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Regular pan-European environmental assessment supported by the Shared Environmental Information System

Draft assessment of greening the economy in the pan-European region: working towards sustainable infrastructure

Note by the Secretariat

Summary

At its twenty-fifth session (Geneva, 13–15 November 2019), the Committee on Environmental Policy requested the secretariat and the United Nations Environment Programme, working in close cooperation with the European Environment Agency, to prepare a limited indicator-based and thematic pan-European environmental assessment.[a]

This document sets out the draft content of one section of the assessment, covering "greening the economy in the pan-European region: working towards sustainable infrastructure" – one of the two themes of the upcoming Ninth Environment for Europe Ministerial Conference (Nicosia, 5–7 October 2022).

The Working Group is invited to review and comment on this section.

[a] ECE/CEP/2019/15, para. 37 (k) (ii).

I. Key messages and recommendations relevant for the theme of the subchapter

A. Key messages

1. 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.

2. 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.

3. 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.

4. 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).

5. 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.

6. 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.

B. Recommendations

7. 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.

8. 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.

9. 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.

10. 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.[1] 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.

11. 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.

II. Context

12. 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.[2] As indicated by Mr. Ban Ki-moon, former Secretary-General: "There is an urgent 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."[3]

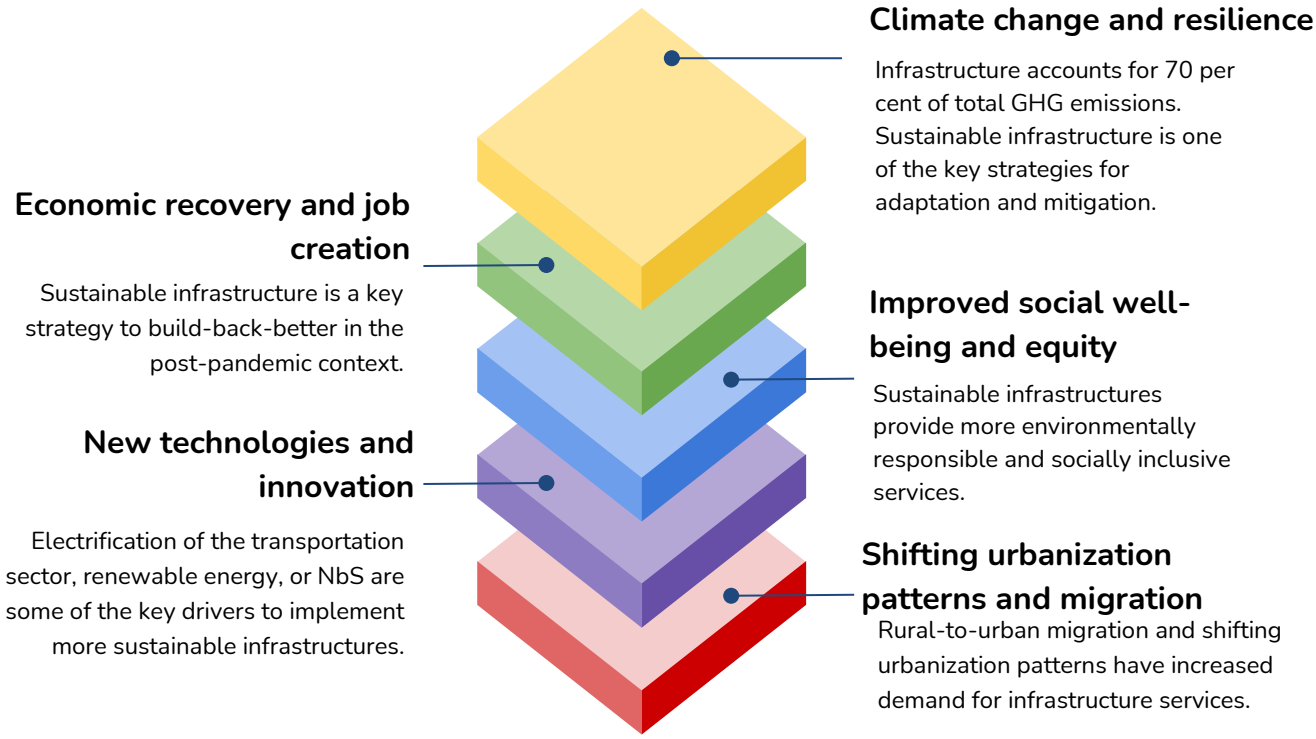
[1] Inter-American Development Bank (IDB), *Increasing Infrastructure Resilience with Nature-based Solutions (NbS)* (n.p., 2020), available at https://publications.iadb.org/publications/english/document/Increasing-Infrastructure-Resilience-with-Nature-Based-Solutions-NbS.pdf.

