energy Sector* sets out more than 400 milestones which include, from today, no investment in new fossil fuel supply projects and no further final investment decisions for new unabated coal plants. The pathway calls for annual additions of solar photovoltaic to reach 630 GW by 2030, and those of wind power to reach 390 GW. Together, this is four times the record level set in 2020. The Roadmap also sets as targets that, by 2035, there will be no sales of new internal combustion engine passenger cars and, by 2040, the global electricity sector has already reached net-zero emissions. Included in the Roadmap is a major worldwide push to increase

[69] European Environment Agency, *The European environment — state and outlook 2020: knowledge for transition to a sustainable Europe* (Luxembourg, Publications Office of the European Union, 2019), available at https://www.eea.europa.eu/soer/2020

[70] According to the approximated greenhouse gas inventory of the European Environment Agency. See European Environment Agency, "EU on track to meet greenhouse gas emissions and renewable energy 2020 targets, progress in 2019 shows more ambitious long-term objectives are reachable", press release, 30 November 2020, available at https://www.eea.europa.eu/highlights/eu-on-track-to-meet.

[71] International Energy Agency, "After steep drop in early 2020, global carbon dioxide emissions have rebounded strongly", press release, 2 March 2021, available at https://www.iea.org/news/after-steep-drop-in-early-2020-global-carbon-dioxide-emissions-have-rebounded-strongly#:~:text=Global%20emissions%20plunged%20by%20almost,for%20road%20transport%20and%20aviation.

[72] International Renewable Energy Agency, *Global Renewables Outlook – Energy transformation 2050* (Abu Dhabi, 2020), available at https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020.

energy efficiency, resulting in improvements of the global rate of energy efficiency averaging 4 per cent a year through 2030 – this is about three times the average over the last two decades.

45. The European Union set a new target for increasing renewable energy in final energy consumption to at least 32 per cent by 2030, while non-European Union parties of the Energy Community (Albania, Bosnia and Herzegovina, Georgia, Montenegro, North Macedonia, the Republic of Moldova, Serbia and Ukraine) could not agree on new targets for decarbonization, renewables and energy efficiency for 2030.

46. The share of energy from renewable sources used in transport activities in the European Union reached 8.9 per cent in 2019,[73] although it is still uncertain if the 10 per cent target for renewable energy use in transport by 2020 will be met. Technological development can enable a switch from fossil-fuelled vehicles to clean vehicles. Electric vehicles combined with renewable electricity generation are seen as a promising approach to decarbonize a substantial fraction of road transportation. However, electric vehicles represent only 0.2 per cent of the European Union's total vehicle fleet and, if they continue to penetrate the market at the current growth rate, it will take around 60 years for them to reach 50 per cent of the current passenger car fleet.[74] At global level, the share of renewables in the transport sector was at 3.3 percent in 2017, the majority of which was consumed in the form of liquid biofuels, predominantly crop-based ethanol and biodiesel.

47. The pan-European region is attractive to tourists from all over the world and the carbon footprint of tourism is significant. The application of the principles of circular economy in the tourism sector in-country or in-resort could reduce the footprint a little, but the major burden remains from travelling itself.

4. Indicators

Greenhouse gas emissions (ECE indicator)

48. The indicator shows the extent to which countries have achieved their specified goals for emissions and the response to country policies for achieving the emissions target.

49. Table 1 overleaf shows available greenhouse gas emission data for pan-European subregions, for the period 2014–2019. The overall changes in the pan-European region, both positive and negative, are highly dependent on "big players", i.e. highly industrialized, populous countries.

50. During the observed period (2014–2019) greenhouse gas emissions were reduced in the European Union by about 12 Mt of CO_2 equivalent, mostly in Germany but with an increase of emissions in 12 other European Union Member States (see figure VI overleaf for an overview). Non-European Union high-income countries also achieved emissions reduction, with the United Kingdom of Great Britain and Northern Ireland accounting for 95 per cent of reductions. In Eastern Europe, the increase of greenhouse gas emissions is dominated by an increase in the Russian Federation, while Ukraine reduced emissions by over 30 Mt of CO_2 equivalent. The trend in South-Eastern Europe and Central Asia is dominated by increase in greenhouse gas emissions in Turkey and Kazakhstan, respectively, while data is not available for several countries.

[73] Eurostat, Renewable energy statistics, Highlights, available at https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics#:~:text=In%202019%2C%20renewable%20energy%20represented,of%20gross%20final%20energy%20consumption).

[74] S. Tagliapietra, G. Zachmann, *Addressing Europe's failure to clean up the transport sector* (Bruegel, 2018), available at https://www.jstor.org/stable/resrep28617?seq=1#metadata_info_tab_contents.

Table 1
Total greenhouse gas emissions in the pan-European region (without land use, land-use change and forestry) by subregion, million tons of CO_2 equivalent (2014–2019)

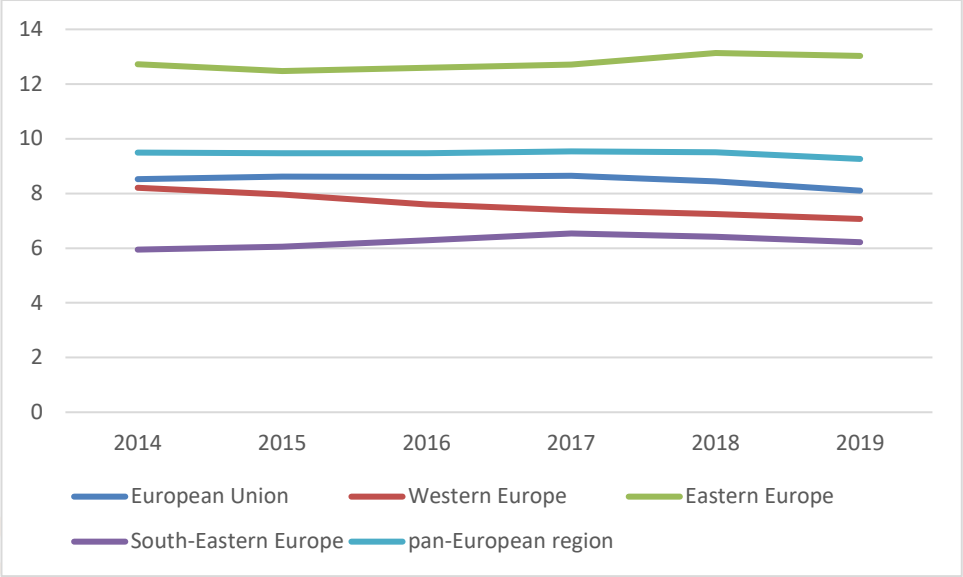
Subregion	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*Trend*
European Union	3,778	3,826	3,829	3,855	3,767	3,616	↘
Western Europe	710	696	670	650	649	633	↘
Eastern Europe	2,492	2,441	2,462	2,483	2,562	2,542	↗
South-Eastern Europe	459	473	499	525	522	506	↗
Pan-European region	7,790	7,795	7,821	7,901	7,898	7,694	→

Legend: ↗ – increase in greenhouse gas emissions; → – no change; ↘ – reduction in greenhouse gas emissions.

Source: United Nations Sustainable Development Goal Indicators Database.

Note: In Western Europe, no data for Andorra or San Marino; in Central Asia, data only for Kazakhstan, so not shown (represents 25 per cent of the subregion's population); in Eastern Europe, data only for Belarus, the Russian Federation and Ukraine (but representing 91 per cent of the population); and in South-Eastern Europe, data only for Turkey (alone 84 per cent of the population). 2018 data used for 2019 in Israel.

Figure VI
Greenhouse gas emissions (without land use, land-use change and forestry) per capita, tons of CO_2 equivalent (2014–2019)



Source: United Nations Sustainable Development Goal Indicators Database and ECE Statistical Database for population data.

Note: Population data for 2018 are used also in 2019; data for Monaco are from 2013 only and for the Russian Federation from 2013. For further notes on CO_2 emissions, see the preceding table on total CO_2 emissions.

Renewable energy share in the total energy consumption (Sustainable Development Goal indicator 7.2.1)

51. The renewable energy share in total final consumption is the percentage of final consumption of energy that is derived from renewable resources. Table 2 overleaf shows this indicator by subregion for the period 2014–2018.

52. Although the consumption of energy from renewable sources in the pan-European region raised between 2014 and 2018 to 1.3 petajoules, the share of renewables stayed the same due to a parallel rise of consumption of energy from non-renewable sources.

53. The renewable energy share in the total energy consumption varies from 4 per cent in Eastern Europe and Central Asia, to 18 per cent in the European Union and Western Europe. The average share for the whole pan-European region is 13 per cent. Only Western Europe saw a stable rising trend in the five-year period (2014–2018).

54. To remain on the 1.5°C pathway requires the share of renewable energy in primary supply to increase globally at an annual growth rate, from 0.25 per cent to 2 per cent.[75]

Proportion of local governments that adopt and implement local disaster risk reduction (DRR) strategies in line with national DRR strategies (Sustainable Development Goal indicator 13.1.3)

55. The Sendai Framework aims at increasing the proportion of local governments that adopt and implement local DRR strategies. Data on Sustainable Development Goal indicator 13.1.3, in the period 2015–2019, indicates that 31 countries from the pan-European region reported such strategies, covering 41,850 local communities (see table 3 below). More than 600 cities in the pan-European region (out of 4,360 cities globally) participate in the "Making Cities Resilient" initiative coordinated by the United Nations Office for Disaster Risk Reduction.[76] Moreover, 9,919 local communities from 33 countries of the pan-European region participate in the Global Covenant of Mayors for Climate and Energy initiative. In 2018, about 41 per cent of the European Union population was living in municipalities that are signatories of the Covenant of Mayors for Climate and Energy.

Table 2
Renewable energy share in the total energy consumption, per cent (2014–2018)

Subregion	*2014*	*2015*	*2016*	*2017*	*2018*	*Trend*
European Union	18%	18%	18%	18%	18%	→
Western Europe	15%	16%	16%	17%	18%	↗
Central Asia	3%	4%	4%	4%	4%	↗
Eastern Europe	4%	4%	4%	4%	4%	→
South-Eastern Europe	14%	15%	15%	13%	14%	→
Pan-European Region	**13%**	**13%**	**13%**	**13%**	**13%**	→

Legend: ↗ – increased share of renewables; → – no change in the share of renewables in the total final energy consumption

Source: United Nations Statistics Division – Energy balances, https://unstats.un.org/unsd/energystats/pubs/balance/

[75] International Renewable Energy Agency, *World Energy Transitions Outlook: 1.5°C Pathway* (Abu Dhabi, International Renewable Energy Agency, 2021), available at https://www.irena.org/publications/2021/March/World-Energy-Transitions-Outlook-

[76] See https://www.unisdr.org/campaign/resilientcities/cities.

Table 3
Number of countries and behaviour regarding local disaster risk reduction strategies, as number of countries per category (2019)

Subregion	*In the subregion*	*Not reporting*	*Having less than 5 per cent of local governments implementing DRR strategies*	*With a stable trend*	*With a rising trend*	*Having 100 per cent of local governments implementing DRR strategies*
European Union	27	13	4	1	0	9
Western Europe	9	5	0	1	1	2
Central Asia	5	2	0	0	2	1
Eastern Europe	7	2	1	0	2	2
South-Eastern Europe	6	1	4	0	0	1
Pan-European Region	**54**	**23**	**9**	**2**	**5**	**15**

Source: Global Sustainable Development Goal Indicators Database, https://unstats.un.org/sdgs/indicators/database/

56. The estimated population covered by local DRR strategies in the pan-European region is 65 per cent, due to the large population of countries that do have strategies (for example, France, Germany, the Russian Federation, Turkey, Ukraine and the United Kingdom of Great Britain and Northern Ireland). Coverage greater than 80 per cent is achieved in Eastern and South-Eastern Europe, as well as in Western Europe (85 per cent), while Central Asia coverage is below 26 per cent (see figure VII below).

5. Case studies

Fossil-fuel free Stockholm 2040

57. Stockholm, the capital of Sweden aims to be fossil-fuel free by 2040. As the city's strategy document explains, "Stockholm's ambition is to be totally fossil-fuel free by 2040 at the latest, precluding the use of fossil fuels within the city's geographical boundaries. However, the municipal authorities recognize that it may prove difficult to eliminate fossil fuels in the aviation and international shipping industries, and that some fossil-based plastics will still be incinerated in heating plants in 2040. Nevertheless, climate neutrality or zero net emissions can be achieved by compensating for these residual effects, for example by investing in carbon sinks. Climate neutrality permits the use of fossil fuels provided that CO_2 emissions are offset by measures that in some way bind the carbon or carbon dioxide."[77]

58. The plan is that, by 2040, natural gas will be entirely phased out of the city's energy grid and heating system, replaced primarily by biogas. The district heating company has decided to phase out fossil fuels by 2030. To increase the use of renewable energy in transportation from the current 16 per cent to 100 per cent by 2040, the city plans to double

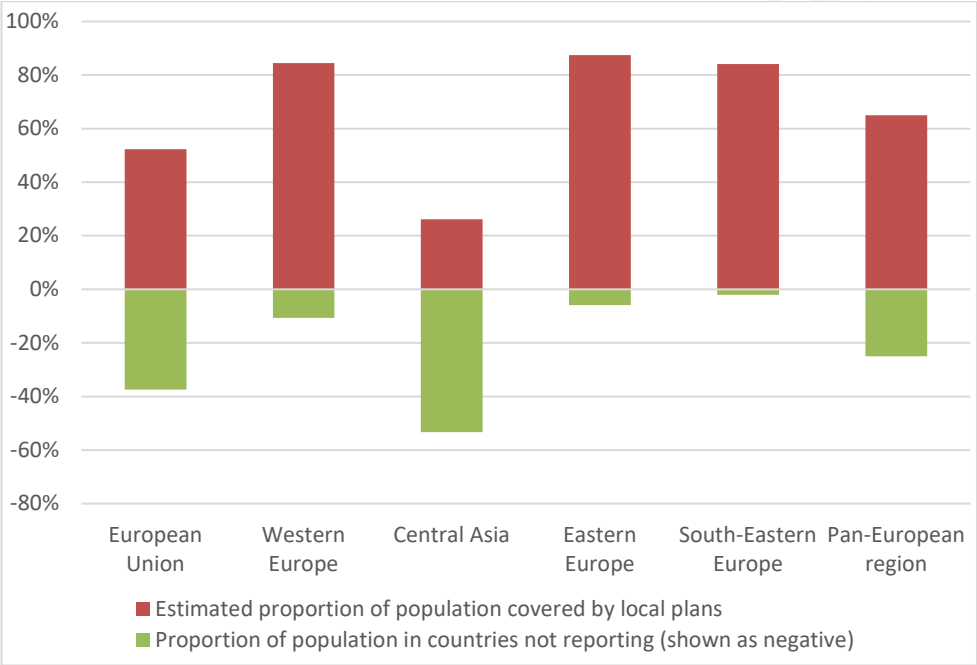
[77] City of Stockholm, *Strategy for a fossil-fuel free Stockholm by 2040*, (Stockholm, City Executive Office, 2016), available at https://international.stockholm.se/globalassets/rapporter/strategy-for-a-fossil-fuel-free-stockholm-by-2040.pdf

the capacity of the public transport system, while improving walking and bicycling infrastructure.

Covenant of Mayors

59. The Covenant of Mayors is the initiative launched by the European Commission in 2008 with the ambition to gather local governments voluntarily committed to achieving the European Union's climate and energy targets. With about 2,000 cities gathered in 2010, the European Commission launched the Covenant of Mayors East initiative that now operates in Armenia, Azerbaijan, Belarus, Georgia, the Republic of Moldova and Ukraine. Nowadays the Global Covenant of Mayors for Climate and Energy is the largest movement of local governments committed to going beyond their own national climate and energy objectives. There are 9,919 members from 33 countries of the pan-European region participating in this initiative. During the Climate Summit in Paris, the European Commission announced the geographical extension of the Covenant of Mayors for Climate and Energy, with new regional offices in Sub-Saharan Africa, North and South America, Japan, India, China and South-East Asia.

Figure VII
Estimated proportion of population covered by local disaster risk reduction strategies, or for which no data is available, per cent (2019)



Sources: Global Sustainable Development Goal Indicators Database, https://unstats.un.org/sdgs/indicators/database/. Population data from ECE Statistics Database, 2019 or latest.

Note: The estimated proportion of the population covered by local plans is the estimated population covered by plans divided by the subregion's total population.

C. Fresh water

1. Key messages and recommendations

Key messages

60. Access to clean fresh water is vital for human dignity and economic development. Water is a cornerstone of life, nature conservation and biodiversity. Moreover, interlinkages and trade-offs between water and other sectors will become deeper and stronger during the coming decade and beyond.

61. Water quantity has an asymmetric space and time distribution in the pan-European region. Climate change is delivering additional challenges in terms of precipitation patterns and temperature; all future climate scenarios indicate that extreme hydrological events will be longer and more frequent and intense. Climate change has an impact on human health through many water-related phenomena: floods, heatwaves, droughts, water-borne diseases and biodiversity changes in wetlands and aquatic ecosystems.

62. Anthropogenic pressures amplify water asymmetry by constraining fresh-water quality and aquatic biodiversity. Indeed, despite increasing efforts on source control, diffuse pollution and urban and industrial wastewater discharges remain significant in many locations. In addition, persistent organic contaminants are under increasing surveillance because of greater public health concern. Therefore, river basins, lakes and aquifers are subject to multiple stressors that threaten their physical, chemical and ecological conditions and the services they provide. At the same time, science is advancing to provide solutions and foster new processes and technologies to face these negative impacts.

63. Financing of water-related projects under the international climate agenda has been limited; setting up bankable projects is difficult. Financing models are highly susceptible to technical and governance insufficiencies and have been restrained by local and regional crises during the past decade.

64. Increasing water resources management challenges indicate that fragmented governance practices are unlikely to succeed in the long term. Involving public and private actors is becoming fundamental to successful water policy. In this framework, information is a pillar of good governance. Granularity of information is important for better knowledge and to provide the link between the micro and macro levels, supporting good decision-making.

65. Transboundary management of shared rivers, lakes and aquifers remains a challenge. The problem is acute when upstream water abstraction and/or retention is significant and downstream countries lack alternative water sources. Despite some good examples, cooperation and participatory processes for water protection, allocation and other practical achievements are not implemented as in depth as they could be in the pan-European region.

Recommendations

66. Integrated water resources management should be pursued, involving a balance between human water needs and water's availability for nature. Water policy should enhance its interdisciplinarity and transdisciplinary character to maximize societal impact. Therefore, the water-food-energy-ecosystems nexus should strengthen an anticipatory policy approach to combining short-term projects with a long-term vision for the pan-European region.

67. Whenever fresh waters and aquatic ecosystems are at risk, the best available technology should be applied. In addition to water conservation measures and conventional mitigation approaches, measures for resource protection and more efficient water use are coming on the water market. For instance, digitalization and precision agriculture can be applied in irrigated crop production, thus reducing water consumption and agrochemical wastage. Nature-based solutions can be used in water retention basins or in riparian zone restoration. New methods for environmental flow regimes are available. Non-conventional water sources deserve proof of concept opportunities. These are just some examples of high readiness solutions that can be applied in the pan-European region.

68. Economic sustainability in water resources management should be pursued and innovative financing mechanisms are still required. Natural and man-made infrastructure development may use several financing tools (e.g., fair water pricing, ecological payments, cost recovery and incentives) but a clear legal framework is vital for success.

69. Good governance is required to bring success to technology and financing. In more cases than might be expected, effective implementation requires social engagement and the consideration of cultural dimensions. Besides, water resources management is more efficient at the basin level. This integrated approach is even more critical in international rivers, lakes or aquifers where floods or droughts are likely to occur. Co-management should be pursued towards environmental protection and benefit-sharing within an efficient and resilient transboundary cooperation framework in the subregions, as envisaged by the United Nations Economic Commission for Europe (ECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

70. Knowledge is instrumental for decision-making and water policy design. Therefore, investment in data collection and information processing is essential (e.g., water accounts, ecosystem assessment and indicators). The continuous improvement of monitoring and communication technologies is a top priority in terms of a water information system for the pan-European region.

2. Context

71. Sustainable use of fresh waters is a continuous challenge from an anthropocentric perspective. Drinking water, agriculture, industrial production, energy production, transportation and leisure are just some of the human activities with an impact on water resources. There are systemic and complex non-linear interconnections between main driving forces, the pressures acting on fresh-water ecosystems, the associated effect on water condition and status and the relationship with policy objectives.[78] Therefore, water strategies aim at shifting from sectoral interventions towards a more integrated resource-use approach.[79] Currently, the mindset in water resources management embraces integration of food, energy and nature policies, giving water its vital binding role. This paradigm requires an improved water governance perspective and evidence-based knowledge to design and implement effective and efficient water policies.[80] Furthermore, water is instrumental across all levels of government, civil society, business and the broader range of stakeholders for promoting human rights, gender equality and poverty decrease.[81]

72. Legislation is a pillar of water governance systems. Public policies encourage sustainable use of fresh waters using command and control measures and measures to reduce contamination at source. The European Union has a comprehensive legal framework for protection of fresh waters, from mandatory urban wastewater treatment targets to fresh-water

[78] Joachim Maes and others, *Mapping and Assessment of Ecosystems and their Services: An analytical framework for mapping and assessment of ecosystem condition in EU – Discussion paper – Final January 2018*, Technical Report No. 2018 – 001 (Luxembourg, Publications Office of the European Union, 2018); and B. Grizzetti and others, "Human pressures and ecological status of European rivers", *Nature Scientific Reports*, vol. 7, art. No. 205 (16 March 2017).

[79] Claudia Pahl-Wostl, Anik Bhaduri and Antje Bruns, "The Nexus of water, energy and food: an environmental governance perspective", *Environmental Science and Policy*, Editorial special issue, vol. 90 (December 2018), pp. 161–163.

[80] Aziza Akhmouch, Delphine Clavreul and Peter Glas, "Introducing the OECD Principles on Water Governance", *Water International*, vol. 43, No. 1 (December 2017), pp. 5–12.

[81] Alberto Matenhauer Urbinatti and others, "The conceptual basis of water-energy-food nexus governance: systematic literature review using network and discourse analysis", *Journal of Integrative Environmental Sciences*, vol. 17, No. 2 (2020), pp. 21–43.

conservation and aquatic ecosystems protection.[82] The European Union water *acquis* is having a significant impact in the pan-European region countries.[83]

73. Nevertheless, diffuse and point source contamination with nutrients, recalcitrant organics and toxic substances, as well as hydrological and morphological stressors, remains in the pan-European region, hindering achievement of water policy objectives. Ecological river status at larger scale is determined not by one but by multiple stressors, thus water resources protection and water allocation processes are more efficient at river basin scale.[84] Attention should be paid to emergent contaminants; new health concerns require stringent limits and further monitoring of surface waters and groundwaters to safeguard drinking water quality in the pan-European region.[85]

74. On top of existing pressures in fresh-water resources management, climate change is becoming the key driving force on water management. Indeed, although water is not directly referred to in the Paris Agreement, it is the top priority for most of the adaptation actions laid out in the Nationally Determined Contributions and is closely related to other priority areas.[86] Climate scenarios foresee that precipitation will have higher peak intensities in the pan-European region, particularly at mid and high latitudes where the precipitation mean value will also rise.[87] An intense precipitation phenomenon is the driver of floods, while land impermeabilization without green infrastructures fosters flash floods.[88] At the same time, severe water shortages will intensify in low latitudes and mid-latitude continental interiors, namely in the Mediterranean zone.[89]

75. Financing is a key aspect to support strategies and programmes of measures and, as was recently highlighted, "while water is the central element and enabler for adaptation, the latter attracted only 5 per cent of all climate finance … and just over one fifth of all climate

[82] George Tsakiris, "The Status of the European Waters in 2015: A Review", *Environmental Processes*, vol. 2 (2015), pp. 543–557.

[83] Osman Özdemir, Deputy Expert, General Directorate of Water Management, Turkey, "Water Management in Turkey: River Basin Protection Action Plans and River Basin Management Plans", presentation, Istanbul, Turkey, 20 May 2015; Şermin Delipınar and Mehmet Karpuzcu, "Policy, legislative and institutional assessments for integrated river basin management in Turkey", *Environmental Science and Policy*, vol. 72 (June 2017), pp. 20–29; and United Nations publication ECE/CEP/184, Bosnia and Herzegovina, Environmental Performance Reviews: Bosnia and Herzegovina Third Review – Environmental Performance Reviews Series No. 48 (2018).

[84] Sebastian Birk and others, "Impacts of multiple stressors on fresh-water biota across spatial scales and ecosystems", *Nature Ecology and Evolution*, vol. 4 (2020), pp. 1060–1068.

[85] United Nations Environment Programme (UNEP)/United Nations Economic Commission for Europe (ECE), *Global Environment Outlook: GEO-6 – Assessment for the Pan-European Region* (Nairobi, 2016); National Institute for Public Health and the Environment of the Netherlands (RIVM), Sanitation in the pan-European region: Draft summary of findings of a scoping study (2019).

[86] Ingrid Timboe, Kathryn Pharr and John H. Matthews, *Watering the NDCs: National climate planning for 2020: How water-aware climate policies can strengthen climate change mitigation and adaptation goals* (Corvallis, Oregon, Alliance for Global Water Adaptation, 2020).

[87] Abdullah Kahraman and others, "Quasi-stationary intense rainstorms spread across Europe under climate change", *Geophysical Research Letters*, vol. 48, No. 13 (July 2021).

[88] Reza Ramyar, Aidan Ackerman and Douglas M. Johnston, "Adapting cities for climate change through urban green infrastructure planning", *Cities*, vol. 117, No. 3 (October 2021).

[89] O. Hoegh-Guldberg and others, "Impacts of 1.5°C Global Warming on Natural and Human Systems", in *Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, Valérie Masson-Delmotte and others, eds. (n.p., Intergovernmental Panel on Climate Change (IPPC), 2019); and Valérie Masson-Delmotte and others, eds., *Climate Change 2021: The Physical Science Basis –Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (n.p., Cambridge University Press, 2021).

finance from developed countries for developing countries".[90] The situation is assumed to be the same throughout the pan-European region, or even worse in non-European Union countries. The fact is that water managers have always faced traditional difficulties regarding cost-recovery goals.[91] The practical difficulties are substantial. For instance, in water intensive agriculture it is still necessary to determine the appropriate cost-recovery measures and the exemptions deemed socially acceptable.[92] This is not an excuse to stop critical thinking on the use of economic incentives towards inclusive and responsible water resources management. The European Union Water Framework Directive[93] (art. 9) was a starting point for stronger economic considerations and cost-recovery principles in the water sector. However, it is undetermined how cost recovery exactly contributes to the attainment of sustainable and equitable water use.[94]

76. In this framework, although water is always a major national issue, its management is by far more complex if rivers, lakes or aquifers are shared with other countries. Regarding transboundary waters, understandably, assessments often differ from State to State but, ultimately, such waters are common resources. In the pan-European region, 52 countries share transboundary rivers, lakes and aquifers and the Water Convention was designed to provide the region with the appropriate framework, notwithstanding bilateral or multilateral agreements. International cooperation is much needed regarding flood events and drought periods, where downstream countries are most at risk and vulnerable to upstream decisions. In general, water allocation mechanisms in transboundary waters are mostly seen from the supply side. However, demand side approaches or benefit-sharing can complement supply focused solutions towards integrated water resources management.[95]

Link to conference themes

77. The development and implementation of green infrastructure and nature-based solutions in the framework of fresh-water resources conservation can bring multiple benefits for society, the economy, the environment and human well-being. Multifunctional nature-based solutions align to meet societal and biodiversity needs, while making the best use of resources and limiting trade-offs.[96]

78. Circular economy principles (water reuse, resource recovery, etc) may guide tourism development that is more sustainable and more adapted to future challenges, even encompassing the Sustainable Development Goals.[97] As highlighted by one researcher: "The

---

[90] "Eighth Round Table on Financing Water, focused on Climate Action in partnership with the [United States] Government, 23–24 September 2021: Session 2: Water as a lever for climate action: "The investment opportunity. Aligning and scaling up financing flows for water security and climate action", background paper presented at the Eighth Round Table on Financing Water, focused on Climate Action in partnership with the [United States] Government, Session 2: Water as a lever for climate action, online, 23–24 September 2021.

[91] Frank A. Ward and Manuel Pulido-Velazquez, "Incentive pricing and cost recovery at the basin scale", *Journal of Environmental Management*, vol. 90, No. 1 (February 2008), pp. 293–313.

[92] Alfonso Expósito, "Irrigated agriculture and the cost-recovery principle of water services: Assessment and discussion of the case of the Guadalquivir River basin (Spain)", *Water*, vol. 10, No. 10 (2018).

[93] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, *Official Journal of the European Communities*, L 327 (2000), pp. 1–73.

[94] Petra E. Lindhout, "A wider notion of the scope of water services in EU water law boosting payment for water-related ecosystem services to ensure sustainable water management?", *Utrecht Law Review*, vol. 8, No. 3 (2012), pp. 86–101.

[95] *Handbook on Water Allocation in a Transboundary Context* (United Nations publication, Sales No. E.21.II.E.10).

[96] *Science for Environment Policy: Future brief: The solution is in nature – Issue 24* (Bristol, University of the West of England, 2021).

[97] Stefán Einarsson and Fabrice Sorin, *Circular Economy in travel and tourism: A conceptual framework for a sustainable, resilient and future-proof industry transition* (n.p., CE360 Alliance, 2020).

strongest relationships and synergies between circular economy practices and [Sustainable Development Goal targets lie within [Sustainable Development Goal] 6 (clean water and sanitation), …and [Sustainable Development Goal] 15 (life on land).”,[98] and these indicators are evaluated below. It is essential to guarantee that water services are dimensioned considering sectoral needs, namely food, energy, ecosystems or human dynamics (e.g., tourism). Circular economy practices associated with closed-loop systems for wastewater recycling and reuse,[99] and recycling of sewage sludge[100] will be indispensable in achieving Sustainable Development Goal 6 (clean water and sanitation). Infrastructure will need to be refurbished and optimized and innovative infrastructure designed to fully enable advanced circular economy practices.[101] One example is urine-diverting toilets for phosphorus recovery in decentralized systems.

3. State, main trends and recent developments

79. Renewable fresh-water resources are asymmetric in the pan-European region. Fresh water abstracted as a proportion of renewable fresh-water resources has a significant national variability. Currently, the problem is worrisome in several countries; Cyprus ranks first as the country with the highest water scarcity, but Greece, Italy, Malta, Portugal and Spain in the European Union, as well as Armenia, Azerbaijan and Turkey, are of concern. In addition, climate change will impact most countries where negatively water availability is already present. Therefore, except for the Scandinavian Peninsula and some small areas in Central Europe, under pessimistic scenarios, river run-off production is projected to reduce all over Europe, but more so in southern countries.[102] On the other hand, heatwaves increase forest fires, which in turn have a negative impact on aquifer recharge and surface water quality. More countries suffered large forest fires recently than ever recorded before, including in northern pan-European countries (for instance, the Russian Federation recorded its most severe forest fires in 2021, in Siberia; Sweden experienced its worst fire season ever in 2018).

80. Fresh-water and ecosystems biodiversity problems are still quite relevant in the different subregions of the pan-European region. Even if a mild indicator like “proportion of bodies of water with good ambient water quality”[103] is considered, 76 per cent of the countries in the pan-European regions present more than 60 per cent of water bodies at “good water quality” level in 2020. This value is similar to the 2017 value, indicating that more should be done to improve water quality. However, if a more demanding water quality assessment indicator is used, like those used in the European Union zone, just 40 per cent of surface water bodies achieved a “good ecological status” and 38 per cent were in “good chemical status” in 2015.[104] A similar pattern can be seen regarding the “good chemical status” of European Union groundwater bodies. In fact, the initial European Union policy target of achieving “good ecological status” for all waters bodies was not met and was postponed to

[98] Patrick Schroeder, Kartika Anggraeni and Uwe Weber, “The Relevance of Circular Economy Practices to the Sustainable Development Goals”, *Journal of Industrial Ecology*, vol. 23, No. 1 (February 2019), pp. 77–95.

[99] Nick Jeffries, “Applying the circular economy lens to water”, Circular Impacts, 26 January 2017. Available at https://circular-impacts.eu/blog/2017/01/26/applying-circular-economy-lens-water.

[100] Andreas N. Angelakis and Shane A. Snyder, “Wastewater treatment and reuse: Past, present, and future”, *Water*, vol. 7, No. 9 (September 2015), pp. 4887–4895.

[101] Tom Williams, “Water utility pathways in a circular economy: Charting a course for sustainability”, International Water Association, 14 July 2016. Available at https://iwa-network.org/water-utility-pathways-circular-economy-charting-course-sustainability/.

[102] V. Lamprini and others, “High-end climate change impact on European runoff and low flows – exploring the effects of forcing biases”, *Hydrology and Earth Systems Science*, vol. 20, No. 5 (May 2016), pp. 1785–1808.

[103] United Nations Statistics Division (UNSD), “SDG Indicators: Metadata repository. Indicator 6.3.2. – Proportion of bodies of water with good ambient water quality”. Available at https://unstats.un.org/sdgs/metadata/ (accessed on 27 January 2022).

[104] Lidija Glovevnik, Teresa Ferreira and Rafaela Schinegger, “Water stressors in Europe: New threats in the old world”, in *Multiple stressors in river ecosystems: Status, impacts and prospects for the future*, Sergi Sabater, Arturo Elosegi and Ralf Ludwig, eds. (n.p., Elsevier, 2018).

80 bis. Despite the threats, aquatic biodiversity areas display an irregular distribution in pan-European subregions, while hydromorphological impacts due to existing or planned water reservoirs remain an environmental challenge. Furthermore, extreme weather events, namely floods, may trigger technological accidents and severe water contamination. Mining activities are an example where extreme weather events may result in technological accidents in several pan-European region countries (for example, Kazakhstan, Romania and Tajikistan). Accidents have potential cross-border effects, but transnational impacts are often disregarded in river basin management plans, even though the ECE Convention on the Transboundary Effects of Industrial Accidents is available as a reference framework.

81. Access to safely managed drinking water services in the pan-European region is higher than 70 per cent on average, with no significant changes in recent years. The European Union and Western Europe subregions present the best results (98 per cent and 99 per cent respectively). The Central Asia subregion presents a lower, but still relatively high, average value (70 per cent). This may explain why access to basic and safely managed water services increased globally by 10 per cent during the period 2000–2015, but in the pan-European region by not more than 4 per cent in the same period.[105] Besides, the presence of emerging contaminants, such as certain veterinary and human pharmaceuticals, brominated flame retardants, microplastics and anti-fouling biocides, should be increasingly monitored in the pan-European region.[106]

82. Nevertheless, more fine data reveal additional asymmetries at the national level. There are large differences in sanitation services and wastewater collection and treatment within the pan-European region.[107] Indeed, it is projected that, on average, 38 per cent of the population, or 344 million people, in the pan-European region do not have access to safely managed sanitation services, with unequal situations among subregions. The European Union and Western Europe have better values (more than 90 per cent) while Eastern Europe and South-Eastern Europe have considerably lower values. Furthermore, ageing sewer infrastructure represents an additional financial challenge. The European Union estimated that it will be necessary to invest about €25 billion annually to rehabilitate and construct new sewers and wastewater treatment plants. Consolidated figures for Eastern Europe and Central Asia are likely to illustrate an even higher need.[108] Lastly, non-conventional water sources should be expanded; wastewater recycling or grey water recycling only seems to be a well-accepted strategy for water conservation. However, less than 3 percent of treated wastewater in the European Union was reused in 2017.[109] Other non-conventional sources of water in arid zones can be considered (e.g., grey water, rain and atmospheric water harvesting, desalination of brackish waters), but water efficiency measures should be considered first.

83. The way forward regarding water nexus is not without risks. The food production sector is very important from the social perspective and deserves special attention. Progress is slow for diffuse pollution abatement in agriculture; excessive nitrate concentrations still affect over 18 per cent of the area of groundwater bodies. Reconciling environmental flows with irrigated cropland practices is an example of how burdensome a nexus trade-off can be.[110] Aquifer capacity to mitigate inter-annual or frequent droughts will be diminished by over-abstraction of groundwaters.[111] Thus, a better strategy is the use of smart technologies

[105] UNEP/ECE, *Global Environment Outlook*.

[106] RIVM, Sanitation in the pan-European region.

[107] UNEP/ECE, *Global Environment Outlook*; and *Handbook on Water Allocation in a Transboundary context.*

[108] RIVM, Sanitation in the pan-European region.

[109] Ibid.

[110] Jonas Jägermeyr and others, "Reconciling irrigated food production with environmental flows for Sustainable Development Goals implementation", *Nature Communications*, vol. 88, art. No. 15900 (2017).

[111] Zbigniew W. Kundzewicz and others, "Fresh water resources and their management", in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Martin Parry and others, eds., (n.p., Cambridge University Press, 2007), pp. 173–210.

and improved water management systems. The adoption of water efficient crops, practices to reduce transpiration, precision agriculture and digitization, agricultural reservoirs and rainwater harvesting for irrigation should be encouraged.[112] However, adaptation should be encouraged as much as mitigation, which is easily accepted by farmers. Other solutions are becoming viable, not just for agriculture, among which nature-based solutions deserve increasing attention for fresh-water protection and biodiversity conservation. Nature-based solutions may play a role in protecting natural catchment areas against diffuse pollution, catalysing social benefits and landscape integration also in urban areas.[113]

84. The climate crisis is very much a water crisis, so good water governance is increasingly mandatory. Good water governance means a participatory and transparent approach, especially when it comes to trade-offs between different sectors or, even more necessary, between countries. Regarding transboundary waters, only 20 countries in the pan-European region have their shared waters covered by operational arrangements and just 19 of them are States parties to the Water Convention, notwithstanding other bilateral and multilateral arrangements. Interestingly, most countries alleged that arrangements incorporate groundwaters, but it is not evident how effective transboundary aquifer co-management is implemented.[114]

85. Spatial, sectoral and temporal information are all crucial to obtain knowledge, devise strategies and monitor water actions. Therefore, water management means data and updated information, transparency and Government-stakeholder dialogue. Around the pan-European region, there is a positive trend regarding information and communication technologies, connecting science and policy. Many geographic information systems are well established at the river scale, even if more must be done, namely at the transboundary level. On a country basis, information granularity in the pan-European region exists at different levels; heterogeneous territorial realities in some countries may hide local and regional water weaknesses and water statistics are required. Other difficulties are due to conceptual reasons: ecological water quality assessment or the identification of hydromorphological pressures requires knowledge not yet available in some regions.

4. Indicators

Water services, including water supply and sanitation (selected Sustainable Development Goal Indicators)

86. Sustainable Development Goal indicators 6.1.1 (Proportion of population using safely managed drinking water services) and 6.2.1 (Proportion of population using safely managed sanitation services) belong to the group of indicators that were defined for the purpose of guaranteeing the availability and sustainable management of water and sanitation for all (Goal 6). More specifically, indicator 6.1.1 intends to contribute to achieving universal and equitable access to safe and affordable drinking water for all, by 2030 (target 6.1), with indicator 6.2.1 being used to contribute to achieving access to adequate and equitable sanitation and hygiene for all and ending open defecation, paying special attention to the needs of women and girls and those in vulnerable situations, by 2030 (target 6.2). Based on the information available in the Global Sustainable Development Goal Indicators Database[115] – which contains global, regional and country data and metadata on the official indicators – the average values for these indicators were calculated for each one of the subregions

[112] Rüdiger Schaldach and others, "Current and future irrigation water requirements in pan-Europe: An integrated analysis of socioeconomic and climate scenarios", *Global and Planetary Change*, vols. 94–95 (2012), pp. 33–45.

[113] *Science for Environment Policy: Future brief: The solution is in nature.*

[114] Annukka Lipponen and John Chilton, "Development of cooperation on managing transboundary groundwaters in the pan-European region: The role of international frameworks and joint assessments", *Journal of Hydrology: Regional Studies*, vol. 20 (December 2018), pp. 145–157.

[115] UNSD, "Statistics: Sustainable Development Goals Indicators Database". Available at https://unstats.un.org/sdgs/unsdg.

included in the pan-European area. The values obtained for the indicators are presented in table 1 below.

87. It should be noted that, in order to be consistent over time with the other indicators analysed within this assessment, it was decided to focus the analysis on 2017, since information was available for all the indicators, with the exception of Sustainable Development Goal indicator 15.3.1 (proportion of land that is degraded over total area), for which there are only base data for 2015. The year 2017 was also selected because it is the closest available year to 2015. Thus, the evaluation of the indicators selected in this chapter has an identical or close time frame, providing uniformity in time of analysis. Nevertheless, for some of the indicators, when available, as is the case for indicators 6.1.1 and 6.2.1, the latest values accessible in the Global Sustainable Development Goal Indicators Database were calculated (i.e. 2020) to perceive any trend in the values throughout time (see table 4 below), with an improving trend apparent for indicator 6.2.1 in all subregions except Central Asia, where data lacks.

Table 4
Proportion of population using safely managed drinking water and sanitation services

	Indicator 6.1.1 (Proportion of population using safely managed drinking water services, per cent)			*Indicator 6.2.1 (Proportion of population using safely managed sanitation services, per cent)*		
Subregion	*2016*	*2018*	*2020*	*2016*	*2018*	*2020*
European Union	97.7	97.8	97.8	89.6	90.1	90.5
Western Europe	99.3	99.3	99.3	95.5	95.7	95.9
Central Asia	68.7	69.3	69.6	-	-	-
Eastern Europe	79.7	79.8	79.9	60.0	60.8	61.5
South-Eastern Europe	78.3	78.0	78.0	67.3	69.9	70.0
Pan-European region	**90.3**	**90.4**	**90.4**	**80.2**	**81.0**	**81.4**

Source: Global Sustainable Development Goal Indicators Database, accessed 10 February 2022.

Note: There is no information available for Czechia (all years), or for indicator 6.1.1 for Croatia and Turkey (all years), or for indicator 6.2.1 for any country in Central Asia except Kyrgyzstan, the Republic of Moldova (all years), Azerbaijan (2020) and Bosnia and Herzegovina (2019–2020).

Economic Commission for Europe indicator C14 (population connected to wastewater treatment)

88. ECE indicator C14 (population connected to wastewater treatment) is included in the list of environmental indicators developed by the ECE Working Group on Environmental Monitoring and Assessment and the Joint Task Force on Environmental Statistics and Indicators.[116] The indicator refers to the percentage of the resident population whose wastewater is treated at wastewater treatment plants. It should be noted that, in fact, some countries do not provide information for this indicator. As such, it was not possible to perform the analysis of the indicator in terms of subregion. However, it is possible to verify that, for the year 2017 (the latest year for which information is available for this indicator), there is some variability in the values provided by some pan-European region countries.

89. France, Latvia, Malta, the Netherlands and Monaco are the countries with the highest proportion of the population connected to wastewater treatment (above 90 per cent). Most countries with available information are above 70 per cent. Azerbaijan and Albania are the countries with the lowest values (20 per cent and 17 per cent, respectively – data from 2017). However, some countries did not provide information and even the "wastewater treatment" concept is not straightforward because the degree of treatment or on-site decentralized systems are not explicit. Nevertheless, it is possible to highlight a global trend of

[116] ECE, "Indicators and Reporting", available at https://unece.org/indicators-and-reporting (accessed on 27 January 2022).

improvement when compared to the situation observed a decade ago, with a stabilization trend over recent years.

Fresh-water resources quality and quantity (selected Sustainable Development Goal Indicators)

90. Indicator 6.3.2 (proportion of bodies of water with good ambient water quality) also belongs to the group of the indicators that were defined to achieve Sustainable Development Goal 6. More specifically, it is an indicator that intends to improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally, by 2030 (target 6.3). This indicator was evaluated for 2017 and 2020. Based on the available information, it was found that no data were produced for several pan-European region countries. Thus, it was decided to present only the available values (see figure VIII below). The global trend regarding the proportion of bodies of water with good ambient water quality is towards stabilization. Even so, it is possible to identify some worsening in a few countries over the time period.

Water governance (selected Sustainable Development Goal Indicators)

91. Sustainable Development Goal target 6.5 calls for the implementation of integrated water resources management at all levels, including through transboundary cooperation as appropriate, by 2030. Indicator 6.5.2 measures the second part of target 6.5, monitoring proportion of transboundary basin area within a country with an operational arrangement for water cooperation. Arrangements are "operational" when there is a joint body, meetings between countries take place and information is exchanged at least once a year, and joint or coordinated management plans or objectives for the basin(s) have been set. Figure IX below presents the results of this indicator for 2017 and 2020, for the pan-European region countries. Nearly half of the countries have reached (and maintained) transboundary water management cooperation over recent years. It is also worth noting that some countries with the worst performance are slowly improving.

5. Case studies

Nature based solutions: from watershed protection to flood control: two contrasting cases

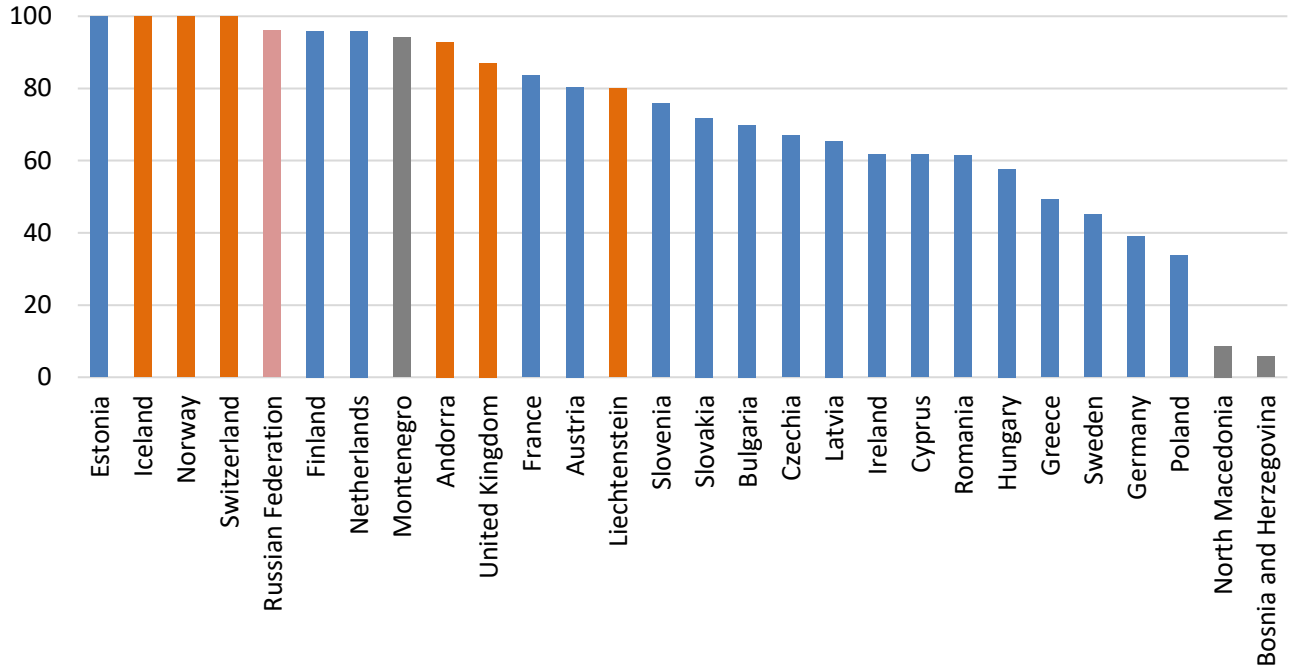
92. One type of investment that is not sufficiently considered consists of protecting, sustainably managing and restoring watersheds. These are natural infrastructures that can filter and recharge water supplies to ensure the provision of water for cities and other users, including farmers, industry and the environment itself. Land use within catchment areas has a major influence on determining whether watersheds are healthy and can deliver these environmental services. An average of € 5.5 billion per year was committed to restoring and conserving watersheds in Europe over the 2014–2020 period and an estimated 99 per cent of funding for these investments came from public sources. Some water service providers and cities have engaged with upstream parties in their source water catchments to support change in agriculture and forestry practices or to build artificial wetlands. But these investments have remained limited, due to regulatory barriers, high risk perception or a general lack of appreciation for what such investments can achieve. Nature-based solutions (NbS) can be a feasible approach for supporting drinking water protection for many cities. According to a recent analysis, they have broad potential: 63 cities demonstrating high feasibility potential for at least one NbS and pollutant type.[117]

[117] Adapted from: Trémolet S., Karres N. (2020). Resilient European Cities: Nature-based Solutions for Clean Water. The Nature Conservancy. London, United Kingdom.

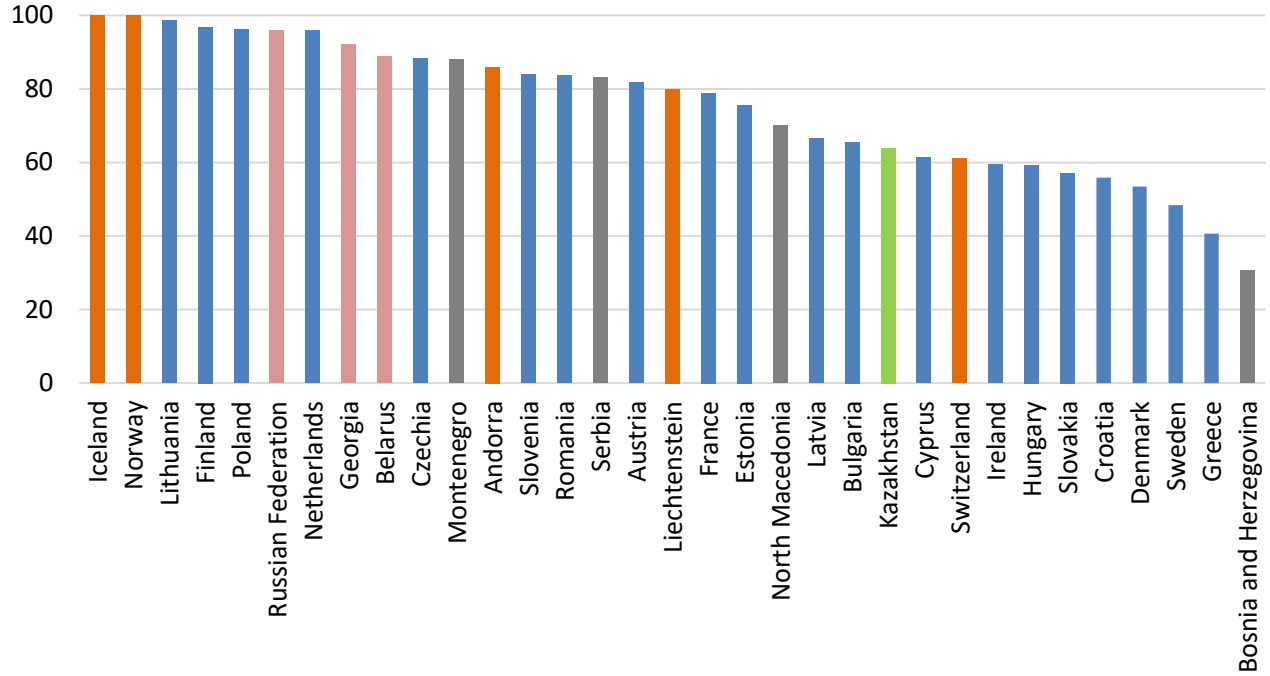
Figure VIII

Proportion of bodies of water with good ambient water quality for countries having data available, per cent: (a) in 2017 and (b) in 2020

(a)



(b)

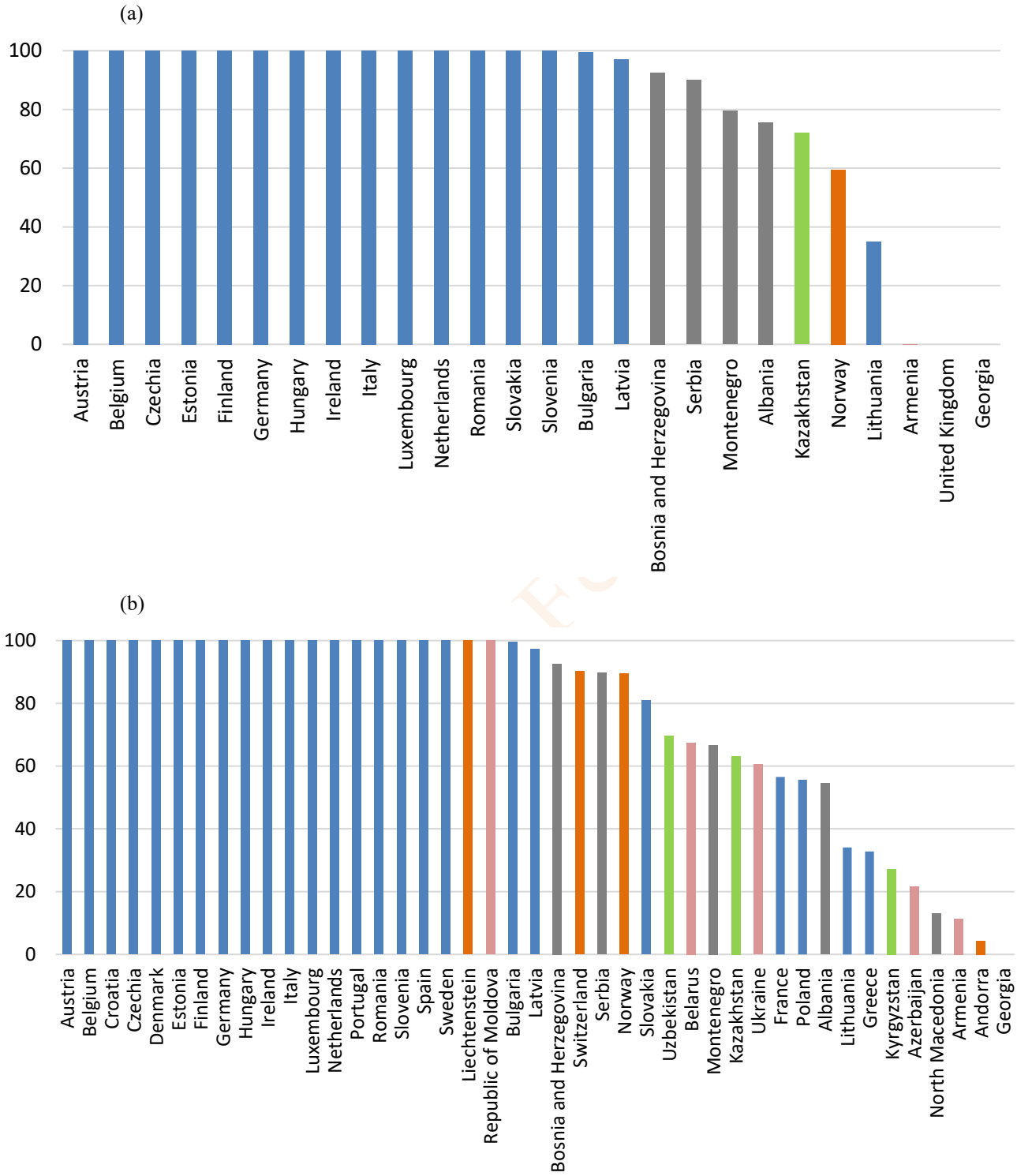


Notes: European Union | Western Europe | Central Asia | Eastern Europe | South-Eastern Europe

Source: Global Sustainable Development Goal Indicators Database.

Figure IX

Proportion of transboundary basin area with an operational arrangement for water cooperation (per cent): (a) in 2017, and (b) in 2020



Notes: European Union | Western Europe | Central Asia | Eastern Europe | South-Eastern Europe

Source: United Nations (2021). Statistics. Sustainable Development Goals Indicators Database, Department of Economic and Social Affairs, available at https://unstats.un.org/sdgs/unsdg.

93. Climate change and flood risks may be addressed using a nature-based solution (NbS) and citizen engagement. The Glinščica river basin in (Slovenia) is within the borders of the city of Ljubljana. The expansion of Ljubljana in the lowlands of the Glinščica river basin has

increased the amount of impervious surface which, coupled with a rise in groundwater level and more torrential rain, has resulted in periodic flooding in parts of the city. To develop a NbS that would be effective at lowering the flood risk whilst addressing other societal challenges, a participatory design process was instigated to gather the risk perception of individuals and institutions from the area. This was done through a couple of workshops in which the risk perceptions of individuals were recorded. The stakeholders were then involved in co-designing and assessing a dynamic model capable of measuring the effectiveness of NbS to deal with floods under a business-as-usual scenario, but also to enable participants in the workshop to look at the potential effects of specific measures on both flood risk reduction and co-benefits.[118]

Ukrainian Farmers Increase Productivity and Resilience through Climate-Smart Technologies

94. Ukrainian farmers are set to benefit from a new project designed to boost climate-smart agriculture in the country. An advisory initiative of the International Finance Corporation (IFC), a member of the World Bank Group, will be implemented in partnership with the Austrian Federal Ministry of Finance. The targeted financing will enable them to adopt climate-smart practices and technologies to increase productivity and revenues, while also helping the country tackle climate change. IFC's Country Private Sector Diagnostic estimates that with $3 billion of investment in climate-smart agriculture technologies, Ukrainian agricultural producers of grains and oilseeds could increase annual revenues by $11 billion. Investments can also help reduce significant greenhouse-gas emissions annually equivalent to 11 metric tons of carbon dioxide. While large agricultural producers have already adopted climate-smart practices in crops, livestock, forestry, and fisheries, smaller producers are unable to afford new technologies due to limited access to finance. IFC will help develop a carbon accounting system to help agricultural producers monetize their greenhouse-gas reductions. A robust system, comprising metrics and climate-smart agriculture standards, will contribute to a conducive environment, promoting green bonds and niche securitization in Ukraine. The efforts are part of the Europe and Central Asia Climate-Smart Finance Facilitation Program which aims to help increase the availability of agricultural finance in emerging markets, supporting countries in their efforts to tackle climate change.[119]

[118] Adapted from: Science for Environment Policy (2021). The solution is in nature. Future Brief 24. Produced for the European Commission DG Environment. Bristol: Science Communication Unit, UWE Bristol.

[119] More information: IFC news, Kyiv, Ukraine, March 16, 2021. https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=26254

D. Coastal waters, marine ecosystems and seas

1. Key messages and recommendations

Key messages

95. Marine pollution, both from land-based (for example, nutrients, plastic, chemicals) and sea-based (for example, plastic, oil) sources, continues to be an urgent problem in most sea regions. Beach and marine litter, dominated by plastic, is recognized as a major global threat to coastal and marine ecosystems in most areas, including remote and less populated areas, for example, the Barents Sea.

94. Amongst the climate-induced changes in coastal and marine ecosystems are increasing sea surface temperatures by about 0.2 °C per decade in the North Atlantic and 0.5 °C per decade in the Black Sea (since 1981) and observed reductions in surface water pH (i.e. acidification), at a rate of approximately 0.02 pH units per decade, in the sea regions surrounding the European Union (and across the global ocean), except for variations near coasts, with as yet unknown impact.

97. Marine Key Biodiversity Areas (KBAs) coverage by protected areas in most littoral ECE countries increased during the period 2000–2019. However, the coverage of marine protected areas (MPAs) in 20 out of 37 littoral countries in the pan-European region lags the Convention on Biological Diversity Aichi target 11 (conserving at least 10 per cent of coastal and marine areas) and is 6.7 per cent for the overall pan-European area.

98. Geographically, there are significant variations in the proportion of sustainable fish stocks. The Mediterranean Sea and Black Sea remain highly overfished, whereas signs of recovery of fish stocks can be observed in the North-East Atlantic Ocean and the Baltic Sea as a result of improved management decisions.

99. A holistic and ecosystem-based approach to the management of coastal waters and marine ecosystems that addresses the combined effects of multiple pressures is progressively integrating social, economic and governance aspects. Such an approach applies equally to the use of nature-based solutions in sustainable infrastructure for enhancing coastal resilience and its climate-proof functionalities, and to the transition to "blue" sustainable tourism as part of the post-COVID-19 recovery.

Recommendations

100. Governments at all levels (local, national and regional) should take urgent action to reduce key pressures to halt the degradation of coastal waters, marine ecosystems and seas. Climate change, biodiversity loss and pollution threats are intricately connected and constitute the triple planetary crisis.

101. Further efforts are needed, in particular in Eastern and South-Eastern Europe, to achieve the target of conservation of 10 per cent of coastal and marine areas in the pan-European area. The target has already been achieved in most of the European Union.

102. The theme "Coastal waters, marine ecosystems and seas", associated indicators and dataflows should be included as a theme within the ECE set of environmental indicators. Promising new developments related to data (for example, earth observation, artificial intelligence, citizen monitoring, models and novel in-situ measurements) should be considered to improve the spatial and temporal coverage, including the need for long-term time-series data to understand climate-change impacts.

103. Policymakers should increase efforts to complement inventories of the number of items of beach and marine litter with information on composition and sources of litter to be able to design more effective measures. In particular, joint efforts should be taken where subregional measures are deemed necessary, as in the Caspian Sea where there is no reliable information on the presence or amount of litter discharged into the coastal or marine environment.

2. Context

104. Oceans play a critical role as a climate regulator and buffer to climate change effects, which comes at the expense of their productivity and the health of marine ecosystems. The ubiquitous degradation of coastal waters, marine ecosystems and oceans is a clear manifest of the triple planetary crisis and the intricately connected threats of climate change, biodiversity loss and pollution.[120] At the global level, two-thirds of the oceans are significantly impacted by human activities that generate multiple pressures ranging from excessive inputs of nutrients and hazardous substances, including plastics, microplastics and nano-plastics; unsustainable fishing, including illegal, unreported and unregulated (IUU) fishing; and habitat destruction due to coastal development – including for tourism – and extraction of natural resources. Other detrimental environmental changes associated with climate change include ocean warming, acidification and deoxygenation impacting the diversity and abundance of marine species.

105. "Blue economy", which is steadily growing and poses sustainability challenges, involves income generating activities in the ocean such as harvesting of food, shipping, seabed mining, offshore hydrocarbon exploration and exploitation, tourism and recreation. Interest in seabed mining is on the rise, in part fuelled by the increased demand for minerals and rare earths, such as cobalt needed in batteries for electric vehicles as a climate change mitigation measure.

106. The systematic nature of these challenges calls for the use of integrated and ecosystem-based management approaches, supported by spatially-based assessments and the analysis of multiple pressures and cumulative impacts.[121]

107. Despite having specific ecological, socioeconomic characteristics and governance structures, a number of similarities related to the key trends and challenges exist among the pan-European sea regions. The assessment follows a combined approach, by integrating existing knowledge available at the sea region level and national data reported under the Sustainable Development Goal 14 "Conserve and sustainably use the oceans, seas and marine resources for sustainable development".

108. The pan-European area includes 37 littoral ECE countries[122] and the following sea regions: Baltic Sea, Black Sea, Caspian Sea, Mediterranean Sea and North-east Atlantic Ocean.[123] For the latter four, extensive knowledge and information are available in publications and indicators maintained by the European Environment Agency and the Regional Seas Conventions.[124] Other sea (sub)regions included in the assessment area, such as the Aral Sea, Barents Sea, East Siberian Sea, North Sea and Norwegian Sea are not systematically discussed.

---

[120] UNEP, *Making Peace with Nature: A Scientific Blueprint to Tackle the Climate, Biodiversity and Pollution Emergencies* (Nairobi, UNEP, 2021), available at www.unep.org/resources/making-peace-nature.

[121] European Environment Agency European Topic Centre on Inland, Coastal and Marine Waters (2019), briefing on "Multiple Pressures and Their Combined Effects in Europe's Seas", available at www.eea.europa.eu/themes/water/europes-seas-and-coasts/multiple-pressures-and-their-combined.

[122] The 37 littoral ECE countries in the pan-European region are (in alphabetic order, with the 22 European Union Member States marked in **bold**): Albania, Azerbaijan, **Belgium**, Bosnia & Herzegovina, **Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France**, Georgia, **Germany, Greece**, Iceland, **Ireland**, Israel, **Italy**, Kazakhstan, **Latvia, Lithuania, Malta**, Monaco, Montenegro, **the Netherlands,** Norway, **Poland, Portugal, Romania**, the Russian Federation, **Slovenia, Spain, Sweden**, Turkey, Turkmenistan, Ukraine and the United Kingdom of Great Britain and Northern Ireland.

[123] The sea (sub)regions covered by the North-east Atlantic Ocean are the Barents Sea, Bay of Biscay, Celtic Sea, Greenland Sea, Iceland Sea, North Sea and Norwegian Sea

[124] Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM Convention); Bucharest Convention for the Black Sea; Barcelona Convention for the Mediterranean Sea; and Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention).

109. Information on the Caspian Sea is mainly available in the Caspian Sea State of the Environment (2019) report by the Tehran Convention.[125] Twenty-two of the thirty-seven littoral countries in the pan-European region are member States of the European Union. The new European Union Biodiversity Strategy 2030 is instrumental for measuring ecosystem health and halting biodiversity loss across ecosystems including marine ecosystems. In parallel, the Marine Strategy Framework Directive (Directive 2008/56/EC; Commission Decision 2017/848) aims at achieving or maintaining Good Environmental Status in the four European Union regional seas by protecting and restoring the marine environment and phasing out pollution. The Maritime Spatial Planning Directive (Directive 2014/89/EU) makes a key contribution to the Marine Strategy Framework Directive on aspects related to use and management of ocean space.

110. A direct link between the theme of coastal waters, marine ecosystems and seas and the two conference themes exists. For example, the use of nature-based solutions in sustainable infrastructure enhances coastal resilience and its climate-proof functionalities. At the same time, this approach addresses multiple issues, such as rising sea levels, flood protection, coastal erosion that causes loss of land, assets and livelihoods, while harmonizing coastal development with habitat and ecological protection.

111. With more than half of the European Union's tourist accommodation establishments located in coastal areas, maritime and coastal tourism is a pillar of the blue economy, in particular in the Mediterranean region, which hosts about one third of world tourism.[126] The prospects of maritime and coastal tourism have been severely impacted by the coronavirus (COVID-19) pandemic, together with many other closely connected sectors. The post-COVID recovery is expected to boost ambitions and trends towards more sustainable tourism.

3. State, main trends and recent developments

112. Marine pollution originating from land-based sources includes discharges from municipal waste, mainly in the form of plastic litter, wastewater and industrial activities. Huge investments on large-scale projects, constructing new or modernizing wastewater treatment plants has led to a general decrease in the discharge of untreated wastewater into the sea, in particular in certain areas of the Black Sea,[127] Caspian Sea[128] and the Mediterranean Sea.[129] The semi-enclosed Baltic and Black Seas are historically known for their high sensitivity to eutrophication, the enrichment of water by nutrients nitrogen and phosphorus, as a result of limited exchange of water with outside seas.

113. Marine litter pollution includes beach, floating and seafloor litter, litter in biota and micro-litter – pieces of plastic less than 5 mm in diameter known as microplastics. Microplastics are of growing concern because they accumulate in the food web, posing a risk to marine biota and human health. Marine litter has been observed throughout the pan-

[125] Interim Secretariat of the Framework Convention for the Protection of the Marine Environment of the Caspian Sea (Tehran Convention), *Caspian Sea: State of the Environment* (Geneva and Arendal, Tehran Convention Secretariat and GRID-Arendal, 2019), available at www.grida.no/publications/476.

[126] UNEP Mediterranean Action Plan and Plan Bleu, *State of Environment and Development in Mediterranean* (Nairobi, UNEP, 2020), available at https://planbleu.org/en/soed-2020-state-of-environment-and-development-in-mediterranean/.

[127] J. Slobodnik and others (2021), "Summary of EMBLAS Project Finding, Gaps and Recommendations." EU/UNDP Project: Improving Environmental Monitoring in the Black Sea–Selected Measures (EMBLAS-Plus) – Agreement ENI/2017/389-859.

[128] Tehran Convention, *Caspian Sea: State of the Environment*.

[129] European Environment Agency and UNEP Mediterranean Action Plan, *Technical Assessment of Progress towards a Cleaner Mediterranean — Monitoring and Reporting Results for Horizon 2020 Regional Initiative* (Luxembourg, Publications Office of the European Union, 2021), available at www.eea.europa.eu/publications/technical-assessment-of-progress-towards.

European area, including the less populated Barents Sea area.[130] Most of the litter comes from land-based sources, except in the North-East Atlantic where sea-based litter is equally important.[131] No reliable information on the volumes of litter discharged into the coastal or marine environment of the Caspian Sea is available, although this is considered a pressing issue.[132]

114. Fishing is one of the main pressures affecting the sustainability, health, productivity and resilience of marine ecosystems. Overexploitation of commercial fish and shellfish stocks continues across the sea regions in the pan-European area. The state of fisheries has improved significantly in the North-East Atlantic Ocean and the Baltic Sea, with clear signs of recovery of commercial fish and shellfish stocks since the early 2000s. On the other hand, the situation remains critical in the Mediterranean Sea and the Black Sea with no signs of improvement. This is due to elevated fishing pressures, significant knowledge gaps on the status of fish and shellfish stocks and the difficulties in the Mediterranean Sea in adopting management measures for a single stock.[133] The Caspian Sea has also seen declining fish stocks,[134] as a result of overfishing and unregulated fishing. IUU fishing is one of the factors that negatively impacts the local economies and coastal livelihoods, as well as being a threat to marine ecosystems.

115. A drastic decline in marine biodiversity is observed, at a faster rate than for land species. The Red List assessments for the European Union sea regions show that of the 1,196 marine species assessed, 9 per cent are threatened, while 3 per cent are near-threatened. Birds, mammals and turtles are particularly at risk, with over 20 per cent of species being threatened.[135] Eighteen species of sturgeon from all over Europe and Asia assessed in the Red List were all found to be threatened. The Beluga sturgeon in the Caspian Sea is listed as critically endangered along with all of the other commercially important Caspian Sea species, which are the main producers of wild caviar[136].

116. The resilience of marine ecosystems is further reduced due to changes in ocean temperature and oxygen content, and ocean acidification as a result of anthropogenic climate change. Such changes in environmental conditions indicate that significant systemic changes are taking place in the European Union sea regions.[137] Increases in sea surface temperature lead to changes in species' distribution ranges (see European Environment Agency indicator on Changes in fish distribution in European seas[138]), abundance and seasonality, affecting marine food webs.

117. Political awareness of the role of oceans in achieving climate targets is on the rise, with more governments committing to more ambitious ocean agendas. The European Union Biodiversity Strategy for 2030 highlights the need for expanding protection of the European Union's sea regions to 30 per cent, creating ecological corridors to help reverse biodiversity

---

130 For example, Bjørn E. Grøsvik and others, "Assessment of Marine Litter in the Barents Sea, a Part of the Joint Norwegian–Russian Ecosystem Survey." *Frontiers in Marine Science* 5 (2018). https://doi.org/10.3389/fmars.2018.00072.

131 European Environment Agency, *State of Europe's Seas* (Luxembourg, Publications Office of the European Union, 2017), available at www.eea.europa.eu/publications/state-of-europes-seas.

132 Tehran Convention, *Caspian Sea: State of the Environment*.

133 WISE-Marine – Marine Information System for Europe, available at https://water.europa.eu/marine, and European Environment Agency, *Marine Messages II – Navigating the Course towards Clean, Healthy and Productive Seas through Implementation of an Ecosystem-based Approach* (Luxembourg, Publications Office of the European Union, 2019, available at www.eea.europa.eu/publications/marine-messages-2/.

134 Tehran Convention, *Caspian Sea: State of the Environment*.

135 European Environment Agency, *Marine Messages II*.

136 International Union for the Conservation of Nature, "Sturgeon more critically endangered than any other group of species", news article, 18 March 2010, available at www.iucn.org/content/sturgeon-more-critically-endangered-any-other-group-species.

137 WISE-Marine – Marine Information System for Europe, available at https://water.europa.eu/marine.

138 See www.eea.europa.eu/data-and-maps/indicators/fish-distribution-shifts/assessment-1.

loss, contribute to climate change mitigation and resilience.[139] A proposal for legally binding instruments on restoration is also included as part of the European Union Restoration Plan. At the global level, 51 countries have pledged to protect at least 30 per cent of marine areas by 2030, known as the Global Ocean Alliance 30by30,[140] of which 17 are ECE countries.[141] Following an extensive participatory process (3rd International Ocean Governance Forum, April 2021), the European Union is revising its International Ocean Governance Agenda – an integral part of the European Green Deal and the European Union's response to Sustainable Development Goal 14 (life below water). Other initiatives at the regional or global level address awareness of marine litter pollution, sustainable blue economy and conservation efforts. The understanding of the seas continues to improve through the deployment of innovative sensors and autonomous observation platforms, enabling the expansion of observation programmes through better coordination and integration.

4. Indicators

118. Sustainable Development Goal 14 provides an appropriate indicator framework for the purpose of the pan-European assessment of coastal waters, marine ecosystems and ocean.[142]

Marine Pollution: Beach litter density

119. This indicator provides the number of litter items on a 100 m beach stretch of European Union sea regions (table 5 and figure X overleaf). No data is available for the Caspian Sea.

120. The data is derived from the citizen-science-based European Environment Agency Marine Litter Watch database (2014–2019). The values are consistent with beach litter densities provided in regional assessments, in particular for the Baltic and Black Seas. Plastic is the most abundant type, comprising around 70-83 per cent of marine litter, exceeding 90 per cent in some areas.

121. Most assessments are not able to draw conclusions on time trends in marine litter. This is due to the survey limitations and methodological challenges with interpreting marine litter data. The abundance of beach litter is highly influenced by water currents, prevailing winds and the exposure of the beach.[143]

[139] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, On a New Approach for a Sustainable Blue Economy in the EU Transforming the EU's Blue Economy for a Sustainable Future, COM(2021) 240 final.

[140] See www.gov.uk/government/topical-events/global-ocean-alliance-30by30-initiative/about.

[141] As at 21 July 2021, these are: Armenia, Belgium, Croatia, Cyprus, Denmark, Finland, France, Germany, Italy, Luxembourg, Monaco, Montenegro, Norway, Portugal, Spain, Sweden and the United Kingdom of Great Britain and Northern Ireland.

[142] The context for the selection of the following indicators is provided above and supplemented with more information in an appendix to be made available online.

[143] European Commission, *Guidance on Monitoring of Marine Litter in European Seas. A guidance document within the Common Implementation Strategy for the Marine Strategy Framework Directive* (Brussels, 2013), MSFD Technical Subgroup on Marine Litter.

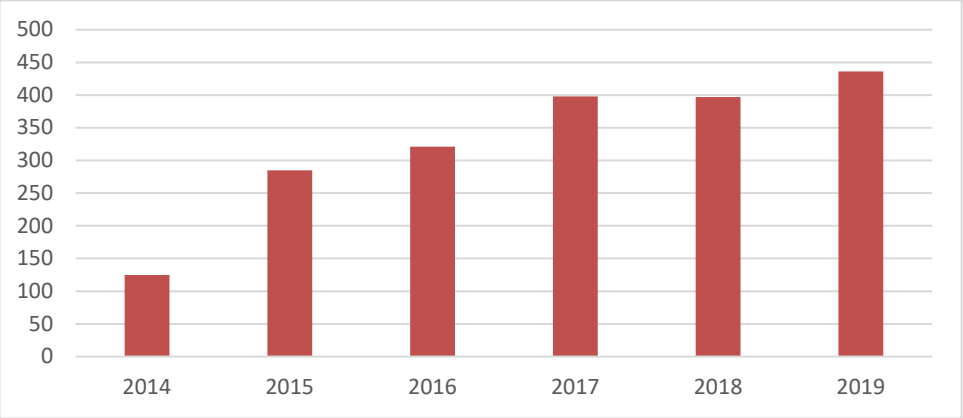
Table 5
Overview of the number of beach litter items and plastic composition

Sea region	*Number of items on beach per 100 m of shoreline, median for the period 2014 –2019* [a]	*Plastic composition*
Baltic Sea	78	70 per cent of beach litter
Black Sea	652	83 per cent of beach litter
Mediterranean Sea	428	95–100 per cent of the total floating marine litter; 50 per cent of the seabed marine litter
North-East Atlantic	105	Over 90 per cent of beach litter in some areas

Source: Kideys and Aydın, 2020.[144]

Note: [a] Only European Environment Agency monitoring data from sea beaches under Marine Litter Watch.

Figure X
Evolution in median beach litter numbers for the four sea regions surrounding the European Union combined, number per 100 m of beach (2014–2019)



Source: Kideys and Aydın, 2020.

Note: Monitoring data only. No data for the Caspian Sea.

Fisheries: Proportion of fish stocks within biologically sustainable levels

122. This indicator is based on data held by the Food and Agriculture Organization of the United Nations (FAO) for Sustainable Development Goal indicator 14.4.1 (Proportion of fish stocks within biologically sustainable levels), which measures the sustainability of the marine capture fisheries by their abundance.[145] Table 6 below shows the proportion of marine fish stocks within biologically sustainable levels, supplemented with data for the four European Union sea regions on the proportion of assessed stocks meeting the Marine Strategy Framework Directive's Good Environmental Status primary criteria.

[144] Kideys, A.E. and M. Aydın, *Marine Litter Watch (MLW) European Beach Litter Assessment 2013–2019* (European Topic Centre on Inland, Coastal and Marine waters, 2020), available at www.eionet.europa.eu/etcs/etc-icm/products/marine-litter-watch-mlw-european-beach-litter-assessment-2013-2019.

[145] A fish stock whose abundance is at or greater than the level that can produce the maximum sustainable yield is classified as biologically sustainable. In contrast, when abundance falls below the maximum sustainable yield level, the stock is considered biologically unsustainable.

Table 6
Proportion of marine fish stocks within biologically sustainable levels

FAO Major Fishing Area [a]	*Proportion of stocks within biologically sustainable levels, 2017 (per cent)*	*Sea region* [b]	*Proportion of assessed stocks meeting specified criteria (per cent)*			
			both GES criteria	*either of the two GES criteria*	*at least one of the two GES criteria*	*neither of the two GES criteria*
Mediterranean and Black Seas	37.50	Mediterranean Sea	0	6.1	6.1	93.9
		Black Sea	0	14.3	14.3	85.7
North-East Atlantic, including Baltic Sea	79.31	Baltic Sea	12.5	50.0	62.5	37.5
		North-East Atlantic	44.1	38.2	82.3	17.7

Sources: [a] FAO, *The State of World Fisheries and Aquaculture 2018 – Meeting the Sustainable Development Goals* (Rome, FAO, 2018), available at www.fao.org/3/I9540EN/i9540en.pdf.; and [b] European Environment Agency, *Marine Messages II*.

Notes: GES = Good Environmental Status. GES primary criteria: achieving (a) a fishing mortality and (b) a reproductive capacity compatible with having population biomass levels above those capable of producing the maximum sustainable yield.

123. Both sources confirm that there are significant differences between regions. The Mediterranean Sea and Black Sea remain highly overfished, whereas signs of recovery of fish stocks can be observed in the North-East Atlantic and the Baltic Sea as a result of improved management decisions.

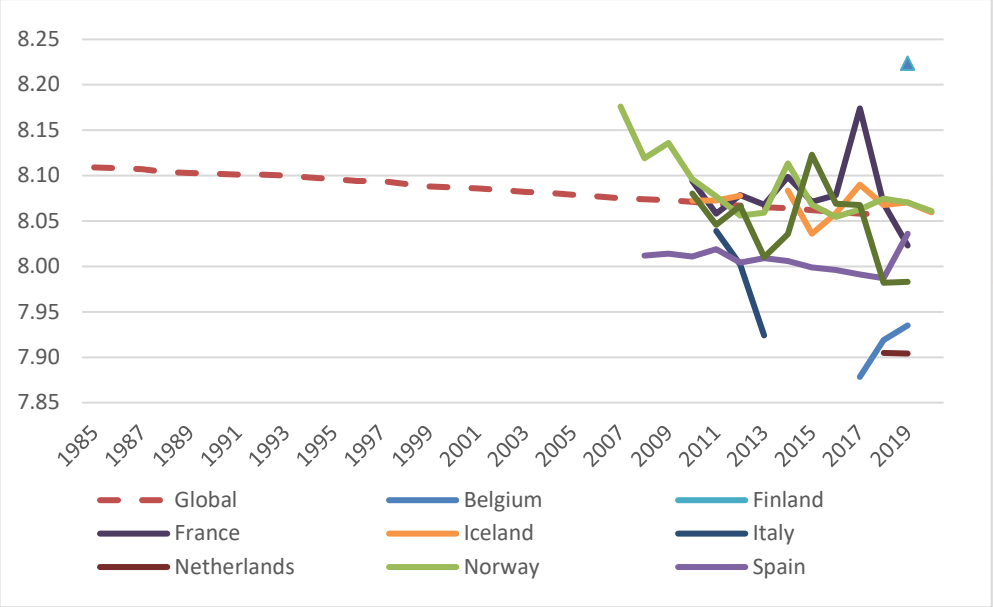
Climate change impacts: Average marine acidity (pH) measured at agreed suite of sampling stations

124. This indicator combines data reported by ECE littoral countries under Sustainable Development Goal target 14.3.1 (Average marine acidity (pH) measured at agreed suite of representative sampling), superimposed on the global annual average of surface ocean pH for the period 1985–2018. The purpose of this indicator is to monitor the carbon system by measuring four parameters: pH, total dissolved inorganic carbon, carbon dioxide partial pressure and total alkalinity. Each country's government decides which sites to select, as long as the same sites are measured regularly to capture the changes in the parameters' values. When at least half of coastal nations report values, regional values can be aggregated.

125. Observations of ocean acidification over the past 35 years have shown an increase in acidity by 0.052 pH units (figure XI overleaf). At the national scale, the trend is more complex with significant variations near the coast. Long-term observational records, especially in the coastal zones, are required to identify the ocean acidification signals.

Figure XI

Global annual average of surface ocean pH taken from the Copernicus Marine Service and based on a reconstruction method using in situ data and remote sensing data, as well as empirical relationships, pH units (1985–2019)



Sources: European Environment Agency, "Yearly mean surface seawater pH reported on a global scale" (2020), available at www.eea.europa.eu/data-and-maps/daviz/yearly-mean-surface-sea-water-1#tab-chart_3); and Sustainable Development Goal target 14.3 national data (United Nations Global Sustainable Development Goal Indicators Database, available at https://unstats.un.org/sdgs/indicators/database/, retrieved on 29 April 2021), with the exception of data from Belgium: Research Institute Nature and Forest, Flanders Region (2020), available at https://www.vlaanderen.be/inbo/backgroundindicatoren/noordzee-oceaanverzuring).

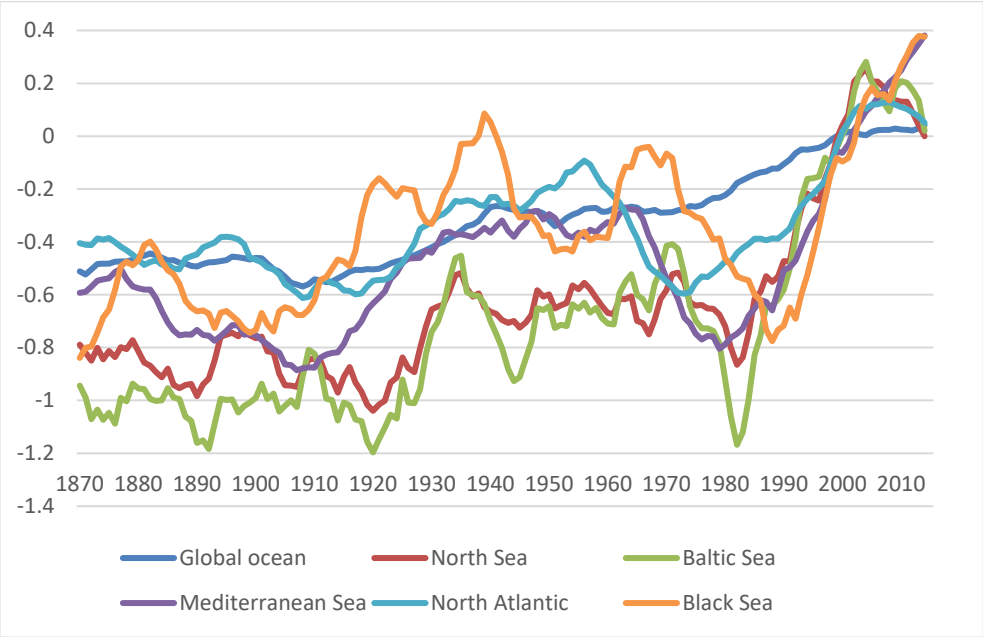
Climate change impacts: Average sea surface temperature anomaly

126. This indicator shows the annual average sea surface temperature (in °C), referenced to the average temperature between 1993 and 2012 in the global ocean and four pan-European seas.

127. All sea regions have warmed considerably since 1870 (see figure XII overleaf). The warming has been evident since the late 1970s and particularly rapid since 1998. Since 1981, marking the satellite era for which more comprehensive data is available, the trend in sea surface temperature rise has been between around 0.2 °C per decade in the North Atlantic and 0.5 °C per decade in the Black Sea. According to the Intergovernmental Panel on Climate Change,[146] the average sea surface temperature has increased by 0.6 °C since 1850. Depending on the emissions scenario, sea surface temperature is projected to continue to increase, albeit more slowly than air temperature over land.

[146] Intergovernmental Panel on Climate Change, *Special Report on the Ocean and Cryosphere in a Changing Climate* (2019), available at www.ipcc.ch/srocc/.

Figure XII
Time series of annual average sea surface temperature (°C), referenced to the average temperature between 1993 and 2012



Source: WISE-Marine[147]

Responses: Coverage of protected areas in relation to marine areas

128. This indicator shows the coverage of marine protected areas (MPAs) in relation to the area of the Exclusive Economic Zone (see table 7).

Table 7
Percentage MPA coverage per subregion

Subregion	*Littoral ECE countries*	*MPA coverage, per cent*
European Union	Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden	15.2
Western Europe	Iceland, Israel, Monaco, Norway, United Kingdom of Great Britain and Northern Ireland	17.1
Central Asia	Kazakhstan, Turkmenistan	31.9
Eastern Europe	Azerbaijan, Georgia, Russian Federation, Ukraine	2.3
South-Eastern Europe	Albania, Bosnia and Herzegovina, Montenegro, Turkey	1.8
Total for pan-European Region		**9.2**

Source: December 2021 release of the World Database on Protected Areas, UNEP World Conservation Monitoring Centre.

[147] WISE-Marine – Marine Information System for Europe, available at https://water.europa.eu/marine.

129. A total of 10.8 per cent of the surface of European Union seas was designated as MPA by the end of 2016, implying that the bloc has reached the global Aichi Biodiversity Target 11.[148] However, that MPA coverage is more than six times higher in coastal waters than in offshore waters, meaning that not all biodiversity features are adequately represented in the MPA network.[149] The greatest growth in protected areas and other effective area-based conservation measures over the last 10-year period has been in marine and coastal areas as compared to terrestrial areas. [150] However, the current MPA coverage stands at 7.74 per cent at the global level, and only 6.7 per cent in 2018 in the pan-European level, falling short of the 10 per cent coverage target.

5. Case studies

"The Black Sea is recovering but chemical and marine litter pollution are still a major issue" [151]

130. For decades, the Black Sea has been the European Union's most polluted sea region. In the 1990s, the Black Sea experienced unprecedented degradation when widespread nutrient loading caused a large dead zone. The main sources of nutrients were runoff from the agricultural sector (fertilizers and livestock waste), domestic and industrial wastes. Three rivers – Dniester, Dnipro and Danube – are the main source of nutrient, chemical and litter pollution into the Black Sea. The contaminants monitoring programme conducted under the EMBLAS series of projects revealed extremely high concentrations of chemicals in offshore waters, biota, fish and mussels. Water samples showed traces of caffeine, medicine and illicit drugs, with pharmaceuticals, especially antibiotics, posing the biggest threat. The number of floating items per km^2 (90.5 items/km^2) is the highest among European Union seas and almost twice that in the Mediterranean Sea. Sediment samples taken from the seafloor were found to contain microplastics.

131. Over the past 20 years, the Danube has been the subject of a massive clean-up operation financed by the European Union. The construction of wastewater treatment plants along the river has prevented the discharge of raw wastewater in the river, leading to an improvement in water quality over the last 15 years. Other improvements included reductions in industrial and agricultural discharges. The ecosystem in the North-western shelf of the Black Sea is recovering, as witnessed by the return of once-abundant red seaweed *Phyllaphora.* This is a clear example of a "source-to-sea" approach to coastal and marine management.

"A green and blue recovery for coastal and maritime tourism in the Mediterranean"[152]

132. In 2019, the Mediterranean basin welcomed more than 400 million international tourists, and the tourism sector accounted for up to 15 per cent of regional GDP. Tourists are

---

[148] By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

[149] See https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/marine-protected-areas.

[150] *Protected Planet Report* (UNEP and International Union for the Conservation of Nature), available at https://livereport.protectedplanet.net/.

[151] Sources: EMBLAS-Plus project (http://emblasproject.org/) and BBC News, "The Black Sea: Can Europe's most polluted sea be saved?", 2 December 2019, available at www.bbc.com/reel/video/p07w83tq/can-europe-s-most-polluted-sea-be-saved-.

[152] Sources: Fosse, J., I. Kosmas, and A. Gonzalez, *The Future of Mediterranean Tourism in a (Post) Covid World* (Eco-union, 2021), available at https://www.ecounion.eu/wp-content/uploads/2021/04/Nota_Thefuture_mediterranean_tourism_03.pdf; European Environment Agency and UNEP Mediterranean Action Plan, *Technical Assessment of Progress towards a Cleaner Mediterranean*; UNEP Mediterranean Action Plan, *Mediterranean Strategy for Sustainable Development 2016–2025* (2016), Valbonne. Plan Bleu, Regional Activity Centre; and Plan Bleu,

attracted by landscapes and rich biodiversity, cultural heritage and traditional lifestyles, coupled with favourable environmental conditions, such as a mild climate, beaches and clear seawater.

133. While being one of the global biodiversity hotspots,[153] the region is also subject to critical levels of habitat loss from unsustainable exploitation of resources, pollution, climate change and invasive marine species. The negative environmental impacts of tourism on the coastal and maritime areas originate mainly from the construction and operations of built infrastructures (resorts, residencies, ports and marinas, facilities, etc.) and from maritime or coastal recreational activities (nautical tourism, golf courses, water sports, etc.). The high spatial and temporal variations of tourism, which is predominantly concentrated along the coastal strip and peaks during the summer season, boosts the amount of potentially mismanaged waste, as well as in discharges of inadequately treated urban wastewater. More than 75 per cent of the annual waste production is generated during the summer.

134. A key challenge is to promote "blue" sustainable tourism practices in coastal and marine areas, promoting positive externalities for the environment, workers and local communities. The Mediterranean tourism sector has been hard hit in 2020 by travel restrictions due to the COVID-19 pandemic. It is now at a crossroads: back to previous overgrowing trends and mass tourism or leapfrog towards more sustainable tourism patterns? The massive investments provided by the ambitious, green and inclusive recovery plans offer a unique opportunity to recover better, by transforming the tourism sector and contributing to a more prosperous region. These measures should be multi-fold, involving various actors and benefitting the environmental, social and economic dimensions.

MED Sustainable Tourism, available at https://planbleu.org/en/projects/med-sustainable-tourism-community/.

[153] A biodiversity hotspot is an area characterized as of exceptional biodiversity value and a large number of endemic species

E. Biodiversity and ecosystems

1. Key messages and recommendations

Key messages

135. Overall forest area in the pan-European region has increased by 33.5 million ha[154] over the past 30 years. Except for the Russian Federation, the relative share of the particularly biodiversity-rich primary forests has stayed stable at about 3 per cent of total forest area between 2000 and 2020.[155] Forest fragmentation remains an important pressure.

136. Beyond forests, the status of ecosystems remains a cause for concern, with no evidence of a clear positive trend. Only a minority of the habitats assessed at the European Union level have a good conservation status, and the overall picture is likely to be similar beyond the European Union.

137. The protected area (PA) estate in the pan-European region has almost tripled over the past 30 years, and key policy targets related to PAs have been met in the region.

138. Land continues to be taken for infrastructure development in the pan-European region, but land take has decreased in most European Environment Agency member countries and even reversed in Eastern Europe.

Recommendations

139. Governments should ensure that trends in forest area remain positive. They should take additional measures to safeguard the remaining primary forests and their ecological functionality, for example, by promoting management standards aimed at preserving high-conservation value forest and by enhancing forest connectivity.

140. Governments should make efforts to consolidate and improve the extended PA network within the ECE region through investment in management effectiveness, ecological representativeness and connectivity. The whole range of governance types should be used, and other effective area-based conservation measures should be integrated;

141. Governments should take measures to reduce land take further and consistently. Measures should also address the conversion of natural to agricultural ecosystems and the degradation of habitat quality due to biodiversity-unfriendly agricultural practices through, for example, more targeted use of subsidies and other incentives.

142. Governments should mainstream biodiversity conservation across sectors and policies, to eliminate or reform harmful subsidies and incentives, and to develop effective positive incentives for biodiversity conservation and sustainable use.

2. Context

Issues at stake

143. Biodiversity, which encompasses diversity within species, between species and of ecosystems, plays an essential role in maintaining Earth's life-support systems, enabling nature-based solutions to societal challenges and maintaining quality of life. Ecosystem services are recognized as a basis for sustainable socioeconomic development.

144. The pan-European region is characterized by its strong overlap with the Palearctic region and its extensive biomes of boreal coniferous and temperate deciduous forests,

[154] ECE, "Forest area in UNECE region continues to increase, says FAO report, but greater efforts needed to protect these fragile ecosystems", press release, 23 July 2020, available at https://unece.org/forestry/press/forest-area-unece-region-continues-increase-says-fao-report-greater-efforts-needed.

[155] This trend might be negative if the share of primary forests in the Russian Federation, which is also one of the top three countries in the world in terms of area of primary forest, would be included. However, there are no official statistics on primary forests available for the Russian Federation.

temperate grasslands and deserts, Mediterranean forest and Arctic tundra, as well as important marine ecosystems. It comprises the largest continuous forest, grassland and peatland ecosystems globally. These act as critical carbon sinks, provide ecosystem services and underpin the region's economies.

Policy objectives and challenges

145. The global policy framework for biodiversity in a broad sustainable development context is defined by the relevant Sustainable Development Goals, particularly Goals 15 and 14.

146. The countries of the pan-European region cooperate under various multilateral environmental agreements. The main multilateral environmental agreement on biodiversity is the 1992 Convention on Biological Diversity. Its last Strategic Plan for Biodiversity ran from 2011 to 2020 and was built around the Aichi Biodiversity Targets.[156] Other relevant multilateral environmental agreements are the 1979 Convention on the Conservation of Migratory Species of Wild Animals, the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, the 1971 Convention on Wetlands of International Importance especially as Waterfowl Habitat and the 1979 Convention on the Conservation of European Wildlife and Natural Habitats.

147. The main policy challenge related to biodiversity is to ensure its effective conservation and sustainable use. This implies addressing the drivers and root causes of pressures on species and terrestrial, marine and other aquatic ecosystems, including oceans, and increasingly requires restoration. Strategies include putting in place ambitious policy mixes (regulatory approaches, economic instruments and voluntary approaches), mainstreaming biodiversity across economic and sectoral policies, eliminating illegal exploitation and trade of biodiversity and eliminating illegal, unreported and unregulated fishing. Enforcement of existing legislation and regulation to end illegal activities is critical in this regard. Biodiversity conservation and restoration also requires reforming and removing environmentally harmful subsidies and strengthening the role of biodiversity-relevant taxes, fees and charges.

3. State, main trends and recent developments

Strategic Plan of the Convention on Biological Diversity has only been partly fulfilled and biodiversity loss continues

148. At the global level, only 6 of the 20 Aichi Biodiversity Targets – as the main concretization of Sustainable Development Goals 14 and 15 – have been partly achieved, and none has been fully achieved, according to the *Global Biodiversity Outlook 5*.[157]

149. For the pan-European region, ECE environmental indicator D-3 on forests and other wooded land shows that efforts to curb deforestation and forest degradation have been met with success. This has been accompanied by a relative increase in planted forest.

150. Large, undisturbed ecosystems – both forest and other types, including wetlands – continue to decline globally. Trends in ecosystems and habitats within the pan-European region may be similar: within the European Union, only 15 per cent of habitat assessments have a good conservation status, with 81 per cent having poor or bad conservation status.

151. The conversion of land from natural to non-natural land cover types is one of the pressures contributing to ecosystem loss and degradation. The intensity of this land take has declined in most but not all countries of the pan-European region over the past 20 years, as is also shown by ECE indicator E-1 on land uptake.

152. Species extinction risk is still increasing, although conservation efforts likely prevented an even steeper increase. Twenty-four per cent of species in well-understood

[156] A post-2020 global biodiversity framework is expected to be agreed in 2022.

[157] Secretariat of the Convention on Biological Diversity, *Global Biodiversity Outlook 5* (Montreal, 2020).

taxonomic groups will continue to edge towards extinction unless the drivers of their decline are dramatically reduced. Climate change is emerging as an additional pressure on biodiversity, interacting with pre-existing pressures. Species richness continues to decline in agricultural landscapes and production forests; agricultural practices are among the main drivers of biodiversity loss at the global and pan-European levels. Although over the period 2005–2015 European production forests have become more diverse in tree species composition, recent research alerts that overall tree species richness is increasingly at risk in Europe, prominently through invasive species.[158]

153. The same trends may be true for the pan-European region; the report *State of nature in the EU*[159] noted a deterioration of the average conservation status of bird populations. Species associated with agricultural areas display a particularly negative trend.

Area coverage of protected areas has increased, but their effectiveness in contributing to conservation goals needs to be further enhanced

154. Protected areas remain a key instrument for reducing biodiversity loss. The area of terrestrial and marine PAs has grown significantly in the pan-European region. The latter is also supported by ECE indicator D-1 on terrestrial PAs. Meanwhile, there remains considerable room for improvement of the representativeness, connectivity and management effectiveness of PAs, and for enhanced enforcement of existing PA legislation.

There is a need for a broader policy response to biodiversity loss, reflecting its repercussions for human well-being and sustainable development

155. Biodiversity mainstreaming into policies, poverty reduction and development planning has largely been an insular rather than a systematic effort in most countries over the past 10 years. One positive example has been the rise of environmental-economic accounting in some countries. Overall, little progress has been made over the past decade in eliminating, phasing out or reforming subsidies and other incentives potentially harmful to biodiversity, and in developing positive incentives for biodiversity conservation and sustainable use. This also broadly applies to the pan-European region.

156. Resource mobilization for biodiversity improved in some but, by far, not in all countries between 2010 and 2020. The mobilized resources are still not sufficient to meet financial needs and are still outweighed by financial support for activities harmful to biodiversity. This is also true in the forestry context, including regarding reforestation. In contrast, understanding of funding needs and gaps has improved, at least in some countries.

157. The status and trends of biodiversity and ecosystem services are of fundamental importance for human well-being and sustainable development. Encroachment of human settlements onto natural systems and wildlife trafficking disrupt the self-regulatory capacity of these ecosystems, increase the frequency of human-wildlife contacts and can lead to the spread of infectious diseases. For instance, it is possible that illegal exploitation of pangolins led to the transmission of coronavirus disease (COVID-19) to humans.

158. The conference theme "Greening the economy in the pan-European region: working towards sustainable infrastructure" responds to the need to mainstream the environment including biodiversity and ecosystems across sectors. This conference theme is directly related to indicator E-1 (land take) as increasing the environmental sustainability of infrastructure development relies partly on reducing its spatial footprint.

159. Tourism is both dependent on and affects the state of biodiversity in the areas where it occurs. By "Applying principles of circular economy to sustainable tourism", the ecological footprint of touristic activities in biodiversity-rich touristic areas – including pressures related to waste production, eutrophication and resource overexploitation – is reduced. In turn, this

[158] Forest Europe, *State of Europe's Forests 2020* (Zvolen, Slovakia, Forest Europe, 2020) available at https://foresteurope.org/wp-content/uploads/2016/08/SoEF_2020.pdf.

[159] European Environment Agency, *State of nature in the EU: Results from reporting under the nature directives 2013–2018*, Report No. 10/2020 (Luxembourg, Publications Office of the European Union, 2020), available at https://www.eea.europa.eu/publications/state-of-nature-in-the-eu-2020.

enables the provision of cultural ecosystem services and thereby enhances the human well-being benefits and broader development opportunities of these areas.

4. Indicators

Terrestrial protected areas (ECE indicator): overall moderate-to-good status

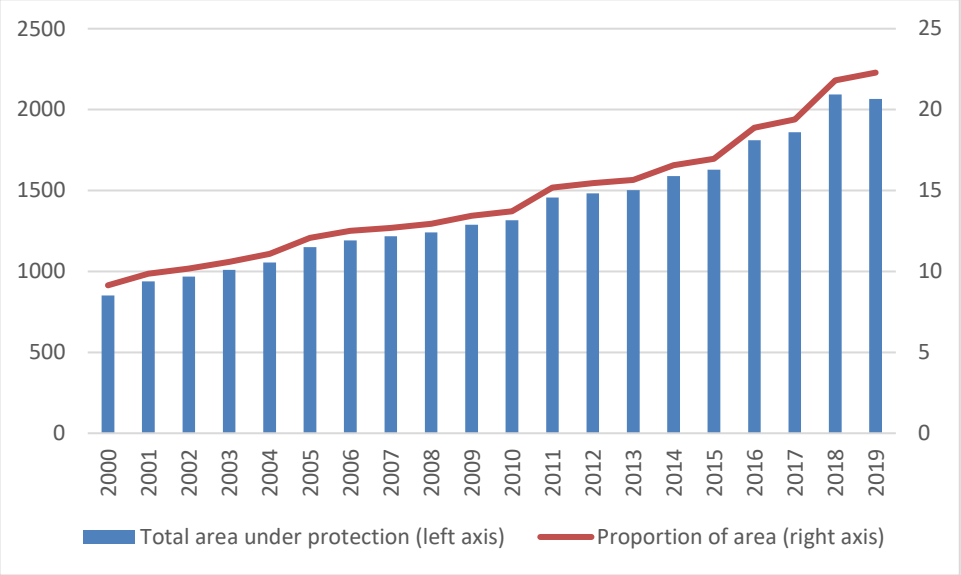
160. This indicator shows the overall area of nationally designated terrestrial PAs in absolute terms and as a share of the countries' total areas. Figure XIII below gives this information for all ECE countries combined, for the period 1990–2019. Data availability for this indicator is very good for European Environment Agency member countries and cooperating countries, and fair-to-good for most other countries.

161. The area extent of PAs in the pan-European region has risen strongly over the past 30 years and increased by 60 per cent over the past 10 years. The share of PA in the European Union and Western Europe is now significantly above the Aichi Target 11 of 17 per cent, but lower rates prevail in the other subregions (see figure XIV). The degree or effectiveness of protection of biodiversity within PA, or about their overall contribution to reducing global biodiversity loss, depend on the PA management effectiveness.

Forests and other wooded land (ECE indicator): overall moderate-to-good status

162. This indicator shows the total area of forests and other wooded land, its ratio to the overall area of the countries, the share of forest areas that are natural and planted, and the contribution of forests designated for production, soil or water protection and the protection of ecosystem services and biodiversity. Figures XV and XVI overleaf show these statistics for all pan-European countries combined,[160] for 10-year intervals over the period 1990–2020.