[2] 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.

[3] 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.

13. 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).[4]

Figure I
Main drivers for infrastructure demand



Source: Figure developed by author.

A. Climate change and resilience

14. 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 GHG emissions,[5] 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

[4] 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*.

[5] 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.

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.

15. 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".[6] Now it is understood that traditional grey infrastructure[7] 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.

B. Economic recovery and job creation

16. 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.[8] 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.

C. New technologies and innovation

17. 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 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.

[6] "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.

[7] "Grey infrastructure" refers to structures such as dams, seawalls, roads, pipes or water treatment plants. Source: Ibid.

[8] 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.

18. 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.

19. 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.

D. Shifting urbanization patterns and migration

20. 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 –[9] 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.[10] 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.[11] 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.

E. Improved social well-being and equity

21. 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.

III. State, main trends and recent developments

22. 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 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

[9] 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.

[10] Ibid.

[11] 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.

coordinated actions in which Governments, public and private institutions, academia and civil society are actively engaged.

23. 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.[12] 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, the United Nations Environment Programme (UNEP) and many other key players, is a significant first step.

24. 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.[13]

25. 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.[14] 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.

26. 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 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".

[12] 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.

[13] Commitments available at www.greengrowthknowledge.org/big-e.

[14] See https://unece.org/DAM/env/eia/documents/legaltexts/Espoo_Convention_authentic_ENG.pdf.

27. In addition to the already existing commitments, in the last couple of years, initiatives such as the European Union Taxonomy[15] 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.

IV. Indicators

A. Current landscape of sustainable infrastructure initiatives

28. 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.

1. High-level principles

29. 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 Organisation for Economic Co-operation and Development (OECD) *OECD Compendium of Policy Good Practices for Quality Infrastructure Investment*[16] and the *OECD Implementation Handbook for Quality Infrastructure Investment: Supporting a Sustainable Recovery from the COVID-19 Crisis*.[17]

2. Safeguard policies

30. 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.

3. Infrastructure sustainability rating systems and schemes

31. 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 of America), CEEQUAL (United Kingdom of Great Britain and Northern Ireland), SuRe (Switzerland) and IS Rating Scheme (Australia).

[15] 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.

[16] Organisation for Economic Co-operation and Development (OECD) (n.p., 2020).

[17] OECD (n.p., 2021).

4. Reporting guidelines

32. 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.

33. 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",[18] 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.

B. List of indicators proposed

34. 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[19] and the newly created "Finance to Accelerate the Sustainable Transition-Infrastructure" (FAST-Infra).[20] 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).

35. 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.

36. These frameworks are compared according to the following main categories: environmental sustainability and resilience; social sustainability; institutional sustainability; and economic and financial sustainability.

37. From the cross comparative analysis, several takeaways were identified:

(a) In the category "Environmental sustainability and resilience", almost all the tools selected incorporate references to GHG-emission reduction, climate-change mitigation

[18] For more information, see https://sustainable-infrastructure-tools.org/.

[19] 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.

[20] 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.

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.

38. The cross comparative analysis conducted has informed the proposal of indicators, subindicators and units of measurement in table 2 below.

C. Quantification of indicators in the pan-European region: trends identified

39. 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.

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	Access and affordability Stakeholder engagement Human and labour rights Disability and special needs	Anti-corruption protocols and procedures Corporate sustainability disclosure	Positive economic and social return (expected rate of return) Job creation

Frameworks	*Core elements*			
	Environmental sustainability and resilience	*Social sustainability*	*Institutional sustainability*	*Economic and financial sustainability*
	Energy and water efficiency	Gender integration Health and safety		
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
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	—	—	—

Frameworks	*Core elements*			
	Environmental sustainability and resilience	*Social sustainability*	*Institutional sustainability*	*Economic and financial sustainability*
	Pollution and control			
	Circular economy			
	Water and marine resources			

Source: Table developed by author.