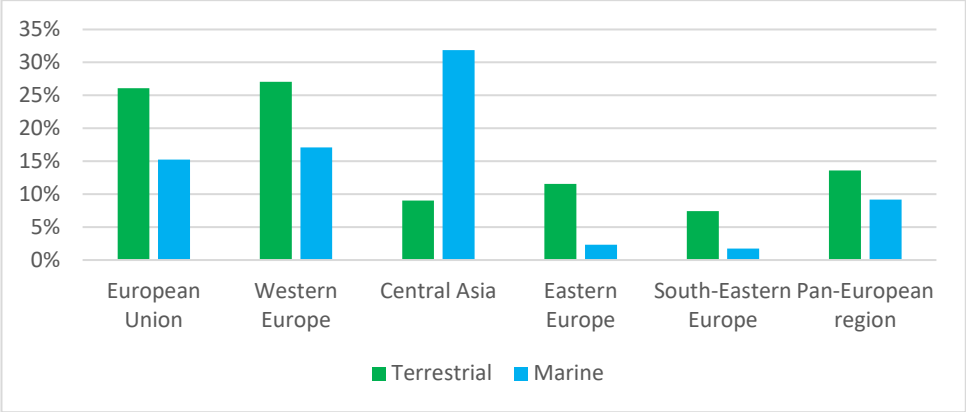
Figure XIII
Protected areas, total area under protection, 1,000 km^2, and share of country area, selected countries, per cent (right axis) (2000–2019)



Notes: Data only for member and cooperating countries of the European Environment Agency, Kazakhstan, the United Kingdom and the countries of Eastern Europe, excluding the Russian Federation.

[160] The Russian Federation alone accounts for 77 per cent of the ECE region's forest area.

Figure XIV
Proportion of terrestrial and marine areas protected (2021)



Source: December 2021 release of the World Database on Protected Areas, UNEP World Conservation Monitoring Centre.

Figure XV
Total area of forest and other wooded land, million ha (1990–2020)

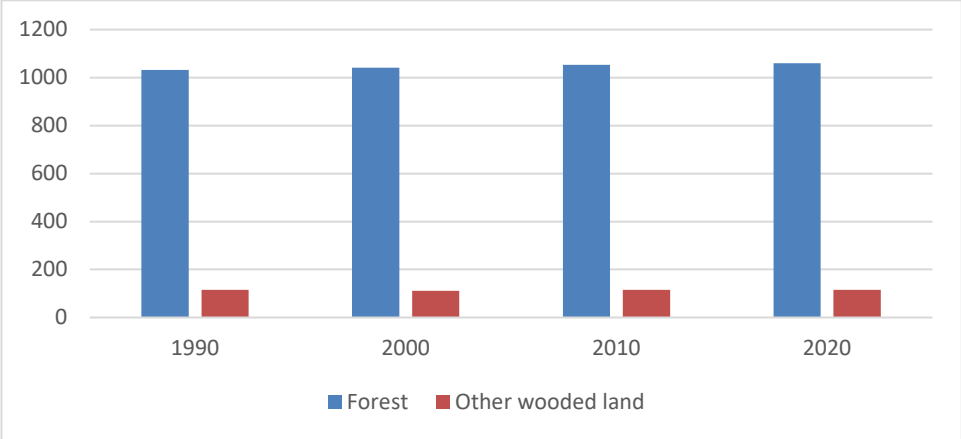
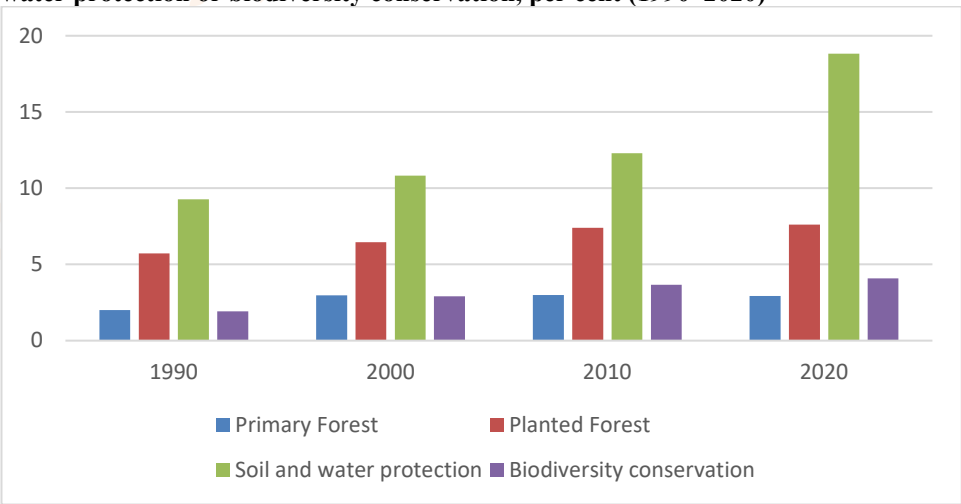


Figure XVI
Share of primary and planted forest and share of forest area designated for soil and water protection or biodiversity conservation, per cent (1990–2020)



Note: No primary forest data for the Russian Federation.

163. The data for this indicator were sourced from Global Forest Resources Assessments of the Food and Agriculture Organization of the United Nations. Data availability for ECE countries from this source is good-to-very-good.

164. Forest area has increased by 2.6 per cent since 1990, and by 0.5 per cent since 2010. The share of forest area has increased by 1 per cent to 39.2 per cent over the past 30 years. Other wooded land has changed little and contributes another 4.3 per cent, as of 2020. This means that the pan-European region has met target 15.1 of the Sustainable Development Goals and Aichi Target 5 in quantitative terms.

165. The share of primary forests, which tend to be particularly biodiversity-rich, remained stable at a low 3 per cent of total forest area between 2000 and 2020. Planted forests became absolutely and relatively more important, increasing from 5.7 per cent in 1990 to 7.6 per cent in 2020. However, this does not mean that expansion of planted forest typically occurs at the expense of primary forest; as seen in the previous paragraph the total forest area increased.

166. Over the past 30 years, forest designation has seen a diversification from a narrow focus on production in 1990 to a broader spectrum including protection of soil, water and biodiversity. This diversification of forest designations can be interpreted as a management response aimed at improving the quality of existing forests, including from a biodiversity conservation perspective. Forest areas designated for water and soil protection more than doubled, from 9.3 to 18.8 per cent, and those for biodiversity conservation doubled from 1.9 to 4.1 per cent.

Land uptake (ECE indicator): overall moderate-to-poor status

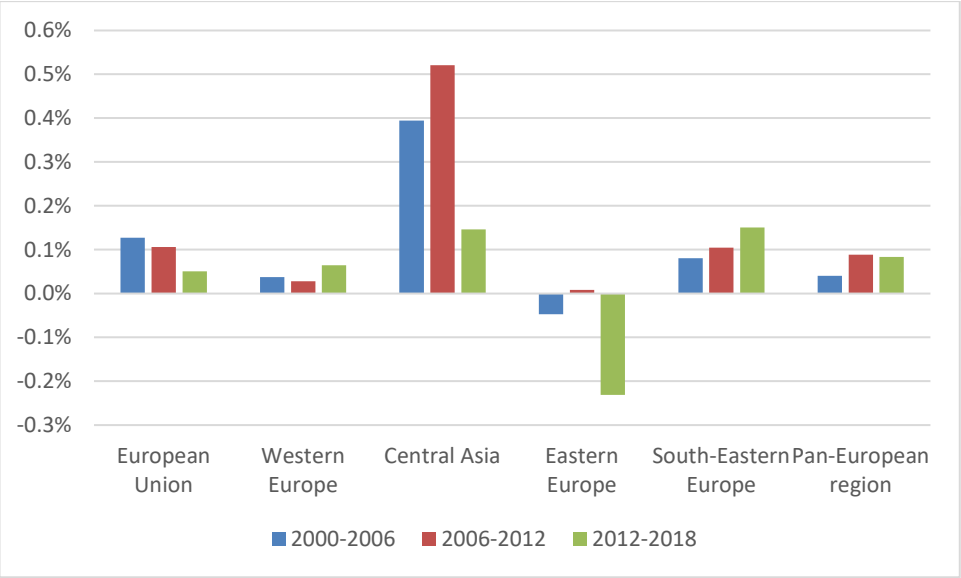
167. A modified version of ECE indicator E-1, based on European Environment Agency indicator "Land take in Europe" (i.e. net conversion of land from non-artificial to artificial land-use categories), has been used in this assessment. The indicator shows only part of the overall relationship between land-use changes and biodiversity. While agriculture is considered a non-artificial use, pressures on biodiversity from habitat loss or degradation are often associated with conversion to agricultural land or change of agricultural practices.

168. The indicator results are most conclusive for European Environment Agency member countries and cooperating countries, while there are some gaps regarding data completeness and consistency of land take data from other ECE countries. Figure VII overleaf shows the indicator for three six-year intervals from 2000 to 2018 for the different subregions.

169. Net land take continues in all subregions, though the rate is decreasing. Land take figures for the countries that joined the European Union since 2004 peaked in the 2006–2012 interval (0.11 per cent) and declined thereafter (0.09 per cent for the 2012–2018 interval), possibly reflecting the adoption of European Union policies and standards. Land uptake in other ECE countries decreased substantially in the period 2012–2018. This trend shows considerable variability across European Environment Agency countries and there are countries where land take rates continued to increase over the entire 2000–2018 period.

170. Land uptake and land take data from European Environment Agency member and cooperating countries are difficult to compare to those from other countries. This is due to differences in methodology, including the availability of reliable remote-sensing data and consistent criteria to analyse them, the continuity of national monitoring efforts, and apparently also shifts in land classification in the early 2000s. This highlights the need to continue investing in consistent land-cover classifications and monitoring capacity, agree on consistent national information to be fed into the Shared Environmental Information System, and carefully retrofit actual land-cover categories to past data, in order to obtain reliable trend information.

Figure XVII
Land take in different subregions across three six-year time periods, per cent of total land area (2000–2018)



Notes: No data for Andorra, Israel, Monaco and San Marino in Western Europe subregion; only Kazakhstan and Uzbekistan in Central Asia; no data for Georgia or Ukraine, nor Armenia and the Republic of Moldova in the first period, nor the Russian Federation in the third period, within Eastern Europe. A negative percentage indicates a return or abandonment of the land.

5. Case studies

Enhancing area-based biodiversity conservation by recognizing other effective area-based conservation measures

171. Other effective area-based conservation measures are areas under management not primarily dedicated to biodiversity conservation, but where management nevertheless contributes to improved biodiversity status. Examples include cultural heritage areas, military training areas and sustainably managed production forests that generate biodiversity benefits. These sites, which occupy a significant share of the area in many countries, went largely unrecognized and attracted only limited resources and efforts to enhance their biodiversity benefits in the past. This started to change with the 2010–2020 Strategic Plan for Biodiversity under the Convention on Biological Diversity and the inclusion of other effective area-based conservation measures in Aichi Target 11, but is likely to be further enhanced in the post-2020 global biodiversity framework.

172. Other effective area-based conservation measures represent a significant but largely untapped opportunity to extend and consolidate area-based conservation networks in the pan-European region. They could contribute greatly to extending overall ecological representation, linking up existing PAs and engaging additional actors to contribute to better biodiversity status.

173. For the European Union and countries with European Union association or partnership agreements transposing European Union water legislation into national legislation, the Water Framework Directive[161] and Floods Directive[162] have the potential to result in land and water management that would be in line with criteria for other effective area-based conservation

[161] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, *Official Journal of the European Union*, L 327 (2000), pp. 1–73

[162] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks, *Official Journal of the European Union*, L 288 (2007), pp. 27–34.

measures. National forest categories of many States of Northern Eurasia, the Caucasus and Central Asia, such as "protective forest" (i.e. forest with the purpose of protecting groundwater reserves or protecting against landslides on slopes), also generate substantial biodiversity benefits and might be recognized as other effective area-based conservation measures.

174. ECE member States should systematically explore and use the emerging designation of other effective area-based conservation measures to further consolidate their area-based conservation networks.

International cooperation to control pressures from linear infrastructure to migratory mammals in Central Asia

175. Many of the iconic migratory mammals of the Central Asian steppes, such as the Saiga antelope, the Goitered gazelle and the Khulan, are globally threatened, partly owing to significant pressure from habitat fragmentation and degradation along linear infrastructure, for instance roads and railways, pipelines and fences. This is directly relevant to the first conference theme "Greening the economy in the pan-European region: working towards sustainable infrastructure".

176. To reduce and mitigate these pressures, ECE member States from Central Asia are cooperating on various initiatives under the Convention on the Conservation of Migratory Species of Wild Animals, including the Memorandum of Understanding concerning Conservation, Restoration and Sustainable Use of the Saiga Antelope and the Central Asian Mammals Initiative. These are aimed at removing barriers to migration, developing and supporting regional ecological networks and, ultimately, preserving animal migrations in the Central Asian region as one of the last global "migration hotspots".

177. The ECE member States in the Central Asian region should continue their cooperation to manage linear infrastructure in such a way that impacts on migratory mammals are minimized.

F. Land and soil

1. Key messages and recommendations

Key messages

178. Land use and land-use change in the pan-European region continue to be mainly driven by agriculture. In Eastern Europe and Central Asia, agricultural production is rising and rapidly approaching Soviet levels, while domestic demand has fallen due to a drop in livestock inventory. The current land-use dynamic shows only a moderate increase of the sown area in fertile soil (steppe and forest-steppe) zones and no sign of agriculture recovering in marginal (forest) areas. However, driven by their desire for a rapidly growing share of the world grain market, countries such as Kazakhstan, the Russian Federation and Ukraine are determined to bring millions of ha of abandoned lands back into cultivation. At the same time, the utilized agricultural area in the European Union is expected to continue declining smoothly towards 2030, though at a slower pace than in the past decade.[163]

179. Soil organic carbon (SOC) content is the most important element of soil due to its role in improving aeration, water retention, nutrient supply, soil biodiversity and climate change mitigation. For example, in Eastern Europe, large-scale land abandonment switched agricultural land from being a small source of atmospheric carbon dioxide (CO_2) to a significant sink of atmospheric CO_2. Conservation agriculture practices in the pan-European region may play an important role in carbon sequestration and raising soil productivity.

180. Land erosion is one of the results of land-use dynamics, and it shows different characteristics throughout the region. Field measurements in European Union countries show an average rate of soil erosion of 0.2–3.2 t ha^{-1} $year^{-1}$ on a per country basis. In Eastern Europe, the average rate of soil erosion has decreased over the past 30 years following massive cropland abandonment and climate change. In the Russian Federation, the total amount of washed soil and the rate of erosion have been reduced by 56.1 per cent and 15 per cent respectively in the past 30 years due to the widespread abandonment of cropland and lower spring runoff. In Central Asia, wind erosion is a dominant type of land degradation, but the contribution of irrigated and rainfed cropland is limited by their relatively small area and relatively low rate of erosion. Erosion can be further reduced in most affected areas by implementing conservation agriculture.

181. The European Union, following changes in consumer behaviour, is increasingly focusing on food safety by developing local, organic, genetically modified organism-free or other types of certified production,[164] which results in more sustainable agriculture practices. Eastern Europe and Central Asia feel the need to prioritize self-sufficiency in key foodstuffs, which might lead to less sustainable agriculture practices.

Recommendations

182. The pan-European countries should increase efforts to provide better guidance to farmers on using soil conservation methods in areas of degraded (eroded) soils. There are already simple models (based on the Universal Soil Loss Equation)[165] allowing farmers to

[163] Land abandonment in the European Union might reach 4.2 million ha, or 3–4 per cent of current utilized agricultural area, by 2030, see Carolina Perpiña Castillo and others, "Agricultural Land Abandonment in the EU within 2015–2030", Joint Research Centre Policy Insights, European Commission, October 2018.

[164] European Commission, Directorate-General Agriculture and Rural Development, *EU agricultural outlook for markets and income, 2019–2030* (Luxembourg, Publications Office of the European Union, 2019).

[165] The Universal Soil Loss Equation model is used to calculate potential erosion on fields as a result of a combination of "pre-disposing factors" such as rainfall pattern, topography, soil texture, cropping systems and management practices. The target audience of the model is farmers who can use the Universal Soil Loss Equation guideline (in a simple table format) to receive advice for their routine practices (A.J. Jones and others, Universal Soil Loss Equation: a Handbook for Nebraska Producers, Nebraska Cooperative Extension Service EC 88-116 (n.p., University of Nebraska-Lincoln, 1987).

explore different options to decrease the rate of erosion on their plots at an economically acceptable cost; however, these methods cannot be used at larger scale or with all types of soils and further research and development is required.

183. Policymakers should strive to maintain a judicious balance between SOC accumulation for higher crop productivity and SOC storage for climate change mitigation, as this is critical for mainstreaming global sustainable initiatives such as "4 per 1,000".[166]

184. The pan-European policy in respect of land resources should focus on consumers' rights to healthy (i.e. free from pesticides and antibiotic, hormone or steroid residues) food, a healthy environment (including animal welfare), stable food prices, and low household expenditures on food. This could be achieved by promoting environmentally sound agriculture practices and a reliable food supply (of domestically produced and imported items) and redirecting investments to storage facilities and transportation where needed.

185. In a condition of intense rural exodus, more active measures should be implemented to reverse the depopulation trend through the diversification of incomes, such as by the development of rural tourism, and the attraction of new settlers. Recognizing the biodiversity value of low-intensity farmland, the European Union provides agri-environmental subsidies in support of farming in marginal areas, but the economic impact of existing European Union programmes in support of rural tourism is modest, while their effects depend on the specific characteristics of the areas.

2. Context

186. Being parties to the United Nations Convention to Combat Desertification (UNCCD), European and Central Asian countries share an ambition to achieve Land Degradation Neutrality (LDN) by 2030. An offsetting scheme is a new component of the LDN approach, meaning that land degradation should be compensated by the restoration or rehabilitation of degraded lands elsewhere. Yet the methodology related to the LDN target does not exist.

187. Most terrestrial carbon (1,500 Gt) is held in soils, more than twice as much as in vegetation or the atmosphere. The soils in the countries that are members of the European Environment Agency hold around 5 per cent of the global SOC pool, whereas the Russian Federation alone holds about 21 per cent. The increase of SOC in pan-European soils can positively contribute to the mitigation of greenhouse gas emissions globally, but nearly 75 per cent of the territory of the Russian Federation lies in the permafrost zone, whose SOC reserve is susceptible to decomposition upon climate warming, thus contributing to the enhanced emission of greenhouse gases.

188. The members of the European Environment Agency recognize agriculture as essential for maintaining biodiversity of extensive farmland biotopes and early successional habitats, such as heathland and meadows. The biodiversity of low-intensity farming land can be higher than that of rewilded, semi-natural and forested areas, and farmers in those areas are producers of both food and ecosystem services. Therefore, the abandonment of such areas is perceived in the European Union as a serious threat to biodiversity. Depopulation (or "desertification") of rural settlements, and not just cropland abandonment, needs to be reversed.

189. A primary role of land and soil resources is food production. Soil underpins 90 per cent of all food, feed and fibre production. The European Union and Western Europe are observing a shift in consumer behaviour towards local, organic, genetically modified organism-free and other types of certified production. The resulting changes in agriculture should be spread over the rest of the pan-European region into subregions where the consumer's right to healthy food is not clearly articulated in food security strategies.

[166] "4 per 1000" is a voluntary action initiative adopted at the 2015 Paris Climate Change Conference that aims to boost carbon storage in agricultural soils by 0.4 per cent each year (www.4p1000.org/).

3. State, main trends and recent developments

190. The European Union Thematic Strategy for Soil Protection adopted in 2006[167] names the following major threats to soil: erosion, organic matter decline, contamination, compaction, salinization, decline in biodiversity, soil sealing, landslides and flooding. Desertification was later included as a further threat. For most of these threats, neither regional nor subregional assessments have been performed because of a lack of systematic approaches and data.

191. In most European Environment Agency member countries, information about SOC is obtained from local soil surveys undertaken by different national or regional institutions, making comparison of the data difficult. The most comprehensive SOC observation network, in England and Wales (United Kingdom of Great Britain and Northern Ireland), shows loss of SOC in all types of ecosystems and land-use classes. The reason for loss is probably increasing decomposition of organic matter with higher temperatures caused by climate change.

192. Support from the European Union Common Agricultural Policy could slow the process of cropland abandonment and rural depopulation in the bloc, but it is not expected to reverse it. In Eastern Europe and Central Asia, about 58 million ha of cropland were abruptly abandoned during the 1990s and are unlikely to be fully restored because of rapid depopulation of marginal rural areas and because no support policy like the Common Agricultural Policy exists in these countries.

193. Numerous field studies show a significant reduction in soil erosion on no-tilling land; moreover, carbon sequestration after no-till is higher than after conventional ploughing. However, there are no explicit national or regional policies in respect to conservation agriculture. Conservation agriculture in the pan-European region demonstrates very limited growth (for example, 2.5 million ha of no-tilling arable land in the European Union) as compared with other world regions. Farmers face a trade-off immediately after adopting no-till: on the one hand, crop yields are often lower; on the other, production costs decrease due to limited use of machinery, fertilizers and less working time per unit area. Farmers following a no-till approach often resort to high and regular applications of herbicides, though longer-term benefits can arise from certified organic produce.

194. Rural tourism can be important for revitalization of abandoned rural settlements. Shifting policymakers' concern from cropland abandonment to "desertification" of thousands of villages throughout the pan-European region is necessary, as low yields are unlikely to be the reason for villages to be left, while an intense demographic rural exodus can certainly cause land negligence. Due to the development of new communication technologies, isolation and lack of employment opportunities are no longer reasons for abandoning small rural and mountainous villages, as the response to the coronavirus disease (COVID-19) pandemic has amply demonstrated with the temporary relocation of urban dwellers to rural areas.[168] An analysis of numerous existing projects for recovering abandoned villages in Italy shows that, among different approaches, rural tourism has the largest potential to succeed.[169]

---

[167] Commission of the European Communities, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, Thematic Strategy for Soil Protection, COM(2006)231 final. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52006DC0231.

[168] Organisation for Economic Co-operation and Development (OECD), "Policy implications of Coronavirus crisis for rural development", 16 June 2020, available at www.oecd.org/coronavirus/policy-responses/policy-implications-of-coronavirus-crisis-for-rural-development-6b9d189a/.

[169] Kristen Elizabeth Sloan, "Reawakening 'Ghost Towns', Alternative Futures for Abandoned Italian Villages", Doctor of Philosophy thesis, University of Wollongong, 2018, available at https://ro.uow.edu.au/theses1/437.

4. Indicators

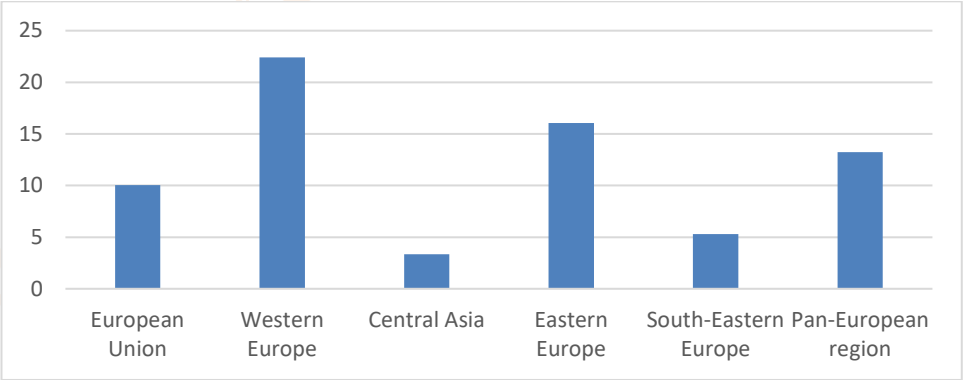
Proportion of land degraded

195. Land degradation and erosion is identified by the European Parliament as "probably the most significant environmental problem in Europe".[170] Most research on land degradation assesses territories in terms of potential risk of erosion because field measurement of actual erosion rates is difficult to conduct, especially at a larger scale. No regional pan-European scale assessment of land degradation is available. At the global level, the UNCCD assessment methodology consists of all three sub-indicators: land cover change, land productivity change and carbon stocks. Parties to UNCCD provide information on the total area of degraded land and level of confidence of assessment,[171] though Conservation International provides complete coverage using remotely sensed data (see figure XVIII overleaf).

Topsoil organic carbon content

196. The Soil Framework Directive[172] called for the delineation of the areas in Europe threatened by a decline in soil organic matter below a definite critical level and for elaboration of appropriate measures to avoid the decline. The "critical" concentration of SOC at 2 per cent (or 3.4 per cent of soil organic matter according to a standard conversion ratio) is the most cited threshold in policy documents. The European Commission Road map for a resource-efficient Europe[173] proposed a goal that SOC levels should not decrease overall and should increase for soils currently with less than 2 per cent SOC by 2020.[174] Figures XIX (below) and XX (overleaf) illustrate the variation in SOC across the region, with 20 g/kg SOC being equivalent to the 2 per cent threshold (coloured green in figure XX); figure XXI (overleaf) summarizes how SOC is changing across the region.

Figure XIX
Soil organic carbon content by subregion, weighted average 0–30 cm (g/kg)



Source: Derived from SoilGrids 2021,[175] courtesy of ISRIC – World Soil Information.

[170] Joint Research Council, *Addressing soil degradation in EU agriculture: relevant processes, practices and policies. Report on the project "Sustainable Agriculture and Soil Conservation (SoCo)"*, (Luxembourg, Office for Official Publications of the European Communities, 2009), available at https://publications.jrc.ec.europa.eu/repository/handle/JRC50424.

[171] ICCD/CRIC(17)/2.

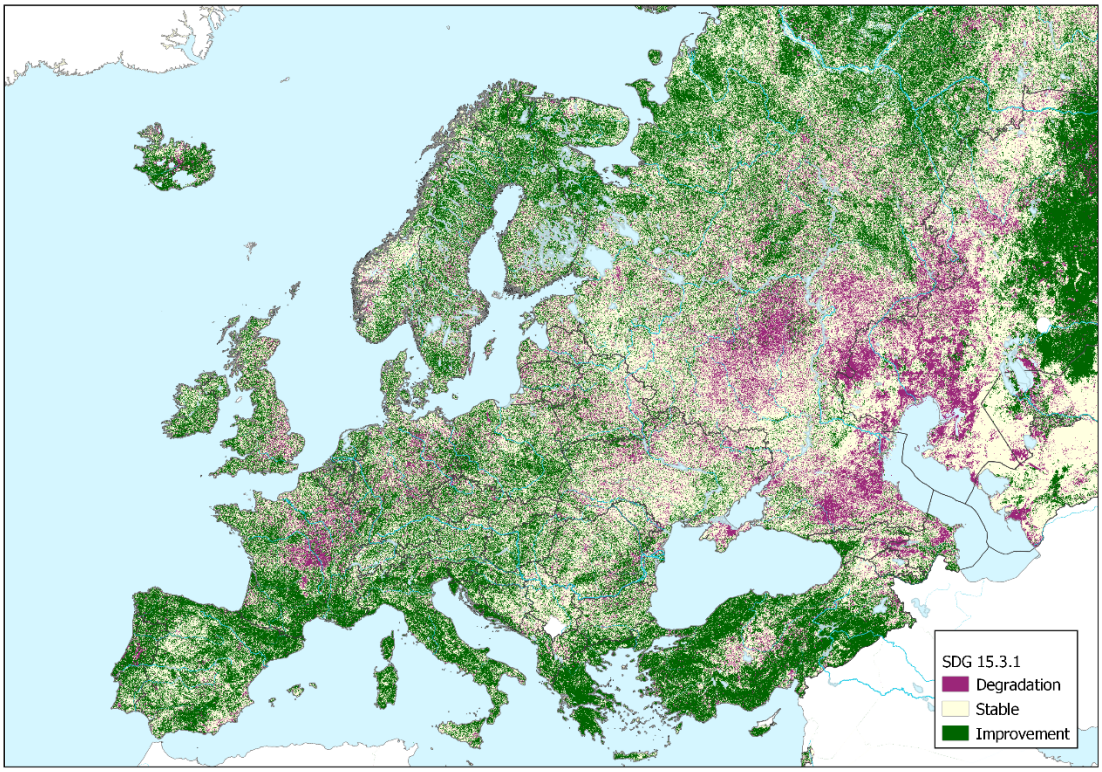
[172] Adopted in 2006 but withdrawn by the European Commission in 2014.

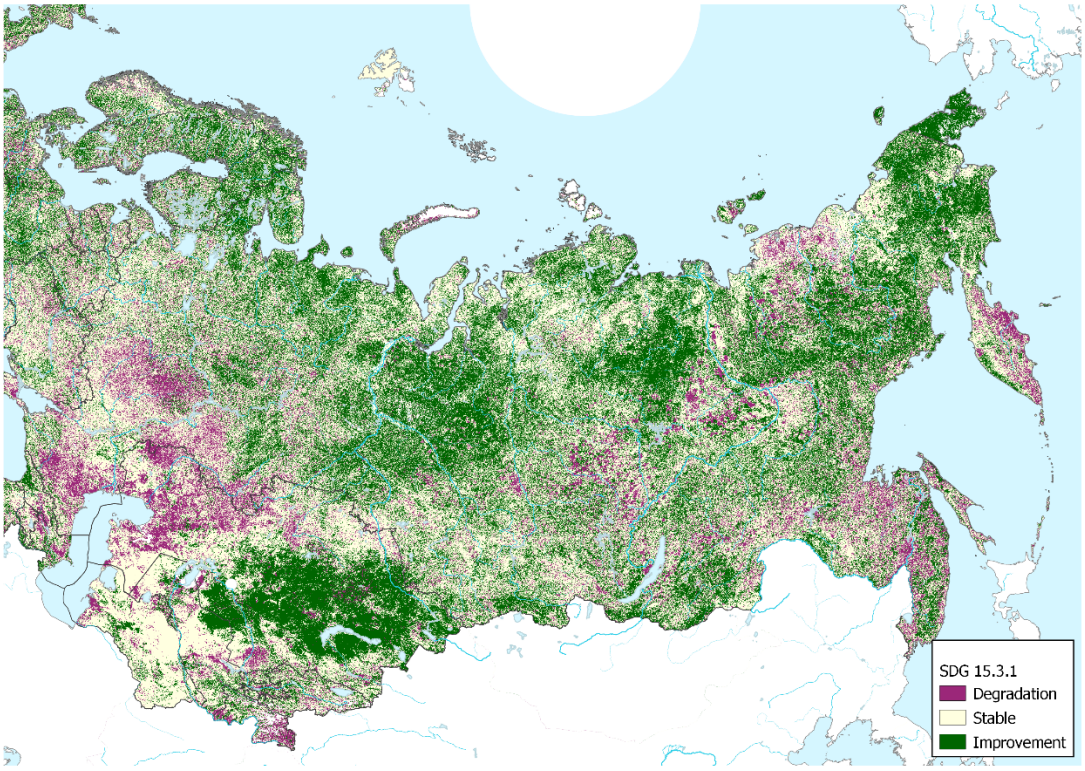
[173] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Road Map to a Resource Efficient Europe, COM(2011) 571 final, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0571.

[174] Panos Panagos and others, "Estimating soil organic carbon in Europe based on data collected through a European network", *Ecological Indicators*, vol. 24 (January 2013), pp. 439–450.

[175] Poggio, L.; de Sousa, L. M.; Batjes, N. H.; Heuvelink, G. B. M.; Kempen, B.; Ribeiro, E. & Rossiter, D. SoilGrids 2.0: producing soil information for the globe with quantified spatial uncertainty SOIL, 2021, 7, 217-240.

Figure XVIII
Trends in land degradation in the pan-European region (2005–2019)

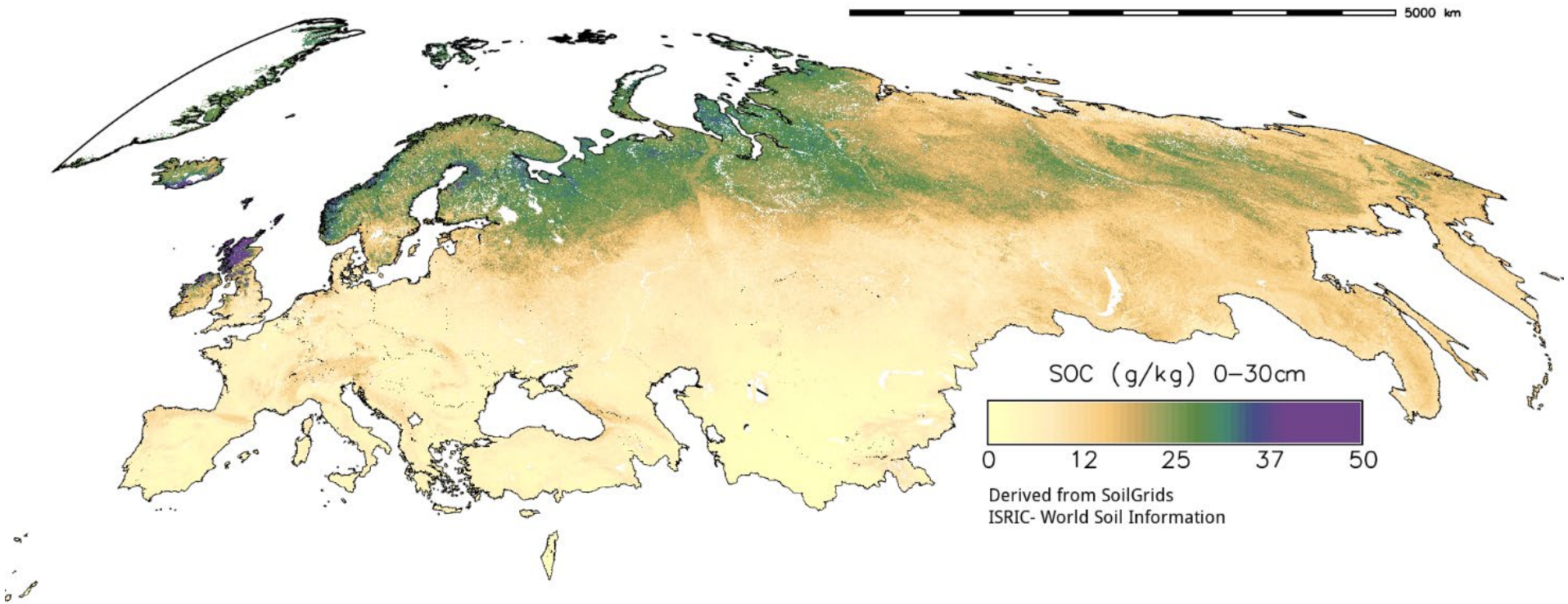




Source: Conservation International.

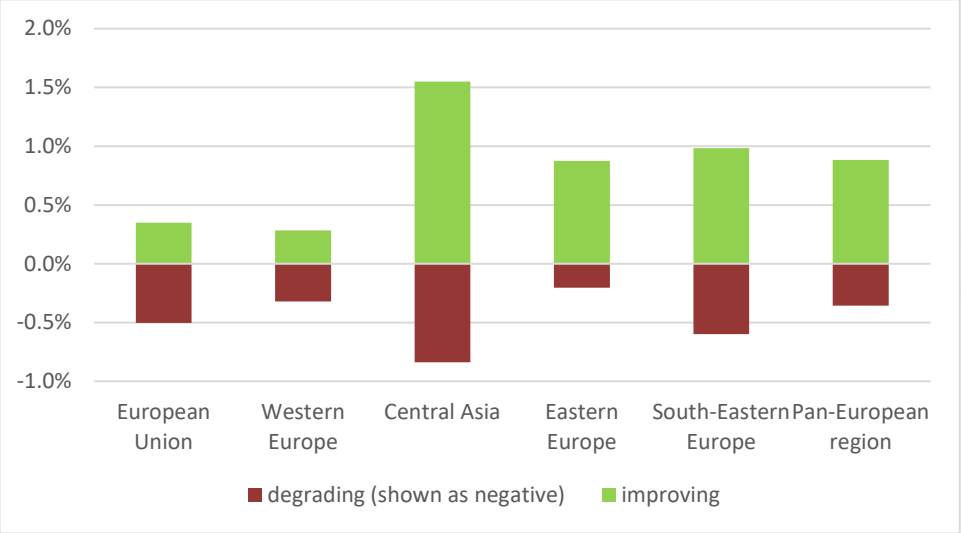
Note: The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. In particular, the boundaries shown on the maps do not imply official endorsement or acceptance by the United Nations.

Figure XX
Soil organic carbon content, 0–30 cm, g/kg



Source: Derived from SoilGrids 2021, courtesy of ISRIC – World Soil Information.

Figure XXI
Proportion of area with improving or degrading soil organic carbon content, by subregion, percentage (2005–2019)

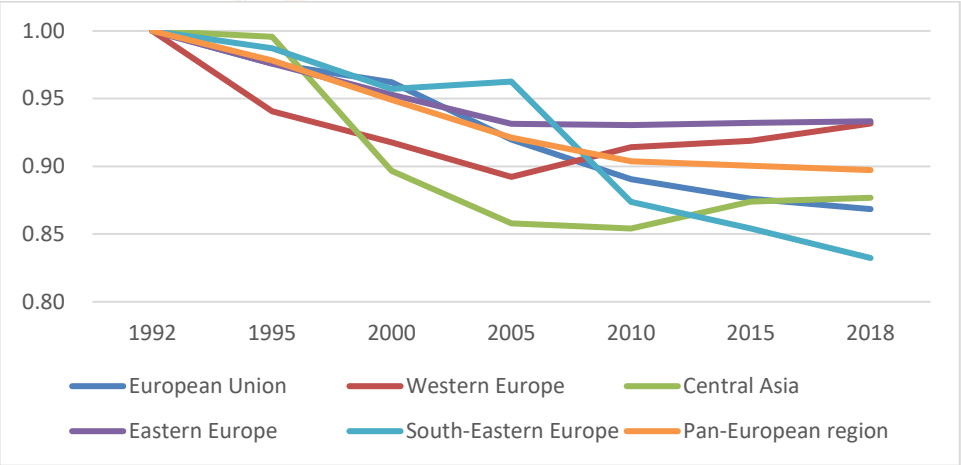


Source: Conservation International

Cropland area

197. There is no definite threshold for agricultural land dynamic, although any decrease of cropland is regarded by default as negative in terms of food security. In the past decade, the long-term trend of a decline in cropland continued in the European Union, though at a slower pace. Moreover, in recent years, a positive trend is observed (see figure XXII below). However, the positive trend may reverse in the next decade.[176] Interestingly, in Eastern Europe and Central Asia, current land-use dynamics also show some increase of sown area, especially in productive areas of Kazakhstan, the Russian Federation and Ukraine.

Figure XXII
Cropland area in 1992–2018 (1992=1)



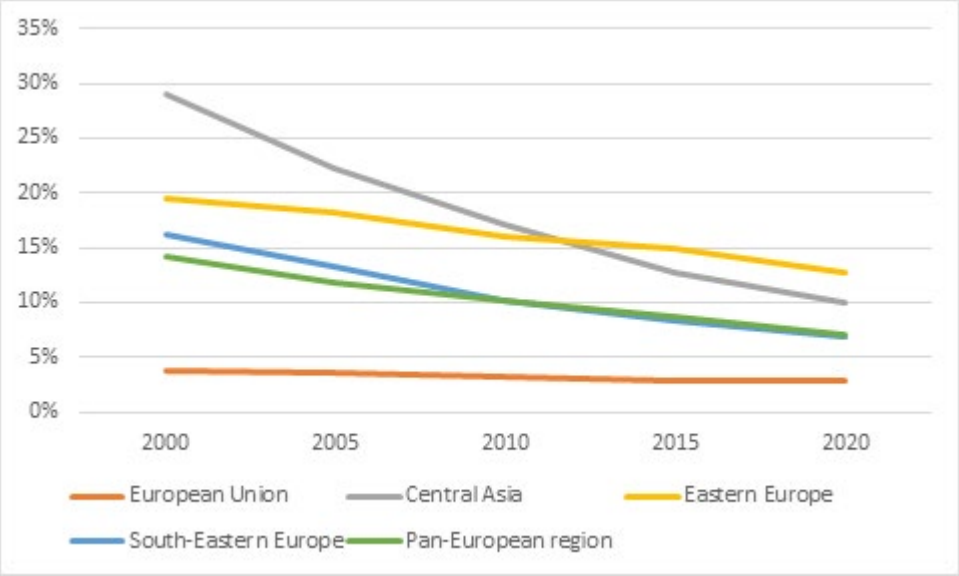
Source: Food and Agriculture Organization of the United Nations Statistics, Data – Land Use, available at www.fao.org/faostat/en/#data/RL.

[176] Cristian Andronic and others, *The challenge of land abandonment after 2020 and options for mitigating measures* (Brussels, European Parliament/Policy Department for Structural and Cohesion Policies, 2020), available at www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU%282020%29652238.

Prevalence of stunting among children aged under five years

198. The malnutrition rate among children aged under five years is an indicator of food security and safety. The indicator is especially important for monitoring progress in the quality of food diet in Eastern Europe and Central Asia. Figure XXIII overleaf demonstrates the impressive progress made this century. The post-Soviet countries can be classified into three broad categories in terms of food and nutrition security: (a) those primarily affected by undernutrition and micronutrient deficiencies (Kyrgyzstan, Tajikistan and Uzbekistan); (b) those facing the triple burden of malnutrition, characterized by residual undernutrition, persisting micronutrient deficiencies and increasing rates of obesity (Kazakhstan); and (c) countries primarily affected by overnutrition (Russian Federation).[177]

Figure XXIII
Prevalence of stunting among children aged under 5 years, per cent



Source: United Nations Children's Fund (UNICEF), World Health Organization and World Bank Joint Child Malnutrition Estimates Expanded Database: Stunting (Survey Estimates), April 2021, New York, Malnutrition in Children.

Notes: No data for Western Europe (non-European Union), the Russian Federation and Turkey. Within European Union, data for Belgium, Bulgaria, Czechia, Estonia, Germany, Greece, the Netherlands, Poland, Portugal and Romania.

5. Case studies

Portuguese *montado* and Spanish *dehesa*: surviving farming in a marginal environment

199. The Common Agricultural Policy supports marginal farming by providing for agro-environmental subsidies in the framework of its second pillar, on rural development. About 4 per cent of the European Union subsidies are directed to agriculturally Less Favourable Areas, which are supposed to have a high level of biodiversity.[178] Some experts challenge this policy, wishing to see subsidies for marginal land without connection to farming activities.[179] However, though few, some positive examples are available of where farming on marginal lands leads to both environmental and economic benefits. Two of the best

[177] Saule Burkitbayeva, Johan Swinnen and Nele Warrinnier, "Food and nutrition security in Eurasia: Evolution, shocks and policies", *Russian Journal of Economics*, vol. 6, No. 1 (March 2020), pp. 6–25.

[178] European Commission, *Rural development in the European Union: Statistical and Economic Information – Report 2013* (Luxembourg, Publications Office of the European Union, 2013).

[179] Thomas Merckx and Henrique M. Pereira, "Reshaping agri-environmental subsidies: From marginal farming to large-scale rewilding", *Basic and Applied Ecology,* vol. 16, No. 2 (March 2015), pp. 95–103.

examples come from the Portuguese *montado* and the Spanish *dehesa*. These agroforestry systems are dominated by cork oak and holm oak woodland, which produce cork as a forestry product and acorns for livestock breeding, respectively. In between trees, farmers seed pastures and cereals. The biodiversity of these systems is very high and they have retained many of the main characteristics of the original vegetation. Also, many of these farms are economically viable because of this multifunctionality and their large operational spatial scale.[180]

[180] T. Pinto-Correia, N. Ribeiro and P. Sá-Sousa, "Introducing the *montado*, the cork and holm oak agroforestry system of Southern Portugal", *Agroforestry Systems,* vol. 82, No. 2 (April 2011), pp. 99–104.

G. Chemicals and waste

1. Key messages and recommendations

Key messages

200. Chemicals and waste management is at the heart of many solutions to the current challenges faced as a part of the transition to a zero carbon and sustainable economy. In the region, capacities to make well-informed decisions on chemicals and waste issues are often either missing or expertise is not well integrated into decision-making processes. Government decision-makers, industry and the public do not have easy access to information and knowledge that will support the making of impact-oriented choices.

201. Chemicals play a vital role in the economy today and are essential in paving the way towards a green economy. However, it remains difficult to capture fully what is the exposure of humans to hazardous chemicals. No set of impact-oriented indicators is regularly monitored across the region. There is also a lack of information regarding the impact of chemicals on the efficiency and economic viability of circular economy schemes such as recycling.

202. While the waste management hierarchy assigns highest priority to waste prevention, waste generation continues to rise across the region. Even where a strong political commitment to a circular economy exists, such as in the European Union and other western European countries, the quantities of waste generated are growing.

203. A specific challenge is electrical and electronic equipment waste (e-waste), which contains both hazardous and precious components. Average e-waste generation is stabilizing in the region as a whole, but it continues to increase rapidly in the economically less mature subregions. E-waste collection and recycling are highly deficient across all subregions; the recovery rates are low. Thus, an important opportunity is being missed to harness economic value for the region and to reduce the region's dependency regarding the sourcing of critical raw materials, which are bottlenecks in the shift towards resilient future economies.

204. Recycling rates differ significantly among the countries and are particularly low in Eastern Europe and Central Asia. Municipal waste recycling rates above 45 per cent exist only in a few European Union countries and Switzerland. Progress is being achieved in all subregions, but slowly.

Recommendations

205. ECE member States should increase efforts to equip public administrations with a skilled work force, ready to engage with all sectors of society, and to increase broad access to reliable and detailed information, in order to achieve sound management of chemicals and waste. Governance of chemicals and waste must be made fitter for the challenges of today and the years of transition of economies that lie ahead by better balancing risks and opportunities.

206. Governments should strive to further advance full and coherent implementation of multilateral environmental agreements, including the Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. Administrations should make efforts to establish a region-wide, impact-oriented monitoring scheme, as a form of cooperation between science and policy, to build up a better picture of the adverse impacts of chemicals on human health and the environment, and to address them.

207. ECE and member States should work on establishing a mechanism across countries and sectors to identify and share benchmarks and good practices for resource efficiency in production processes. Sharing of knowledge will allow decision-makers at all levels to tap into the potential gain from using existing good practices.

208. The countries of the region should establish a resource-oriented, pan-European e-waste management partnership, which would aim at the effective collection and sound handling of recyclables to enable the recovery of valuable resources. An urgent priority is the

recovery of secondary resources from e-waste, especially in view of the rapidly growing quantities across Eastern Europe, South-Eastern Europe and Central Asia.

209. Governments should support waste prevention, repair, refurbishment and remanufacturing, including through financial incentives such as tax relief, in order to reduce waste. These waste prevention efforts would improve resource efficiency.

2. Context

210. Usage of chemicals and the occurrence of waste are tightly interwoven with standards of living and economic prosperity. An estimated 40,000 to 60,000 industrial chemicals are commercially traded worldwide[181] and used, for example, in agriculture, health care and the manufacturing of items such as electronics, textiles, furniture and toys. Chemicals also have a major role to play in the transition towards a green economy, since they represent building blocks of resource-efficient technologies and products.[182] However, some chemicals cause risks to the environment and human health. Chemicals released into air, water and soil can influence individual species, alter biodiversity and undermine the resilience of ecosystems. Harmful exposure to chemicals can negatively affect human health through a broad range of implications, including damage to immune, endocrine and reproductive systems, genetic effects and chronic diseases such as cancer, cardiovascular disorders and asthma.

211. The occurrence of large amounts of waste is linked to inefficient use of resources as part of unsustainable consumption and production practices in modern-day societies. Some waste has hazardous properties and its sound handling is an essential element in reducing chemical pollution. Other waste streams cause losses of materials and energy and aggravate pressures on the environment, for example, the introduction of microplastics into the food chains, affecting biodiversity and human health. At the same time, sound and value-oriented management of solid waste can substantially contribute to the mitigation of climate change by potentially displacing around 15 to 20 per cent of greenhouse gas emissions worldwide.[183]

212. The pan-European region faces the dual challenges of protecting the ecosystem services available to current and future human societies and decoupling environmental degradation from economic prosperity. To meet these challenges, the adoption of more sustainable consumption and production patterns, and the sound management of chemicals and waste, as parts of the transition to a green economy, are required. Risks and opportunities must be well understood and responded to with effective measures.

3. State, main trends and recent developments

213. In 2017, the global chemical industry's production capacity amounted to 2.3 billion tons, making the chemical industry the second-largest manufacturing industry in the world in terms of economic relevance.[184] The volume of traded chemicals is expected to significantly grow in the future;[185] the number of new chemicals is also rising.[186] Of the 345 million tons of chemicals consumed in the European Union in 2016, 62 per cent belonged to categories classified as hazardous to human health and 35 per cent were hazardous to the

[181] United Nations Environment Programme (UNEP), *Global Chemicals Outlook II: From legacies to innovative solutions – Implementing the 2030 Agenda for Sustainable Development* (n.p., 2019), available at www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions.

[182] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Chemicals Strategy for Sustainability Towards a Toxic-Free Environment, COM(2020) 667.

[183] UNEP and the International Solid Waste Association, *Global Waste Management Outlook* (n.p., 2015), available at www.unep.org/resources/report/global-waste-management-outlook.

[184] UNEP, *Global Chemicals Outlook II*.

[185] Ibid.

[186] Beate I. Escher, Heather M. Stapleton and Emma L. Schymanski, "Tracking complex mixtures of chemicals in our changing environment", *Science*, vol. 367, No. 6476 (January 2020), pp. 388–392.

environment.[187] The latest European Environment State and Outlook report identified as a specific issue of concern the potential combined effects of different chemicals.[188] The full extent of exposure to hazardous chemicals and the impacts on environmental and human health are difficult to capture because of the complexity of this field and the high number of different chemicals in use, and because no concise set of impact-oriented indicators is regularly monitored across the region. Methodologies for such risk assessments are still rather fragmented.[189] The knowledge base is reasonably broad although still fragmented for the European Union[190] but strongly deficient for other subregions.

214. A complex body of legislation addresses usage and handling of chemicals. The most stringent regulations exist in the European Union, with approximately 40 legislative instruments.[191] These include the European Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals,[192] which identifies the key characteristics of the listed chemicals. In October 2020, the European Union Chemicals Strategy for Sustainability – Towards a Toxic-free Environment was launched; it aims to phase out the most harmful substances from consumer products and to support financially the uptake of safe and sustainable chemicals.[193] For all countries, the Globally Harmonized System of Classification and Labelling of Chemicals has established standards for hazard classification, labelling and elaboration of material safety sheets since 2002; adoption was much slower than foreseen,[194] but the region is now on the right path.[195] Furthermore, the Strategic Approach to International Chemicals Management, hosted by UNEP, has advanced policy responses to issues of particular concern, including lead in paint,[196] and, together with the chemical manufacturing industry's Responsible Care initiative,[197] has contributed to capacity-building. The mandate of Strategic Approach to International Chemicals Management expired in 2020; designing the process for the period beyond 2020 represents an opportunity to further strengthen multilateral cooperation and advance frameworks that ensure that stakeholders

[187] European Environment Agency, "Consumption of hazardous chemicals", briefing, 26 November 2019, available at www.eea.europa.eu/airs/2018/environment-and-health/production-of-hazardous-chemicals.

[188] European Environment Agency, *The European environment — state and outlook 2020: Knowledge for transition to a sustainable Europe* (Luxembourg, Publications Office of the European Union, 2019), available at https://www.eea.europa.eu/soer/publications/soer-2020.

[189] S. Rotter and others, "Overview on legislation and scientific approaches for risk assessment of combined exposure to multiple chemicals: the potential EuroMix contribution", *Critical Reviews in Toxicology*, vol. 48, No. 9 (2018), pp. 796–814.

[190] Milieu Ltd, Ökopol, Risk and Policy Analysts and the National Institute for Public Health and the Environment of the Netherlands, *Study for the strategy for a non-toxic environment of the 7th Environment Action Programme: Final Report* (Luxembourg, Publications Office of the European Union, Luxembourg, 2017), available at https://op.europa.eu/en/publication-detail/-/publication/89fbbb74-969c-11e7-b92d-01aa75ed71a1.

[191] European Commission, Chemicals Strategy for Sustainability.

[192] Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, *Official Journal of the European Union*, L 396 (2006), pp. 1–849.

[193] European Commission, "Green Deal: Commission adopts new Chemicals Strategy towards a toxic-free environment", press release, 14 October 2020, available at https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1839.

[194] UNEP and ECE, *GEO-6: Global Environment Outlook: Regional assessment for the Pan-European Region* (Nairobi, 2016).

[195] ECE, "GHS implementation", available at https://unece.org/ghs-implementation-0.

[196] UNEP Strategic Approach to International Chemicals Management (SAICM), website, https://www.saicm.org/, accessed 2 September 2021.

[197] International Council of Chemical Associations, "Responsible Care", available at https://icca-chem.org/focus/responsible-care/.

have adequate data and knowledge at their disposal during their decision-making processes, and adequate capacities when it comes to the implementation of measures.[198]

215. Several multilateral environmental agreements regulate the processing of substances that are of high concern for human and environmental health. These instruments establish a powerful framework, but full benefits can only be unlocked if universal ratification is achieved across the region, which is currently not the case. Eight out of fifty-four countries of the pan-European region are not party to the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Only thirty-seven countries of the region are party to the Protocol on Pollutant Release and Transfer Registers.

216. Regarding waste management, strong differences continue to exist between Western Europe and the other subregions. As a common challenge, total waste generation has continued to increase in most countries, even though waste prevention is the top priority in the waste management hierarchy. National waste prevention programmes exist for European Union and European Free Trade Agreement countries – promoting reuse and repair activities is a frequent focus – but only a few programmes explicitly support market-driven reuse activities such as refurbishment or remanufacturing.[199]

217. The European Union waste regulations establish a fairly robust framework for the collection, valorisation or sound disposal of waste. Average European Union recycling rates of municipal solid waste have been continuously increasing over the last 10 years and, since March 2020, the new Circular Economy Action Plan is in place as part of the European Green Deal. Countries joining the European Union show pronounced progress on waste management, which illustrates the effectiveness of the bloc's regulations. Across Eastern Europe, South-Eastern Europe and Central Asia, valorisation of municipal solid waste has made some progress; however, overall, the recycling rates remain at relatively low levels and the change is slow. This signals that circular economy schemes are not yet effectively in place across these subregions. Some countries, however, have initiated ambitious reforms of waste management frameworks, including the specification of target municipal solid waste recycling rates (Russian Federation, Uzbekistan).

218. Rapidly rising volumes of e-waste across Central Asia, Eastern Europe and South-Eastern Europe are a specific challenge. In the European Union and Western Europe, e-waste quantities are stabilizing, but at a remarkably high level; per capita e-waste generation was more than twice the global average of 7.3 kg per capita in 2019 (see below). Of particular concern are the low shares of e-waste collection; collection is a prerequisite for valorisation. Even in the European Union, where advanced schemes are in place, less than 45 per cent of the estimated generated e-waste volume was collected in 2017.[200]

219. Circularity-oriented initiatives have also emerged in the region as an effort of civil society or the private sector. Repair initiatives, sharing approaches and remanufacturing schemes are only a few examples of new business models, community schemes and alternative production systems. They signal that all sectors of society have started to respond to the need for more sustainable resource usage and the prevention of wastes.

220. Implementation of a circular economy represents a major opportunity to ensure future prosperity in the region. One promising element to support sustainable consumption is the introduction of a right to repair. Urgent measures must also be taken to end premature obsolescence of products. Two circular economy schemes to reach an industrial scale are

[198] The Strategic Approach is expected to be revised in 2022.

[199] European Environment Agency (EEA), *Waste prevention in Europe — policies, status and trends in reuse in 2017*, EEA Report No. 4/2018 (Luxembourg, Publications Office of the European Union, 2018), available at https://circulareconomy.europa.eu/platform/sites/default/files/eea_report_waste_prevention_in_europe_2017_th-al-18-0008-en-n.pdf.

[200] Eurostat, Waste statistics – electrical and electronic equipment, data from August 2020, available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_electrical_and_electronic_equipment (accessed 29 May 2021).

remanufacturing and industrial symbiosis. Independent and transparent sustainability assessments are essential. International expert groups could help countries analyse their future needs for specific resources and how these can be met.

221. Greenwashing, by misleading consumers and exploiting their environmental concerns, can have severe detrimental impacts and is not acceptable. Countries that manage their transition well today will be the ones with a competitive advantage in a few decades.

4. Indicators

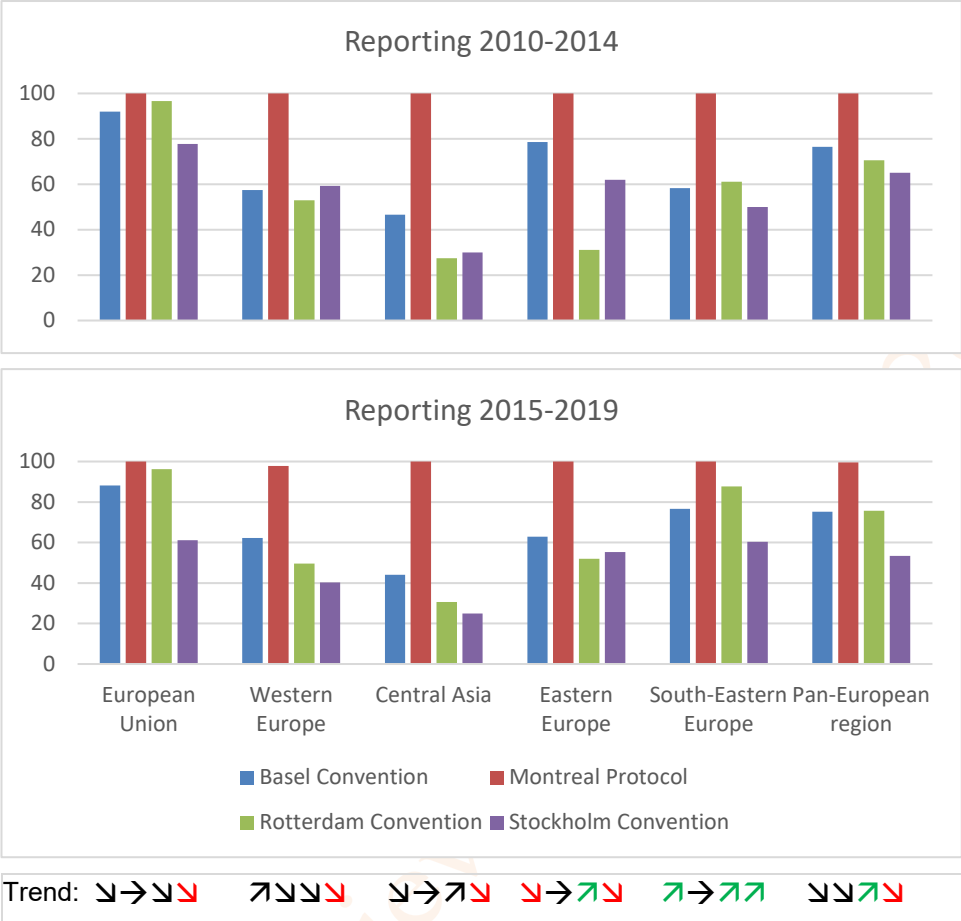
Compliance with multilateral environmental agreements on hazardous waste and other chemicals (indicator 12.4.1 of the Sustainable Development Goals)

222. This indicator identifies progress in managing chemicals and hazardous wastes in a sound way, as regulated by the Rotterdam Convention, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Stockholm Convention on Persistent Organic Pollutants and the Montreal Protocol on Substances that Deplete the Ozone Layer. The Minamata Convention on Mercury has recently been added, with 102 of the 114 Parties reporting by June 2021. Compliance in meeting reporting obligations as required by the multilateral environmental agreements is monitored in 5-year cycles (annual monitoring is not possible because the multilateral environmental agreements foresee differing time schedules to submit reports). While the region performs well regarding the Montreal Protocol, insufficient performance is recorded regarding the Stockholm Convention with all subregions, apart from South-Eastern Europe, performing worse than in the previous period and average compliance below 60 per cent (see figure XXIV below). For the Basel and the Rotterdam Conventions, average compliance in the region ranges between 70 and 80 per cent; the European Union and South-Eastern Europe perform better than the other subregions. There has been an improvement across South-Eastern Europe and, for the Rotterdam Convention, also across Eastern Europe.

223. All countries have room for improvement. Participation in multilateral environmental agreements enables Governments to co-shape international negotiations and policymaking in the environmental field and facilitates coordinated measures. Effective implementation of multilateral environmental agreements requires continued efforts and the allocation of sufficient financial resources to the responsible environmental institutions.

Figure XXIV

Compliance with waste and chemicals related multilateral environmental agreements in the reporting cycles 2010–2014 and 2015–2019, by subregion, per cent with trend also indicated



Source: Global Sustainable Development Goal Indicator Database, https://unstats.un.org/sdgs/indicators/database/, retrieved 18 May 2021.

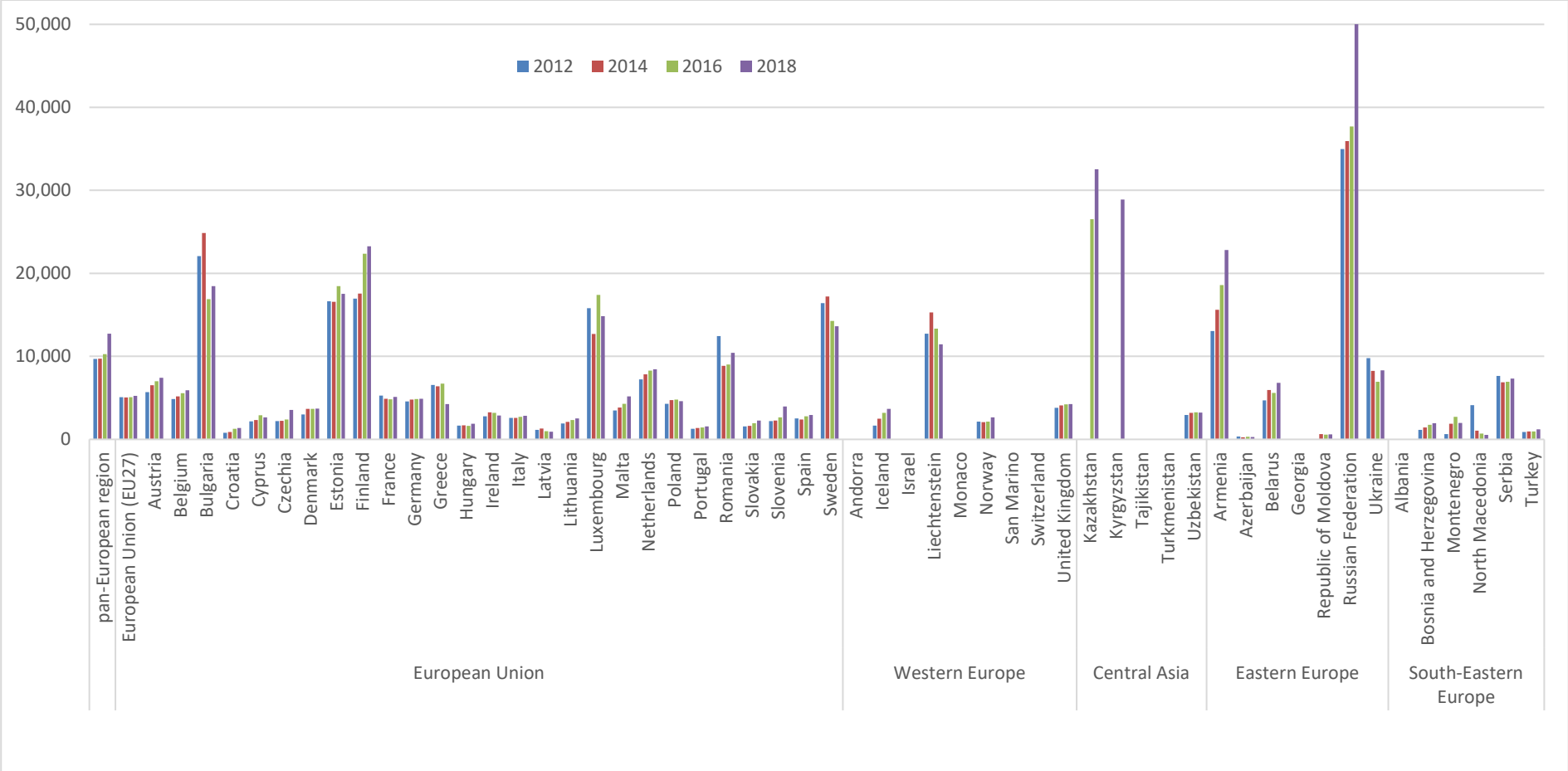
Notes: The trend is calculated as a percentage change between reporting periods 2010–2014 and 2015–2019, with an improvement shown as an upwards arrow and a worsening as a downwards arrow (horizontal arrow means no change). The arrow is shown in black unless the change is an improvement of at least 5 per cent (green) or a worsening of at least -5 per cent (red).

Total waste generation per capita

224. This indicator describes the quantity of total waste (hazardous and non-hazardous) produced in a country per year, by all sectors. Waste generation is an ECE environmental indicator; good progress was reported in the Shared Environmental Information System assessments (ECE/CEP/AC.10/2021/6) and thus it represents a robust indicator. Average waste generation per capita increased in the region by 31 per cent between 2012 and 2018 (see figure XXV overleaf), and by 7 per cent when excluding major mineral wastes. Most countries have witnessed growth of waste occurrence. Large variations exist between countries; some of this difference can be explained by specific economic sectors being dominant in certain countries. As an example, in Estonia, much of the waste comes from the oil shale industry, a unique situation in the region. Mining waste largely explains the high quantities across Eastern Europe and Central Asia. Although progress has been made regarding the reporting of relevant data, it is not possible to derive waste quantities excluding major mineral wastes for all countries.

Figure XXV

Total waste generation per capita, by subregion, kg per capita and year, with trends



Trends:	Increase in average waste generation; 21 out of 27 countries with an increase in period 2016–2018	Mixed picture	Increase in nearly all countries in period 2016–2018	Mixed picture

Sources: national statistics; for the European Union, Iceland, Liechtenstein, Norway, the United Kingdom of Great Britain and Northern Ireland, and South-Eastern Europe except Albania: Eurostat data, retrieved 20 May 2021; other countries: national data published by country statistical entities, retrieved May–July 2021.

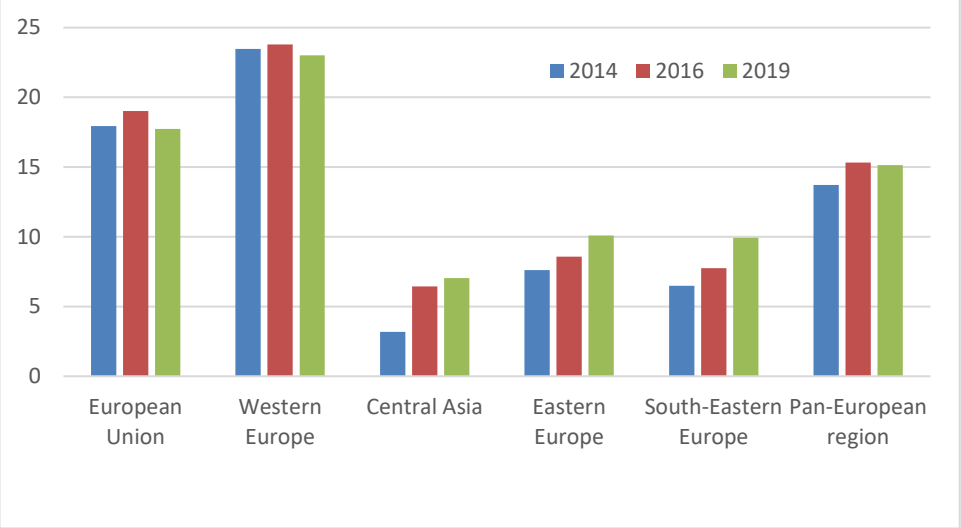
Notes: No data for Andorra, Georgia, Israel, Monaco, San Marino, Switzerland, Tajikistan and Turkmenistan. 2019 value instead of 2018 for Uzbekistan; 2017 value instead of 2016 for the Republic of Moldova. Limited data for the Republic of Moldova, Kazakhstan and Kyrgyzstan. Average value for pan-European region is calculated based on the available country data in each year (weighted average by considering population in each country and year).

225. Despite the commitments of countries to foster waste prevention, overall, waste generation is growing across the pan-European region and all subregions. More efforts are required. Benchmarks are needed to assess the waste quantities that can be prevented in different sectors. To foster waste prevention, economic instruments, such as landfill taxes, deposit-refund systems, tax reductions or other fiscal incentives for innovative businesses and extended producer responsibility, should be explored urgently.

E-waste generation per capita

226. E-waste contains both hazardous components and precious resources such as critical raw materials. For the pan-European region, the average annual e-waste generation per capita is plateauing at around 15 kg, with differing trends in the subregions (see figure XXVI below). This is mainly due to a stabilized or slightly declining quantity in the European Union and in Western Europe, while it continues to grow at a rapid pace across Central Asia, Eastern Europe and South-Eastern Europe. The level of e-waste generation in the region is much above the global average,[201] but countries in Western Europe on average generate more than three times the per capita volumes in Central Asia. Separate collection is a prerequisite for high-value valorisation of this material stream. However, even across the European Union and Western Europe, where collection and recycling infrastructures are in place, significant quantities of e-waste do not enter the official collection and valorisation schemes.[202]

Figure XXVI
Domestic e-waste generation per capita in the region and the subregions, kg per capita, with trends



Trends:	Stabilizing but at a very high level	Below average but rapidly increasing	Stabilizing

Sources: *Global E-Waste Monitor*, 2014, 2017 and 2020 editions.

Notes: 48–50 countries; no data for Andorra, Liechtenstein, Monaco or San Marino in all years, and no data for Tajikistan and Uzbekistan in 2016 and 2019.

[201] At a global level, e-waste generation per capita increased from 5.8 kg in 2014 to 7.3 kg in 2019, according to Cornelis Peter Baldé and others, *The Global E-waste Monitor 2014: Quantities, flows and resources* (Bonn, United Nations University (UNU), 2015); and Vanessa Forti and others, *The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential* (Bonn, Geneva and Rotterdam, UNU/United Nations Institute for Training and Research/International Telecommunication Union (ITU)/International Solid Waste Association (ISWA), 2020).

[202] Cornelis Peter Baldé and others, *The Global E-waste Monitor 2017: Quantities, flows and resources* (Bonn, Geneva and Vienna, UNU/ITU/ISWA, 2017); and Forti and others, *The Global E-waste Monitor 2020*.

Recycling rate of municipal solid waste

227. There are significant differences in municipal solid waste recycling between the subregions (see figure XXVII overleaf), but all subregions have made some progress. Some countries of the European Union, such as Austria, Germany, the Netherlands and Slovenia, have the highest recycling rates in the world. The average European Union recycling rate has increased from 37.3 per cent in 2009 to 47.7 per cent in 2019. Five European Union countries still have municipal solid waste recycling rates below 25 per cent. Croatia, Latvia, Lithuania, Slovakia and Slovenia, which joined the bloc around 15 years ago, present the most pronounced improvement. Across Eastern Europe, South-Eastern Europe and Central Asia, no country has a municipal solid waste recycling rate of above 25 per cent and rates tend to be substantially lower than 25 per cent or even negligible. A few positive cases stand out, such as Uzbekistan, where the municipal solid waste recycling rate is currently around 20 per cent (see case study below). Overall, the region is advancing to more recycling and thus to a more circular economy, but progress is slow. To accelerate the transition, a strong commitment by policymakers is required, along with an adequate allocation of financial resources and the readiness to learn from successful schemes.

5. Case studies

Reforming the waste management framework in Uzbekistan

228. Uzbekistan has initiated ambitious reforms of its environmental frameworks, including new institutional arrangements for waste management since 2017 and the launch of a strategy on municipal waste management for the period 2019–2028.[203] Coverage of the population by waste services increased from 22 per cent in 2016 to 53 per cent in 2018.[204] The national target is to reach 100 per cent of the population covered by waste collection services by 2025; furthermore, the strategy aims to achieve 45 per cent municipal solid waste recycling by 2025 and 60 per cent by 2028. The country is on the right path; the municipal solid waste recycling rate in 2019 was close to 20 per cent, up from 9 per cent in 2017.

Chemicals in plastics

229. Recent research identified more than 6,000 different additives in plastic products.[205] Only some are polymerized within the plastic matrix, while many can leach and potentially have an impact on the environment and humans.[206,207] When plastics are recycled, individual chemicals or cocktails of substances can unintentionally be transferred to the new products as contaminants, which creates new risks in the value chains. Such cross-contamination has been identified in, for example, children's toys and food contact articles.[208]

[203] UNEP, *Waste Management Outlook for Central Asia* (n.p., 2017).

[204] *Environmental Performance Reviews: Uzbekistan – Third Review* (United Nations publication, Sales No. E.20.II.E.26).

[205] Nicolò Aurisano, Roland Weber and Peter Fantke, "Enabling a circular economy for chemicals in plastics", *Current Opinion in Green and Sustainable Chemistry*, vol. 31, special issue (October 2021).

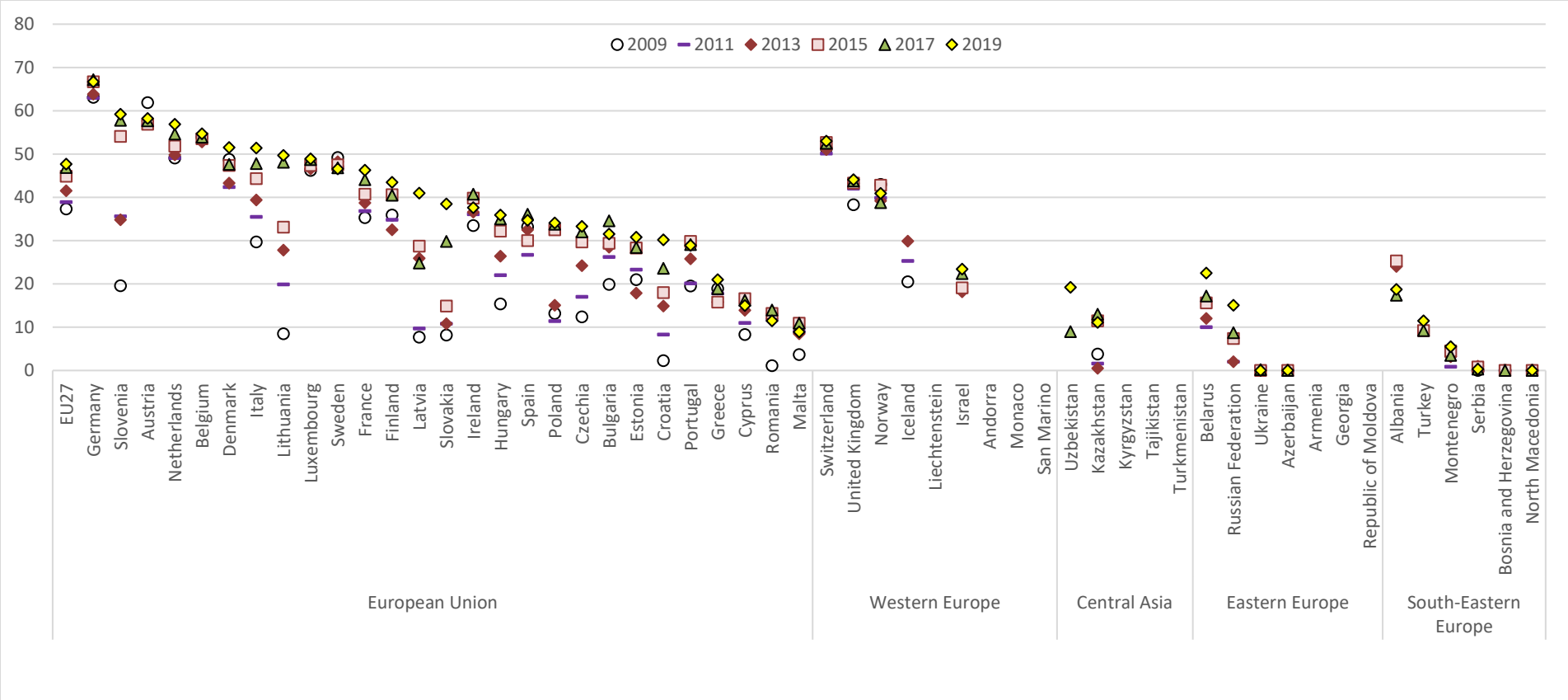
[206] John N. Hahladakis, "An overview of chemical additives present in plastics: migration, release, fate and environmental impact during their use, disposal and recycling", *Journal of Hazardous Materials*, vol. 344 (February 2018), pp. 179–199.

[207] Lisa Zimmermann and others, Benchmarking the in vitro toxicity and chemical composition of plastic consumer products, *Environmental Science and Technology*, vol. 53 (2019), pp. 11467–11477.

[208] Antonella Guzzonato, Franky Puype and S.J. Harrad, "Evidence of bad recycling practices: BFRs in children's toys and food-contact articles", *Environmental Science: Processes and Impacts*, vol. 19, No. 7 (June 2017), pp. 956–963; and Alin C. Ionas and others, "Downsides of the recycling process: harmful organic chemicals in children's toys", *Environment International*, vol. 65 (April 2014), pp. 54–62.

Figure XXVII

Recycling rate of municipal solid waste, including composting and anaerobic digestion, by subregion, per cent (biennially 2009–2019), with trends,



Status and trends	Average over 45 per cent, with 7 countries over 50 per cent and up to 67 per cent; increasing average, with good improvement in most countries and strong improvement in some countries; 5 countries still below 25 per cent	Mixed picture; only 1 country over 45 per cent	Mixed picture; some countries good progress; all below 25 per cent; for some no data available	Slow change; all countries still below 25 per cent

Sources: National statistics; for the European Union, Iceland, Liechtenstein, Norway, Switzerland, the United Kingdom of Great Britain and Northern Ireland and South-Eastern Europe except Albania: Eurostat data, retrieved 27 May 2021; other countries: data published by country statistical entities, retrieved May–July 2021.

Notes: 2018 instead of 2019 data for Bulgaria, Montenegro, Serbia, the United Kingdom of Great Britain and Northern Ireland; for Ireland 2012 instead of 2013, 2014 instead of 2015, 2016 instead of 2017, 2018 instead of 2019 data; for Israel 2014 instead of 2013; for Belarus 2012 instead of 2011; for the Russian Federation and Turkey 2016 instead of 2015; Albania: urban waste only.

H. Environmental financing

1. Key messages and recommendations

Key messages

230. Despite their negative impacts on the environment, all countries continue to implement fossil fuel subsidies to varying degrees. International Monetary Fund (IMF) projections suggest that these subsidies will remain in place at least until 2025, with implicit subsidies increasing until that time.

231. Environmental tax revenues increased in all pan-European region countries between 2000 and 2019. In 2019, European Union environmental tax revenue amounted to €330.6 billion, an increase of 52 per cent in nominal terms since 2002.

232. In all countries across the pan-European region for which data is available, government expenditures on environmental protection have increased since 2000, closely following gross domestic product (GDP) growth.

233. Over the last five years, there has been an increase in the use of green bonds as a tool for financing environmentally friendly projects. These bonds have been used both by the private sector and by sovereign Governments. Across the pan-European region, European Union countries are leaders in the use of green bonds – in particular France, Germany and the Netherlands. However, since 2019, countries from other regions have also started using such instruments, for example, Georgia, Kazakhstan, the Russian Federation and Turkey.

234. There is a severe lack of quantitative data for countries of Central Asia and South-Eastern Europe. This hinders attempts to evaluate progress in environmental protection and environmental financing. The lack of reliable data also implies that investment and operational costs of meeting environmental objectives cannot be calculated in a robust way and used in policy development.

Recommendations

235. National environmental policies across the pan-European region should aim at abolishing harmful subsidies and transitioning towards greener energy sources quickly.

236. Environmental taxes are one of the most efficient tools for providing economic agents with incentives to decrease different kinds of pollution and protect the environment. Compared to green subsidies, which provide the same incentives, they have the added advantage of allowing Governments to raise revenues, which can be used to decrease distortionary taxes within economies and/or finance public environmental protection expenditures. It is recommended that countries strengthen the use of these instruments or of equivalent ones, for example, cap-and-trade schemes.

237. The future of government spending on environmental protection should be considered in the wider context of environmental and public finance. Subsidies always distort markets and increase public sector spending. Therefore, the need for environmental subsidized finance is to be periodically reconsidered in the light of the "polluter pays" principle. Furthermore, to help target subsidies better – so that the funds can bring a genuine value added where and when necessary – it is important that impact assessment analysis of such funding be performed regularly.

238. Pan-European region Governments should favour the development of green finance, and green bonds markets, in particular, through a series of policies including demonstration issuance, dissemination of clear guidelines for green bonds issuance, and implementation of favourable regulatory policies.

239. There is an urgent need to improve data-collection systems in Central Asia and South-Eastern Europe, in line with internationally recognized standards, such as those of OECD and Eurostat. For example, data on environmental expenditures have to be collected according to internationally acknowledged methodologies and classifications. In particular,

it is important to clarify and report which entities spend money on the environment, how much, with what objectives and who finances these expenditures.

2. Context

240. To meet the Paris Agreement goals and protect the environment – while ensuring an adequate quality of life for their citizens – countries need major environmental and energy transitions. At the global level, OECD estimates that $95 trillion in public and private investments will be necessary in energy, transport, water and telecommunications infrastructure between 2016 and 2030, so as to support growth and sustainable development – [209] that is around $6.3 trillion per year. According to the same source, an additional $0.6 trillion a year would also be necessary to make these investments climate compatible – a small additional cost compared to the expected benefits. The European Union Green Deal plans to invest a total of €1trillion until 2030, or around €125 billion a year.[210]

241. Governments have a responsibility in leading the way for these necessary transitions, by implementing policies that align private interests with the common good. Public spending alone will not suffice. Well-designed environmental, fiscal and investment policies are therefore important to maximize the impact of public spending and leverage private investment.

242. The pan-European region encompasses countries that vary considerably in terms of political, economic and social context. However, environmental protection and climate change mitigation need to be objectives shared by all countries. In particular, getting fundamental environmental protection policies right is essential to aligning incentives across the region. There is also an urgent need to accelerate reform of inefficient fossil fuel subsidies and broaden the carbon pricing base, while focusing on tracking the impact of implemented policies and sharing policy experiences.

3. State, main trends and recent developments

243. At the global level, environmental protection and climate change mitigation goals are far from met; a recent UNEP report entitled *Measuring Progress: Environment and the SDGs*[211] shows that several indicators continue to experience negative trends.[212] The pan-European region is no exception. For example, despite the European Union being a leading region on environmental issues, the key objectives of its Seventh Environment Action Programme are, for the moment, out of reach.[213] At the national level, environmental goals are often not achieved: for instance, even in environmental forerunner Sweden, 15 of the 16 national environmental quality objectives set by parliament to be achieved by 2030 have not been met so far.[214]

---

[209] Organisation for Economic Co-operation and Development (OECD), *Investing in Climate, Investing in Growth* (n.p., 2017).

[210] For additional details, see https://europa.eu/investeu/contribution-green-deal-and-just-transition-scheme_en.

[211] Nairobi, 2021.

[212] This concerns, among other things, increased water stress levels and a decrease in local water management (6.4.2 and 6.5.1), an increase in the consumption of domestic material products and increased material footprint (12.2.1 and 12.2.2), consumption and production patterns with an increase in hazardous waste generated per capita (8.4.1/8.4.2 and 12.4.2), oceans with a decrease in sustainable levels of fish stocks (14.4.1), and land and biodiversity, with a decrease in the proportion of total forest area and in the Red List Index (15.1.1 and 15.5.1).

[213] European Environment Agency (EEA), "Achieving EU's key 2020 environmental objectives slipping away", 29 November 2018. Available at www.eea.europa.eu/highlights/achieving-eus-key-environmental-objectives#:~:text=According%20to%20the%20European%20Environment,protecting%20biodiversity%20and%20natural%20capital.

[214] Sveriges Miljömål, "Många insatser behövs för miljömålen", 31 March 2021, available at https://sverigesmiljomal.se/sa-fungerar-arbetet-med-sveriges-miljomal/uppfoljning-av-miljomalen/arlig-uppfoljning-2021/ (Swedish only).

244. These observations highlight the need for countries within the pan-European region to further reinforce their environmental policies and step up investments for environmental protection and climate change mitigation. Environmental financing tools need to be used to their full extent.

245. In line with these objectives, public expenditures for environmental protection and environmental tax revenues have increased across the region since the early 2000s. Similarly, green finance and green bonds are picking up, led by the European Union zone. However, fossil fuel subsidies are still in place and projections are that they will remain so until at least 2025.[215]

4. Indicators

Environmental tax revenue

246. The environmental tax revenue used in this assessment (from the IMF Climate Change Indicators Dashboard and the Eurostat database) is to be considered as a lower bound estimate, as it does not include environmental fees and charges; it does, however, include energy, transport and pollution taxes.

247. In the European Union, on average, environmental tax revenues have remained at around 2.5–3 per cent of GDP since 2000. Individual situations within the region are nevertheless more contrasted. For instance, since 2015, environmental tax revenues have represented over 4 percent of GDP in Croatia, while amounts levied by Germany, Ireland and Luxembourg are slightly below 2 per cent of those countries' respective GDPs.

248. In Western Europe,[216] on average, environmental tax revenues represented 2.5–3 per cent of GDP during the 2000–2007 period, subsequently stabilizing at around 2 per cent of GDP. Looking in more detail at the total amounts of revenue levied, Iceland, Norway and the United Kingdom of Great Britain and Northern Ireland all experienced a sharp decline in revenues in the 2007–2008 period, most certainly due to the financial crisis. Data for Switzerland are only available from 2008 and show environmental tax revenues representing around 1.4 per cent of its GDP since that year.

249. Serbia and Turkey are the two other countries for which data on environmental tax revenues are available for most of the period 2000–2019. For Turkey, environmental tax revenues increased sharply between 2000 and 2003, rising from 2.4 per cent to around 4 per cent of GDP. They then stabilized at around 3.5 per cent of GDP, before declining to around 2.3 per cent of GDP in 2018 and 2.2 per cent of GDP 2019 (i.e. to around €15.5 million for both years). Serbia, on the other hand, has continuously increased the amount of environmental taxes levied. In the 2005–2018 period, the amount rose from €631 million to €1,791 million, i.e. a 184 per cent increase (see figure XXVIII below). In these two countries, environmental tax revenues represent a higher share of GDP compared to countries of both the European Union and Western Europe.

250. As mentioned in the key messages above, there is a lack of data for most countries outside Western Europe.

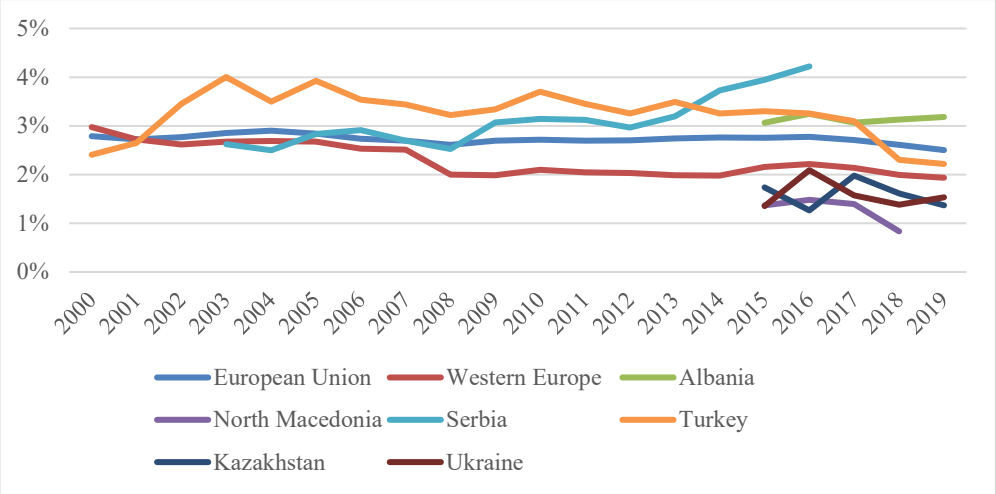
251. When looking at environmental tax revenues per inhabitant (see figure XXIX below), the Netherlands collects the highest amount, with almost $2,000 in environmental tax revenues per capita, while Kazakhstan collects the smallest, with a little less than $210 per capita. Environmental tax revenues tend to be correlated to GDP per capita, but not perfectly. For example, in 2019, Slovenia and Estonia levied quite a significant amount of

[215] International Monetary Fund (IMF) Climate Change Dashboard, "Government Policy Indicators", available at https://climatedata.imf.org/pages/go-indicators (accessed on 27 January 2022).

[216] Environmental tax revenue data are only available for Iceland, Israel (since 2015), Norway, Switzerland and the United Kingdom of Great Britain and Northern Ireland.

environmental taxes per inhabitant ($1,311 and $1,285, respectively) compared to their GDP per capita ($27,421 and $20,835, respectively).[217]

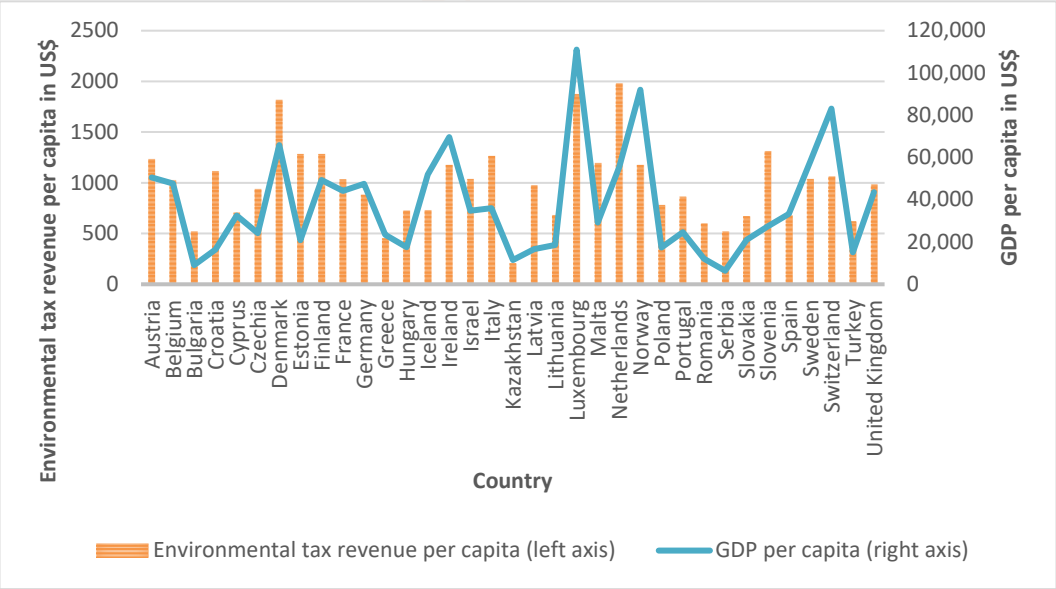
Figure XXVIII
Environmental tax revenues as a percentage of gross domestic product (2000–2019)



Source: IMF Climate Change Dashboard, Indicators.

Note: Values for European Union and Western Europe are simple unweighted averages across the countries.

Figure XXIX
Environmental tax revenue and gross domestic product per capita, thousands of United States dollar (2019)



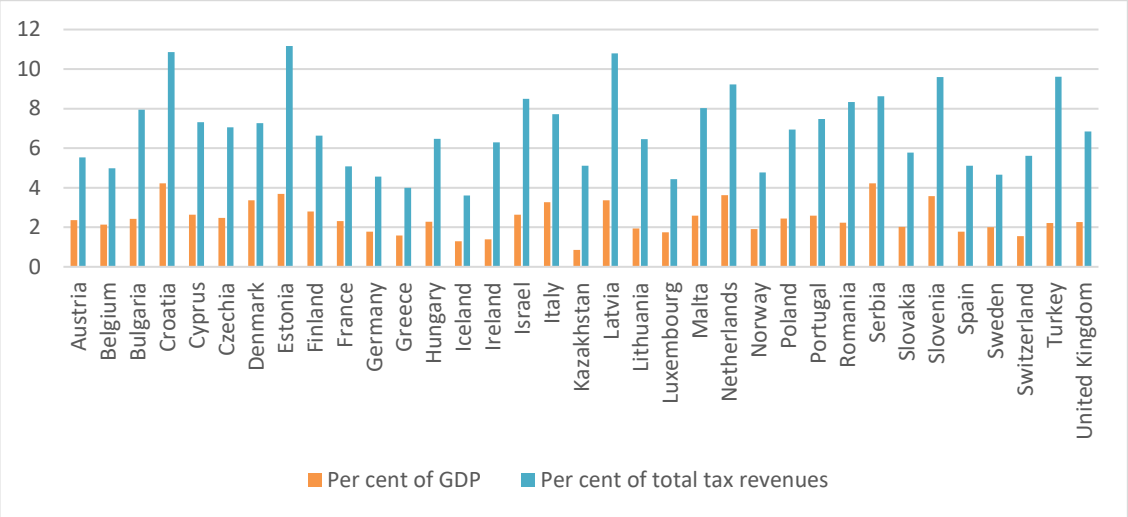
Sources: "Compare your country: Environmentally related tax revenue, Overview, Per capita, United States dollars, 2019"; and The World Bank, DataBank, available at https://databank.worldbank.org/source/sustainable-development-goals(sdgs)/Series/NY.GDP.PCAP.KD.

Note: 2019 GDP per capita in constant 2010 United States dollars. Tax revenue data for Israel and Kazakhstan are from 2018 and for Serbia from 2016.

[217] For comparison, in 2019, Greece had a GDP per capita of $23,503 and collected $454.27 of environmental taxes per inhabitant. Slovakia had a GDP per capita of $21,003 and environmental tax revenues per inhabitant of $669.91.

252. Another relevant way of looking at environmental taxes is to compare how much their revenue represents, not only compared to a given country's GDP, but also to the total tax revenue levied. In figure XXX below, constructed using OECD data,[218] it appears that environmental tax revenues represent a fairly high share of total tax revenues (i.e. around 11 per cent) in Croatia, Estonia and Latvia. Unfortunately, data are not available for many Central Asian and Eastern European countries.

Figure XXX
Environmental tax revenue as proportion of gross domestic product and of total tax revenue per cent (2019)



Source: OECD, "Compare your country: Environmentally related tax revenue, Overview, Per capita, United States dollars, 2019".

Notes: Tax revenue data for Israel and Kazakhstan are from 2018 and for Serbia from 2016.

Government expenditures on environmental protection

253. Environmental protection public expenditures include government spending on biodiversity and landscape protection, environmental protection research and development, pollution abatement, as well as on waste and wastewater management.

254. This measure represents the minimum amount spent yearly within the different countries, as only public expenditures are accounted for. Hence, total environmental protection expenditures within each country are likely larger, as the private sector also contributes to environmental protection. As a matter of fact, in the European Union, for example, in 2019, Governments spent €60.5 billion on environmental protection expenditures, while corporations spent almost €149 billion (i.e. more than double the amount spent by Governments), and households spent around €56 billion.[219] However, data on total (i.e. public and private) environmental protection expenditures are, unfortunately, not available for most of the countries outside the European Union and Western Europe.

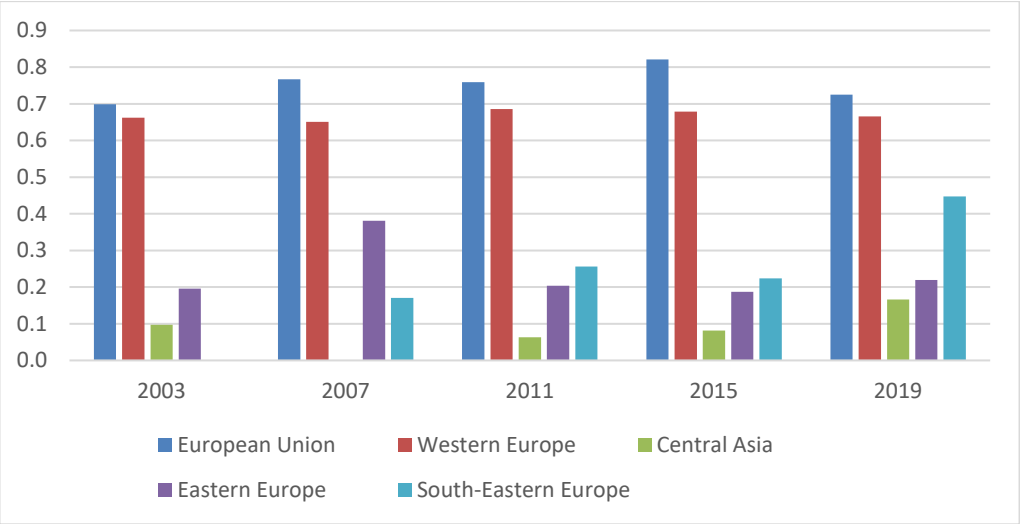
255. European Union countries spend, on average, an amount equivalent to 0.8 per cent of their GDP on public environmental protection. This is the highest fraction within the pan-European region, followed by Western Europe countries. For all other countries, government environmental protection represents a lower share of their GDP (see figure XXXI below).[220]

[218] OECD, "Compare your country: Environmentally related tax revenue, Overview, Per capita, United States dollars, 2019". Available at www.compareyourcountry.org/environmental-taxes/en/0/182/default (accessed on 27 January 2022).

[219] Eurostat, Data Brower, available at https://ec.europa.eu/eurostat/databrowser/view/ENV_AC_EPNEIS__custom_1428687/default/table?lang=en (accessed on 27 January 2022).

[220] IMF Climate Change Indicators Dashboard.

Figure XXXI
Government environmental protection expenditures, as percentage of GDP (2003–2019)



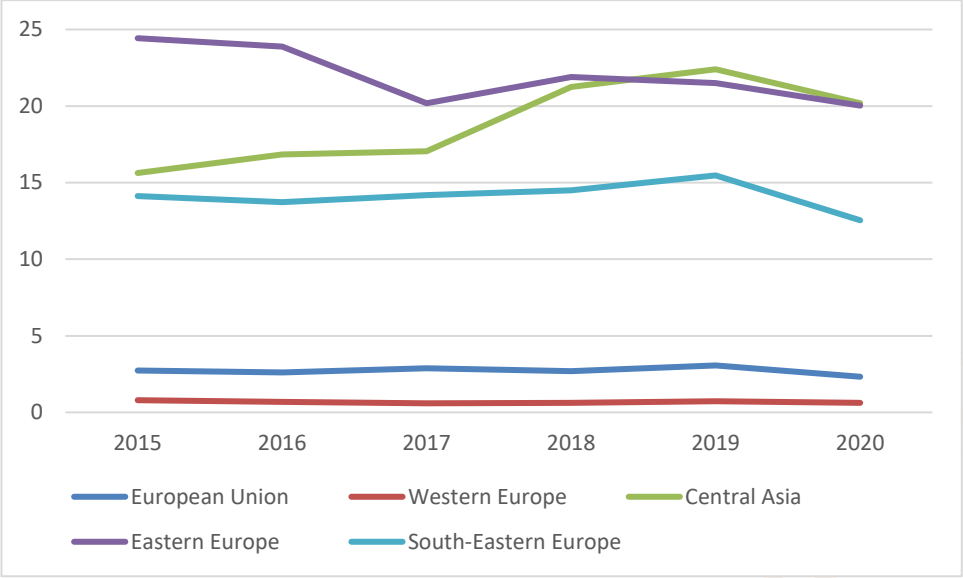
Source: IMF Climate Change Dashboard, Indicators, available at https://climatedata.imf.org/pages/go-indicators.

Notes: Values are simple unweighted averages across the countries. No data for Central Asia in 2007 or for South-Eastern Europe in 2003. No data for Andorra, Bosnia and Herzegovina, Liechtenstein, Monaco, Montenegro, San Marino, Tajikistan or Turkmenistan, nor for Albania (2003), Armenia or North Macedonia (2003, 2007, 2011, 2015), Azerbaijan or Turkey (2003, 2007), Kyrgyzstan (2003, 2011), the Russian Federation (2007), Serbia (2003, 2015) or Uzbekistan (2003).

Fossil fuel (implicit and explicit) subsidies

256. All countries across the pan-European region subsidize fossil fuels (see figures XXXII and XXXIII below), except for San Marino. Also, data are not available for Andorra, Liechtenstein and Monaco. This indicator is the estimated value of explicit and implicit government subsidies related to fossil fuels (i.e. coal, natural gas and oil). Explicit subsidies reflect under-pricing due to supply costs being greater than prices paid by users. Implicit subsidies reflect the difference between supply costs and socially efficient prices (incorporating the cost of negative externalities of fossil fuel use and foregone consumption tax revenues), exclusive of any explicit subsidy. Hence, together these subsidies show the impact of government policy decisions on fossil fuel prices paid by consumers compared to an unsubsidized price that accounts for climate change and other externalities.

Figure XXXII
Fossil fuel subsidies as percentage of gross domestic product (2015–2020)

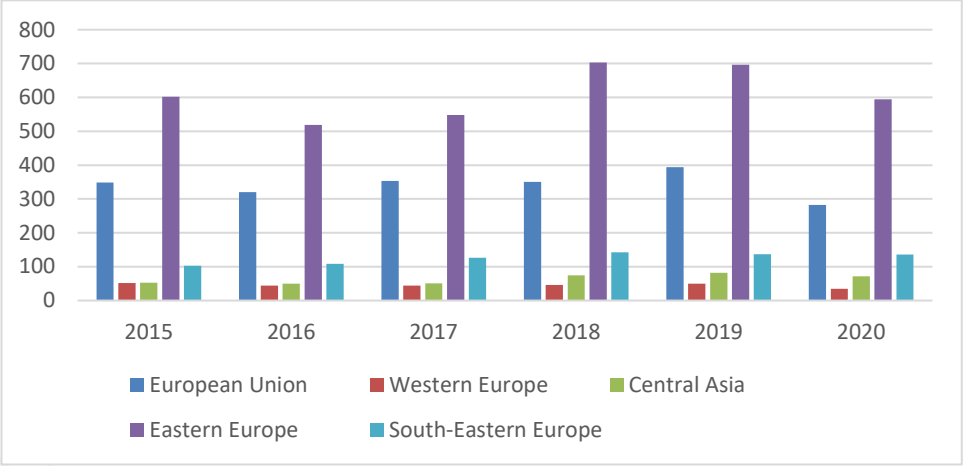


Source: Data from IMF Climate Change Dashboards, Indicators (https://climatedata.imf.org/pages/go-indicators)

Notes: Values are simple unweighted averages across the countries. No data for Andorra, Liechtenstein or Monaco.

Figure XXXIII
Total fossil fuel subsidies (2015–2020)

(Billions of United States dollars)



Source: Data from IMF Climate Change Dashboard, Indicators.

Note: No data for Andorra, Liechtenstein or Monaco.

257. Countries of Eastern Europe subsidize fossil fuels at higher rates than countries of the other regions. This result is mainly driven by the important subsidies implemented by the Russian Federation, which represented more than €520 billion in 2019, i.e. around 35 per cent of the country's GDP.

258. High levels of fossil fuel subsidies can mainly be explained by two factors. First, countries whose economies partially depend on fossil fuel production have economic incentives to subsidize them. For example, the three countries with the highest shares of fossil fuel rents in 2019, according to the World Bank, namely Azerbaijan (25 per cent of GDP), Kazakhstan (29 per cent of GDP) and the Russian Federation (35 per cent of GDP), are also amongst the countries subsidizing fossil fuels to a significant extent relative to their GDP – respectively, 33.4 per cent, 29.4 per cent and 35.2 per cent. Second, explicit fossil fuel

subsidies tend to be implemented as poverty alleviation measures to decrease the burden of transport and energy costs for poorer households and are, therefore, more common in poorer economies. This mechanism also seems to be at play in the sample used in the present report. Table 8 below shows the 10 countries with the lowest 2019 GDP per capita; they all implement fossil fuel subsidies that amount to more than 10 per cent of their respective GDP (with the exception of Albania and the Republic of Moldova, where subsidies represent around 2 per cent and 9 per cent of GDP, respectively).

Table 8
Fossil fuel subsidies and gross domestic product per capita, in order of increasing per capita gross domestic product (2019)

Country	*Total fossil fuel subsidies (implicit and explicit) (as per cent of GDP)*	*Explicit fossil fuel subsidies (as per cent of GDP)*	*GDP per capita (US dollars)*
Kyrgyzstan	22	6.5	1 117.5
Tajikistan	16.2	8	1 123.2
Uzbekistan	22.2	3.7	2 464.5
Ukraine	31.9	4.9	3 224.6
Republic of Moldova	9	4.4	3 712.4
Armenia	10.4	5.4	4 732.1
Georgia	12.6	4.1	4 977.5
Albania	1.9	0	5 207.3
North Macedonia	14	1.2	5 625.7
Azerbaijan	33.4	5.7	5 895.2

Sources: Data on GDP per capita provided by the World Bank. Data pertaining to estimated fossil fuel subsidies provided by IMF.

Capital levied through green bonds

259. Green bonds were created to fund projects that have environmental and/or climate benefits and can be issued by sovereign Governments, regional and local government entities, as well as by private sector actors. Proceeds from these bonds are earmarked for green projects but are backed by the issuer's entire balance sheet. The green bond market has seen exponential growth since its creation around 2007 (see figure XXXIV below for data on value of green bonds 2014–2021). In December 2020, it reached the symbolic threshold of $1 trillion in cumulative issuance.

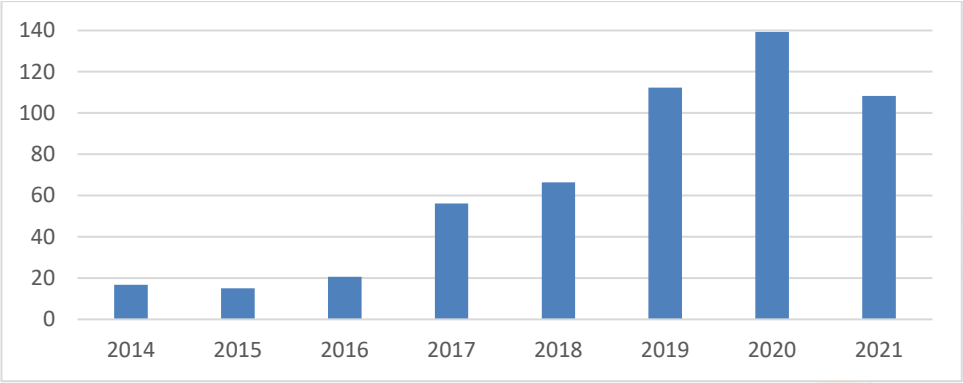
260. Certified green bonds have been shown to effectively contribute to greenhouse gas emissions reduction in the private sector.[221] While additional research is needed on how such bonds could be used by Governments, it is important to keep track of the development of green finance in general, and green bonds in particular should be tracked. Indeed, the presence of green and climate finance might have an impact on the optimal level of more traditional policy instruments such as carbon taxes.

261. The European Union countries are leaders in the green bond market.

[221] Caroline Flammer, "Corporate green bonds", *Journal of Financial Economics*, vol. 142, No. 2 (November 2021), pp. 499–516.

Figure XXXIV
Value of green euro bonds (2014–2021)

(Billions of United States dollars)



Source: Data extracted from Climate Bonds Initiative, available at www.climatebonds.net/market/data/.

5. Case studies

Croatia

262. Croatia's environmental policy has been strongly shaped by European Union accession in 2013; While some indicators show the country has made significant efforts towards environmental protection and green growth, there is still room for improvement. In particular, Croatia can decrease the existing diesel differential and increase its fund absorption capacity.

263. One of the institutions that plays a key role in environmental financing is the Environmental Protection and Energy Efficiency Fund (EPEEF). EPEEF is the central point for collecting environmental fees and charges and managing programs and projects promoting environmental protection, energy efficiency and the use of renewable energy sources. Funds for such projects come from foreign funds, international organizations, financial institutions and bodies, as well as national and foreign entities. In particular, as a part of the European Union, Croatia has been allocated a total of € 10.7 billion from European Structural and Investment Funds for 2014–2020. The country also benefited from € 8.6 billion (current prices) in total cohesion policy funding for the period 2014–2020. Part of these funds are earmarked for environmental protection and energy efficiency.

264. Regarding the use of European Union funds, however, a recent report by the SGI Network [222] points to difficulties in funds absorption. Following the National Strategic Reference Framework, which guides the use of European Structural and Cohesion Fund money, Croatia is required to spend almost € 10 billion on waste management, water management and air protection—the three most important environmental issues in the European Union accession negotiations—by 2023. Nevertheless, the SGI network highlights difficulties in policy implementation, largely due to an incoherent Public Procurement Law. The uncertainty caused by the law's interpretation is presented as the main issue affecting absorption of European Structural and Investment Funds in Croatia. According to European Commission data, Croatia remains amongst the 5 countries with lowest absorption rates.[223]

265. Croatia's revenue from environmentally relevant taxes—in proportion to its GDP—is amongst the highest in the European Union. In 2019, environmental taxes accounted for around 4.2 per cent of GDP, while the European Union average is around 2.5 per cent. According to the latest assessment made by the European Commission,[224] there are several

[222] https://www.sgi-network.org/2018/Croatia/Environmental_Policies

[223] https://cohesiondata.ec.europa.eu/overview

[224] European Commission (2019), "The Environmental Implementation Review 2019: Country Report Croatia"

examples of sound fiscal measures for the environment being implemented in Croatia. For example, the country levies a "forest public benefit function fee", which is a charge paid by companies and other business associations once a year since 1983. Besides managing restoring forests in karst regions, part of the funds levied are spent on demining activities (10 per cent), firefighting (5 per cent) and scientific work (5 per cent).

266. However, as in all other countries of the pan-European region, fossil fuel subsidies are still in place. In 2019 these amounted to $ 1.3 billion. The country also has not completely eliminated the "diesel differential" which is difference in the price of diesel and petrol amounting to an implicit subsidy on diesel.

Turkey

267. Turkey has been experiencing environmental pressures due to population growth, industrialization and rapid urbanization.[225] These pressures translate into a range of environmental challenges such as desertification, deforestation, water scarcity, nature degradation and marine pollution.[226] To address these challenges, the country has adopted new legislation and institutional practices as part of an effort to comply with the European Union environmental regulation.[227]

268. Turkey has relatively high environmental taxes as a percentage of its GDP (3.4 per cent on average for the 2002–2017 period, a bit less since), largely due to high taxes on gasoline and diesel. However, while transport taxes do provide some green incentives, they also tend to push poorer consumers towards older, more polluting, vehicles.[228] A revision of the transport tax schemes would therefore be beneficial.

269. While the country remains highly dependent on fossil fuels, the share of renewables in the country's energy mix has been increasing, mainly due to feed-in tariffs implemented by the government. At the end of 2020, Turkey finalized the draft legal and institutional framework for a pilot Emissions Trading Scheme (ETS) for the power and industry sectors.[229]

270. Eurostat data allows for a more detailed look at environmental protection expenditures by Turkey for the 2013–2019 period (see figure XXXV). The data shows a private sector that is quite active and spending between 50 and 100 per cent more than the government. Turkey can expand the use of instruments that leverage private sector investment in environmental projects, including public-private partnerships, green banks and green bonds.

271. Regarding fossil fuel subsidies, tax exemptions for petroleum products and heating subsidies to poor families constitute the bulk of harmful subsidies.[230] These should be gradually eliminated and replaced with support for a transition towards cleaner alternatives.

[225] Turkey's GDP per capita went from USD 4300 in 2000 to USD 9100 in 2019, i.e. a 111% increase.

[226] https://www.eea.europa.eu/soer/2015/countries/turkey

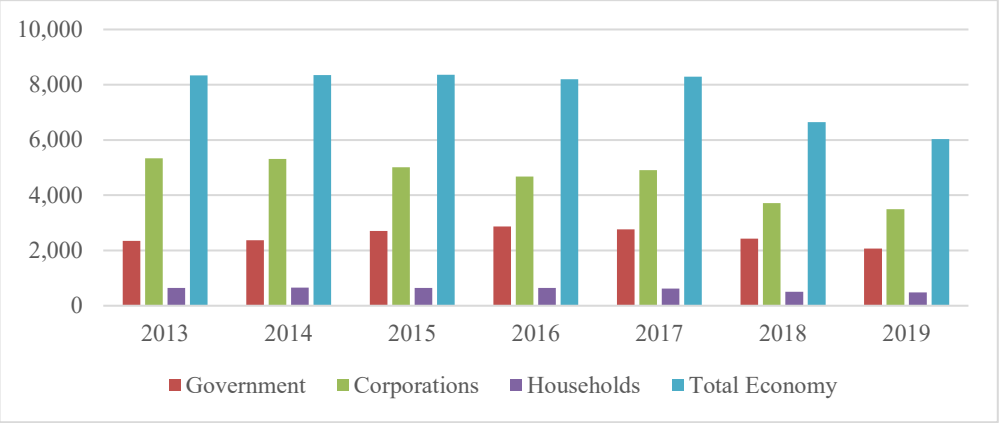
[227] OECD (2019), "Environmental Performance Reviews: Turkey", available at: https://www.oecd-ilibrary.org/environment/oecd-environmental-performance-reviews-turkey-2019_9789264309753-en

[228] Ibid.

[229] World Bank (2021), "State and Trends of Carbon Pricing 2021", available at: https://openknowledge.worldbank.org/handle/10986/35620

[230] OECD (2019), "Environmental Performance Reviews: Turkey".

Figure XXXV
Environmental protection expenditures in Turkey, million Euros (2013–2019)



Source: Eurostat

Alternative case study: Carbon pricing in the post-pandemic recovery

272. The COVID-19 pandemic has affected all countries and induced an economic crisis in many of them. However, despite the unequivocal negative impacts of the pandemic, this opens an interesting opportunity to use policy instruments to support an economic recovery that is in line with environmental protection objectives. As the attention of governments turns to stimulating and stabilizing their economies, the design of these recovery packages will play a decisive role in our climate and economic future. Alongside other measures, a carbon price can play a role to support a sustainable recovery, primarily through three mechanisms: supporting green industries, encouraging investments, and raising revenue (OECD, 2021).

273. First, carbon pricing helps support sustainable industries and the competitiveness of low-carbon products, which can generate additional green jobs, in line with many Sustainable Development Goal targets. Secondly, a carbon price can encourage investments in and mobilize revenue toward low-carbon, net-zero, and net-negative technologies. Finally, carbon pricing can generate much needed government revenue to support additional stimulus and investment programs.

274. However, for the time being, a large share of stimulus expenditure is not directed toward a green recovery. Only a fraction of economic recovery expenditure is being spent on low-carbon or environmental projects. For example, the Greenness of Stimulus Index[231] reports that only 12 per cent of the almost $ 15 trillion stimulus spending of G20 countries as of end of June 2021 is directly channelled to low-carbon or environmental projects—or have environmental conditions. In what concerns some of the Pan-European countries cited, stimulus as they were announced, will likely have a negative impact on the environment in Iceland, Italy, Norway, the Russian Federation and Turkey. In Denmark, Finland, France, Germany, Spain, Sweden, Switzerland and the United Kingdom, the overall expected impact is positive.

275. There is, however, time to redesign the post-COVID recovery policies to maximize their environmental benefits. Some measures that would allow that include:

- Corporate bailouts with green conditions
- Loans and grants for green investments
- Green R&D subsidies

[231] Finance for Biodiversity Initiative (2021), https://www.f4b-initiative.net/publications-1/greenness-of-stimulus-index---6th-edition. The Greenness of Stimulus Index examines 30 economies to assess the environmental orientation of their stimulus funding based on: the total stimulus funds flowing into environmentally intensive sectors; the existing green orientation of those sectors, such as the share of renewables in the energy sector; and the green orientation of new stimulus measures.

IV. Themes for the Ninth Environment for Europe Ministerial Conference

1. This chapter provides an assessment of the two themes of the Ninth Environment for Europe Ministerial Conference. For each theme, key messages and policy recommendations are presented based on an assessment of the state, trends and outlook towards meeting policy objectives.

A. Greening the economy in the pan-European region: working towards sustainable infrastructure

1. Key messages and recommendations relevant for the theme of the sub-chapter

Key messages

2. Sustainability should be mainstreamed as early as possible in the strategic planning phase. Although sustainability should be present throughout the entire project life cycle, the earlier it is incorporated the greater the benefits it can deliver. By considering sustainability as early as possible, policymakers can create a proper policy, regulatory and institutional environment that enables better integration of sustainability further "downstream". As the project timeline advances, the ability to make effective political, technical or economic changes decreases. However, decision-making processes are still siloed, reducing the capacity to identify synergies at the national and sectoral levels and interconnections between infrastructure sectors. Those silos must be dismantled in order to achieve more sustainable outcomes of infrastructure development.

3. Sustainable infrastructure investment has been recognized as one of the strategies with the most impact in terms of building back better in the post-coronavirus disease (COVID-19) pandemic recovery; this is due to its essential role in job creation, short-term economic growth and long-term development in alignment with global sustainability commitments such as the Sustainable Development Goals and the Paris Agreement. The lack of pipelines of bankable sustainable infrastructure projects, as well as of technical and institutional capacity to plan and prepare sustainable infrastructure projects, and the urgent need to boost economic development and job creation worldwide are pushing decision-makers towards business-as-usual projects instead.

4. Infrastructure needs are more variable and fast-changing than ever before. Thus, sustainable infrastructure should be flexible, interconnected and rely on real-time information to adapt to changing conditions.

5. Climate resilience, ecosystem services preservation, environmental restoration and biodiversity protection are key considerations for planning of future infrastructure projects. Achieving these goals while providing much-needed infrastructure services will require the mainstreaming of Nature-based Solutions (NbS), an approach already incorporated into the Pan-European Strategic Framework for Greening the Economy (ECE/BATUMI.CONF/2016/6).

6. Efficient use of materials and a circular economy are at the core of a sound sustainable consumption and production strategy. New technological advances in resource efficiency, recycling and reuse (including through increased modularity of infrastructure project components), should be considered as key elements in the planning, design, construction and operation of infrastructure projects.

7. Sustainable infrastructure must be environmentally responsible, socially inclusive and economically viable. It is important to guarantee that the needs of all stakeholders are identified and addressed.

Recommendations

8. A common definition of sustainable infrastructure should be developed in the pan-European region. This would allow reporting on and quantifying of progress across countries

and subregions. Significant data gaps have been identified both in the social, environmental, institutional, economic and financial indicators proposed and when quantifying the contribution (positive or negative) of infrastructure development and the achievement of the indicators proposed in this assessment.

9. Governments should make use of existing tools to promote sustainable infrastructure development, including the United Nations Economic Commission for Europe (ECE) Protocol on Strategic Environmental Assessment, and ensure an integrated and full life cycle approach where decisions made today about infrastructure are aligned with other national and international sustainable development targets and commitments, such as greenhouse gas (GHG) emission reduction and social inclusion. A life cycle approach should help to reconcile short- and long-term objectives; for instance, investing in traditional, carbon-intensive energy sources could meet short-term needs, but will lock in unsustainable development patterns and prevent countries from achieving the goals of the Paris Agreement and the Sustainable Development Goals, closing the already small window of opportunity for achieving a sustainable future.

10. There remains a significant capacity gap that is preventing sustainable infrastructure from being deployed at scale. Additional resources should be devoted to ensuring that the institutional and technical capacity necessary for the planning, design, execution, operation and decommissioning of sustainable infrastructure projects is achieved. Creating a common understanding of what "sustainable infrastructure" means and defining a common strategy to quantify progress across nations could contribute to closing these capacity gaps.

11. NbS can be used to complement, substitute or safeguard traditional grey infrastructure, thus contributing to closing the infrastructure access and quality gap in a climate-resilient manner. Thus, NbS can play an important role in increasing climate-change resilience and ensuring delivery of sustainable infrastructure services.[232] There is abundant research and literature on the potential and capacity of NbS to increase resilience of communities; however, the lack of demand and incentives does not make it viable in some cases. Economic and financial incentives should be deployed by Governments in the region in the short and medium term to support implementation of NbS. Special incentives and capacity-development will be required to strengthen and implement circular economy strategies at the regional and national levels. These incentives must find alignment with the work already conducted on the European Union Taxonomy and the Pan-European Strategic Framework for Greening the Economy in sustainable consumption and production patterns.

12. To ensure that the needs of all stakeholders are identified and addressed, it is crucial that environmental and social impact assessments be conducted. These assessments should include, among other topics, a gender analysis recognizing women's specific needs. This will help to mainstream gender in infrastructure planning, design, construction and operation.

2. Context

13. Infrastructure development has, for decades, been seen as the backbone of economic growth and development. However, in recent years, the world has come to realize that the potential benefits of infrastructure delivery do not always materialize. Environmental degradation, loss of biodiversity, social displacement and increase of GHG emissions are some of the unintended consequences of unsustainable infrastructure. To meet climate and development objectives while also "leaving no one behind," it will be vital to bridge the infrastructure gap, which will require an estimated investment of $6.9 trillion a year until 2030.[233] As indicated by Mr. Ban Ki-moon, former Secretary-General: "There is an urgent

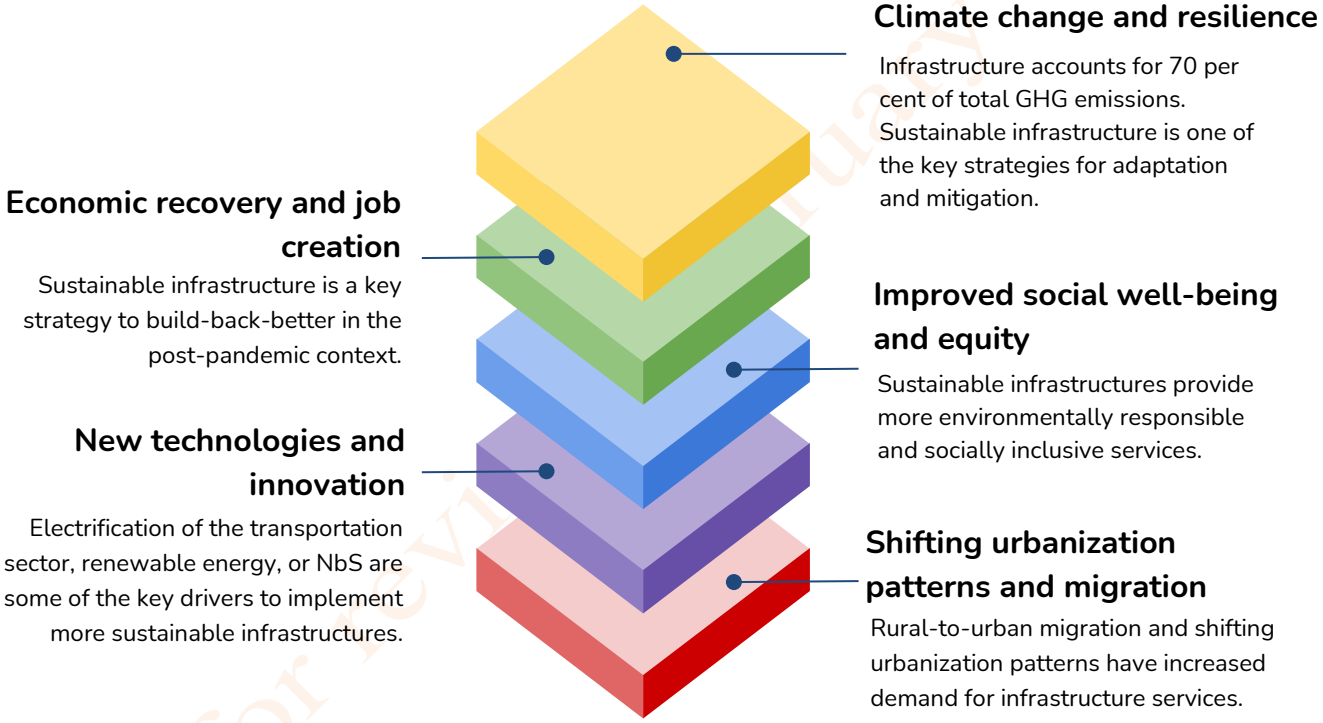
[232] Inter-American Development Bank (IDB), *Increasing Infrastructure Resilience with Nature-based Solutions (NbS)* (n.p., 2020), available at https://publications.iadb.org/publications/english/document/Increasing-Infrastructure-Resilience-with-Nature-Based-Solutions-NbS.pdf.

[233] Organisation for Economic Co-operation and Development (OECD), the World Bank and the United Nations Environment Programme (UNEP), *Financing Climate Futures: Rethinking Infrastructure – Policy Highlights* (Paris, 2018), available at www.oecd.org/environment/cc/climate-futures/policy-highlights-financing-climate-futures.pdf.

need to include sustainable and climate-resilient infrastructure as an integral part of green growth to deliver energy, water and transportation solutions that will facilitate opportunity, connection and sustainable growth."[234]

14. The countries of the Pan-European region face similar challenges, as energy demand continues to rise, climate-related hazards become more frequent and intense, and demand for improved social well-being and equity increases. These drivers and many more will define the needs to develop more sustainable infrastructure (see figure I below).[235]

Figure I
Main drivers for infrastructure demand



Source: Figure developed by author.

Climate change and resilience

15. GHG emissions in the pan-European region continue on an upward trajectory. Paired with the fact that infrastructure construction and operations account for 70 per cent of total

[234] UNEP, "Sustainable infrastructure can drive development and COVID-19 recovery: UNEP report", story, 4 March 2021, available at www.unep.org/news-and-stories/story/sustainable-infrastructure-can-drive-development-and-covid-19-recovery-unep.

[235] Sustainable infrastructure (sometimes called "green infrastructure") systems are those that are planned, designed, constructed, operated and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience) and institutional sustainability over the entire infrastructure life cycle. Sustainable infrastructure can include built infrastructure, natural infrastructure or hybrid infrastructure that contains elements of both. Note: This definition was published by UNEP in its report *International Good Practice Principles for Sustainable Infrastructure* (Nairobi, 2021), as an adaptation of the definition provided by IDB in its March 2018 Technical Note No. IDB-TN-1388 entitled *What is Sustainable Infrastructure? A Framework to Guide Sustainability Across the Project Cycle*.

GHG emissions,[236] infrastructure development should be at the core of any sound climate strategy. Infrastructure development will play a dual role in achieving a more climate-resilient future, first as mitigation, and second as an adaptation strategy. Considering the significant contribution the infrastructure sector makes to GHG emissions, it is vital that the current productive models be transformed into less carbon-intensive ones. Moreover, large areas in the pan-European region are already suffering on a regular basis from the effects of climate change, including in the form of, for example, heatwaves, extended droughts, sea-level rise or flooding. Thus, infrastructure solutions are widely recognized as a key strategy for climate change adaptation.

16. For many decades the value added of infrastructure was thought of as its capability to create strong, resilient barriers to protect the population from unwanted disturbances such as flooding. However, this approach has been reversed and complemented with NbS, sometimes known as "green infrastructure".[237] Now it is understood that traditional grey infrastructure[238] is often unable to withstand the intensifying effects of climate change. Thus, a combination of NbS and a comprehensive understanding of the ecosystem services that nature provides, together with the predictability from traditional grey infrastructure options, offers a broader spectrum of synergies (green-grey) that will better serve the multitude of solutions required, based on the context.

Economic recovery and job creation

17. The COVID-19 pandemic has created an unprecedented global economic downturn. This crisis has exposed gender inequality, global gaps in accessibility to basic services, and the lack of flexibility and resilience of infrastructure systems. According to the International Labour Organization (ILO), the crisis-induced job gap will reach 75 million in 2021 before falling to 23 million in 2022.[239] Additionally, the employment growth lost will not be recovered until 2023. However, the pandemic also creates a once-in-a-century opportunity to build back better by building a foundation for a sustainable and green future through investments in sustainable infrastructure. Infrastructure investment is likely to be a key element of recovery measures in many countries, in part because of its job creation potential. Besides, ensuring that infrastructure investments are climate resilient and do not increase exposure and vulnerability will reduce direct economic damages from climate-related disasters, while minimizing the indirect costs created by the cascading impacts of the disruption of both critical services and economic activities.

New technologies and innovation

18. The pandemic has exposed the interconnectedness of the world and the reality that existing infrastructure systems are, in many cases, fragile, not fit for purpose and even obsolete. Thus, the health crisis, combined with an inequality crisis and lack of flexibility in infrastructure systems, has created a domino effect, amplifying the pandemic's devastating consequences. In this day and age, when digital communication technologies update their operating systems every couple of months, multimillion-dollar infrastructure projects are still planned, designed, built and operated that are rigid, inflexible and expected to operate unchallenged for decades to come. Thus, it is unsurprising that countries struggle to

[236] Deblina Saha and Akhilesh Modi, *Low-Carbon Infrastructure: Private Participation in Infrastructure (PPI) – 2002 TO H1 2017* (n.p., World Bank, 2018), available at https://ppi.worldbank.org/content/dam/PPI/documents/2017_Low_Carbon_Infrastructure_PPI.pdf.

[237] "Green infrastructure" refers to natural systems including forests, floodplains, wetlands and soils that provide additional benefits for human well-being, such as flood protection and climate regulation. Source: Green-Gray Community of Practice, *Practical Guide to Implementing Green-Gray Infrastructure* (n.p., 2020). Available at www.conservation.org/docs/default-source/publication-pdfs/ci-green-gray-practical-guide-v07.pdf?Status=Master&sfvrsn=3cc5cf18_4.

[238] "Grey infrastructure" refers to structures such as dams, seawalls, roads, pipes or water treatment plants. Source: Ibid.

[239] Janine Berg and others, *World Employment and Social Outlook: Trends 2021* (Geneva, International Labour Office (ILO), 2021), available at www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_795453.pdf.

accommodate shifting needs for temporary health-care facilities, teleworking and the next generation of transportation systems, such as electric or driverless vehicles. To better accommodate future infrastructure needs, it is key to ensure that the infrastructure sector focuses broadly on provision of infrastructure services instead of narrowly on projects. A problem-solving approach promotes innovation, creates opportunities to explore new technologies, and incentivizes more efficient solutions.

19. For example, it will be critical to frame the problem as "the need to deliver more drinking water", instead of the solution being "creating more water treatment facilities". The second and more conventional alternative limits the capacity to integrate non-traditional and more sustainable alternatives, such as NbS, to address the problem at hand.

20. Data-driven decision-making, geospatial design and simulation will be crucial to ensure better understanding of the complexity of the world ahead, where human needs, environmental and social impacts, and planetary boundaries should all be part of the design of the most optimal solution.

Shifting urbanization patterns and migration

21. Migration has been a pattern connected to the search for better opportunities all around the world. In recent years, the shifting urbanization pattern has been intensified as the result of climate change, violence and conflict. The International Organization for Migration estimates that there are 272 million international migrants – 3.5 per cent of the world's population –[240] surpassing projections for 2050. Europe has traditionally been a major destination for international migrants. In 2019, Europe hosted around 82 million international migrants and Asia around 84 million; together they accounted for 61 per cent of the total global international migrant stock that year.[241] Considering the complexity in predicting mitigation patterns due to the close connection with economic crises, political instability and conflict, the lack of predictability puts significant pressure on existing infrastructure such as hospitals, or drinking water, making it impossible to deliver the needed services for an increased number of users.[242] Consequently, it is key to ensure that the upstream infrastructure planning process takes a long-term view, including demographic changes such as an ageing population and potential migration patterns that may result in shifting urbanization patterns and, therefore, higher infrastructure demand.

Improved social well-being and equity

22. Creating and maintaining healthy and safe environments is central to the delivery of sustainable infrastructure. Hence, the direct and indirect safety and health implications of an "unsustainable solution" should also be considered. Exposure to air, water or soil pollution, as well as to other poisonous hazards, can have a long-term impact on human health and well-being. To guarantee well-being and equity for all potential infrastructure users, the special needs of certain groups, such as women, should also be addressed. Stakeholder engagement processes, public consultations and gender mainstreaming strategies should be core considerations of every infrastructure project, helping to identify and minimize the risk of social exclusion.

3. State, main trends and recent developments

23. Climate change, population growth, growing inequality and biodiversity protection are just some of the challenges humanity will have to face in the years to come. In response to all of them, global initiatives supporting more inclusive, responsible and sustainable development models have emerged in recent decades. Some examples are the 2030 Agenda

[240] Marie McAuliffe and Binod Khadria, eds., *World Migration Report 2020* (Geneva, International Organization for Migration, 2019), available at https://publications.iom.int/books/world-migration-report-2020.

[241] Ibid.

[242] International Federation of Red Cross and Red Crescent Societies, *New Walled Order: How barriers to basic services turn migration into a humanitarian crisis* (Geneva, 2016). Available at https://reliefweb.int/sites/reliefweb.int/files/resources/Migration-policy-Report-Final-LR.pdf.

for Sustainable Development and its Sustainable Development Goals. Although these initiatives address different topics, they all agree on one thing; a paradigm shift towards a more sustainable development model is necessary to face the crucial challenges of the twenty-first century. The achievement of this new paradigm is only possible through coordinated actions in which Governments, public and private institutions, academia and civil society are actively engaged.

24. The ongoing pandemic has shone a spotlight on the great opportunity that sustainable infrastructure represents to build back better in the post-pandemic recovery era. In this regard, the role of sustainable infrastructure in supporting inclusive growth and productivity, as well as in accelerating the transition toward low-carbon and climate-resilient economies, is now widely recognized.[243] However, global efforts to foster the green economy and develop more sustainable and resilient infrastructure were a topic of conversation prior to the pandemic – how can member States ensure that this critical period of awakening does not pass by with little result or action? The Pan-European Strategic Framework for Greening the Economy, developed in 2016 by the ECE Committee on Environmental Policy with the support and cooperation of the ECE secretariat, UNEP and many other key players, is a significant first step.

25. The main goal of the Pan-European Strategic Framework is to guide the pan-European region in its transition to an inclusive green economy by 2030, in alignment with the outcomes of the Rio+20 Conference and the 2030 Agenda. The Framework envisions the pan-European region pursuing a development pattern that ensures economic progress, social equity and the sustainable use of ecosystems and natural resources, thus ensuring that the needs of current generations will be met without compromising those of future generations. The implementation of the Framework is supported by the Batumi Initiative on Green Economy, which encompasses the period 2016–2030 and comprises voluntary commitments on the green economy by countries and both public and private organizations. To date, over 30 countries and organizations have submitted more than 100 commitments to the Batumi Initiative platform.[244]

26. Achieving all these ambitious goals requires cooperation among countries, as well as regulatory and policy instruments that support and embrace the transition to a more sustainable way of development. Equally important, all these efforts should take place at an early stage of the development process. A good example that illustrates the significance of these elements is the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention, adopted 1991), according to which parties are obliged to assess the environmental impact of certain activities at an early stage of planning.[245] The Espoo Convention builds on the idea that adverse environmental consequences and threats do not respect national borders. As such, it imposes an obligation of consultation between parties on all major projects that might cause a negative environmental impact across borders, thus contributing to reducing environmental threats and potential damage. The Espoo Convention laid the foundations for the introduction at the international level of strategic environmental assessment, a systematic decision-support process aimed at ensuring that environmental and other sustainability aspects are considered effectively in policymaking and plan- and programme-making.

27. The COVID-19 crisis has not just worsened countries' budgetary constraints but has also reinforced the need to invest in sustainable and more resilient projects. Financial mobilization toward sustainable investments can have a great impact on achieving sustainable development projects. Tools such as thematic bonds – mainly green, social and sustainable bonds – can greatly contribute to supporting the Sustainable Development Goals and sustainable recovery from the pandemic's impacts. However, sustainable finance was part of the international conversation for years before the pandemic. In 2015, the Paris

[243] Amar Bhattacharya and others, *Attributes and Framework for Sustainable Infrastructure: Consultation Report*, Technical Note No. IDB-TN-01653 (n.p., IDB, May 2019). Available at https://publications.iadb.org/en/attributes-and-framework-sustainable-infrastructure.

[244] Commitments available at www.greengrowthknowledge.org/big-e.

[245] See https://unece.org/DAM/env/eia/documents/legaltexts/Espoo_Convention_authentic_ENG.pdf.

Agreement (art. 2 (1) (c)) included the commitment to "making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development".

28. In addition to the already existing commitments, in the last couple of years, initiatives such as the European Union Taxonomy[246] have been put in place. Created in 2020, the Taxonomy is a classification system that establishes a list of environmentally sustainable economic activities. Besides its importance in the sustainable recovery from the pandemic, the Taxonomy also plays a role in meeting European Union climate and energy commitments and implementing the European Green Deal. Mobilization of finances and strengthening of policy frameworks will need to be accompanied by capacity-development initiatives. This will ensure that countries have the technical and institutional capacity to integrate these changes into their infrastructure pipelines.

4. Indicators

Current landscape of sustainable infrastructure initiatives

29. Due to the broad spectrum of actors involved in the project life cycle of infrastructure projects, numerous initiatives have been developed to define indicators to quantify progress around sustainable infrastructure. The different approaches identified range in scope and intent, from high-level aspirational principles, safeguards and good practices, infrastructure sustainability rating systems and schemes, to reporting guidelines.

High-level principles

30. High-level principles aim to provide aspirational lines of action at a global scale, in most cases published by international groups. Examples of high-level principles include the Group of 20 (G20) Principles for Quality Infrastructure Investment, the UNEP International Good Practice Principles for Sustainable Infrastructure and the *OECD Compendium of Policy Good Practices for Quality Infrastructure Investment*[247] and the *OECD Implementation Handbook for Quality Infrastructure Investment: Supporting a Sustainable Recovery from the COVID-19 Crisis*.[248]

Safeguard policies

31. Multilateral development banks (MDBs) and other international financial institutions have traditionally incorporated safeguards and good practices aimed at providing a minimum baseline for due diligence processes to support decision-making. These environmental and social considerations provide the foundation for a better understanding of the potential unintended consequences and other risks associated with infrastructure development. Examples of well-known and widely applied safeguard and risk management frameworks include the International Financial Corporation Performance Standards and the Equator Principles. Most MDBs have their own safeguard policies as the baseline for due diligence processes.

Infrastructure sustainability rating systems and schemes

32. Numerous infrastructure sustainability rating systems have been developed in different geographic locations. These frameworks aim to provide comprehensive guidance and scoring criteria to rate projects across 50+ indicators. The application of these tools is in many cases linked to the achievement of a certification or sustainability award. Examples of some of the best infrastructure sustainability rating systems include Envision (United States

[246] European Union Technical Expert Group on Sustainable Finance, *Taxonomy: Final report of the Technical Expert Group on Sustainable Finance – Technical Report* (n.p., 2020). Available at https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf.

[247] Organisation for Economic Co-operation and Development (OECD) (n.p., 2020).

[248] OECD (n.p., 2021).

of America), CEEQUAL (United Kingdom of Great Britain and Northern Ireland), SuRe (Switzerland) and IS Rating Scheme (Australia).

Reporting guidelines

33. To monitor and communicate the sustainability performance of a given project – not necessarily infrastructure – several reporting guidelines have been developed in the last few years, including the Global Reporting Initiative and the Dow Jones Sustainability World Index.

34. The complexity of infrastructure development, diversity of sectors, phases within its life cycle and stakeholders engaged have created a significant number of tools and frameworks to quantify progress for sustainable infrastructure. This has created the need to be able to access information and better understand the use of currently existing tools to find the one that best fits user needs. Consequently, the German Agency for International Cooperation created a platform called "The Sustainable Infrastructure Tool Navigator",[249] designed to help users identify the most relevant tools for their needs and goals. This new initiative provides access to a comprehensive database of sustainable infrastructure tools that users can navigate by keyword or filter by types of tools, sectors and infrastructure life cycle phases, among other things. This initiative has been recently supported by UNEP as a partner.

2. List of indicators proposed

35. As previously identified, a significant number of frameworks and quantification criteria for sustainable infrastructure have been developed in recent years. However, different stakeholders have recognized the need for consolidation and harmonization of approaches and indicators. Some of the key initiatives working on consolidation include the MDB Infrastructure Cooperation Platform[250] and the newly created "Finance to Accelerate the Sustainable Transition-Infrastructure" (FAST-Infra).[251] These initiatives, together with other efforts by public and private groups, as well as international institutions, are presented in the cross comparative analysis below (see table 1 below).

36. The comparative analysis includes six relevant frameworks:

(a) Pan-European Strategic Framework for Greening the Economy;

(b) MDB Common Set of Aligned Sustainable Infrastructure Indicators;

(c) UNEP International Good Practice Principles for Sustainable Infrastructure;

(d) G20 Principles for Quality Infrastructure Investment;

(e) Finance to Accelerate the Sustainable Transition-Infrastructure (FAST-Infra);

(f) European Union Taxonomy for Sustainable Activities.

37. These frameworks are compared according to the following main categories: environmental sustainability and resilience; social sustainability; institutional sustainability; and economic and financial sustainability.

38. From the cross comparative analysis, several takeaways were identified:

[249] For more information, see https://sustainable-infrastructure-tools.org/.

[250] The Infrastructure Cooperation Platform was formed in January 2018 in response to the growing consensus over the role of multilateral development banks in supporting the preparation and financing of infrastructure investments, as well as in mobilizing private finance to close the global infrastructure services gap. The Platform is supported by the G20 Infrastructure Working Group.

[251] FAST-Infra was conceived in early 2020 by Climate Policy Initiative, the Hong Kong and Shanghai Banking Corporation (HSBC), the International Finance Corporation, OECD and the Global Infrastructure Facility under the auspices of the One Planet Lab of the President of the French Republic, Mr. Emmanuel Macron. The new FAST-Infra Sustainable Infrastructure Label (SI Label) is designed to enable project sponsors, developers and owners to signal the positive sustainability impact of infrastructure assets, and attract investors seeking assets that positively contribute to sustainable outcomes.

(a) In the category "Environmental sustainability and resilience", almost all the tools selected incorporate references to GHG-emission reduction, climate-change mitigation and adaptation, environmental preservation and circular economy or efficient use of resources. This category is the one that presents the most alignment across frameworks;

(b) Regarding "Social sustainability", all the frameworks but one incorporate references to equity, inclusiveness and/or gender. Nevertheless, considerations of human and labour rights, health and well-being and resettlement are not always covered;

(c) In the "Institutional sustainability" category, references to transparent and anti-corruption practices are addressed in two thirds of the tools analysed. Other accountability procedures such as sustainability certification, sustainability disclosure, or sustainability and compliance policies, are other specific considerations addressed by some of the frameworks;

(d) Regarding "Economic and financial sustainability", less homogeneity was identified. Several frameworks refer to the need to guarantee positive economic returns and job creation. In contrast, others address the importance of mobilizing innovative financing sources and externality accounting.

39. The cross-comparative analysis conducted has informed the proposal of indicators, subindicators and units of measurement in table 2 below.

Table 1
Cross comparative analysis of sustainability criteria

	Core elements			
Frameworks	*Environmental sustainability and resilience*	*Social sustainability*	*Institutional sustainability*	*Economic and financial sustainability*
Pan-European Strategic Framework for Greening the Economy	Natural capital Ecosystem services Sustainable production patterns (circular economy)	Healthy living and well-being Sustainable consumption Public participation and education	Externalities and natural capital Green and fair trade	Externalities and natural capital Green and decent jobs, and human capital
MDB Common Set of Aligned Sustainable Infrastructure Indicators	GHG reduction Climate risk, resilience Biodiversity Pollution control and monitoring Efficient use of materials Energy and water efficiency	Access and affordability Stakeholder engagement Human and labour rights Disability and special needs Gender integration Health and safety	Anti-corruption protocols and procedures Corporate sustainability disclosure	Positive economic and social return (expected rate of return) Job creation
UNEP International Good Practice Principles for Sustainable Infrastructure	Resilience Environmental impacts and nature Resource efficiency Circular economy	Equity, inclusiveness and empowerment	Life cycle assessment Strategic planning Transparent, inclusive and evidence-based decision-making	Fiscal sustainability and innovative finance Enhancing economic benefits

	Core elements			
Frameworks	*Environmental sustainability and resilience*	*Social sustainability*	*Institutional sustainability*	*Economic and financial sustainability*
G20 Principles for Quality Infrastructure Investment	GHG reduction Climate risk, resilience Biodiversity Natural capital Pollution control and monitoring Resource efficiency Circular economy	Community development Stakeholder engagement Displacement Female jobs Data gathering	Participatory project identification Procurement standards Conflict of interest and ethics Sustainability certification	Rates of return and cost contingencies Cost overruns Domestic goods and services Training and education Permanent and construction jobs
FAST-Infra	GHG reduction Climate-change mitigation, resilience Biodiversity Natural environment Pollution prevention and control Waste reduction Circular economy	Stakeholder Engagement Human and labour rights Land acquisition and resettlement mitigation Gender and inclusivity Health and safety	Sustainability and compliance policies Anti-corruption policies and procedures Transparency and accountability	Embedding government policies for project fiscal transparency and procedures
European Union Taxonomy for Sustainable Activities	Climate-change mitigation Climate-change adaptation Biodiversity and ecosystems Pollution and control Circular economy Water and marine resources	—	—	—

Source: Table developed by author.

Table 2
Sustainability infrastructure indicators

		Indicator at the national level and unit of measurements	
Indicator	*Definition*	*Indicator*	*Units of measurement*
1. Climate-change adaptation	Infrastructure projects should reduce/avoid GHG emissions, be climate-	1.1 GHG emission reduction	Total CO_2 emissions reduction according to Nationally Determined Contributions (per

		Indicator at the national level and unit of measurements	
Indicator	*Definition*	*Indicator*	*Units of measurement*
and mitigation	resilient and integrate adaptation and mitigation strategies through the full cycle	1.2 Disaster risk reduction: Strategies to prevent resilience and climate-related hazards and natural disasters	cent decrease in CO_2 emissions) SDG 13.1.2 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030
2. Environ-mental conservation and biodiversity protection	Infrastructure projects should avoid negative impacts and/or restore biodiversity and the environment while preserving ecosystems and ecosystem services during the entire life cycle	2.1 Biodiversity: Progress towards national biodiversity targets 2.2 Ecosystem services: Resources available for ecosystem services protection	SDG 15.9.1Progress towards national targets established in accordance with Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011–2020 SDG 15.b.1 Official development assistance and public expenditure on conservation and sustainable use of biodiversity and ecosystems
3. Resource efficiency and circular economy	Infrastructure projects should be planned and designed, constructed and operated considering the efficient use of resources (including materials, energy and water), as well as principles of circular economy	3.1 Circular economy: Reduction of waste generation through prevention, reduction, recycling and reuse 3.2 Resource efficiency: Definition of national targets for water, energy and materials efficiency	SDG 12.5.1 National recycling rate, tons of material recycled SDG 6.4.1 Change in water-use efficiency over time SDG 7.2.1 Renewable energy share in the total final energy consumption SDG 8.4.1 Material footprint, material footprint per capita and material footprint per GDP
4. Equity, inclusiveness and gender empower-ment	Infrastructure projects should promote social inclusion, gender equality and human rights protection by fostering economic empowerment and social mobility and equal opportunities for all. Integration of adequate and timely stakeholder engagement should also include other vulnerable groups, such as indigenous peoples	4.1 Gender equality: Guarantee equal opportunities for all 4.2 Empowerment: Allocation of resources for women's empowerment.	SDG 11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities SDG 5.5.2 Proportion of women in managerial positions SDG 5.c.1 Proportion of countries with systems to track and make public allocations for gender equality and women's empowerment
5. Positive economic and social returns	Infrastructure projects should consider the net economic and social returns, as well as the real cost of economic activities	5.1 Life cycle cost accounting: Apply cost-benefit analysis techniques that adequately capture the	Social return on investment Return on investment

		Indicator at the national level and unit of measurements	
Indicator	*Definition*	*Indicator*	*Units of measurement*
	and natural capital over the entire project life cycle, taking into consideration both positive and negative externalities	net economic and social returns generated	
6. Human health and well-being	Infrastructure projects should improve physical and economic access to services, healthy living and well-being.	6.1 Access to resources: Guarantee access to resources for all (including water, electricity, transportation, digital communications and housing)	SDG 1.4.1 Proportion of population living in households with access to basic services SDG 6.1.1 Proportion of population using safely managed drinking water services SDG 7.1.1 Proportion of population with access to electricity SDG 9.1.1 Proportion of the rural population who live within 2 km of an all-season road SDG 9.c.1 Proportion of population covered by a mobile network, by technology
7. Trans-parency and anti-corruption	Infrastructure development should be planned and designed, constructed and operated in a transparent manner to guarantee that relevant information is available and accessible to all stakeholders. Projects should have anti-corruption and anti-bribery management systems in place for long-term monitoring	7.1 Transparency and anti-corruption: Ensure transparency and existence of anti-corruption procedures	SDG 16.6 Develop effective, accountable and transparent institutions at all levels SDG 16.5 Substantially reduce corruption and bribery in all their forms
8. Fiscal sustain-ability and innovative finances	Infrastructure development should guarantee fiscal sustainability of assets through the full life cycle. Some of the aspects to consider are fiscal transparency, financial integrity, debt sustainability, risk allocation and mobilization of innovative sources of capital at scale	8.1 Sustainability investment	Percentage of the national budget is devoted to sustainability in infrastructure, green infrastructure and development

Source: Table developed by author.

Abbreviations: CO_2, carbon dioxide; GDP, gross domestic product; SDG, Sustainable Development Goal (target/indicator).

3. Quantification of indicators in the pan-European region: trends identified

40. An infrastructure project is sustainable when different environmental, social, institutional and economic considerations are met throughout the project's entire life cycle. However, due to the multidimensional nature of sustainability and the lack of an agreed baseline, limited-to-no information exists at the pan-European regional or subregional levels regarding infrastructure sustainability performance. As such, and after defining the most commonly used sustainability indicators and the information available at the country and regional levels, the author conducted an indicator-by-indicator analysis.

41. Indicator 1 "Climate change adaptation and mitigation" aims to reduce GHG emissions while ensuring that infrastructure projects are resilient and integrate adaptation and mitigation strategies through the entire cycle. Due to the broad scope of this indicator, it is divided into two subindicators, "1.1 GHG emission reduction" and "1.2 Disaster risk and reduction strategies". As reported in the Sustainable Development Goal Indicators Database, regarding the quantification of progress on Sustainable Development Goal indicator 13.2.2 "Total greenhouse gas emissions per year", net GHG emissions have increased in the pan-European region, taking 2014 as the baseline year. From 2014 to 2018, two subregions in the pan-European region (European Union and Western Europe) showed positive progress in reducing GHG emissions. However, the Central Asia, Eastern Europe and South-Eastern Europe subregions presented an overall GHG increase, raising emissions in the general region. When considering the progress achieved on subindicator "1.2 Disaster risk and reduction strategies" and based on United Nations Statistics Division (UNSD) data on the Sendai Framework Monitoring System, all the subregions, and, therefore, the pan-European region as a whole, increased the adoption and implementation of disaster risk-reduction strategies from 2015 to 2018. As such, indicator 1 shows mixed performance results overall, and additional effort should be devoted to climate-change adaptation and mitigation. See also section III.B on climate change in the assessment.

42. Indicator 2 "Environmental conservation and biodiversity protection" seeks to avoid negative impacts and/or restore biodiversity and the environment, while preserving ecosystems and ecosystem services during the entire life cycle of the infrastructure project. This indicator is quantified using two subindicators, "2.1 Biodiversity protection" and "2.2 Ecosystem services protection". Biodiversity protection is quantified in alignment with Sustainable Development Goal 15 and its indicator 15.9.1. (a) "Number of countries that have established national targets in accordance with or similar to Aichi Biodiversity Target 2 of the Strategic Plan for Biodiversity 2011–2020 in their national biodiversity strategy and action plans and the progress reported towards these targets". According to information published by UNSD, every country in the pan-European region has established its respective strategic plans for biodiversity and action plans. The achievement of this target does not necessarily indicate that biodiversity objectives are achieved but that national strategies are in place. It is worth noticing that there is limited-to-no information currently available at the national, subregional or regional levels regarding the effects of infrastructure development on biodiversity disruption. Subindicator "2.2 Ecosystem services protection" has been quantified in alignment with Sustainable Development Goal indicator 15.3.1 "Proportion of land that is degraded over total land area." According to the ECE Dashboard for the Sustainable Development Goals, there are significant differences in land degradation by country, ranging from 97 per cent (Tajikistan) – because of erosion caused by overgrazing, poor irrigation services and salinization[252] – to a total of 1 per cent of degraded land (Belarus and Finland). Similarly to biodiversity, limited-to-no information has been identified across countries regarding the percentage of land degraded associated with infrastructure development or other relevant information regarding quantification of services provided by

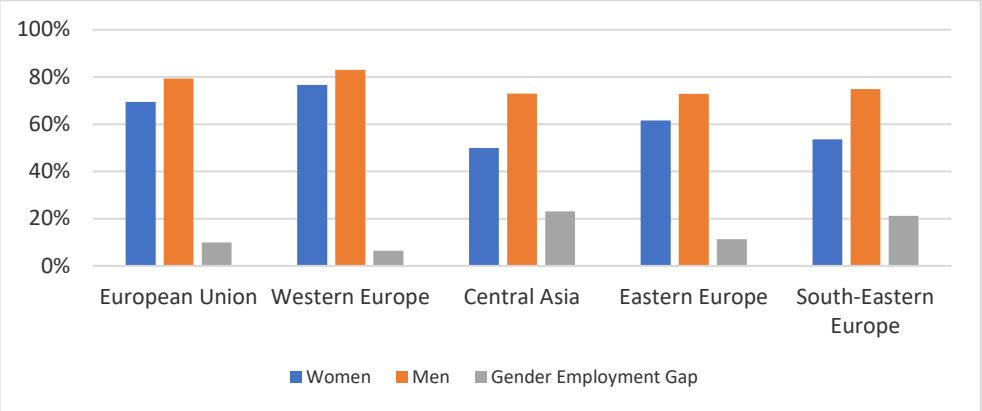
[252] United Nations Development Programme (UNDP)-UNEP, *Final Report: The economics of land degradation for the agriculture sector in Tajikistan - A scoping study* (n.p., 2012), available at www.undp.org/content/dam/tajikistan/docs/projects/PEI/Economics%20of%20Land%20Degradation%20Report%20ENG%20pre-final%20(2).pdf.

natural ecosystems. See also the assessment of biodiversity and ecosystems in section III.E above.

43. Indicator 3 "Circular economy" looks at the importance of making good use of resources over the full life cycle of the infrastructure project. Based on the information available and its alignment with infrastructure development, the most relevant unit of measurement identified is "Recovery rate of construction and demolition waste." Limited information was identified at the pan-European regional level. However, this indicator is part of the European Commission Circular Economy indicator set. Consequently, detailed information exists at the European Union level for the period 2014–2018. According to the most recent information published by Eurostat in 2018, the average recovery rate of construction and demolition waste has remained almost constant at 87 per cent in 2014 and 2016 and 88 per cent in 2018. The data gathering process followed in the European Union could be extrapolated at the pan-European region level to quantify this indicator. See also section III.G of the assessment on chemicals and waste.

44. Indicator 4 "Gender equality and empowerment" aims to promote social inclusion, gender equality and human rights protection by fostering economic empowerment, social mobility and equal opportunities for all. Based on data availability, the unit of measurement proposed is "Gender employment gap across the pan-European region." According to the most recent information published by ILO, ILOSTAT Database in 2021, essential differences are appreciated by subregion (see figure II below). For example, the gender employment gap in the South-Eastern Europe subregion is currently 21.2 per cent, compared to the Western Europe subregion (6.4 per cent) and the European Union subregion (9.9 per cent). The gender employment gap has shown a positive trend, having decreased in most subregions. This is the case for the European Union, whose gender employment gap dramatically decreased from 20.8 percent in 1990 (oldest data available) to 9.9 per cent in 2019, or the Western Europe subregion, where the gap was reduced from 18.2 per cent in 1990 to 6.4 per cent in 2019. The Central Asia and Eastern Europe subregions bucked this trend since their gender employment gaps increased by 1.5 per cent and 0.9 per cent, respectively, from 1990 to 2019. The pan-European region's gender employment gap decreased from 19.2 percent in 1990 to 14.4 per cent in 2019; however, significant opportunities for improvement still exist in this area.

Figure II
Gender employment gap, simple average of national values per subregion (2019)



Source: ILOSTAT database.

45. Indicator 5 "Life cycle cost accounting" is at the core of the concept of sustainability. This indicator considers the net economic and social returns of infrastructure over the entire project life cycle (including positive and negative externalities). Specific references to externalities are found in the Pan-European Strategic Framework for Greening the Economy. One of its nine focus areas (FA.2) aims to promote the internalization of negative externalities and the sustainable use of natural capital. However, limited data exist regarding the quantification of externalities across the region. The existence of cost-benefit analysis represents the first step in that direction. Consequently, the quantification criteria for this indicator look at the number of countries that conduct cost-benefit analysis by infrastructure

sector. According to a 2014 OECD questionnaire on the challenges and applications of cost-benefit analysis for the preliminary feasibility study of capital investments,[253] 15 countries from the pan-European region that participated in this study applied cost-benefit analysis in large infrastructure projects. However, just one third of the countries did so because of a legal requirement. Furthermore, the traditional cost-benefit analysis does not incorporate sustainability considerations (such as climate risk) and externality accounting (such as the cost of pollution, ecosystem services or biodiversity protection). As such, the existence of cost-benefit analysis should not be the end goal but rather good progress towards a more comprehensive analysis of infrastructure development in its whole life cycle.

46. Indicator 6 "Access to basic services" seeks to improve physical and economic access to basic services, ensuring healthier living conditions and well-being. Given the scope of this work and data availability, the services considered for quantifying this indicator are access to drinking water, sanitation, electricity and 2G, 3G, and 4G mobile networks. The quantification of access to drinking water is done in alignment with Sustainable Development Goal indicator 1.4.1 "Proportion of population living in households with access to basic services." According to data published by the World Health Organization/United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply, Sanitation and Hygiene in 2021, access to basic drinking water services is consistent across the pan-European subregions and above 90 per cent in all cases. In this regard, the Western Europe subregion is the only one with full access to the service, closely followed by the European Union (98.6 per cent). In almost all countries, access is above 75 per cent in a rural context.

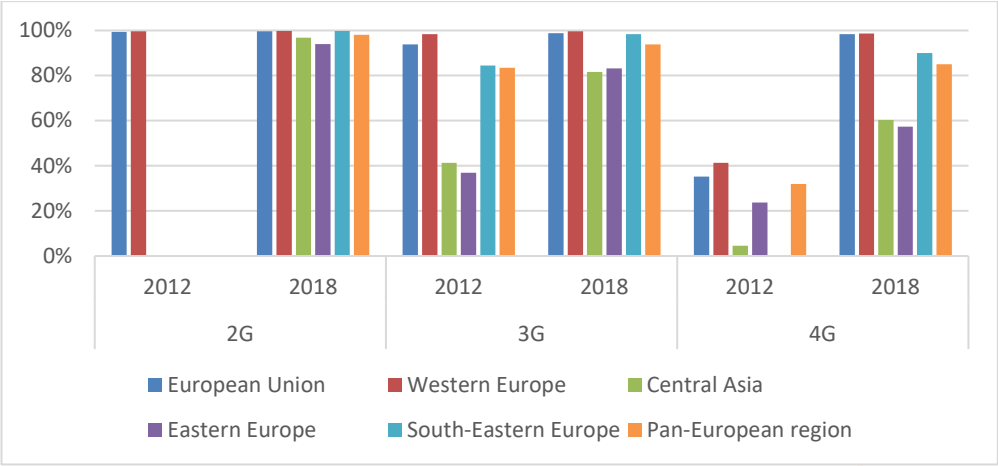
47. When looking at the proportion of the population using basic sanitation services, the information gathered shows more heterogeneity in the results than the previous subindicator. The results range from 82.3 per cent access in rural Eastern Europe to 99.5 per cent in urban South-Eastern Europe and Western Europe. The overall proportion of the population using basic sanitation services in the pan-European region is 96.3 per cent. At the country level, the lowest percentages (72 per cent) of access to sanitation services are found in rural areas in two countries. Electricity access is equally relevant when looking at basic services. This subindicator is quantified in alignment with Sustainable Development Goal indicator 7.1.1 and refers to the proportion of the population that has access to electricity. According to UNSD, the pan-European region shows full access to electricity, with the exception of Central Asia with 99.9 per cent electricity access. See also the assessment of fresh water presented in section III.C of the seventh pan-European environmental assessment.

48. The last subindicator considered as part of access to basic services is "proportion of population covered by a mobile network." Provision of mobile networks is covered by Sustainable Development Goal indicator 9.c.1 and refers to the percentage of inhabitants living within range of a mobile-cellular signal. While 2G offers limited voiced-based services, 3G and 4G provide high-speed, reliable, high-quality access. The ECE Statistical Database indicates that almost all populations across the different pan-European subregions were covered by 2G mobile network in 2018. In the case of 3G, in 2018, the range varied from 83.8 to 99.3 per cent depending on the region. In comparison, 4G presented broader differences ranging from 63.1 to 98.3 per cent. Compared to previous years, the proportion of the population covered by 2G in the pan-European region does not vary. However, a significant increase exists in the 3G and 4G coverage from 2012 – the earliest records available – to 2018 – the latest year recorded. In 2012, the percentage of population covered by 3G was 77.7 per cent, 17.6 per cent lower than in 2018. In the case of 4G, the difference is even greater: while the percentage of the population with access to 4G in 2012 was 22.6 per cent, in 2018 this figure rose to 83.6 per cent, an increase of 61 per cent (see figure III below).

[253] Available at https://qdd.oecd.org/subject.aspx?Subject=17375f7e-fc6c-4a5f-81bf-5b7e6a1da53c.

Figure III

Proportion of population covered by a second-, third- or fourth-generation mobile telephone network, by subregion, per cent (2012 and 2018)

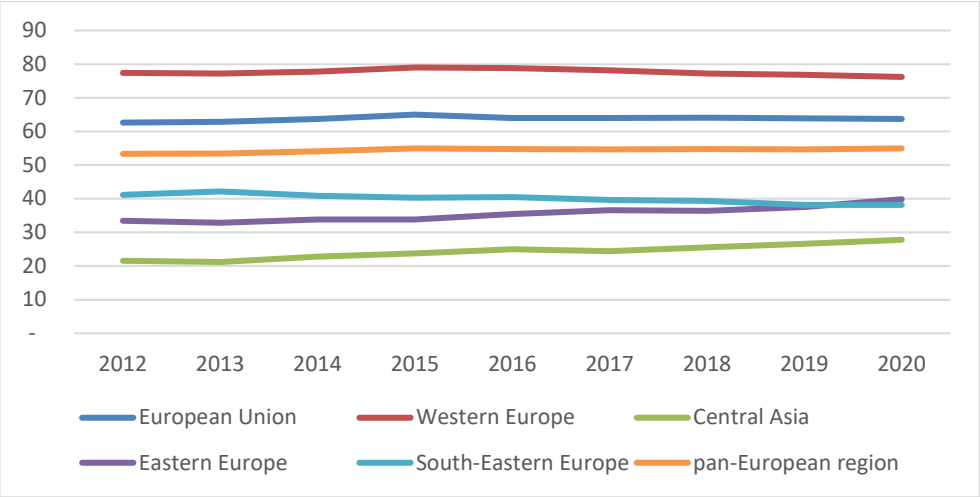


Source: ECE Statistical Database.

Notes: Insufficient 2G data for Central Asia, Eastern Europe, South-Eastern Europe (and the region as a whole) in 2012; no 3G data for the Russian Federation in 2012, among others; and insufficient 4G data in South-Eastern Europe in 2012, among others. For population data, figures for Monaco only in 2016, latest figures for the Russian Federation 2013, and for Turkmenistan 2009.

49. Indicator 7 "Transparency and anti-corruption" aims to guarantee that projects are planned, designed, constructed and operated transparently to ensure that relevant information is available and accessible to all stakeholders. This indicator is quantified in alignment with the Transparency International "Corruption Perceptions Index", where 0 represents the highest level of corruption, and 100 the lowest. According to Eurostat, this indicator is part of the European Union Sustainable Development Goals indicator set, and is used to monitor progress towards Sustainable Development Goal indicator 16.5.2. Based on the results published in the Corruption Perceptions Index 2020, Western Europe is the subregion with the lowest level of corruption (76.2), followed by the European Union (63.7). However, the score for the remaining subregions is below 40, meaning that the public sector is perceived as more corrupt than in the western subregions. In this regard, Central Asia is the subregion with the highest level of corruption (27.8), followed by South-Eastern Europe (38.2) and Eastern Europe (39.9). Scores from previous years are available only for the European Union. When comparing 2019 and 2020 scores, most countries in the European Union slightly lowered their level of corruption or remained at the same level. However, taking a much broader time frame (2012–2020), the situation looks very different, with 17 of the 27 countries experiencing an increase in corruption (see figure IV below).

Figure IV
Corruption Perceptions Index, simple average by subregion, with 0 being the highest and 100 the lowest level of corruption (2012–2020)



Source: Corruption Perceptions Index, Transparency International, available at www.transparency.org/en/cpi/2020/index.

Notes: No data for Andorra, Liechtenstein, Monaco or San Marino.

50. Indicator 8 "Fiscal sustainability and innovative finances" seeks to guarantee the financial sustainability of assets through the entire life cycle. This includes the mobilization of innovative sources of capital at scale. Significant work has been done in different subregions to mobilize finance for more sustainable and resilient projects. An example is the European Green Deal Investment Plan, which will mobilize European Union funding and create an enabling framework stimulating the public and private investments needed to transition to a climate-neutral, green, competitive and inclusive economy. The unit of measurement proposed for this indicator is aligned with Sustainable Development Goal indicator 13.a.1 and the aim is to mobilize funding for the $100 billion international commitment for climate-related expending. According to the European Environment Information and Observation Network and the European Commission Directorate-General for Climate Action, in 2019, the European Union contributed €16.206 billion, a 37 per cent increase compared to the 2014 base year. Limited information exists regarding some of the other pan-European subregions. This indicator does not cover the full scope of sustainability finances. However, it is a first step towards financing other key sustainability considerations such as biodiversity protection and social inclusion. See also the assessment of environmental financing in section III.H of the forthcoming pan-European environmental assessment.

5. Case Studies

Naples-Bari (Italy) railway line: the first-ever sustainability-certified project in Europe by Envision rating system

51. Railway systems are at the core of the long-term transportation strategy defined by many countries around the world. However, these linear projects can often have potential consequences on environmental and social disruption and be affected by climate change, among other risks. Thus, applying a sustainable infrastructure framework can help to identify opportunities for improvement and existing gaps affecting the sustainability performance of infrastructure projects. This case study provides an overview of the application of the Envision rating system,[254] as one of the most widely applied methodologies for quantifying

[254] As defined by the Institute for Sustainable Infrastructure (ISI). This tool is divided into 64 sustainability and resilience criteria in five main categories: quality of life, leadership, resource allocation, natural world, and climate and resilience.

infrastructure sustainability and its application to the first Envision-certified project in Europe, the Naples-Bari (Italy) railway line.

52. The Naples-Bari (Italy) route is part of the Scandinavia-Mediterranean railway corridor of the Trans-European Transport Network.[255] This project aims to improve the service by increasing travelling speed, accessibility, capacity and interconnection with other transportation modes, including port and airport. This €6.2 billion effort will also integrate a multifunctional corridor where synergies with other infrastructure sectors such as energy and telecommunications are also considered.[256]

53. The application of Envision and the project verification cover a shorter 21 km-long section of the project (Frasso Telesino–Telese–San Lorenzo (Italy)). The holistic sustainability approach provided by the application of Envision during the early phases of the project enabled the achievement of the highest sustainability performance – the platinum award. Some of the benefits of the incorporation of sustainability indicators into the projects include the selection of the route so as to minimize environmental impact. The application of environmental indicators at an early stage of the project enabled the identification of high ecological value areas, floodplains and farmland used for wine production, so they could be avoided. Specific climate change and resilience considerations and the engagement of local authorities were also identified as part of the Envision assessment of this project.[257] According to the project team, the application of sustainability tools and its indicators makes it possible to: "favour an innovative approach to design. Those who design according to the environmental sustainability criteria of the protocol [Envision] are also driven to seek new and creative solutions to achieve a high-quality goal with less waste, more optimization of natural resources, use of innovative materials".[258]

Lower Danube Green Corridor: floodplain restoration for flood protection

54. More than two decades ago, the governments of Bulgaria, the Republic of Moldova, Romania and Ukraine came together to define what has been known as the Lower Danube Green Corridor. This 1,000 km corridor project aims to have a positive effect on flood management, water purification, and climate change mitigation while restoring areas of high ecological value.[259] As defined in the Declaration of Cooperation for the Creation of a Lower Danube Green Corridor, signed in 2000 in Bucharest by the ministers of the environment of the four countries, the scope of the project includes "a minimum commitment of 773,166 ha of existing protected areas, 160,626 ha of proposed new protected areas, and 223,608 ha areas proposed to be restored to natural floodplain".[260]

55. Currently, 70 per cent of the floodplain along this section of the river has been lost or damaged. This project has the potential to restore 25 per cent of the total floodplain. The restoration of the former wetlands could store up to 1.6 billion m^3, significantly minimizing the flooding risk in the area.[261] From the economic viability point of view, floodplain

[255] ISI, "Itinerario Ferroviario Napoli-Bari, Tratta Frasso Telesino-S. Lorenzo", 17 May 2019. Available at https://sustainableinfrastructure.org/itinerario-ferroviario-napoli-bari-tratta-frasso-telesino-s-lorenzo/ (English and Italian).

[256] Stantec, "La linea ferroviaria Napoli-Bari è la prima infrastruttura in Europa certificate Envison per la sostenibilità", 20 March 2019. Available at www.stantec.com/it/news/2019/Naples-Bari-railway-line-first-Envision-certified-infrastructure-for-sustainability-in-Europe (Italian only).

[257] ISI (2019).

[258] Stantec, "La linea ferroviaria Napoli-Bari è la prima infrastruttura in Europa certificate Envison per la sostenibilità.

[259] WWF (2015). Green Infrastructure for Europe: The Lower Danube Green Corridor. https://climate-adapt.eea.europa.eu/metadata/case-studies/lower-danube-green-corridor-floodplain-restoration-for-flood-protection/danube_document-1.pdf.

[260] Declaration on the Cooperation for the Creation of a Lower Danube Green Corridor (2000). Bucharest. http://awsassets.panda.org/downloads/ldgcdeclaration.pdf.

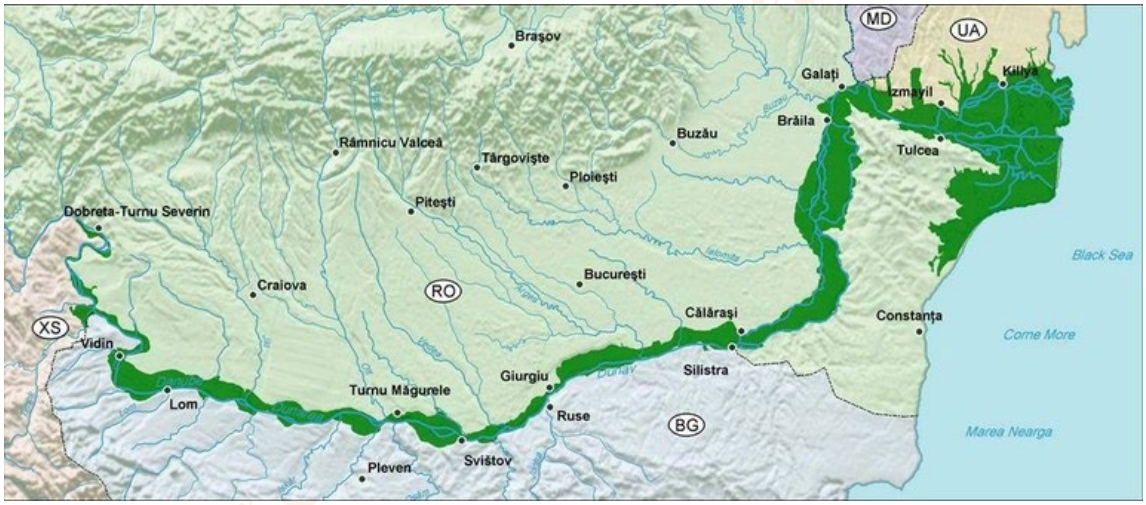
[261] WWF (2010). Lower Danube Green Corridor VISION restored floodplain new Protected Areas Protected Areas 733,166 ha Floodplain restoration – a long term solution for storing flood waters

restoration along the Lower Danube Green Corridor has been estimated to cost € 183 million. On the other side, the annual earning associated with ecosystem services[262] has been estimated at € 111.8 million per year.

56. Beyond the previously mentioned project benefits (flood risk prevention, natural connectivity, etc.), the restoration of ecosystem services and the use of NbS provide significant positive additional externalities. Some of the main ones include the key role of wetlands as carbon sinks, the restoration of biodiversity in the area of influence, the development and protection of economic zones, and the reduction of water pollution in floodplains and wetlands.

57. This project illustrates the importance of environmental restoration and the positive externalities associated with the protection of natural capital. Green infrastructure solutions help mitigate the imminent effects of climate change, environmental degradation, and biodiversity loss.[263]

Figure V
Lower Danube Green Corridor (shown in dark green)



Source: WWF Factsheet "Lower Danube Green Corridor", available at http://awsassets.panda.org/downloads/wwf_ldgc.pdf.

Connecting people, connecting nature One of the world's most important ecoregions with outstanding and distinctive biological resources. WWF. http://awsassets.panda.org/downloads/wwf_ldgc.pdf.

262 The main ecosystem services identified are flood control, water purification, groundwater replenishment, sediment and nutrient retention, reservoirs of biodiversity, recreation, tourism, etc.

263 Climate ADAPT. (2021). Lower Danube green corridor: floodplain restoration for flood protection. https://climate-adapt.eea.europa.eu/metadata/case-studies/lower-danube-green-corridor-floodplain-restoration-for-flood-protection.

B. Applying principles of circular economy to sustainable tourism

1. Key messages and recommendations

Key messages

58. A pan-European circular tourism economy will be more resilient to and better equipped to cope with future crises, be they economic, health-related, or derived from the environmental challenges that face the region. Circular economy is essential for the sustainable development of tourism and can contribute to the achievement of the Sustainable Development Goals. With the rapid growth of tourism, its impacts are growing despite efficiency improvements, increasingly contributing to environmental and social problems.

59. Circular economy mainly covers the physical environmental issues of energy and resource use and closing resource cycles. Sustainable tourism development takes the broader perspective of economic development within social and environmental constraints. Therefore, circular economy is a necessary but incomplete element of sustainable tourism development.

60. Circular economy is an economic system that replaces the (linear) end-of-life concept with reducing, reusing, recycling and recovering materials in production, distribution and consumption processes.[264] The application of its principles in tourism is still in its infancy, apart from individual cases. Due to its cross-sectoral nature, a circular approach in tourism is complex but also holds opportunities to become driven through other sectors.

61. Key areas in tourism with a strong relation to both Sustainable Development Goals and circular economy are energy use and emissions in transport, accommodation and restaurants, waste management of accommodation and restaurants (including food waste), water consumption and generation of wastewater in general, and resource usage in building, for interiors, and in amenities.

62. Opportunities may be most straightforward in construction and operations, including (food) waste management, of accommodations and restaurants. Opportunities in sustainable aviation fuels (e-fuels) are exploited on a very small scale. Many sharing economy initiatives currently have too many non-circular counter effects like additional construction or kilometres travelled.

63. Indicator development for sustainable tourism, let alone for monitoring circularity, is still evolving but hampered by various issues. There are currently no indicators across the pan-European region that give explicit information on tourism's circular state. On several general circularity aspects, classification definitions differ between states. Finally, even mainstream tourism statistics tend to be incomplete and suffer from varying definitions, while detailed statistics needed for accurate circularity monitoring are absent. Digitalization holds promise for better and more uniform measurement and monitoring, but depends on the availability of uniform and relevant data on circular economy in tourism.

Recommendations

64. Governments should increase efforts to help reduce energy use and greenhouse gas emissions from tourism transport, as large gains can be achieved with relevance for climate policy and the 2030 Agenda for Sustainable Development. Widespread commitment to the Glasgow Declaration on Climate Action in Tourism can contribute to these efforts, and align climate action across tourism stakeholders, including governments, civil society and others.[265] Actions include, amongst others, the scaling-up of international, long-distance rail infrastructure and travel, and electric charging infrastructure in tourism destinations. Next to reductions of energy and emissions in transport, such reductions in tourism can also be achieved by facilitating the transition towards renewable energy use by accommodations,

[264] Julian Kirchherr and others, "Conceptualizing the circular economy: An analysis of 114 definitions", *Resources, conservation and recycling*, vol. 127 (September 2017), pp. 221-232.

[265] UNEP, "Glasgow Declaration on Climate Action in Tourism" (December 2021) available at https://www.oneplanetnetwork.org/sites/default/files/2021-11/GlasgowDeclaration_EN_0.pdf

restaurants and attractions. In general, the sharing of good circular practices in tourism is recommended.

65. The Governments of the pan-European region should take the opportunity, when elaborating coronavirus disease (COVID-19) recovery plans, to prioritize domestic tourism, as it is more resilient to crises,[266] has lower impacts on climate, and product loops are tighter and easier to make circular than those of medium and long-distance international tourism products.

66. Decision-makers and entrepreneurs in the region should apply circular economy principles across the tourism value chain. A value chain approach could accelerate the transformation to more circularity in tourism and increase its long-term health and resilience. Tourism has the potential for long-lasting positive impacts beyond the sector itself, due to its interlinkages with other economic activities and the direct producer-consumer interaction. Financial support can aid tourism regions to set up adequate (recycling and other) infrastructures that can cope with the high seasonal variations of material streams.

67. ECE member States and governing bodies should select a limited number of specific key-impact tourism indicators to be included in ECE statistical databases. Indicators for circular economy in tourism should be aligned with those being developed for the monitoring of sustainable development in tourism (particularly with the most promising) and be compatible with Sustainable Development Goals. Circular economy indicator development could follow the approach adopted by the UNWTO initiative towards a Statistical Framework for Measuring the Sustainability of Tourism (SF-MST),[267] i.e.:

(a) Further integration of established measurement frameworks (Tourism Satellite Accounts, System of Environmental-Economic Accounting, European Tourism Indicator System and SF-MST) to provide a platform for the measurement of sustainable and/or circular tourism;

(b) Further engagement with the definition and measurement of Sustainable Development Goal indicators, including the development of a complementary set of circular tourism indicators;

(c) Advancing the development of subnational tourism statistics recognizing the importance of location-specific information in decision-making on tourism.

2. Context

68. Over the past half-century the extraction of minerals has tripled, with the extraction and processing of natural resources accounting for over 90 per cent of biodiversity loss and water stress and about 50 per cent of climate change impacts.[268] Critical resources are already becoming scarce, while ecosystem services are increasingly degraded, and man-made pollution and waste have become increasingly difficult to absorb.[269] Over the past decades, tourism has started to play a considerable role in this development, having become a major industry with 1.5 billion international tourist arrivals in 2019.[270] It currently represents 10 per

[266] European Commission, Scenarios towards co-creation of transition pathway for tourism for a more resilient, innovative and sustainable ecosystem. Commission staff working document. SWD(2021) 164 final.

[267] United Nations World Tourism Organization (UNWTO), "SDG Indicators for 'Sustainable tourism': A UNWTO contribution to the IAEG-SDG", 2 March 2016, available at https://webunwto.s3-eu-west-1.amazonaws.com/2019-08/unwtosdgtourismindicators02032016_unlocked.pdf.

[268] Bruno Oberle and others, *Global Resources Outlook 2019: Natural Resources for the Future We Want*, (Nairobi, United Nations Environment Programme, 2019), available at www.resourcepanel.org/reports/global-resources-outlook.

[269] Will Steffen and others, "Planetary boundaries: Guiding human development on a changing planet", *Science*, vol. 347, No. 6223 (13 February 2015), with abstract available at http://science.sciencemag.org/content/347/6223/1259855.abstract.

[270] UNWTO, "International Tourism Growth Continues to Outpace the Global Economy", 20 January 2020, available at www.unwto.org/international-tourism-growth-continues-to-outpace-the-economy.

cent of global employment and 10 per cent of global gross domestic product (GDP).[271] Tourism consists of various resource-consuming practices including flights, accommodation, restaurants and attractions. Tourism practices follow the traditional linear economy paradigm that has an impact on climate and environment. The environmental issues in which tourism plays a considerable role are energy use and emissions, biodiversity loss, water use, overconsumption (of food but also other environmental and social aspects) and waste generation.

69. Tourism's share of global fossil energy consumption and associated emissions of carbon dioxide (CO_2) is estimated at 5 per cent globally for 2005, of which tourism transport was responsible for 75 per cent (air transport 40, car transport 32 and other transport 3 per cent), accommodation for 21 per cent and activities for 4 per cent.[272] Air transport also has a considerable non-CO_2 impact on climate change due to effects at high altitude. A more recent study, using a wider scope, points at tourism representing around 8 per cent global emissions in 2013.[273] In 2016, transport-related tourism emissions alone were estimated to represent 5 per cent of global emissions and forecast to grow by 25 per cent by 2030, under a current ambition scenario.[274] Under another (pre-COVID) business-as-usual scenario, worldwide tourism is on track to exceed the complete carbon budget for all sectors and households required to stay within the maximum temperature increase agreed upon in the Paris Agreement by 2060–2070.[275] This relates to the high energy use in tourism, notably in transport and accommodations where it increases with luxury.

70. Travel distance and modal choice are the key determining factors in transport emissions from tourism. UNWTO and the International Transport Forum (ITF) forecast the number of domestic and international arrivals to reach 15.6 billion and 1.8 billion by 2030 respectively. Tourism arrivals by surface modes of transport will grow by 70 per cent between 2016 and 2030 (almost 5 billion trips more), but emissions from these trips will grow by 12 per cent (691 million to 775 million tonnes of CO_2), representing 44 per cent of the total (compared to 50 per cent in 2016). In contrast, in 2030, tourism arrivals by air (both international and domestic) are expected to represent 33 per cent of the total arrivals but to produce 56 per cent of emissions.[276] The type and volume of growth will depend on the post-COVID-19 development of tourism.

71. Water use in tourism is problematic in a range of destinations due to travel taking place in warm countries during dry seasons, with high consumption for swimming pools, accommodations and attractions, but also, for instance, in the production of artificial snow for winter tourism.[277] This leads to pressures on water availability, groundwater levels and frequently inadequate infrastructure.

72. Food consumption in tourism, with an estimated 75 billion meals a year, leads to a range of environmental issues.[278] For instance, the average food waste shares of hospitality

[271] UNWTO and the International Transport Forum (ITF), *Transport-related CO_2 Emissions of the Tourism Sector – Modelling Results* (Madrid, 2019).

[272] UNWTO and UNEP, *Climate Change and Tourism: Responding to Global Challenges* (Madrid, 2008).

[273] Manfred Lenzen and others, "The carbon footprint of global tourism", *Nature Climate Change*, vol. 8 (May 2018), pp. 522–528.

[274] UNWTO and ITF, *Transport-related CO_2 Emissions of the Tourism Sector, Modelling Results* (Madrid, 2019).

[275] P.M. Peeters, "Tourism's impact on climate change and its mitigation challenges: How can tourism become 'climatically sustainable'?", doctoral thesis, Delft University of Technology, 2017.

[276] UNWTO and ITF, *Transport-related CO_2 Emissions of the Tourism Sector, Modelling Results* (Madrid, 2019).

[277] Stefan Gössling, "New performance indicators for water management in tourism", *Tourism Management*, vol. 46 (February 2015), pp. 233–244.

[278] Stefan Gössling and others, "Food management in tourism: Reducing tourism's carbon 'foodprint'", *Tourism Management*, vol. 32, No. 3 (June 2011), pp. 534–543.

waste and restaurant waste are estimated at 40 per cent and 60 per cent, respectively.[279] UNEP estimated that international tourism would be responsible for around 200 Mt of waste in 2050, which appears a conservative estimate since international tourists in Europe already produce 1 kg of solid waste per day.[280] Tourism waste can stress the local waste management infrastructure, particularly during the high season and in destinations where facilities are still underdeveloped.

73. Tourism contributes to biodiversity loss through land conversion, indirectly through its share in GHG emissions, overexploitation of natural resources for food, materials, freshwater and recreation, the spread of invasive species, disturbance of wildlife, and pollution from wastewater, sewage effluents, solid wastes, use of fertilisers and pesticides.[281] Tourism can also contribute to biodiversity protection through nature conservation. At the global level, the share of land use for tourism is still small. But locally, tourism can have strong impacts and cause many issues with land rights and land distribution, including competition with nature and agriculture and issues with landscape quality.[282]

74. Next to these environmental issues is the relatively recent problem of over-tourism, which describes situations "in which the impact of tourism, at certain times and in certain locations, exceeds physical, ecological, social, economic, psychological, and/or political capacity thresholds".[283] The underlying contributing factors to over-tourism are often related to those causing some of the above-mentioned environmental problems such as tourist density, air travel intensity and online rental platform (such as Airbnb[284]) bed capacity shares.

75. Modelling shows that the resource use of energy and emissions, water, land and food by the tourism sector will double within 25 to 45 years.[285] This will contribute to already significant anthropogenic stress on several planetary boundaries,[286] and is in conflict with policy objectives such as those formulated in the Paris Agreement and the Sustainable Development Goals. Many of these stresses already have, or will have, impact on tourism itself, like climatic change that may lead to shifts in the attractiveness of destinations, causing tourist flows to change, increasing water and snow shortages impacting the tourism offer, or weather extremes damaging tourism infrastructure, ultimately also leading to reduced incomes and contributions to national and local economies.

76. While the transformation to a more sustainable development of tourism has been pursued at all levels for at least two decades, attempts have not succeeded on a broad scale and cannot keep up with the impacts of the overall growth in volume. UNWTO acknowledges that approaches "such as the circular economy – promoting business models based on renewable resources, longer and diverse product life cycles, shared consumption and interconnected value chains – can play a significant role when designing and improving

[279] Sanaa I. Pirani and Hassan A. Arafat, "Solid waste management in the hospitality industry: A review", *Journal of Environmental Management*, vol. 146 (December 2014), pp. 320–336.

[280] UNEP, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* (Nairobi, 2011).

[281] UNWTO, *Tourism and Biodiversity – Achieving Common Goals Towards Sustainability* (Madrid, 2010).

[282] Ward Anseeuw and others, *Land rights and the rush for land: Findings of the Global Commercial Pressures on Land Research Project* (Rome, International Land Commission, 2012).

[283] Paul Peeters and others, "Research for TRAN Committee - Overtourism: impact and possible policy responses. European Parliament, Policy Department for Structural and Cohesion Policies", (Brussels, European Parliament, Policy Department for Structural and Cohesion Policies, 2018), p. 22.

[284] Reference to commercial companies and products does not imply endorsement by the United Nations or its Member States.

[285] Stefan Gössling and Paul Peeters, "Assessing tourism's global environmental impact 1900–2050", *Journal of Sustainable Tourism*, vol. 23, No. 5 (March 2015), pp. 639–659; See also UNEP and UNWTO, *Tourism in the Green Economy – Background report* (Madrid, 2012).

[286] Steffen and others, "Planetary boundaries: Guiding human development on a changing planet".

resource management systems not only in the tourism sector, but also for the sustainable development of destinations".[287]

77. In essence, the circular economy concept is seen as an alternative business model to the traditional linear economic development model, with a fundamental role for the environment. An overarching definition for the circular economy is that of "an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates … with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" [288], and thus is a condition for the sustainable development of tourism.[289] Its classic 3 Rs principles (reduction, reuse and recycle) are frequently extended to "ladders" or R-frameworks, containing up to 10 principles or strategies (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover).[290] The main benefits of circular economy lie in its potential to boost sustainable development and lower pressure on the environment, whilst also creating economic gain and jobs. Some stress that circular economy cannot be used as a system to support further economic growth.[291] Technological, but more so cultural barriers, are found to be the most pressing in slowing down the transition to circularity.[292]

78. The United Nations Development Programme (UNDP) and UNEP identify tourism as one of a few sectors that are key to the economic development of all countries, while also providing opportunities for climate change mitigation through resource efficiency and increasing circularity.[293] They recommend a circular or value chain approach to tourism, to allow for the identification and assessment of its interdependencies with other sectors, for example those defined for climate action. Under a circular economy approach, responses could be developed that would drive (climate) action across all the various sectors on which tourism depends. Tourism's strong relation to food production, distribution and disposal is named as an example. UNDP sees a particular potential for a circular economy approach in tourism in countries where tourism is a large economic force.[294] The circular economy is regarded as very promising for contributing to the achievement of several Sustainable Development Goals, particularly Goal 7 on energy, Goal 8 on economic growth, Goal 11 on sustainable cities, Goal 12 on sustainable consumption and production, Goal 13 on climate action, Goal 14 on oceans and Goal 15 on life on land.

79. The main policy challenge related to circular economy is to ensure its effective definition and implementation in the tourism sector, specifically because of the number of different industries forming part of the tourism value chain – from building to transport – and its being mainly a service sector. Policy awareness is also an issue as, in their 2019 review

[287] UNWTO and United Nations Development Programme (UNDP), *Tourism and the Sustainable Development Goals – Journey to 2030* (Madrid, 2018). See p. 94.

[288] Julian Kirchherr and others, "Conceptualizing the circular economy: An analysis of 114 definitions", *Resources, conservation and recycling*, vol. 127 (September 2017), pp. 221-232. See p. 229.

[289] Note the definition of sustainable tourism: "Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities." UNEP and WTO, 'Making tourism more sustainable: a guide for policymakers', (Paris, 2005), p. 12.

[290] José Potting and others, "Circular economy: what we want to know and can measure. Framework and baseline assessment for monitoring the progress of the circular economy in the Netherlands", (The Hague, PBL Netherlands Environmental Assessment Agency, 2018), p. 27.

[291] Patrizia Ghisellini and others, "A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems", *Journal of Cleaner Production*, vol. 114 (September 2015), pp. 11-32.

[292] Julian Kirchherr and others, "Barriers to the Circular Economy: Evidence From the European Union (EU)", *Ecological Economics*, vol. 150 (April 2018), pp. 264-272.

[293] UNDP, *A 1.5°C World Requires a Circular and Low Carbon Economy* (New York, 2020).

[294] Ibid.

of 73 national tourism policies, UNWTO and UNEP only found one reference to circularity.[295]

3. State, main trends and recent developments

80. The *Circularity Gap Report 2020* estimated the global circularity rate at 8.6 per cent, down from 9.1 per cent in 2018, while 17 per cent is required to close the global emissions gap. [296] Progress in the development of circular economy in the pan-European region is varied.

81. ECE reports an increase in the efficiency of resource use in its region from 2000 to 2017. While domestic material consumption per unit of GDP decreased by about 10 per cent, aggregate output increased by 40 per cent. Again, there are large differences between ECE countries, with an average 3.1 per cent decrease of domestic material consumption by European members of OECD versus an increase in eastern ECE States. In the same period, the material footprint continued to grow by 18 per cent in the ECE region, partly due to the import of raw materials, substituting domestic production. ECE also points to the major role of ECE countries in global material demand and a consequent responsibility (in a transition towards more sustainable consumption and production) beyond the ECE region.[297] This issue is also extremely present in international tourism, where resources are mainly consumed abroad. Material resource use in the ECE region is very much a mirror of the economic level of States: in less advanced economies, growth is accompanied by high resource use, whereas in more developed (service) economies material use is less intensive.

82. In the European Union, the circular material use rate (recovered materials as a percentage of overall materials used) increased from 8.2 per cent in 2004 to 11.2 per cent in 2017, though with little change since 2012.[298] The Netherlands, for instance, is regarded as a global circularity front-runner (rate of 24.5 per cent), whereas a country like Norway (2.4 per cent) lags far behind the global average.[299]

83. The European Commission, as part of its European Green Deal[300] and for aligning to new strategies, presented a new circular economy action plan in March 2020,[301] following an earlier version.[302] In its circular economy action plan, the European Commission notes that "Scaling up the circular economy from front-runners to the mainstream economic players will make a decisive contribution to achieving climate neutrality by 2050 and decoupling economic growth from resource use, while ensuring the long-term competitiveness of the [European Union] and leaving no one behind". To achieve this shift, the "[European Union] needs to accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advance towards keeping its resource consumption within planetary boundaries, and therefore strive to reduce its consumption footprint and double its circular

[295] UNWTO and UNEP, *Baseline Report on the Integration of Sustainable Consumption*.

[296] Laxmi Haigh and others, "The circularity gap report 2021", (n.p., Circle Economy, 2021), available at www.circularity-gap.world/2021.

[297] E/ECE/1495, "Circular economy and the sustainable use of natural resources: Trends and opportunities in the region of the Economic Commission for Europe" paras. 2–3.

[298] de Wit, Hoogzaad and von Daniels, *Circularity Gap Report 2020.*

[299] Laxmi Adrianna Haigh, "Countries: The crucial piece to finish the circular economy puzzle", Circle Economy, 2 November 2020, available at www.circle-economy.com/blogs/countries-the-crucial-piece-to-finish-the-circular-economy-puzzle.

[300] European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal, COM(2019) 640 final.

[301] European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, A new Circular Economy Action Plan. For a cleaner and more competitive Europe, COM(2020) 98 final.

[302] European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, Closing the loop – An EU action plan for the Circular Economy, COM(2015) 614 final.

material use rate in the coming decade". The action plan includes proposals on product design, circular production processes, waste reduction and consumer empowerment. The European Parliament followed up with a resolution on the action plan, demanding additional measures aiming for a fully circular economy by 2050.[303] The resolution underlines the major contribution that the circular economy may give to reaching the goals of the Paris Agreement and the Convention on Biological Diversity, as well as to achieve the Sustainable Development Goals.

84. Circular approaches have yet to make it into direct European Union tourism policy, the Commission's current framework being from 2010.[304] The Council of the European Union encourages European Union member States to consider a number of challenges and opportunities when developing tourism strategies and policies, of which "sustainability, including resource efficiency, circular economy, seasonality and the management and distribution of increasing tourism flows" is one. Policies are to contribute to European Union climate goals, the Paris Agreement and the Sustainable Development Goals.[305] It is likely that circular economy aspects will be included in the Tourism Transition Pathway process leading up to a new European Agenda for Tourism 2030/2050.[306]

85. The development of circular economy in tourism – and therefore also for sustainable development of tourism – globally and in ECE countries is still very limited. Tourism products are very diversified, often cross-sectoral and usually consist of a whole range of components, such as accommodation, transport, activities, and food and beverages. The tourism value chain is complex. A vast number of businesses and organizations are responsible for all these tourism components, with the tourist often combining them into a final product.[307] It may thus prove difficult to apply circular economy principles to overall tourism products on a large scale. To address single components will be more practicable, but a value chain approach will be more rewarding in the longer term. There are some longer established businesses in tourism that are linked to circularity, based around replacing ownership by access, offering shared amenities and product-service-systems.[308] Well-known examples are Airbnb and Uber. Currently, such initiatives present a range of adverse effects, including additional house building and car-kilometres, beside a range of other environmental, social and leakage issues.[309] Examples of sharing without these externalities can be found in transport (bicycle and, to a lesser extent, scooter schemes). Examples are also found in traditional accommodations (circular hotels). The UNEP and UNWTO Global Tourism Plastics Initiative include commitments such as the engagement of the value chain in moving towards 100 per cent of plastic packaging being reusable, recyclable, or

[303] European Parliament, European Parliament resolution of 10 February 2021 on the New Circular Economy Action Plan, (2020/2077(INI)).

[304] European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, Europe, the world's No 1 tourist destination – a new political framework for tourism in Europe, COM(2010) 352 final.

[305] Council of the European Union, Outcome of Proceedings, The competitiveness of the tourism sector as a driver for sustainable growth, jobs and social cohesion in the EU for the next decade, 9707/19 TOUR 10 IND 186 COMPET 434.

[306] European Commission Staff Working Document, "Scenarios towards co-creation of transition pathway for tourism for a more resilient, innovative and sustainable ecosystem", SWD(2021) 164 final.

[307] Stefán Einarsson & Fabrice Sorin, "Circular Economy in travel and tourism: A conceptual framework for a sustainable, resilient and future proof industry transition", (CE360 Alliance, 2020).

[308] Jesper Manniche and others, "Destination: A circular tourism economy. A handbook for transitioning toward a circular economy within the tourism and hospitality sectors in the South Baltic Region", (Centre for Regional and Tourism Research, 2017).

[309] Paul Peeters and others, "Research for TRAN Committee - Overtourism: impact and possible policy responses. European Parliament, Policy Department for Structural and Cohesion Policies", (Brussels, European Parliament, Policy Department for Structural and Cohesion Policies, 2018).

compostable, investments to increase recycling rates, and public reporting of targets.[310] Some measures can be simple and effective, like making drinkable tap water accessible in public places, reducing tourist dependence on bottled water and prevent packaging waste.[311]

86. The COVID-19 pandemic has had a devastating effect on tourism, particularly international tourism. UNWTO reports that, in 2020, global international arrivals dropped by 74 per cent due to travel restrictions and various socioeconomic challenges. For the first three quarters of 2021, international arrivals continued at 76 per cent below 2019 levels.[312] The collapse of international tourism in 2020 alone was estimated to represent a loss of $1.3 trillion in export revenues and around 120 million direct jobs at risk. There is growing scientific and political consensus that a recovery of the sector must be anchored on sustainability to reduce impacts and underpin resilience.[313] UNWTO acknowledges that the COVID-19 crisis "has raised awareness of the importance of local supply chains and the need to rethink how goods and services are produced and consumed, both key elements of a circular economy. Integrating circularity and further advancing resource efficiency in the tourism value chain represent an opportunity for the tourism sector to embrace a sustainable and resilient growth pathway".[314] Thus, for a circular economy transition in tourism, UNWTO recommends investing in transforming tourism value chains, integrating circular economy processes, prioritizing sustainable food approaches for circularity and shifting towards a circularity of plastics in tourism. UNWTO concludes that there is growing consensus among tourism stakeholders that recovering from the pandemic must also involve tackle the underlying reasons and sustainability challenge. However, the time for a genuine transition is short, with many tourism-dependent countries and businesses desperate to reopen after various lockdowns, and consumers longing for holidays away from home. A return to business-as-usual is a risk, with implications for (additional) investments in sustainable or circular tourism development. In terms of energy use (and emissions), the faster recovery of domestic tourism that some countries have experienced is positive in terms of circular economy.

4. Indicators

87. Universally agreed circular economy indicators are still being developed. A simple and effective monitoring framework was called for in the first European Union circular economy action plan. In 2018, the European Commission presented a new set of measures

[310] UNEP, UNWTO and Ellen MacArthur Foundation, "Global Tourism Plastics Initiative - Recommendations for the tourism sector to continue taking action on plastic pollution during COVID-19 recovery", (2020).

[311] European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, A new Circular Economy Action Plan. For a cleaner and more competitive Europe, COM(2020) 98 final.

[312] UNWTO, "2020: Worst Year in Tourism History with 1 Billion Fewer International Arrivals", 28 January 2021, available at www.unwto.org/news/2020-worst-year-in-tourism-history-with-1-billion-fewer-international-arrivals, and UNWTO, "UNWTO World Tourism Barometer and Statistical Annex, November 2021", available at www.e-unwto.org/toc/wtobarometereng/19/6.

[313] Gössling, Scott and Hall, "Pandemics, tourism and global change: a rapid assessment of COVID-19"; Organisation for Economic Co-operation and Development (OECD), "Tourism Policy Responses to the coronavirus (COVID-19)", 2 June 2020, available at www.oecd.org/coronavirus/policy-responses/tourism-policy-responses-to-the-coronavirus-covid-19-6466aa20/; UNWTO, "One planet vision for a responsible recovery of the tourism sector", available at www.unwto.org/covid-19-oneplanet-responsible-recovery-initiatives; UNGA, "Promotion of sustainable tourism, including ecotourism, for poverty eradication and environment protection", December 2020, available at https://undocs.org/en/A/RES/75/229, and United Nations Sustainable Development Group, "Policy Brief: COVID-19 and Transforming Tourism", August 2020, available at https://unsdg.un.org/resources/policy-brief-covid-19-and-transforming-tourism.

[314] UNWTO, *Recommendations for the Transition to a Green Travel and Tourism Economy* (Madrid, 2021).

including a Monitoring Framework for the Circular Economy,[315] which was operationalized by Eurostat.[316] The framework consists of 10 indicators, some of which are broken down into subindicators, and aims at measuring progress towards a circular economy in a way that encompasses its various dimensions at all stages of the lifecycle of resources, products and services. Indicators cover four thematic areas: production and consumption; waste management; secondary raw materials; and competitiveness and innovation. The list is constructed to be short and focused. It uses available data while also earmarking areas where new indicators are in the process of being developed, particularly for green public procurement and food waste. The European Commission indicators are largely restricted to the circulation of materials and focused on waste, partly due to the availability and reliability of data, and the lack of other options.[317] In its 2021 resolution, the European Parliament calls on the Commission to propose binding European Union targets for 2030, to be monitored with new indicators to be adopted by the end of 2021, as part of an updated Monitoring Framework for the Circular Economy. The European Commission relates these new indicators to the focus areas in its action plan, but it also desires interlinkages between circularity, climate neutrality and its zero-pollution ambition.

88. In previous decades, the impacts of tourism have been measured from an economic angle and it has become pressing to redefine how success is measured, which implies reinforcing the measurement of social and environmental dimensions – with circular economy indicators playing an important role for the latter. Therefore, in 2016, the UNWTO with the support of the United Nations Statistics Division (UNSD) launched the initiative Towards a Statistical Framework for Measuring the Sustainability of Tourism (SF-MST). The aim of the SF-MST is to "develop an international statistical framework for measuring key aspects of tourism's role in sustainable development, including economic, environmental and social dimensions".[318] In the last reported development stage of SF-MST, the four core main accounts identified were flows of water, energy, GHG emissions and solid waste.[319]

89. As the literature on circular economy in tourism is still in its infancy, there are very few direct references to indicators for measuring the circular economy in tourism other than their recommendation. UNWTO and UNEP assert that "embracing circularity implies robust measurement and monitoring of the sustainable development impacts of economic activities".[320] Effective indicators need to be relevant to core issues and (statistical) data for evaluation need to be available and should be comparable over time and geographical, economic or political regions. Others recommend not making indicator (sets) too ambitious.[321] This may be politically and scientifically appealing but is not necessarily practicable. They also advise against a "choice overload", suggesting that the focus be on a small set of meaningful indicators. Indicators to monitor the circularity of tourism could be generated from policymaking related to the establishment of the pan-European Shared

[315] European Commission, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions on a Monitoring framework for the circular economy, COM(2018) 29 final.

[316] Eurostat, Circular Economy – Monitoring Framework, available at https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework.

[317] Opinion of the European Economic and Social Committee on the 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a monitoring framework for the circular economy', *Official Journal of the European Union*, C 367 (2018), pp. 97–102; and Gustavo Moraga and others, "Circular economy indicators: What do they measure?", *Resources, Conservation and Recycling*, vol. 146 (July 2019), pp. 452–461.

[318] UNWTO, Working group on Measuring Sustainable Tourism. Terms of Reference (Madrid, 2016).

[319] UNWTO, Linking the TSA and the SEEA: A technical note (Madrid, 2019).

[320] UNWTO and UNEP, *Baseline Report on the Integration of Sustainable Consumption and Production Patterns into Tourism Policies* (Madrid, 2019), p. 66.

[321] Elizabeth Agyeiwaah, Bob McKercher and Wantanee Suntikul, "Identifying core indicators of sustainable tourism: A path forward?" *Tourism Management Perspectives*, vol. 24 (October 2017), pp. 26–33.

Environmental Information System.[322] Digital platforms are widely seen as an opportunity to harmonize indicators, allowing for a comprehensive outlook taking into account the economic, sociocultural and environmental aspects.

90. To propose relevant indicators for measuring and monitoring circular economy development in tourism in ECE member States, a starting point is to identify the key issues in the tourism value chain that are relevant in terms of their environmental impacts, contribution to the Sustainable Development Goals and potential for the application of circular principles. This is rather similar to the identification of "hotspots" as part of the Hotspot Analysis framework advocated in the UNEP Lifecycle Initiative.[323] UNEP considers an environmental impact to be a hotspot if it contributes to more than 50 per cent of total lifecycle impact across all of the product or service lifecycle stages in any given impact category (for example, GHG emissions, energy or water use, or waste), ensuring that most of the impact is considered.[324]

91. In the remainder of this section, a simplified approach is taken to arrive at provisional indicators at the national level, where the main elements of tourism are compared with the key environmental impact categories. Indicators could then follow from these hotspots, i.e. where the contribution of a certain element of the tourism value chain to an impact category is significantly larger or more relevant than that of other tourism elements. In "warm spots", this contribution is relevant but less pressing than in hot spots, and in "cold spots" it is not or hardly relevant. Through this analysis, based on the impact literature summarized in the preceding subsection on context, several hotspots are identified for accommodation operations, origin-destination transport, and events and activities (see table 3 below). Service providers do not make a direct impact but can serve as driving agents of impacts.

92. Several hot and warm spots in table 3 can be identified as priority areas in the tourism value chain with potential for integrating circular principles. These are the operations and building of accommodations, as well as the operations of restaurants and bars, where circular potential can be found in all impact categories except for biodiversity. They range from renewable energy usage to water saving, circular building, using circular food chains, to upscaling reuse and recycling and, as a result of some of these steps, lowering emissions. Similar potential can be identified for various activities. In transport the largest potential is in saving energy through lowering distances and energy efficiency, and switching to renewable energy sources, ultimately lowering emissions.

93. The final step is to define provisional indicators and measure their performance, to determine the current state of circularity in tourism. Where applicable, such indicators can overlap with indicators for the sustainable development of tourism. In the discussion on indicators in the following sub-sections, provisional indicators for monitoring circular economy in tourism are presented, including the origin of or a database for each indicator. Each indicator is discussed in terms of the state and trends in ECE member States, data comparability and data availability.

[322] *Sharing our vision for the pan-European region: Setting strategic goals and objectives for the Working Group on Environmental Monitoring and Assessment* (United Nations publication, ECE/CEP/187).

[323] Mark Barthel and others, *Hotspots Analysis: An overarching methodological framework and guidance for product and sector level application* (UNEP, 2017).

[324] UNEP, "How to map tourism value chains and identify key actions: Online training #1 – Sustainable Tourism Programme", video, 17 April 2019, available at https://www.oneplanetnetwork.org/sites/default/files/tourism_value_chain_mapping_methodology_-_april_2019__1.pdf.

Table 3
Validating and prioritizing tourism environmental impact hotspots

Tourism element / *Impact category*	*Energy use*	*Water use*	*Material resource use and/or over-consumption*	*Waste*	*Climate change and/or GHG emissions*	*Bio-diversity*
Accommodation: Buildings	Warm	Warm	Warm	Warm	Warm	Warm
Accommodation: Operations	Hot	Hot	Hot	Hot	Hot	Cold
Restaurants and bars: Buildings	Warm	Warm	Cold	Warm	Cold	Cold
Restaurants and bars: Operations	Warm	Warm	Warm	Hot	Warm	Cold
Transport: Local	Warm	Cold	Cold	Cold	Warm	Warm
Transport: Origin to destination	Hot	Cold	Hot	Cold	Hot	Warm
Activities: Events, attractions and festivals	Warm	Warm	Hot	Hot	Cold	Warm
Services (tour operators, travel agencies, financial and booking services)	Driving agent					

Notes: Cold spot | Warm spot | Hotspot | Driving agent

37. Due to data limitations, sometimes only selected ECE countries from each subregion (European Union, Western Europe, Eastern Europe, South-Eastern Europe and Central Asia) are compared to show how circularity has developed over the past decade. A European Union bias could mostly be avoided, but not always due to data unavailability.

38. Indicator development is hampered by various issues. There are currently no indicators across ECE countries that give explicit information on tourism's circular state. On several general circularity aspects, classification definitions differ between States. Despite recommended standards for tourism satellite accounting going back to 2008,[325] data about tourism tends to be incomplete and suffering from varying definitions. The most important data gaps are about transport modes, transport distances travelled and almost all domestic tourism flows in terms of trips, arrivals, nights, passenger-kilometres and transport modes used. Finally, detailed statistics needed for accurate circularity monitoring in tourism are largely absent. Digitalization holds promise for better and more uniform measurement and monitoring but depends on the availability of uniform and relevant data on circular economy in tourism.

Waste generation

39. Reducing waste is a focus in aiming for circularity, and tourism contributes significantly to local waste production. Tourism inflows significantly increase municipal solid waste generation (measured per resident) at first, up to a turning point where more

[325] UNWTO, "UN standards for measuring tourism", https://www.unwto.org/standards/un-standards-for-measuring-tourism

arrivals contribute to lowering municipal waste per capita due to a counterbalancing technological effect linked to changes in the characteristics of tourism firms that arise with an increase in tourism arrivals.[326] For achieving a circular tourism economy, special attention needs to be drawn to countries with a high tourism activity and high disposal rate. The examples of the Netherlands, Norway and Turkey show that national municipal waste disposal (i.e. not composted, recycled or energy recovered) shares differ greatly from country to country. While the Netherlands disposes of 2.6 per cent of its total municipal waste, Norway disposes of 9.7 per cent and Turkey 88.4 per cent. And whereas the Netherlands has cut its disposal rate in half since 2010, Norway has increased its disposal share, mainly due to an increasing amount of waste.

40. To determine the real impact of tourism on national waste production, more specific indicators must be measured. Multiplication of waste figures by tourism's share of the national GDP[327] gives an indication of waste generated by tourism. It could be considered a coarse proxy for the ratio of tourists to residents and tourist expenditure, which have been identified as factors in municipal waste generation.[328] UNWTO suggests that the collection of information for tourism may require direct data supply from tourism industries, for example estimating the volume of solid waste generated per visitor.[329] The European Tourism Indicator System suggests determining percentage waste recycled per tourist compared to total waste recycled per resident per year. [330]

41. Future policies may use tourism income to invest in recovery plants, or to introduce a maximum tourism capacity where necessary to manage the amount of waste. Furthermore, tourism businesses may be asked to actively reduce waste production by banning non-recyclable packaging and encouraging restaurants and hotels to donate food leftovers.

Water consumption

42. There is strong evidence that tourists use considerably more water at their destination than they do when at home and compared to local inhabitants.[331] Water consumption in tourism is closely linked to energy and food production, and best addressed in accommodations, where much of the consumption in tourism takes place.[332]

43. To make water usage circular, the aim should be that all demand is covered by renewable water sources, including closed cycle usage. No fossil water sources (fossil groundwater or ice) should be used. As tourism concentrates in the warm and dry season, many (summer) tourism destinations suffer from water shortages. In destinations with concerns about the availability of water to support tourism activity, it will not be sufficient to record only the levels of water use by tourism activities.[333] Information on the stock of water and changes in this stock also need to be recorded.

[326] Italo Arbulú, Javier Lozano and Javier Rey-Maquieira, "Tourism and solid waste generation in Europe: A panel data assessment of the Environmental Kuznets Curve", *Waste Management*, vol. 46 (December 2015), pp. 628–636.

[327] WTTC, "WTTC Data Gateway" (2021), available at wttc.org/Research/Economic-Impact/Data-Gateway

[328] Italo Arbulú and others (2015)

[329] UNWTO, Linking the TSA and the SEEA: A technical note (Madrid, 2019).

[330] European Union, *The European Tourism Indicator System: ETIS toolkit for sustainable destination management* (Luxembourg, Publications Office of the European Union, 2016).

[331] Stefan Gössling and others, "Tourism and water use: Supply, demand, and security. An international review", *Tourism Management*, vol. 33 (2012), No. 1, pp. 1–15.

[332] Gössling, "New performance indicators for water management in tourism", *Tourism Management*, vol. 46 (2015), pp. 233-244.

[333] UNWTO, Statistical Framework for Measuring the Sustainability of Tourism. Consultation Draft. Draft prepared for discussion with the Working Group of Experts on Measuring the Sustainability of Tourism (October 2018).

44. The preliminary indicator proposed for water circularity in tourism is derived from the work of Gössling and others[334] and consists of two (national) subindicators: the share of water used for tourism; and the share of renewable water in overall supply (the stock). Figures in the pan-European region differ, with frequently high tourism water shares in Mediterranean countries, while shares of renewable water vary. The share of water extracted from renewable sources depends on water scarcity and therefore differs greatly between countries.

45. Using national figures can mask water scarcity at the regional and local scales.[335] Trends show an increasing demand for fresh water in destinations, which puts pressure on renewable resources, and water scarcity is becoming an increasing problem due to climate change. More comprehensive water management indicators are recommended for bridging the gap between current scientific opinion and industry practices, addressing the water situation in the specific area, the infrastructure planning process, and operations.[336] These can be linked with circularity, such as renewable water resources per guest night (in peak season), area of solar thermal and photovoltaic panels installed per bed, and energy use per guest night.

46. Future policy responses may focus on demanding the use of water-saving technologies and a water management plan in dry regions that accounts for the allocation of water between tourism, agriculture and the local inhabitants. Furthermore, research has shown that informing tourists about their water consumption footprint and water shortage issues can have a positive impact on lowering water demand.[337] Advanced water generation methods may also become indispensable for tourism in the coming decades.

Energy use by accommodation and restaurants

47. Accommodation and restaurants account for 21 per cent of tourism emissions and are tourism's main energy consumer at the destination, excluding transport.[338] Substantial differences in the energy consumption of tourists and residents can occur, notably depending on the level of luxury and facilities of accommodation. On the other hand, the volume of emissions caused by energy use can be reduced by using renewable energy sources and energy-saving technologies.

48. The share of renewable energy in total final energy consumption at the destination can function as an indicator for circularity in tourism's non-transport energy consumption. The ECE Dashboard for Sustainable Development Goals[339] includes data on renewable energy for each member State. The European Tourism Indicator System suggests measuring the annual amount of energy consumed from renewable sources compared to overall energy consumption at the destination level per year to better define the energy consumption of tourism.[340]

49. One of the limitations of comparing destinations or nations is that the share of renewable energy in the energy mix differs greatly from country to country. For example, Iceland produces 76.7 per cent of its energy from renewable sources, while Turkmenistan uses 99.9 per cent non-renewable sources.[341] The ECE member State average is 21.5 per cent renewable energy in the energy mix. Historic development of energy supply determines the

[334] Gössling and others, "Tourism and water use: Supply, demand, and security".

[335] Ibid.

[336] Gössling (2015).

[337] Lluís Garay, Xavier Font and August Corrons, "Sustainability-oriented innovation in tourism: An analysis based on the decomposed theory of planned behaviour", *Journal of Travel Research*, vol. 58, No. 4 (April 2018), pp. 622–636.

[338] UNWTO and UNEP, *Climate Change and Tourism: Responding to Global Challenges*.

[339] Available at https://w3.unece.org/SDG/en.

[340] European Union, *The European Tourism Indicator System*.

[341] United Nations Economic Commission for Europe, Indicator 7.2.1: Renewable energy share in the total final energy consumption, %, available at https://w3.unece.org/SDG/en/Indicator?id=23.

status quo. Between 2000 and 2017, both positive and negative trends in the usage of renewable energy can be observed.

50. Future policies should focus on pushing the transition towards renewable energy, also in remote tourism destinations, and should demand the implementation of energy-saving technologies in new facilities and during renovation.

Energy use and contribution to climate change, through tourism transport

51. Tourism transport almost completely depends on fossil fuels and is the main source of tourism's CO_2 emissions, with aeroplanes also having a considerable non-CO_2 impact on climate change. Transport between the tourist's home and destination produces the bulk of the travel distance and thus of the energy use and emissions. To define circularity measures for this hotspot, it is important to know how tourists arrive at and depart from their destinations: by aeroplane, car, or a more sustainable mode of transport like bicycle, bus or train. The more tourists use these more sustainable modes and travel shorter distances, the more energy can be saved and emissions prevented. The opportunities to decarbonize transport using renewable energy are also much greater for other modes than for the aeroplane. The choice of travel mode is related to the availability of transport modes and the psychological default of transport modes of citizens of a country.

52. As there are no good indicators for tourism transport's energy use, it is proposed to look at the proportion of trips that are domestic and the proportion of international trips that are made by air.

53. With some reservations for large countries, domestic tourism trips are expected to create lower emissions than outbound travel, due to shorter distances and a transport mix that should contain less air travel. In 2019, 73.3 per cent of trips taken in the ECE countries shown in figure VI overleaf were domestic,[342] with the proportion strongly correlated with country area.[343] Between 2012 and 2019, 0.4 per cent more domestic trips were taken in European Union countries.[344]

54. In 2019, 48.6 per cent of inbound tourism in the ECE countries shown in figure VII overleaf involved arrival by air. In 2019, 49.3 per cent of outbound tourism trips from the European Union (minus Sweden but plus Switzerland) were by air, up from 46.1 per cent in 2012. Between 2012 and 2019, outbound travel by air increased in these countries by 34.8 per cent (see figure VIII overleaf), which represents 61.5 per cent of the total increase in outbound travel.

55. Future policies should invest in infrastructure for low-emission transport modes such as rail, instead of aviation, and increase marketing for domestic tourism.

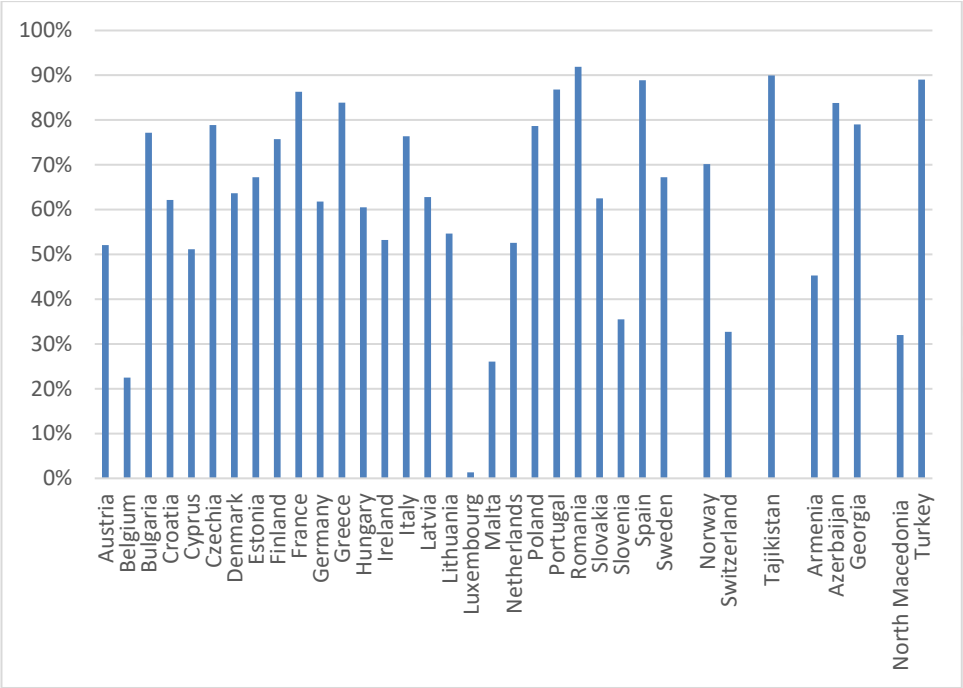
[342] Eurostat, "Number of trips by mode of transport", 21 April 2021, available at https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=tour_dem_tttr&lang=en; and UNWTO. (2021). Compendium of Tourism Statistics data set [Electronic], Series 2.9: Domestic tourism - Total trips by mode of transport – Thousands, and Series 3.2: Outbound tourism - Departures of overnight visitors (tourists) - Thousands. UNWTO.

[343] Area from ECE Statistical Database, 2020.

[344] No data for Sweden.

Figure VI

Proportion of overnight trips that are domestic, selected countries grouped by subregion, per cent (2019)

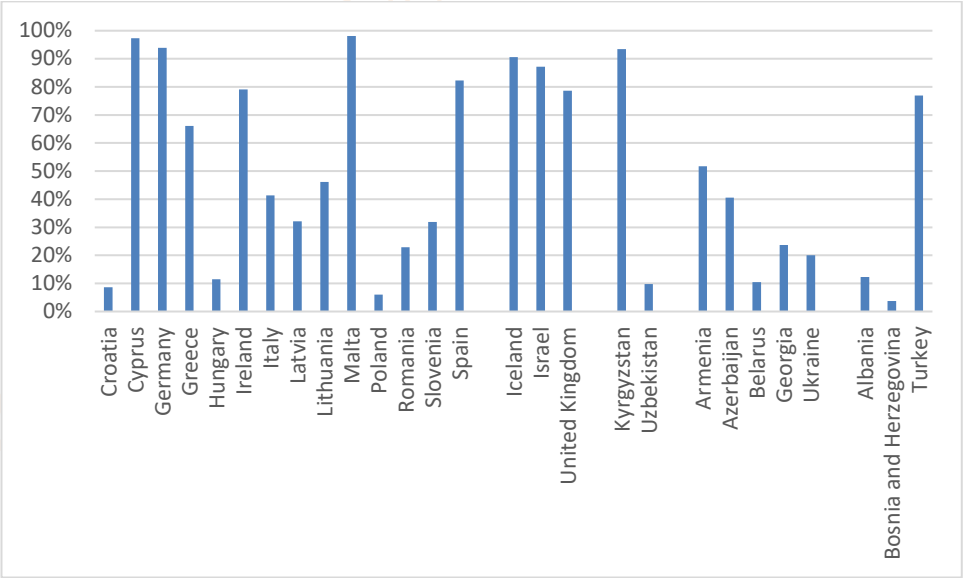


Source: UNWTO and Eurostat.

Notes: Norway and Tajikistan – 2018.

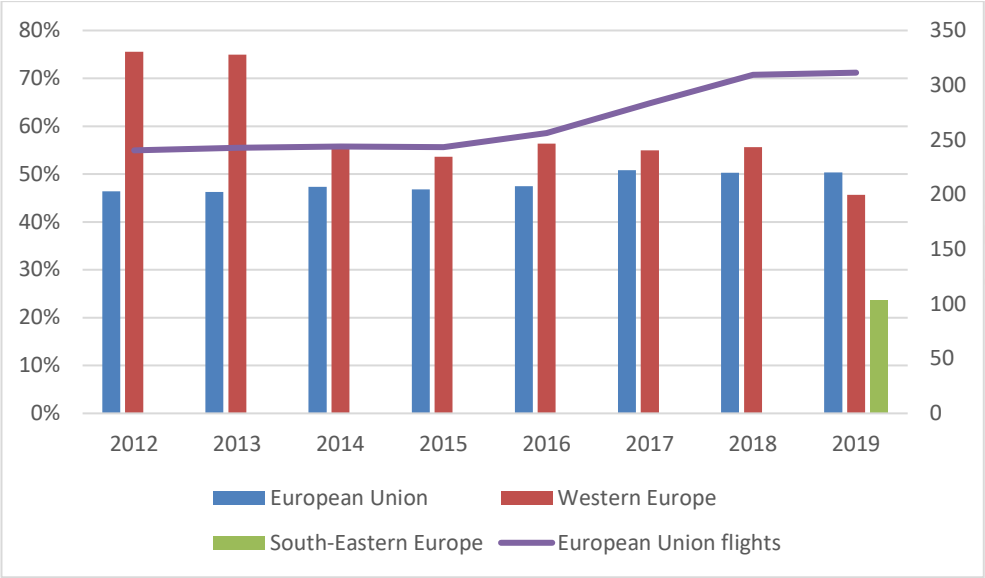
Figure VII

Proportion of in-bound arrivals by air, selected countries grouped by subregion, per cent (2019)



Source: UNWTO.

Figure VIII
Proportion of overnight outbound trips by air, per cent (left axis), and total number of flights, million flights (right axis) (2013–2019)



Source: Eurostat.

Notes: No data for Sweden in 2012–2013 (for number of flights, the value for 2014 is used); for Western Europe, only Norway (2013–2018), Switzerland (2012–2019) and the United Kingdom of Great Britain and Northern Ireland (2012–2013); for South-Eastern Europe, only North Macedonia (2019). The step change in the proportion of outbound trips by air from 2013 to 2014 in Western Europe is explained by the lack of data for the United Kingdom of Great Britain and Northern Ireland after 2013.

Material resources use for tourism facilities

56. Resource use in the construction and maintenance of tourism facilities (for example, accommodation) is high and can well be addressed with a circular economy approach. These aspects are as yet unmeasured, so this section cannot report on their state.

57. To increase circularity within tourism facilities, suggestions include using the share of circular building material flows, remanufacturing furniture, leasing contracts for high-end appliances and usage of easy-to-repair materials and interiors,[345] but these will be a challenge to use as an indicator. There are some cases where circularity in construction has been used for marketing purposes.

58. Future policies should support the usage of recycled resources and circular building material flows and make it mandatory to offer repairs for appliances.

(Sustainable) tourism management plans

59. Sustainable tourism development plans can connect destination strategies to national sustainability goals and push tourism circularity beyond simply reducing impacts.[346] Also, some international processes as for instance defined by the ECE Protocol on Strategic Environmental Assessment[347] will help to reduce impacts and thus to reduce the challenge to reach circularity. To measure tourism circularity, the integration of sustainable development (or even circular economy) policies in national tourism policy plans shows to what extent governments demand sustainable practices from tourism stakeholders and in destinations. In

[345] Jesper Manniche and others, *Destination: A circular tourism economy – A handbook for transitioning toward a circular economy within the tourism and hospitality sectors in the South Baltic Region* (Nexoe, Denmark, Centre for Regional and Tourism Research, 2017).

[346] Ibid.

[347] See https://unece.org/text-protocol.

their report on sustainable consumption and production patterns, UNWTO and UNEP review 73 national tourism policies and their extent of reporting on sustainable consumption and production is presented.[348] The report shows that biodiversity and sustainable land use have entered tourism sustainability reports in countries across the world. However, policies on water efficiency are lacking and circularity was only mentioned once. A similar pattern has been observed where tourism development plans focus on policies that facilitate growth and economic benefit, such as nature conservation, but do not define sustainability as the core of their overall strategy.[349]

61. To achieve circular practices at destinations, future policies should favour funding destination marketing organizations that base their tourism development plans not only on sustainable development principles but also on circular frameworks and opportunities to learn about circular tourism. In addition, policymakers should identify barriers to circular tourism development and provide a policy framework necessary to overcome those challenges.

5. Case studies

E-fuels for aviation

62. International aviation has been identified as one of the sectors difficult to align with climate targets,[350] despite the European Union part of aviation being part of the European Union Emissions Trading System. E-fuels are based on the well-developed power-to-liquids process: producing jet fuel (Jet A) from CO_2, water and a substantial amount of renewable energy.[351] The CO_2 source could be a large industry, but ultimately it could be the atmosphere itself. In the latter case, one would completely close the carbon cycle (hence the term "circular kerosene" is used sometimes). E-fuels need 80 per cent less land than other sustainable aviation fuels, very little water and do not compromise feedstocks, nature and agriculture. The development of e-fuels for (international) aviation is a perfect transnational case for a circular development related to tourism, which also directly contributes to international targets for mitigating climate change, in line with Sustainable Development Goal 13 (Climate Action).

63. Various projects are under development. In the Netherlands, the start-up Synkero, in collaboration with the Port of Amsterdam, Schiphol Airport, KLM and SkyNRG, aims to develop a commercial plant in the Port of Amsterdam, using waste CO_2 and green hydrogen.[352,353] SkyNRG is also building a factory for e-fuels in Delfzijl (Netherlands), with KLM, Schiphol Airport and SHV Energy.[354] The Zenid initiative, with Uniper, Rotterdam The Hague Airport, Climeworks, SkyNRG and Rotterdam The Hague Innovation Airport, aims to construct a demonstration factory for sustainable kerosene using captured CO_2 from the air as a raw material in Rotterdam.[355] The Norwegian consortium Norsk e-Fuel is planning a commercial plant for hydrogen-based renewable aviation fuel.[356] In February

[348] UNWTO and UNEP, *Baseline Report on the Integration of Sustainable Consumption*.

[349] Manniche and others, *Destination: A circular tourism economy*.

[350] Energy Transitions Commission, *Mission possible: Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century* (n.p., Energy Transitions Commission, 2018).

[351] Patrick Schmidt and others, "Power-to-Liquids as Renewable Fuel Option for Aviation: A Review", *Chemie Ingenieur Technik*, vol. 90, No. 1–2 (January/February 2018), pp. 127–140.

[352] Synkero, "Synkero: Futureproof aviation", available at https://synkero.com/wp-content/uploads/2021/06/Synkero-White-Paper.pdf.

[353] The mention of commercial companies, services or products does not imply endorsement by the United Nations or its Member States.

[354] SkyNRG, "SkyNRG, KLM and SHV Energy announce project first European plant for sustainable aviation fuel", 7 May 2019, available at https://skynrg.com/press-releases/klm-skynrg-and-shv-energy-announce-project-first-european-plant-for-sustainable-aviation-fuel/.

[355] SkyNRG, "Consortium launches Zenid – Sustainable Aviation Fuel from Air", 8 February 2021, available at https://skynrg.com/press-releases/consortium-launches-zenid-sustainable-aviation-fuel-from-air/.

[356] Norsk e-fuel, "Supplying your renewable fuel. Unlimited.", available at www.norsk-e-fuel.com/en/.

2021, KLM announced having carried out a passenger flight partly flown on sustainably produced synthetic kerosene, based on CO_2, water and renewable energy from solar and wind energy.[357]

64. The production process does require a very high amount of energy, however, which could further increase the mismatch between the demand for and failing increase in renewable electricity supply, and these fuels will be two to six times more expensive than Jet A was in 2017. E-fuels cannot enter the market without a very substantial tax on fossil kerosene and/or subsidies, or through the application of a mixing mandate with an increasing share over time, up to 100 per cent in 2050.[358] A mandate would be the most direct and secure way to reach the goal of zero aviation emissions in 2050, with the costs falling on airlines and thus passengers (polluter-pays principle). Mixing mandates are already included in national level aviation policies in Germany, the Netherlands, Norway and Sweden. The European Union announced its "Fit for 55" package of regulatory proposals on 14 July 2021, of which a part is a blending mandate for sustainable aviation fuel.[359]

Circular hotels and restaurants

65. 2018 saw the launch of The Circular Hotels Leaders Group in the Netherlands. A group of currently 12 hotels, mainly located in Amsterdam, have already taken many steps along the path to sustainability or are on the verge of doing so. The group explores opportunities for circular business operations and has shown that cooperation, beyond knowledge, can lead to new circular opportunities. It includes, amongst others, joint purchasing and bundling of waste streams for useful applications. Hotel Jakarta is one of the better-known examples (see box 1).

66. In 2019, Circular Restaurants Leaders Groups started in the cities of Haarlem and Rotterdam, Netherlands, as a follow-up to the Circular Hotels Leaders Group. The groups in Haarlem and Rotterdam consist of around 20 restaurants each which also explore circular solutions. The prevention of food waste plays is an important objective, but it is not the only focus. The project also focuses on circular procurement (from sustainably produced, local ingredients to circular clothing and alternatives for plastic straws), packaging, the menu, kitchen management, waste management and communication with guests.[360]

67. In Spain, the Impulsa Balears Foundation, in line with the recommendations of One Planet Vision, has built its own strategic circularity framework for the hotel sector. It is aimed at enabling good practices to be established and monitored among those within the sector, encouraging circular connections to be created along its value chain and, in this way, contributing to closing the gap in implementing the global principles relating to sustainability and tourism at a local level. The framework also proposes a metric that allows hotel companies to track their circular progress, using 81 key performance indicators that are directly linked to 125 lines of action to inspire the implementation of good circular practices.[361]

[357] KLM, "World first in the Netherlands by KLM, Shell and Dutch ministry for Infrastructure and Water Management: first passenger flight performed with sustainable synthetic kerosene", 8 February 2021, available at https://news.klm.com/world-first-in-the-netherlands-by-klm-shell-and-dutch-ministry-for-infrastructure-and-water-management-first-passenger-flight-performed-with-sustainable-synthetic-kerosene/.

[358] Jörgen Larsson and others, "International and national climate policies for aviation: a review", *Climate Policy*, vol. 19, No. 6 (January 2019), pp. 787–799.

[359] European Commission, Proposal for a Regulation of the European Parliament and of the Council on ensuring a level playing field for sustainable air transport, COM(2021) 561 final.

[360] CREM, "Circular Restaurants Leaders Group Haarlem and Rotterdam", (July 2020) available at www.crem.nl/en/1687/#more-1687

[361] Fundación Impulsa Balears, "Circularity in the hotel industry and competitiveness: a manual for implementing good practices", (April 2020) available at www.impulsabalears.org/pdf/idossiers/i_dossier_3_EN.pdf

Box 1
Sustainability and circularity measures Hotel Jakarta, Amsterdam (selection)

1. Construction
   - BREEAM "excellent" score. BREEAM stands for Building Research Establishment Environmental Assessment Method and is the certification method for a sustainable built environment.
2. Energy Consumption
   - 1700 m^2 of solar panels have been installed on the roof and on the sunny side of the building.
   - Interior garden to cool down entire interior by 5°C, so air conditioning is rarely needed.
   - Water from the surrounding Ij River used to cool down the building through its floors.
   - Ground heat pump sources natural heat to warm the hotel's water.
3. Water Usage
   - Water irrigation system that uses rainwater and greywater to water the garden and plants.
   - Water-saving showerheads and taps to reduce guests' consumption.
   - All plastic water bottles (besides in minibars) replaced with water filtration machines that purify tap water.
4. Food Sourcing and Disposal
   - The hotel's restaurant and bakery mainly use local ingredients. Food waste is recycled in a press, generating dense blocks that are used as compost.
5. Single-Use Plastics
   - Strict attitude against single-use plastics, and no plastic bottles sold.
   - Refill bathroom toiletries instead of throwaway travel versions.

Source: Hotel Jakarta (2021), Pantaleoni (2019)[362]

Circular destination

68. Since 2008, the Danish island of Bornholm has wanted to become sustainable and carbon-neutral. Inspired by the Sustainable Development Goals, the municipality defined eight development goals (see box 2). Without specifically mentioning circular goals, the wide scope, systematic approach and carbon-neutrality goals of this destination development strategy come close to how a circular tourism destination can look like. The strategy was developed by the municipality, the tourism marketing organization and various local actors leading to a successful transition over the past 13 years. The case study shows how long-term strategies co-developed by key stakeholders can have great impact and support transitioning to circular economy.

[362] Hotel Jakarta, "Sustainably built", (2021) available at www.hoteljakarta.com/sustainably-built/, and Maxime Pantaleoni, "Hotel Jakarta Amsterdam: Where circular economy meets hospitality", (August 2019) available at www.seagoinggreen.org/blog/hotel-jakarta-amsterdam-where-circular-economy-meets-hospitality

Box 2
Bornholm goals for sustainable and carbon-neutral development

1. Business: Make sustainability a good business
2. Fact-based sustainability: Document and keep track of the green transition
3. Carbon neutrality (2025 in energy production, 2032 all waste treated as resources, 2035 zero-emission society)
4. Mobility: Make a land-based transportation green
5. Housing: Make sustainable housing part of our cultural identity
6. Food products: be a pioneer within Danish sustainable food
7. Nature: make the protection of natural resources vital to everyone's bottom line
8. Inclusion: Ensure that everyone on Bornholm is part of the Bright Green Island

Source: Bright Green Island (2019)[363]

[363] Bright Green Island, "Welcome to Bornholm, Bright Green Island", (July 2019) available at www.brightgreenisland.dk/Sider/In-English.aspx

V. Strengthening environmental governance

A. Introduction

1. "Today's multilateral system is too limited in its instruments and capacities, in relation to what is needed for effective governance of managing global public goods." – Secretary-General of the United Nations, to the General Assembly on 21 September 2021.

2. Environmental governance relates to decision-making on the environment and natural resources and the interactions that take place between different actors, whether the state, private sector or civil society and at different levels, which for the purposes of this assessment are limited to regional, subregional and national. Fundamental principles of environmental governance include participation, rule of law, transparency, responsiveness, consensus, equity and inclusiveness, effectiveness, efficiency and accountability. The main interest here is in decisions, often commonly agreed, that further environmentally sustainable development.

3. Given that the Ninth Environment for Europe Ministerial Conference is being held in conjunction with a meeting of Ministers of Environment and Education, and the importance of education for participative and informed decision-making, this chapter also addresses education for sustainable development.

4. Considering the importance also of adhering human rights for good governance, the document also addresses human rights. Rights can be considered in terms of substantive rights, including the right to a clean, healthy and sustainable environment,[364] and procedural rights, such as those provided by the ECE Aarhus Convention, its Protocol on Pollutant Release and Transfer Registers (PRTRs), the Espoo Convention and its Protocol on Strategic Environmental Assessment.

5. The 2030 Agenda for Sustainable Development can also be viewed as a good governance framework as realization of the 17 Sustainable Development Goals is dependent on good governance. However, unravelling the 2030 Agenda to reveal indicators of good environmental governance is more difficult and incomplete. Not only do the indicators address environmental governance in a limited way, but there is also a severe lack of data for those indicators that are relevant.

6. Commitments to advancing gender equality and women's empowerment are a key part of the 2030 Agenda and the Sustainable Development Goals, the universal adoption of which demonstrates the global recognition of the importance of gender equality and women's empowerment for the realization of sustainable development.[365] As such, effective environmental governance must also take into consideration and analyse the effects of environmental policies and programmes through a gender perspective.

B. Intergovernmental bodies

1. Regional and subregional bodies

7. The highest-level regional meeting on environment is the Environment for Europe Ministerial Conference, prepared by the ECE Committee on Environmental Policy; their outcomes provide substantive regional input to the United Nations Environment Assembly.

8. Numerous other international bodies support environmental governance at a subregional level, including:

(a) The GREEN Action Programme Task Force, established under the Environment for Europe Ministerial Process and serviced by OECD, with its focus

[364] Recognized by the Human Rights Council on 8 October 2021 through its resolution 48/13.

[365] <https://unsdg.un.org/sites/default/files/2019-09/UNCT%20GEM%20UN%20INFO%20final%20draft%20June%202019.pdf> accessed 18 December 2021.

supporting countries in Eastern Europe, the Caucasus and Central Asia to reconcile their environment and economic goals;

(b) The Executive Committee of the International Fund for saving the Aral Sea, which promotes cooperation between the Central Asian Governments in the field of water resources and environmental management. Its subsidiary bodies include the Interstate Commission on Sustainable Development;

(c) Bodies of the European Union, including the European Environment Agency, whose task is to provide sound, independent information on the environment through its European environment information and observation network (Eionet), which brings together member (European Union members, plus Iceland, Liechtenstein, Norway, Switzerland and Turkey) and cooperating (West Balkan) countries.

9. With the dissolution of the Regional Environmental Centre for Central and Eastern Europe, only two (sub-) regional centres remain: that for the Caucasus and that for Central Asia.

2. Treaty bodies

10. The region's multilateral environmental agreements also provide a forum for environmental governance through their treaty bodies, including governing bodies, working groups and implementation or compliance bodies. These agreements include the ECE environmental treaties as well as, for example, the Barcelona Convention, the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas, the Framework Convention on the Protection and Sustainable Development of the Carpathians and, aiming at the protection and sustainable development of the Alps, the Alpine Convention.

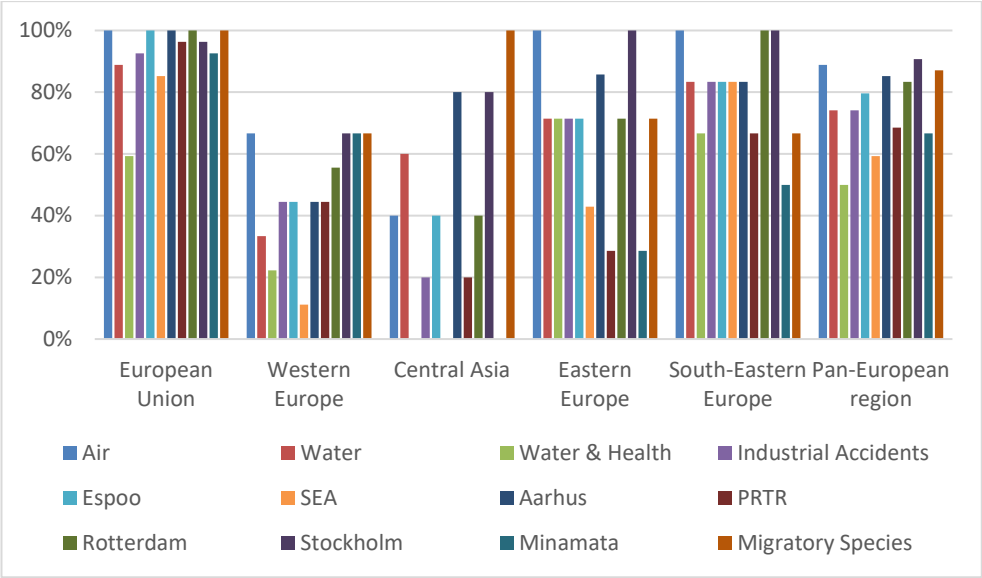
11. Though the number of parties exceeds the level of 50 per cent noted in the regional GEO-6 report, being a contracting party to these agreements (see figure I overleaf) and attendance at meetings of their governing bodies is not sufficient to ensure improved environmental governance. However, the effectiveness of such agreements can be measured through their implementation and compliance mechanisms and by assessments of the achievement of their aims and with the help of regular reporting under the agreements. For example, one of the obligations of the Parties to the ECE Water Convention is to enter into agreements on transboundary water cooperation. This obligation corresponds to Sustainable Development Goal indicator 6.5.2 on the proportion of transboundary basin area with an operational arrangement for water cooperation" (see figure II overleaf, in which improvements reflect better reporting rather than new agreements).

12. For the Espoo Convention and its Protocol on SEA, the number of occasions on which their environmental assessment procedures are applied to projects, plans, and programmes provides a good measure of their effectiveness and of improved governance, but many Parties to these agreements lack centralized databases and there is no legal obligation to report on their practical application. Another measure of effectiveness of the Espoo Convention can be determined based on the work of the Convention's Implementation Committee following a reporting exercise for the period 2015–2018. On the basis of the reports, 25 of the 45 Parties to the Convention were asked to provide clarifications, all of which were deemed satisfactory, while 2 of the 33 Parties to the Protocol were also contacted, with the Committee finding that the legislation of 1 Party was not compliant with the treaty.

13. In the case of the Air Convention, one of the basic obligations is to report national emission inventories. Emission inventories reported by Parties to the Convention in 2019 demonstrate in more than 90 per cent of cases a reduction in air pollutant emissions in the region. Regular reporting by countries of their emissions inventories enables the assessment of emission reduction trends and emission control strategies in support of informed policymaking and decision-making. In that regard, in the 2016 Scientific Assessment Report of ECE, it was detailed how reductions in particulate matters concentrations at European measurement sites and in the United States of America had declined by approximately one third between 2000 and 2012 and declined by 4 per cent in Canada, leading to an estimated prevented 600,000 premature deaths annually. The Protocol on PRTRs requires establishing and maintaining a publicly accessible national register on pollutant release and transfer.

Figure I

Membership of selected regional and global multilateral environmental agreements, by subregion, per cent of countries in each subregion that are parties

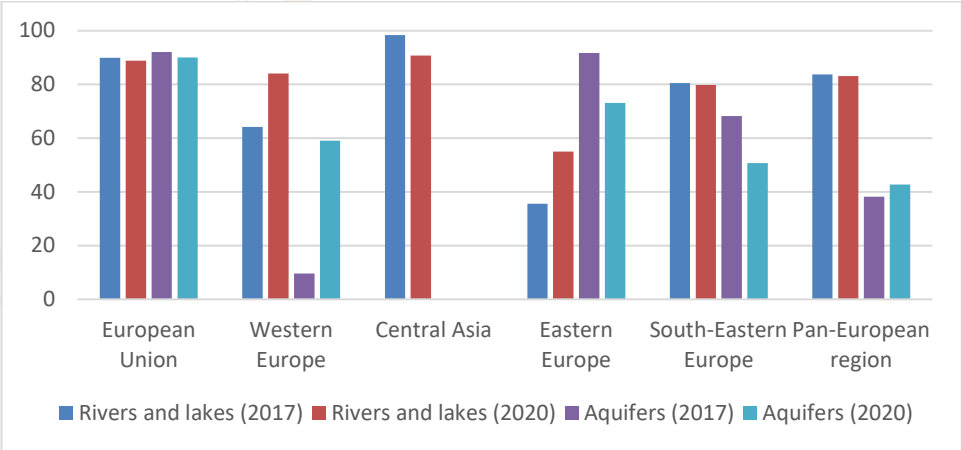


Source: United Nations Treaty Collection and websites of treaties.

Notes: Air = Convention on Long-range Transboundary Air Pollution; Water = Water Convention; Water & Health = Protocol on Water and Health; Industrial Accidents = Convention on the Transboundary Effects of Industrial Accidents; Espoo = Convention on Environmental Impact Assessment in a Transboundary Context; SEA = Protocol on Strategic Environmental Assessment; Aarhus = Aarhus Convention; PRTR = Protocol om PRTRs; Rotterdam = Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm = Stockholm Convention on Persistent Organic Pollutants Chemicals and Waste; Minamata = Minamata Convention on Mercury Chemicals and Waste; Migratory Species = Convention on the Conservation of Migratory Species of Wild Animals.

Figure II

Proportion of transboundary basin area with an operational arrangement for water cooperation, by subregion, for rivers and lakes and for aquifers, per cent (2017 and 2020)

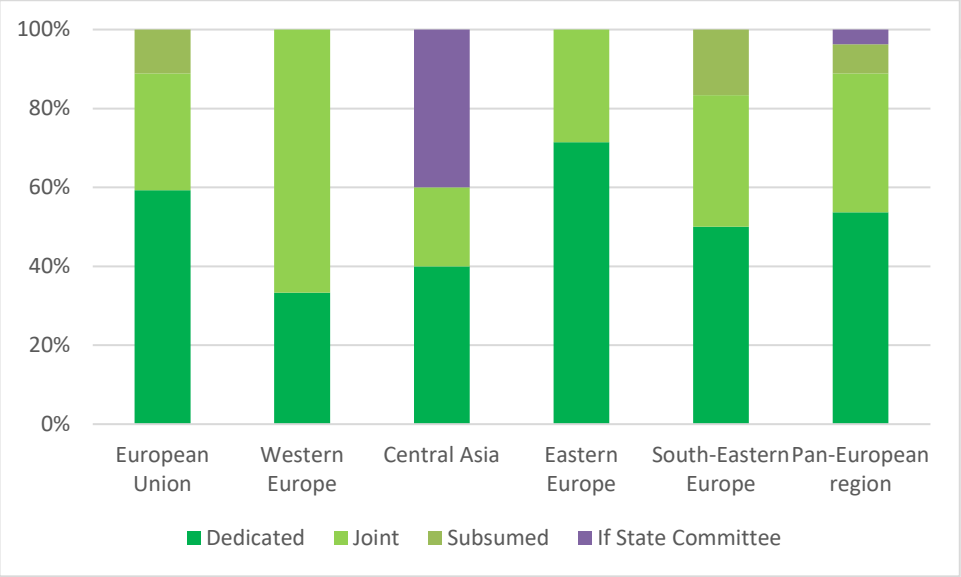


Source: United Nations Statistics Sustainable Development Goal indicator database. National values weighted by area in a transboundary basin, whether surface or groundwater, to generate subregional values. No data for Israel, Russian Federation, Tajikistan or Turkey, nor – in the case of aquifers, and among others – Finland, France, Portugal, Spain or Turkmenistan. No reported arrangements for aquifers in Central Asia.

C. National institutions and legislation

14. At the national level, the weight given the national environmental policy authority reflects the political priority given to environmental protection (the smaller States in Western Europe often have ministries leading on multiple portfolios, including the environment, because of the low number of ministers) – see figure III. One measure of national legislation for environmental governance is the existence of national environmental impact assessment (EIA) and strategic environmental assessment (SEA) laws (see figure IV).

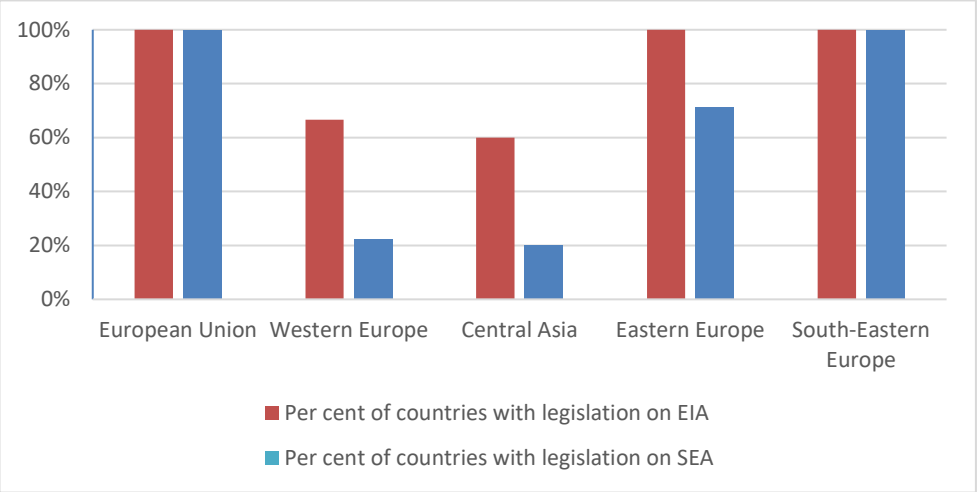
Figure III
Status of the main national environmental policy authority in each country, grouped by subregion, per cent



Source: ECE and national websites, accessed on 1 March 2021.

Notes: "Dedicated" ministry, including if with climate change, water, forests, (spatial) planning, natural resources, or sustainable development; "Joint" ministry if with at least one other economic sector; "Subsumed" ministry if no mention of the environment in the ministry's name; "If State Committee" includes "State Agency".

Figure IV
Existing national legislation on environmental impact assessment (EIA) and strategic environmental assessment (SEA), by subregion, per cent of countries in each subregion that have legislation in place



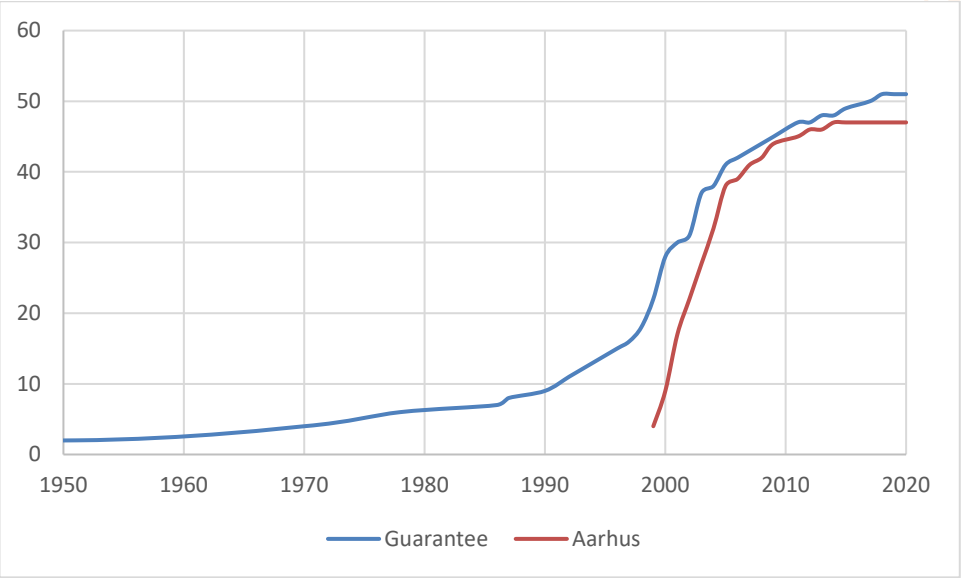
Note: This figure gives information on available legislation but does not reflect full compliance with the Espoo Convention and its Protocol on SEA, nor its effective application. Data gaps for some countries.

D. Civil society

15. The role of civil society in environmental governance is generally framed by three topics: public participation in decision-making, access to information and access to justice in environmental matters.

16. These are also the three pillars of the Aarhus Convention and the general Sustainable Development Goal indicator on access to information (16.10.2, the number of countries that adopt and implement constitutional, statutory and/or policy guarantees for public access to information) and is closely tracked by the number of Parties to that Convention (see figure V below).

Figure V
Cumulative number of countries in the pan-European region that adopt and implement constitutional, statutory and/or policy guarantees for public access to information (Sustainable Development Goal indicator 16.10.2) and number of Parties to the Aarhus Convention (to date)



Note: Sweden adopted such a guarantee in 1766. The Aarhus Convention was adopted in 1999.

17. Sustainable Development Goal indicator 16.7.2 (the proportion of population who believe decision-making is inclusive and responsive, by sex, age, disability and population group) could provide a similar picture for the pillar on public participation in decision-making, but data are severely lacking at present.

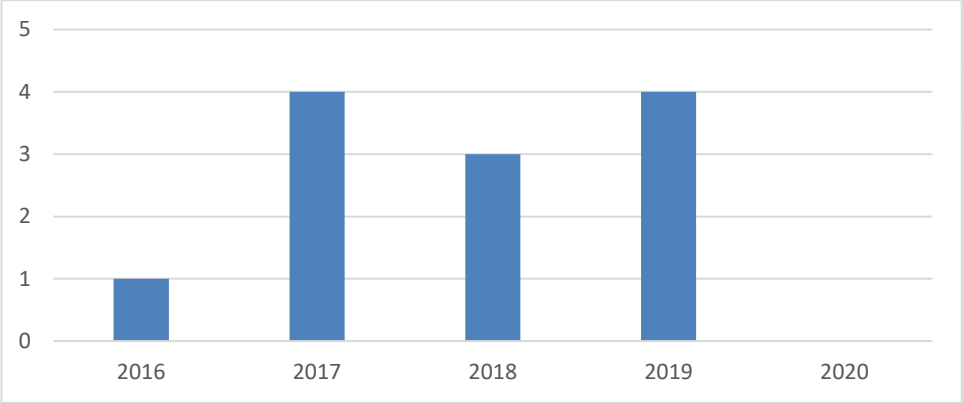
18. Access to justice is even more difficult to track. The number of environmental defenders killed might be used, but the tally is mercifully in the pan-European region (see figure VI overleaf). The number of environmental courts or courts with environmental units, or the number of environmental lawyers, per capita might provide more positive measures of access to justice in environmental matters.

19. The Espoo Convention and its Protocol on SEA promote access to information through the mandatory notification of the public on projects, plans and programmes that are likely to significantly affect the environment and provide for public participation and due consideration of the public's comments in the related decision-making and planning processes.

20. The latest Synthesis report on the status of implementation of the Aarhus Convention (ECE/MP.PP/2021/6), prepared further to the sixth reporting cycle (2017–2020) under the Convention, demonstrated that overall, most aspects of access to information and public participation have been regulated. At the same time, challenges remain in implementing certain provisions regarding access to justice and public participation. General obstacles hampering the full and effective implementation often include lack of awareness among the public authorities, financial constraints and lack of human resources and technical facilities,

or the low quality of these resources, in conjunction with lack of coordination between different environmental bodies, governmental bodies, NGOs and the public. Some countries reported considerable legislative changes to transpose the Convention's provisions into national legislation. Implementation, however, continues to vary across countries depending, inter alia, on the countries' legal traditions, governing structures and socioeconomic conditions.

Figure VI
Number of environmental defenders killed each year in the pan-European region (2016–2020)



Source: Global Witness, annual reports, 2017–2021
Note: Zero reported deaths in 2020.

21. With respect to access to information, only a few countries have updated and changed their national legislation, as most Parties already adequately address the Aarhus Convention's provisions in this area. However, some obstacles remain with respect to the access to information, including difficulties in distinguishing between environmental and non-environmental information and applying the appropriate procedure for handling requests from the public. Ensuring the public's rights to environmental information and considering at the same time rights related to commercial and industrial secrets, confidentiality of statistical information and personal data, intellectual property and copyright continue to present a challenge in many countries. Many Parties to the Aarhus Convention noted delays and missed deadlines in the provision of requested information, including due to the COVID-19 pandemic. Some Parties continue to note challenges related to review procedures of "fictitious decisions" on access to information requests. Some Parties reported obstacles, such as a lack of interoperability of databases, and incomplete and fragmented data that lead to providing incomplete information. On a positive note, Parties across the region reported significant progress in ensuring that environmental information is available in electronic databases that are easily accessible to the public through public telecommunication networks. This highlights the important contribution of the Shared Environmental Information System to environmental good governance. Numerous effective electronic tools are being further developed in this area, e.g., electronic databases, publicly accessible governmental electronic services, websites and information portals, which are routinely updated and improved. Despite the progress reported in this area, additional steps are needed in this regard in countries in the Eastern Europe and Central Asia and South-Eastern Europe subregions to enable them to establish and operate more efficient information systems and online environmental monitoring systems. This is particularly the case when it comes to pollution and emissions registers.

22. The Parties and a few non-Parties[366] to the Protocol on the Strategic Environmental Assessment reported that, in the period 2016–2018, virtually all ensured the "timely public availability" of a draft plan or programme and the environmental report, and that they did so through both public notices and electronic media (see figure V below). Some indicated that

[366] Non-Parties that timely reported and are included in the statistics above are Georgia, Italy, Kazakhstan.

other means were also employed, such as publication in the electronic journal of official announcements, in newspapers and via letters.[367] The majority identified the "public concerned" based on the geographical location of the plan or programme and/or by making the information available to all members of the public and letting them determine whether they constituted the public concerned. Many also considered the nature of the environmental effects (significance, extent, accumulation, etc.) of the plan or programme in question. In order to communicate effectively and efficiently when it concerned a regional or local plan, the plan or programme was usually announced regionally and/or locally.

23. With respect to implementation of public participation provisions of the Aarhus Convention in Eastern Europe, Central Asia and in South-Eastern Europe, countries reported recent legislative developments. These changes for some Parties focused on setting legal frameworks for public participation in environmental impact assessment, strategic environmental assessment processes and environmental permitting, while for others on improving existing provisions in this regard. Similar developments in Eastern Europe and Central Asia[368] and in South-Eastern Europe were reported by Parties to the Protocol on SEA during the third review of implementation of the Protocol in the 2016–2018 period.[369] Still, Aarhus Convention Parties from these subregions mentioned many obstacles in ensuring public participation in practice. Parties from the European Union, Iceland, Norway, Switzerland and United Kingdom subregion continue to sharpen procedures for public participation in decisions on specific activities, as well as widen the scope of decisions and decision-making stages where public involvement is required.

24. For environmental impact assessment procedures, participation is increasingly ensured by Parties to the Aarhus Convention in the screening procedure, at the scoping stage, and at the stage of draft environmental impact assessment decision prior to its adoption. The Parties to the Protocol on strategic environmental assessment reported that they ensured that the public was able to provide comments and opinions on draft plans and programmes in a number of economic areas[370] which set the framework for the development consent for projects requiring environmental impact assessment and that public increasingly participates in screening, scoping and drafting stages of preparation of environmental report.[371] The public concerned could do so primarily by sending comments to the relevant authority or focal point, or by taking part in a public hearing.

25. Other types of decisions affecting the environment, where Parties to the Aarhus Convention made efforts to ensure public participation, include building and planning decisions, integrated environmental permits/authorisations, decisions on the environmental protection measures, decisions on authorization of projects that may have a significant impact on Natura 2000 sites, decisions on nature and landscape protection, decisions on forest management, environmental licensing, decisions on the lifetime extension, and decisions related to management of radioactive waste.

26. In accordance with the Protocol on SEA, all Parties are obliged to ensure that, when a plan or programme is adopted, due account is taken of comments received through public participation. The same holds true for Parties to the Espoo Convention with respect to projects that are likely to cause significant adverse impacts.

27. In general, implementation of the access to justice provisions of the Aarhus Convention remains the most difficult pillar for Parties. Two of the main issues mostly reported were: the regulation of the rights of environmental NGOs to seek judicial or administrative remedies in environmental cases (standing); and financial barriers. Parties

[367] ECE/MP.EIA/SEA/14, Para. 34.

[368] Kazakhstan and Kyrgyzstan reported on their preparations for joining the Protocol on SEA.

[369] See Parties' reports following the link: https://unece.org/environment-policy/environmental-assessment/review-implementation-national-reporting.

[370] Including agriculture, forestry, fisheries, energy, industry including mining, transport, regional development, waste management, water management, telecommunications, tourism, town and country planning or land use

[371] ECE/MP.EIA/SEA/14, para. 27, 38.

were aware of these difficulties, and the efforts reported demonstrate how keen Parties are to promote implementation of this Convention pillar. Some Parties amended their legislative provisions as a result of developments in the case law or on the basis of recommendations by the Aarhus Convention Compliance Committee. During the current reporting cycle, four positive trends had been identified, namely:

(a) Increasing admissibility of public interest litigation environmental cases;

(b) Increasing review by courts and other review bodies of the substantive legality of challenged decisions, acts and omissions;

(c) Measures introduced to remove or reduce financial barriers;

(d) Promotion of awareness-raising and specialization of judiciary and other legal professionals in environmental matters.

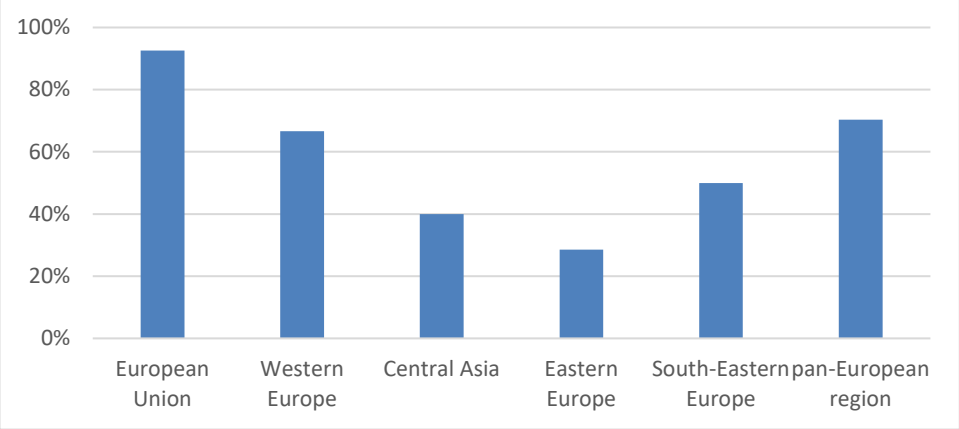
28. All reporting Parties stated in their reports that their legislation ensured the principles of non-discrimination, equality before the law, as well as protection against penalization, prosecution or harassment of persons exercising their rights under the Convention. At the same time, practice on the issue of penalization, prosecution and harassment of environmental defenders varies significantly among the Parties.

29. There is research to show that women are often excluded from environmental decision making.[372] This occurs at all levels: at the personal, household level; within private companies and at the local and national governance level.

E. Private sector

30. One indicator of the engagement of the private sector is sustainability reporting (Sustainable Development Goal indicator 12.6.1). A simple measure is whether any company in a country publishes a minimal report (see figure VII below), but the sparsity of the reporting undermines any possible message. As reporting improves, more meaningful values may emerge. Another indicator related to governance in the private sector is the "number of countries with legislation and regulation on mandatory corporate sustainability reporting" in place, as shown in table 1 below.

Figure VII
Proportion of countries in each subregion in which at least one company published a minimum requirement sustainability report (Sustainable Development Goal indicator 12.6.1), per cent



Source: Global Sustainable Development Goal Indicators Database.

[372] Lorena Aguilar and others, 'Women in Environmental Decision Making: Case Studies in Ecuador, Liberia, and the Philippines' <https://genderandenvironment.org/wp-content/uploads/2015/02/CI-REPORT.pdf> accessed 18 December 2021.

Table 1
Indicator on number of countries with legislation and regulations on mandatory corporate sustainability reporting

	European Union	Western Europe	Central Asia	Eastern Europe	South-Eastern Europe	**Pan-European region**
Number of countries with mandatory legislation	27	5	1	2	3	38

Source: Database of mandatory and voluntary instruments that either require or encourage organizations to report sustainability-related information, 2020, Carrots & Sticks, https://www.carrotsandsticks.net/

Note: There are no data for several countries in Centra Asia, Eastern Europe and South-Eastern Europe.

31. The exclusion of small- and medium-sized enterprises (SMEs) from mandatory environmental, social, governance (ESG) reporting instruments in most of the countries in the pan-European region may be one of the reasons for rather limited ESG reporting so far, considering that SMEs account for the majority of companies.

32. The European Union Non-Financial Reporting Directive (NFRD) requires certain large companies and public-interest companies to disclose material on environmental, social and employee-related matters, such as anti-bribery, corruption, and human rights performance. The forthcoming Corporate Sustainability Reporting Directive which will amend or replace the NFRD Directive should alter the picture for European Union member States requiring all large and listed European Union companies to introduce mandatory sustainability reporting standards. Under the Protocol on Pollutant Release and Transfer Registers, a lack of technical capacity in companies for emissions monitoring and data production is observed.

33. The report on the outcomes of a survey on the experiences in implementing the Protocol on Pollutant Release and Transfer Registers[373] conducted in 2020 noted that PRTRs have significantly evolved since the Protocol was adopted in 2003. The PRTRs play an important role in ensuring transparency and public participation in environmental decision-making.

F. Gender

34. Gender mainstreaming is important for both men and women. The importance of gender mainstreaming in policies and programmes stems from the fact that the needs, responsibilities and roles of men and women differ. There may be negative consequences, especially for women, if policies and programmes are developed without analysing the effects of such policies on men and women. Moreover, male perspectives are so ingrained in society that policies, programmes and infrastructure often cater to men even if a gender-neutral approach is taken. This so called "gender blind" approach results in policies and programmes that only cater to men.

35. In environmental governance it is important to make the processes gender-responsive so that the needs and interests of both women and men are taken into consideration equally, and so that the negative consequences of discriminatory policies, strategies or programmes are mitigated. Such approaches also ensure that environmental policies are equitable and that the benefits are distributed fairly.

36. In a just transition to a sustainable society, policies must be designed to include women, with the need for participation in decision making by women. This is especially

[373] Report on the outcomes of the survey on the experiences in implementing the Protocol on Pollutant Release and Transfer Registers https://unece.org/fileadmin/DAM/env/pp/prtr/WGP-8/ODS/ECE_MP.PRTR_WG.1_2020_4_E.pdf

pertinent in roles that will be subject to automation in the future and roles in the informal economy which women form a large part of.

37. Approaches to gender mainstreaming in environmental governance should also take into consideration the differences in women's experiences. Social categorizations including race, class, age and disability lead to different lived experiences for women. Thus, a one-size-fits-all approach to gender mainstreaming should be avoided.

38. Whilst there is no overarching framework for gender mainstreaming in environmental governance across the pan-European region, some ECE subprogrammes have developed guidance and are mainstreaming gender in their work. For instance, the guidelines of the Committee on Housing and Land Management were revised in 2017 to recommend the analysis of a gender dimension in housing and urban development policies. The ECE Gender Responsive Standards Initiative led to the development of a Declaration for Gender Responsive Standards and Standards Development, which invites all standards bodies to ensure that their processes are gender responsive with the ultimate foal of contributing to gender equality. Moreover, at the nineteenth session of the Steering Committee of the Transport, Health and Environment Pan-European Programme in October 2021, it was decided that further work on gender mainstreaming should be undertaken and be incorporated into the programme's workplan for 2021–2025.

39. A difficulty in analysing environmental governance that incorporates a gender perspective is the lack of a baseline and disaggregated data demonstrating how environmental policies affect women. However, even non-disaggregated data is missing for gender-related indicators on governance. For instance, only 34 per cent of countries have data for Sustainable Development Goal indicator 5.c.1 which indicates the proportion of countries with systems to track and make public allocations for gender equality and women's empowerment, and less than 50 per cent of countries have data on Sustainable Development Goal indicator 5.1.1, which indicates whether legal frameworks are in place to promote, enforce and monitor equality and non-discrimination on the basis of sex.[374]

G. Reviewing progress made and guiding future steps

40. The peer-reviewed environmental performance reviews (EPRs) carried out by ECE and OECD provide a mechanism for the regular impartial review of progress in environmental governance. The reviews also provide recommendations on how environmental performance and governance may be improved; see box 1 for an example of how implementation of recommendations made in a previous review is followed up. The figure below records EPRs carried out in the pan-European region since their instigation over 25 years ago. The methodologies employed by ECE and OECD have evolved over the past 25 years. The latest, fourth cycle of ECE reviews introduces a nexus option (for example, water-food-energy-ecosystems, air-transport-health, or water-soil-waste) to be offered to interested countries. The nexus approach will be guided by the principle of integration of governance and management across nexus components, with a view to making recommendations that increase policy coherence, improve synergies and mutual benefits and highlight trade-offs (or compromises) and decrease them over time. Such an approach is also expected to support the transition to a green economy and increase resource efficiency. The implementation of recommendations made in a nexus approach chapter would require boosted joint actions and collective efforts from relevant institutions and stakeholders.

[374] https://unstats.un.org/sdgs/UNSDG/DataAvailability, accessed 21 December 2021.

Box 1
Environmental Performance Review recommendations implemented by countries reviewed

Many countries have now undergone three reviews, at intervals of 5 to 15 years. Part of each country review is the examination of the implementation of recommendations made to the same country in the previous review. For example, in 2018, the overall rate of implementation was calculated to be 70 per cent for the two countries reviewed: Kazakhstan and North Macedonia.

Kazakhstan had 28 (80 per cent) of recommendations implemented, partially implemented or with implementation on-going, out of 35 recommendations made in its previous review in 2008. North Macedonia had 29 (63 per cent) of recommendations implemented, partially implemented or with implementation on-going out of 46 recommendations made in its previous review in 2011.

Full implementation of the recommendations from the second review had yet to be achieved by 2018 in the two reviewed countries. Lack of capacity and resources, as well as gaps in legislation, institutional development and administrative organization, and frequent changes in the institutional framework and/or in governmental policy were identified as major obstacles to the two countries' efforts to implement the EPR recommendations.

41. The fourth cycle of ECE EPRs will cover similar topics to the third cycle reviews, addressing environmental governance and financing, the domestic-international interface, media and pollution management, and the integration of the environment into selected sectors. Reviewing progress made in attaining relevant Sustainable Development Goals targets and covering green economy remains important. If requested by the country under review, the content on green economy can be enhanced to address circular economy. The climate change chapter will be strengthened and continue to focus on the impact of climate change on priority sectors, mainstreaming climate adaptation into priority sectors, mitigation of greenhouse gases and low-carbon development, among other issues. The fourth cycle EPRs will continue to address issues related to human rights and the environment, including considering the needs of vulnerable groups. The decision on the substantive content of fourth cycle EPRs will continue to be taken in a flexible manner, guided by the specific needs of each reviewed country. Assessment of the status of implementation of EPR recommendations made in previous reviews will continue to figure prominently in the ECE EPRs.

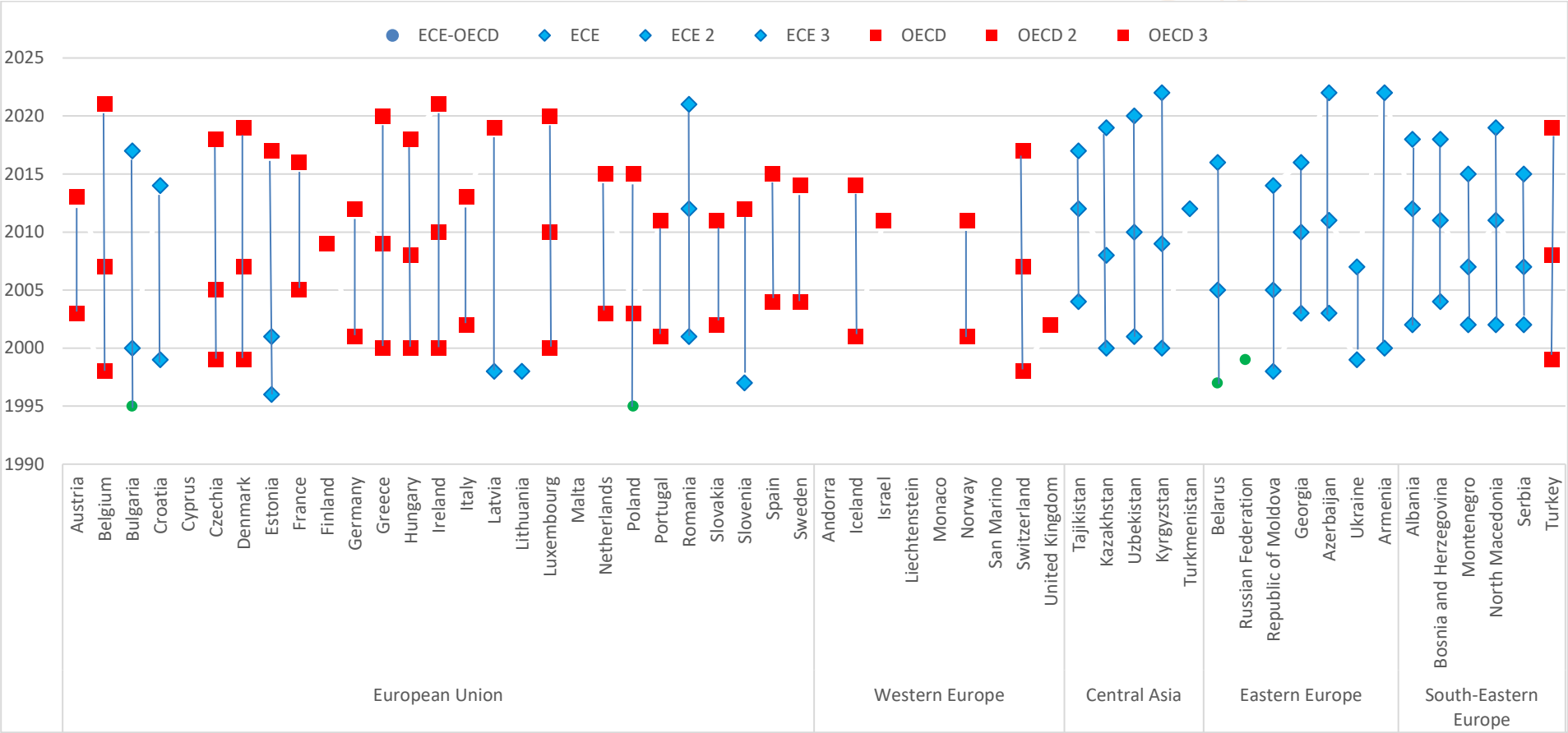
42. Figure VIII overleaf shows some gaps in coverage by the EPR programmes and the opportunities that exist for countries to benefit from further reviews employing the latest methodologies.

H. Education for sustainable development

43. Education for sustainable development (ESD) equips people with knowledge and skills to give them opportunities to lead healthy and productive lifestyles in harmony with nature and with concern for social values, gender equity and cultural diversity. Such education also endows people with capacities to play an active role in environmental governance. The UNECE Strategy for Education for Sustainable Development provides a framework for ESD in the pan-European region.

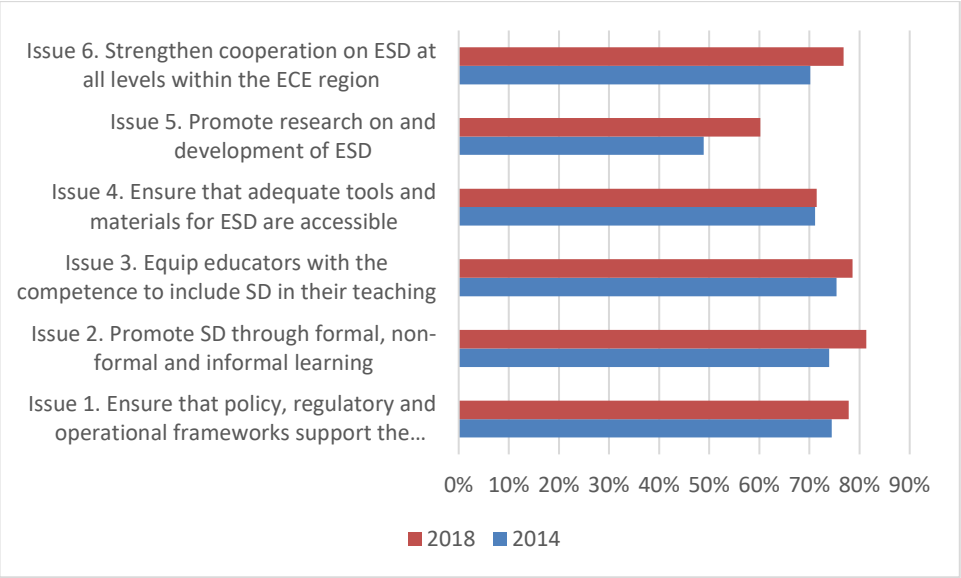
44. Periodically, a questionnaire is issued to member States to gather information on the state of ESD in each country. The two latest rounds of information gathering were in 2014 and 2018. Six issues are monitored against a series of 51 criteria. The figure IX overleaf shows progress made across all six issues. For five of the issues the level of achievement has risen from above 70 per cent to close to 80 per cent; only for the issue of research and development is a lower level of achievement evident; figure X overleaf provides a subregional perspective.

Figure VIII
Environmental performance reviews (1995–2022)



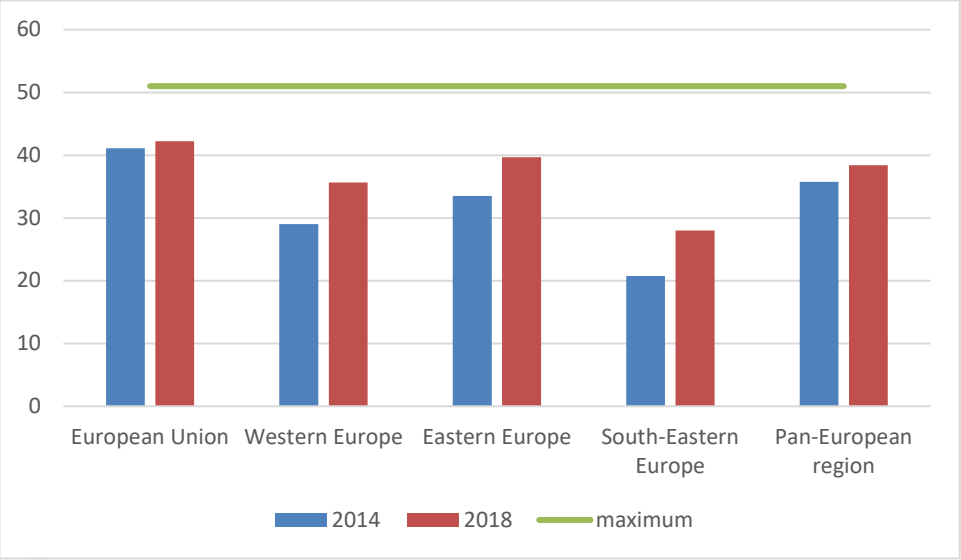
Note: The third reviews of Azerbaijan and Kyrgyzstan are underway in 2022; the second review of Armenia is also underway in 2022.

Figure IX
Proportion of maximum number of ESD criteria met in the pan-European region, by issue, per cent (2014 and 2018)



Source: ECE, national ESD implementation reports, 2014 and 2018.

Figure X
Total number of criteria met by subregion, with a maximum possible of 51 (2014 and 2018)



Source: ECE, national ESD implementation reports, 2014 and 2018.

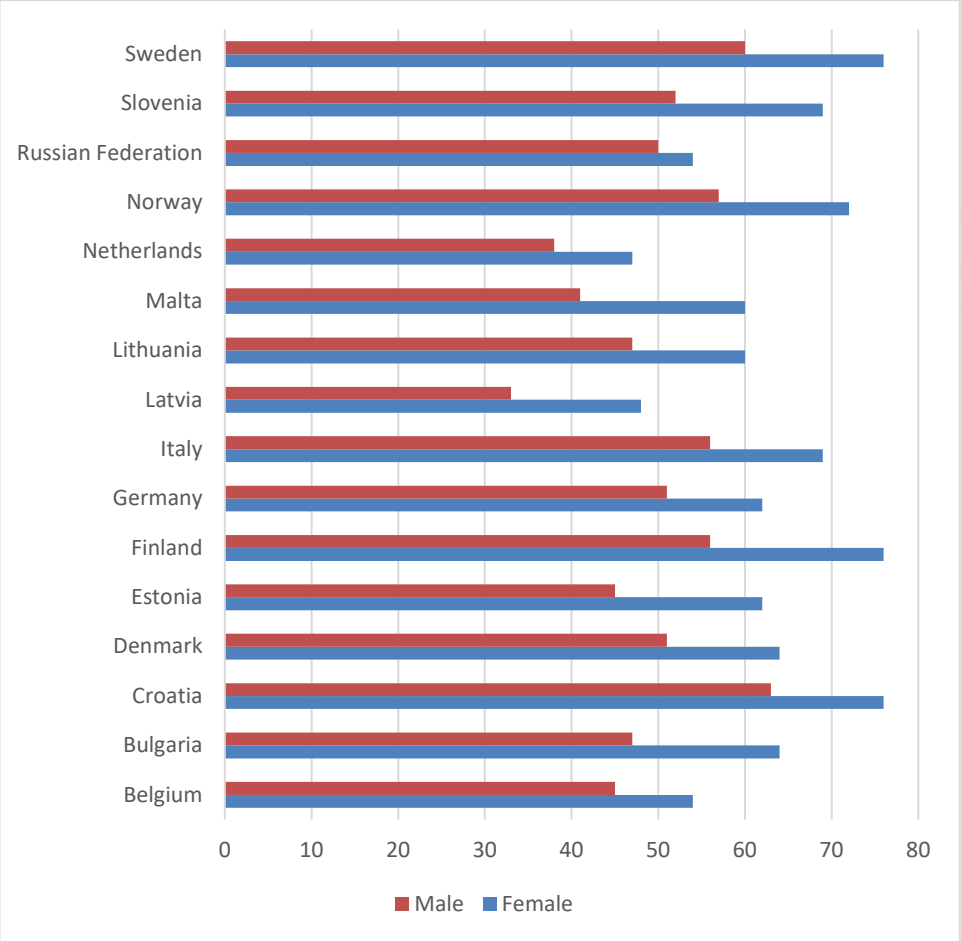
45. ESD is also reflected in the 2030 Agenda for Sustainable Development and in initiatives of UNESCO. For example, UNESCO published an ESD roadmap in 2020 (having adopted it in 2019, https://unesdoc.unesco.org/ark:/48223/pf0000374802.locale=en) and gathers detailed data in relation to the related Sustainable Development Goal indicator (4.7.1, 12.8.1 or 13.3.1), as shown in figure XI overleaf for a few countries. For the countries for which data are available, it is apparent that more female students show an adequate understanding of issues relating to global citizenship and sustainability than their male counterparts. There is also a great disparity in levels of understanding between countries, even those that are members of the European Union.

46. Also in 2019, the General Assembly adopted a resolution (A/RES/74/223) on ESD in the framework of the 2030 Agenda. It called upon the international community to provide inclusive and equitable quality education at all levels so that all people may have access to

lifelong learning opportunities that help them to acquire the knowledge and skills needed to exploit opportunities to participate fully in society and contribute to sustainable development.

Figure XI

Proportion of students in lower secondary education showing adequate understanding of issues relating to global citizenship and sustainability, by sex (countries reporting), per cent (2016)



Source: UNESCO, Institute for Statistics, Technical Cooperation Group, https://tcg.uis.unesco.org/sdg-4-dashboard/.

I. Conclusions on governance

47. While existing policies and MEAs, institutions, the private sector and civil society have contributed to environmental protection and progress has been achieved in certain areas throughout the region, the assessment of state and trends and policy recommendations in the thematic chapters of this assessment indicate the need to further strengthen the environmental governance system and existing policies in the region and to make necessary adjustments to address substantive gaps and inequalities. The following chapter on the way forward provides an overview on findings and recommendations in support of improved environmental governance and the protection of the environment in the coming years.

VI. Way forward

1. The environmental governance system and environmental legislation and policy landscape in the pan-European region have evolved and have become more integrated and coherent since the last Environment for Europe Ministerial Conference, in particular through developments under key mechanisms such as the 2030 Agenda for Sustainable Development, the Paris Agreement and other multilateral environmental agreements and efforts to establish a Shared Environmental Information System, as well as many other policy instruments not directly focusing on environment. This landscape is based on an indispensable system of science-policy interaction with key elements of monitoring, assessment and knowledge creation, and enabled by partnerships and cooperation among stakeholders and countries in the pan-European region.

2. While progress has been achieved in environmental protection in certain areas, there are significant shortcomings that pose a threat to the health of both people and the environment in the pan-European region, as highlighted in this assessment. The seventh pan-European environmental assessment has identified knowledge gaps in various areas including air quality, fresh water, marine ecosystems and land and soil. In addition, knowledge and data gaps exist in chemicals and waste including e-waste, and common policy targets are missing in most countries for biodiversity, resource efficiency and waste prevention, the development of sustainable infrastructure and circular economy. Environmental monitoring and measurement continue to be weaker than in most other sectors, and there is little disaggregated information. There is also room for improvement in integrative environmental planning and in enhancing integrative policies, including with respect to environment and health, particularly in countries in the eastern part of the region as identified in the assessment.

3. Further, the environmental governance system in the pan-European region remains partly fragmented in terms of the application of policies, the strengthening of institutions and the harmonization of legislation, as illustrated by the incomplete participation of the countries in existing MEAs and their implementation and reporting exercises.

4. Tracking progress and evaluating the effectiveness of policies in the region remains a challenge too, on the one hand because of lack of data and information but also, on the other hand, because there is a lack of established standard procedures to evaluate whether the policies are fulfilling their goals. The selected indicators in the assessment provide only a narrow snapshot on where progress has been achieved and what developments are expected in the coming years. Nonetheless, they provide guidance on where urgent action is required.

5. Availability and accessibility of timely, relevant and robust data is essential for ensuring informed decisions, transparency and public participation. The sparsity of underlying data, particularly for the assessment of sustainable infrastructure and applying the principles of circular economy in sustainable tourism, highlights the need for better integration between the environmental dimension of the Sustainable Development Goals and the social and economic dimensions of sustainable development.

6. Besides strengthening the participation in existing MEAs and international policy instruments including the BIG-E, there is a need to develop policy and set coherent and quantitative targets to address better emerging topics including circular economy and sustainable infrastructure to support the transition to sustainable development in the region. There is also a need to strengthen the implementation of policies on the ground, for example, through upscaling successful pilots, mobilizing resources from state and non-state actors and improving regulatory frameworks.

7. Strengthening of the knowledge base in support of environmental policies is another crucial enabling condition for improved environmental governance. The enhanced use of geospatial data and new technologies, including big data, artificial intelligence and specifically machine learning, and increased digitalization will increase efficiency and effectiveness in integrating policies if used in a sound manner. Strong partnerships within countries but also across borders will be crucial and need to be further strengthened.

8. There is little time left to ensure the successful implementation of the 2030 Agenda for Sustainable Development. The 2021 ECE assessment *Is the UNECE region on track for 2030?* indicates that the ECE region will achieve only 23 of the 169 Sustainable Development Goal targets by 2030 and only 7 of the targets related to environment and climate change. On 57 targets, progress needs to accelerate, and for 9 targets, the current trend needs to be reversed. Data are insufficient for the assessment of 80 targets.[375] Therefore, it is essential to make best use of existing tools and initiatives in the coming years in support of the Sustainable Development Goals. Where needed, additional measures and more ambitious goals, such as for e-waste or resource efficiency, can accelerate the implementation of the policy agenda.

9. The following areas have been identified as enabling conditions for a successful transition to a green and circular economy and sustainable development in the region.

A. Strengthening of policies and their implementation and up-scaling of actions

1. Promotion of participation in multilateral environmental agreements and harmonization of polices and legislation

10. Policy fragmentation should be reduced across the region to promote the existing multilateral environmental agreements and participation therein and support countries in ensuring coherency and harmonization of legislation.

2. Acceleration of the implementation of the Pan-European Strategic Framework for Greening the Economy

11. Participation in the Pan-European Strategic Framework for Greening the Economy and BIG-E needs to be enhanced. Governments and public and private organizations should scale up contributions through voluntary commitments in the form of green economy actions and envisage, in particular, commitments on circular economy and sustainable infrastructure development including through promoting nature-based solutions. Successful pilot actions including those illustrated in the case studies presented in this assessment could be scaled up or replicated.

3. Development and adoption of common and coherent policies in the pan-European region for emerging topics including circular economy and sustainable infrastructure

12. To address emerging challenges stemming from increased pressures on ecosystems and health, the development and adoption of systemic policy frameworks across the region in support of green economy and the transition to sustainable development will be crucial to keep pace and address challenges in an increasingly complex world. Possible areas of engagement include adoption of common and systemic policies with common targets for circular economy, sustainable infrastructure and resource efficiency. Gender should be mainstreamed in policy development.

4. Strengthening of mechanisms for monitoring the effectiveness of policies and legislation, including at the international level

13. The tracking of progress and evaluation of the effectiveness of policies in the region remains a challenge and standard procedures to evaluate whether the policies are fulfilling their goals often need to be established or improved and data and information gaps need to be closed.

[375] ECE (2021), Is the UNECE region on track for 2030? Assessment, stories and insights, available at https://unece.org/statistics/publications/unece-region-track-2030.

B. Investing in a just transition, and redirecting finance notably to sustainable infrastructure, a circular economy and nature-based solutions

14. The COVID-19 pandemic has created an unprecedented global economic downturn with significant losses in human lives and employment in certain sectors. It has exposed gaps in knowledge, capacity, accessibility to basic services and gender equality. However, the pandemic has also created an opportunity to correct the path of resource exploitation, the rise of greenhouse gas emissions and other injustices, which came at the expense of healthy ecosystems and the wellbeing of people. Countries should make use of this opportunity and invest in a just and green transition.

1. Investing in and reorienting finance to support a just transition

15. Governments and private actors need to invest in and redirect finance towards sustainable infrastructure, circular economy and especially nature-based solutions. While the transition will require major investments, the pan-European region will gain immensely, both in terms of reduced pressure and impacts on ecosystems and nature and through gained health benefits and new economic opportunities. Investments in nature-based solutions should be given priority where possible to enhance resilience while at the same time constructing and operating in a climate-friendly manner.

2. Strengthening of participation and access to information

16. Good environmental governance is built on broad participation and pluralistic governance, which are key for a just transition. Furthermore, participative processes in planning, implementation and evaluating the effectiveness of actions for a just transition are needed to ensure optimal solutions and buy-in, paying particular attention to the participation of vulnerable groups. Access to and availability of timely and reliable information are fundamental.

3. Investing in capacity development and education for sustainable development

17. Develop and invest in capacity and education in responsible authorities, the private sector and civil society for ensuring a transition to sustainable development.

C. Strengthening the science-policy interaction and the use of technology and innovation

18. The pan-European region is home to many outstanding scientific organizations, universities, research centres and individuals capable of innovation and of filling knowledge and data gaps. To support existing and upcoming environmental policy objectives, there is a need to strengthen the science-policy dialogue and the monitoring of environmental conditions and progress in policy implementation. Innovation and technology, including earth observation, big data supported by analysis through artificial intelligence, developments in digitalization and citizen science provide major opportunities for the pan-European region to enhance the creation of knowledge to complement existing monitoring.

1. Enhancing the use of technology and innovation in support of system thinking

19. Decision-making can benefit from strengthened science-policy interaction supported by data-driven innovation and technology. Digitalization in all areas, while respecting personal rights, will be crucial to enhance the understanding of complex processes and interlinkages of human needs, environmental and social impacts, and planetary boundaries.

2. Benefiting from existing knowledge and potential new sources,

20. Making use of existing knowledge, tools and systems is beneficial not only from an economic perspective but also for sustainability reasons. The ECE and OECD environmental performance review programmes, the Shared Environmental Information System, the various

UNEP assessments and the European Environment Agency's state and outlook environmental reports are examples of existing knowledge products and tools in the pan-European region. Their continued development and alignment to emerging policy needs should be supported. The use of the revised ECE Guidelines for the Application of Environmental Indicators and ECE set of environmental indicators, in accordance with the principles of the Shared Environmental Information System, will support sound policymaking. At the same time, better environmental monitoring and reporting will help facilitate reporting on Sustainable Development Goal indicators.

D. Development and strengthening of partnership initiatives and cooperation at regional and subregional levels

21. To reach the Sustainable Development Goals and other global and regional policy targets, Governments, the private sector, academia, and citizens must work together. In the pan-European region various forms of cooperation, partnerships, institutional information exchanges and the engagement of citizens have advanced the protection of the environment in certain areas. Challenges remain, however, in many areas including the creation of partnerships for emerging policy topics.

1. Strengthening of existing partnerships to address regional challenges

22. Governments should promote cooperation at all levels to address transboundary environmental challenges including in integrated water resources management, the prevention of industrial and chemical accidents, environmental impact assessment and the establishment of environmental information systems in line with the principles and pillars of a Shared Environmental Information System.

2. Development of new partnerships for emerging policy themes

23. Governments and others need to consider creating new partnerships on emerging and urgent policy themes, including on circular economy, sustainable infrastructure, resource efficiency and waste management.

Glossary

Adequate food – the concept of adequacy is an element of the normative content of the right to food and it overlaps partly with the FAO utilization pillar of food security. Food is considered to be adequate in terms of food safety, nutritional quality, quantity and cultural acceptability

Affordability of food – the availability of food is a necessary, but not sufficient condition for food security. Affordability is a major aspect of food access.

Agricultural intensification refers to any practice that increases productivity per unit land area at some cost in labour or capital inputs. One important dimension of agricultural intensification is the length of fallow period (i.e. letting land lie uncultivated for a period) and whether the management approach uses ecological or technological means.

Agriculture, Forestry and Other Land Use (AFOLU) is a category of activities defined by Intergovernmental Panel on Climate Change (IPCC) in the context of accounting of greenhouse gas emissions and sinks. In comparison with LULUCF (explained below) it consists of Agriculture plus LULUCF.

Antibiotic-free is when no antibiotic drugs have been given to the animal in its feed or by injection.

Bioaccumulation is the gradual accumulation of substances in a living organism. Uptake of the substance typically occurs via food or exposure to the environment. Bioaccumulation occurs when metabolic absorption of the substance exceeds elimination by excretion and catabolism. Bioaccumulating toxins affect food chains and health of individuals. Some examples of bioaccumulating chemicals are mercury and persistent organic pollutants (POPs).

Biodynamic agriculture considers both the material and spiritual context of food production and works with terrestrial as well as cosmic influences. The influence of planetary rhythms on the growth of plants and animals, in terms of the ripening power of light and warmth, is managed by guiding cultivation times with an astronomical calendar.

Blue Economy is an economy that comprises a range of economic sectors and related policies that together determine whether the use of ocean resources is sustainable (United Nations definition).

Blue-green infrastructure is an approach to urban flood resilience, recognised globally and in international literature, that capitalises on the benefits of working with urban green spaces and naturalised water flows.

Climate neutrality refers to the idea of achieving net zero greenhouse gas emissions by balancing those emissions so they are equal to (or less than) the emissions that get removed through the planet's natural absorption.

Coastal resilience is the ability of a community to "bounce back" after hazardous events such as hurricanes, coastal storms, and flooding – rather than simply reacting to impacts.

Conservation agriculture is a farming system that promotes minimum soil disturbance (i.e. no tillage), maintenance of a permanent soil cover, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency and to improved and sustained crop production. (Source: Food and Agriculture Organization of the United Nations)

Conventional agriculture is an industrialized form of farming characterized by mechanization, monocultures, and the use of synthetic inputs such as chemical fertilizers, pesticides and genetically modified organisms (GMOs), with an emphasis on maximizing productivity and profitability and treating the farm produce as a commodity.

Critical Raw Materials (CRMs) are raw materials of a high importance to the current and future economy and whose availability is associated with a high risk, either due to absolute scarcity or due to market characteristics or strong regional concentration. Based on the main two parameters economic importance and supply risk, a list of currently 30 CRMs has been

determined for the European Union (European Commission 2020d). It depends on the region and sector which materials display criticality and therefore are to be considered CRMs.

Decarbonization is the reduction of carbon dioxide emissions through the use of low carbon power sources, achieving a lower output of greenhouse gasses into the atmosphere.

Energy mix refers to how final energy consumption in a given geographical region breaks down by primary energy sources.

Enhanced Transparency Framework comprises the reporting and review processes under the UNFCCC and the Paris Agreement, aimed at ensuring the transparency of mitigation and adaptation actions and the transparency of support.

Extended Producer Responsibility (EPR) is a concept that extends the producer responsibility to the collection, recovery and final disposal phases of a product. The producer is considered the entity that brings a product to the market, i.e. manufacturer or importing entity. Under the EPR scheme, producers are made responsible to organize and operate take-back and sound management (including valorisation) of end-of-life products (they can make use of the services of third parties or set up own schemes). By making the producer responsible for the end-of-life stage of a product, EPR schemes integrate environmental costs into the market price of products and create a connection between design and recycling/re-use phases. This stimulates design of more durable products and production of easily and cheaply recyclable goods. The best-known applications of EPR are for batteries, packaging materials and electrical and electronic equipment. More recently, the European Union considers implementing EPR for textiles to overcome a particularly low resource efficiency in this field (European Commission 2021a).

Eutrophication is the process ss by which a body of water becomes enriched in dissolved nutrients (such as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

E-waste, or waste electrical and electronic equipment (WEEE), refers to electrical and electronic equipment which the owner discards, intends to discard or must discard. This can be because the equipment does no longer satisfy the owner or because it is no longer functional. E-waste comprises any appliance with an electric power supply when the appliance has reached its end of life. This includes large technical appliances such as washing machines, small household appliances such as toasters, IT and telecommunication equipment such as computers and telephones, consumer equipment such as radios, lighting equipment, and other technical devices.

Flame Retardants are chemicals added to materials or applied as coating to products or components in order to increase fire resistance of flammable products.

Food safety is the assurance that food will not cause harm to the consumer and will provide the expected nutritional value when it is prepared and/or eaten according to its intended use.

Food security exists when all people have, at all times, physical, social and economic access to sufficient, safe and nutritious food that meets their dietary energy requirements and food preferences for an active and healthy life.

Fossil fuels are carbon-based fuels from fossil hydrocarbon deposits, including coal, peat, oil and natural gas.

Greenhouse gases (GHGs) covered by UNFCCC are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen triflouride (NF_3).

Humus is decomposed, dark brown and amorphous organic matter of soils, having lost all trace of the structure and composition of the vegetable and animal matter from which it was derived. Humus hence refers to any organic matter that has reached a point of stability and which is used in agriculture to amend soil.

Illegal, Unreported and Unregulated (IUU) fishing comprises all fishing activities that break fisheries laws or occur outside the reach of fisheries laws and regulations.

Industrial Symbiosis describes synergistic networks between traditionally separated industrial entities. Participants engage in collaborative management of material or energetic resources and share infrastructures, capacities, or know-how. High-value valorisation of by-products and wastes by another company in the network is one widespread element. Industrial symbiosis goes beyond traditional waste management because it represents a coordinated effort of several entities to align their activities and needs, with the goal to find mutually beneficial solutions. Industrial symbiosis increases resource efficiency in an economically viable way, and thus accomplishes both higher business profit and reduced adverse environmental impacts.

Land abandonment refers to land that was previously used for crop or pasture/livestock grazing production, but does not have farming functions anymore and has not been intentionally converted into forest or artificial areas either.

Land conversion is the converting of an area to another use such as converting forest area or wetlands into agricultural land or urban area.

Land Use, Land Use Change and Forestry (LULUCF) sector is a category of activities defined by Intergovernmental Panel on Climate Change (IPCC) in the context of accounting of greenhouse gas emissions and sinks. Principles of accounting GHG emissions and sinks from LULUCF activities are agreed by Marrakesh Accords.

Malnutrition essentially means "bad nourishment". It encompasses overnutrition as well as undernutrition. It concerns not only the quantity and quality of food (not having enough food, having too much food or the wrong types of food), but also the body's response to a wide range of infections that result in mal-absorption of nutrients or the inability to use nutrients properly to maintain health.

Microorganisms – soil scientists often refer to soil biota as microorganisms, even though some of them are microscopic. Microorganisms play a key role in soil quality and fertility as they are involved in nutrient cycling and transformation processes, soil aggregate stability, as well as in plant pathology or plant growth promotion.

Modern renewables are all renewable energy sources except traditional use of biomass (traditionally used in developing countries for heating and cooking).

Municipal solid waste (MSW) covers waste from households and waste generated by other sources which is similar in nature and composition to household waste. This includes waste from commerce and small businesses. It also includes waste from selected municipal services, such as park and garden maintenance, street cleaning, litter containers in public spaces.

Nationally Determined Contributions (NDCs) are expressed by Parties to the Paris Agreement, describing national efforts by each country to reduce national emissions and adapt to the impacts of climate change.

Nature-based solutions (NbS) are actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (IUCN definition).

No tillage (or zero tillage) is the simple technique of drilling seed into the soil with little or no prior land preparation. No tillage is a technical component used in conservation agriculture, but not everyone carrying out zero tillage is practising conservation agriculture.

Organic agriculture is a holistic production management system which promotes and enhances agroecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, cultural, biological and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system

Over-nutrition is a daily energy intake that consistently exceeds energy requirements, leading to people being overweight or obese. Obesity is associated with risk of chronic diseases, such as high blood pressure, diabetes, etc. Children and adults, whose body weight significantly exceeds their normal weight for an extended period, are thus over nourished.

Persistent Organic Pollutants (POPs) are a group of organic compounds that are resistant to environmental degradation, i.e. they show high stability against chemical, biological, and photolytic processes occurring in the environment. Polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and brominated flame retardants are some examples. Most POPs are halogenated organic compounds with high lipid solubility and bioaccumulating characteristics, and thus a high risk for detrimental impacts on the environment and human health (e.g. cancer, endocrine disruption, impacts of the immune system). Most POPs are manmade. They are or were used for example as pesticides, as flame retardants in plastics and electrical goods, as heat exchange fluids or in capacitors. Others, such as dioxins are furans, are unintentional by-products of high-temperature processes including combustion.

Pollutant Release and Transfer Registers (PRTRs) are publicly accessible databases which establish inventories of pollution by documenting chemicals or pollutants released from industrial sites and other sites to air, water and soil and transferred off-site for treatment. A set of specified activities and pollutants is considered.

Polycyclic Aromatic Hydrocarbons (PAHs) are aromatic hydrocarbons composed of multiple aromatic rings form the group of PAHs. Human exposure to PAHs has been linked with cancer, cardiovascular disease and damage to foetus development. Bioaccumulation is a specific concern.

Rare earth elements (REE) – the group of rare earth elements is composed of the 15 lanthanides plus yttrium, and often also includes scandium, thus 17 elements in total. All are metals; therefore, they are alternatively also often referred to as the rare earth metals. REE are vital components in many of our applications today such as communication technology, mobility, energy technology. They are rarely found in sufficiently concentrated earth minerals deposits to allow economical exploitations, and they are often mixed together and closely attached to each other and to other substances, which makes extraction difficult. 86 per cent of global REE supply today comes from China, with the European Union sourcing more than 98 per cent of its REE usage from China (European Commission 2020d). Pan-European countries with REE deposits are Russia, Sweden, Norway, Denmark, Finland, Greece.

Recycling rate is calculated by dividing the weight of a (recyclable) material that enters the recycling facilities by the total weight of the (separately) collected (recyclable) material. The amount of collected waste (or collected recyclables) is not equivalent to the amount of generated waste (or generated recyclables), since some generated waste does not enter the collection schemes. The recycling rate refers to the collected amount only.

Recycling refers to a material reprocessing operation by which secondary raw materials are recovered from waste materials, including the reprocessing of organic material through composting or anaerobic digestion.

Refurbishment denotes a process of bringing a product up to standards and upgrading it to more satisfying working condition or a more appealing appearance. Common measures are the replacement of outdated components such as hardware devices of a computer and cosmetic changes to improve the appearance of an item (e.g., painting, changing surface coating). Refurbished products sold on the market often have a warranty which covers the whole product (unlike repair). Unlike a remanufactured product, a refurbished product usually has a performance which is not equivalent to an original device.

Remanufacturing is a product lifetime extension scheme carried out at an industrial scale, either by the original manufacturer or a remanufacturing company (Nasr et al. 2018). It returns an already used product to the performance specification of the original equipment manufacturer, typically using a combination of reused, repaired and new parts. A prerequisite of remanufacturing is a scheme which ensures the specific product is returned to the manufacturer/remanufacturer. Products are dismantled and the components restored; the reassembled product is extensively tested. Remanufacturing supplies products in like-new conditions; they meet the same customer expectations as new products. Warranty is in general at least equal to that of the original product. Examples from different sectors have been compiled by the European Remanufacturing Network (2021).

Repair is an operation to fix a fault of a product. This can be done in a private setting or by making use of a business service. Repair measures will usually be performed with no guarantee on the product as a whole.

Reuse means any setting which achieves that a product which is not waste, or its components are used again for their original purpose, i.e. the same purpose for which they have already been used at least once (EEA 2018c; EU 2008a). Where products or components are used again but for a purpose other than the original one, this represents a further use. Reuse is part of waste prevention. In contrast, "preparing for reuse" is part of waste management and subject to the availability of waste management infrastructures and waste collection and handling procedures. Preparing for reuse means checking, cleaning or repairing operations, by which products or components of products that have become waste are prepared so that they can be reused without any other pre-processing (EEA 2018c). Preparing for reuse is a waste valorisation scheme. Reuse and preparing for reuse both are product lifetime extension schemes. Remanufacturing, refurbishment and repair are relevant operations in the context of reuse schemes.

Soil carbon sequestration is a biogeochemical process where soils take up and fix carbon. Soil carbon sequestration is one of the options for climate change mitigation with a wide range of synergies. By increasing carbon concentrations in the soil through better management practices, this option offers benefits for biodiversity, soil fertility and productivity, and soil water storage capacity. Further, it stabilizes and increases food production reversing land degradation and restoring the "health" of ecological processes

Soil erosion – geologically, erosion is defined as the process that slowly shapes hillsides, allowing the formation of soil cover from the weathering of rocks and from alluvial and colluvial deposits. Erosion caused by human activities, as an effect of careless exploitation of the environment, results in increasing runoffs and declined arable layers and crop productivity.

Soil fertility is the ability of soil to produce and sustain a plant cover. Soil fertility is the cornerstone of organic management as organic farmers do not use synthetic nutrients to restore degraded soil.

Soil formation is the action of combined primary (weathering and humidification) and secondary processes to alter and rearrange mineral and organic material to form soil. A substantial number of invertebrates (earthworms, millipedes, termites, mites, nematodes, etc.) play a role in the development of upper soil layers through decomposition of plant litter, making organic matter more readily available, and creating structural conditions that allow oxygen, food and water to circulate

Soil organic carbon (SOC) refers to the carbon held within the soil and is expressed as a percentage by weight (gC/Kg soil). Climatic shifts in temperature and precipitation have a major influence on the decomposition and amount of SOC stored within an ecosystem and that released into the atmosphere. The amount of SOC stored within an ecosystem, is dependent on the quantity and quality of organic matter returned to the soil matrix, the soils ability to retain organic carbon (a function of texture and caption exchange capacity), and biotic influences of both temperature and precipitation.

Soil water retention – the spaces that exist between soil particles, called pores, provide for the passage and/or retention of gasses and moisture within the soil profile. The soil's ability to retain water is strongly related to particle size; water molecules hold more tightly to the fine particles of a clay soil than to coarser particles of a sandy soil, so clays generally retain more water.

Total final energy consumption refers to the consumption of primary and secondary energy by manufacturing, construction and non-fuel mining, by transport, and by others (agriculture, forestry and fishing, commerce and public services, households, and other consumers).

Triple planetary crisis comprises the interlinked and cascading effects of climate change, biodiversity loss, and pollution.

Waste Management Hierarchy, or waste hierarchy, ranks waste management options to prioritize the options which are best for the environment. The waste management hierarchy

applied across the European Union consists of five levels, namely waste prevention, preparing for reuse, recycling, other recovery, disposal. In other regions or contexts, alternative versions of the waste management hierarchy exist, including versions with a breakdown of priorities into more than five levels. In all cases, waste prevention is defined as top priority, while disposal represents the least preferred option to manage waste.

Waste means any substance or object which the holder discards or intends or is required to discard (EU 2008a). This is not equivalent to residues. A production residue is a material that is not deliberately produced in a production process; it may or not be a waste. A by-product is a production residue that is not a waste.

Waste prevention includes activities and measures which prevent products, substances or materials from becoming waste. Waste prevention can be achieved by reducing the quantity of materials used in goods, for example, through eco-design, or the amount of materials used for the delivery of services; by increasing the efficiency with which products are used, e.g. sharing products instead of purchasing them; and by adopting product lifespan extension schemes such as reuse, repair and refurbishment (EEA 2018c). Changes in lifestyles of citizens towards more non-material-oriented consumption habits and a dematerialisation of the economy, for example, due to a higher share of services, tourism, culture, also contribute to waste prevention.

The glossary will be expanded prior to publication, if necessary.