Table 2
Sustainability infrastructure indicators

Indicator	*Definition*	*Indicator at the national level and unit of measurements*	
		Indicator	*Units of measurement*
1. Climate-change adaptation and mitigation	Infrastructure projects should reduce/avoid GHG emissions, be climate-resilient and integrate adaptation and mitigation strategies through the full cycle	1.1 GHG emission reduction 1.2 Disaster risk reduction: Strategies to prevent resilience and climate-related hazards and natural disasters	Total CO_2 emissions reduction according to Nationally Determined Contributions (per 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. Environmental 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	3.1 Circular economy: Reduction of waste generation through prevention, reduction, recycling and reuse 3.2 Resource efficiency:	SDG 12.5.1 National recycling rate, tons of material recycled SDG 6.4.1 Change in water-use efficiency over time

		Indicator at the national level and unit of measurements	
Indicator	*Definition*	*Indicator*	*Units of measurement*
	principles of circular economy	Definition of national targets for water, energy and materials efficiency	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 empowerment	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 and natural capital over the entire project life cycle, taking into consideration both positive and negative externalities	5.1 Life cycle cost accounting: Apply cost-benefit analysis techniques that adequately capture the net economic and social returns generated	Social return on investment Return on investment
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

		Indicator at the national level and unit of measurements	
Indicator	*Definition*	*Indicator*	*Units of measurement*
			mobile network, by technology
7. Transparency 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 sustainability 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).

40. 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 seventh pan-European environmental assessment.

41. 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[21] – 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 natural ecosystems. See also the assessment of biodiversity and ecosystems in section III.E of the forthcoming pan-European environmental assessment.

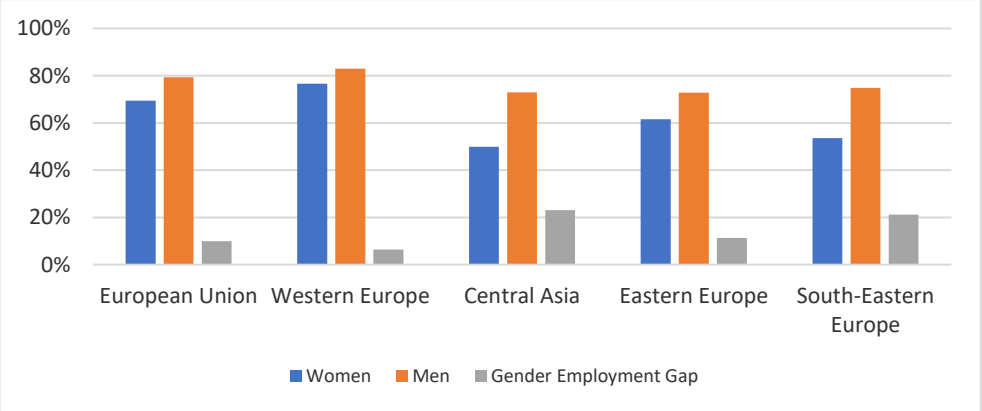
42. Indicator 3 “Circular economy” looks at the importance of making good use of resources over the full life cycle of the infrastructure project. Based on the information available and its alignment with infrastructure development, the most relevant unit of measurement identified is “Recovery rate of 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 forthcoming pan-European environmental assessment for the assessment of chemicals and waste.

43. 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

[21] 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.

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.

44. 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,[22] 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.

45. 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.

46. 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

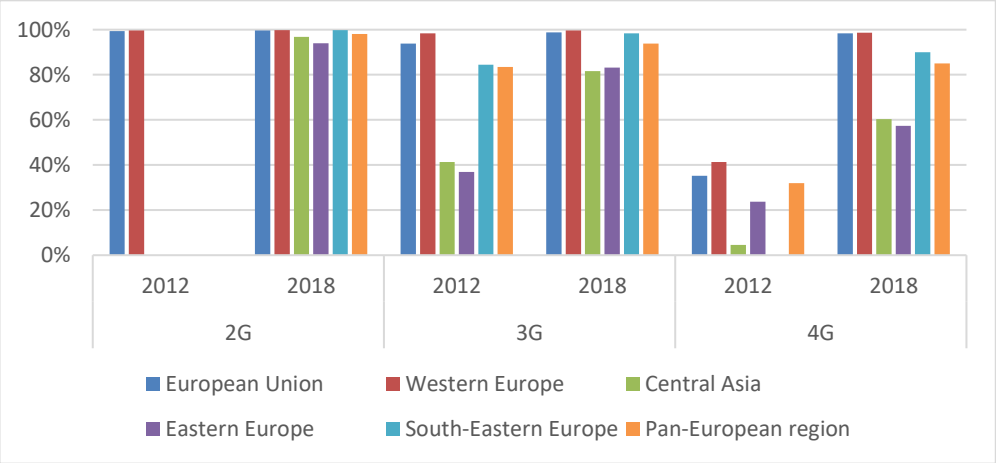
[22] Available at https://qdd.oecd.org/subject.aspx?Subject=17375f7e-fc6c-4a5f-81bf-5b7e6a1da53c.

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.

47. 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).

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.

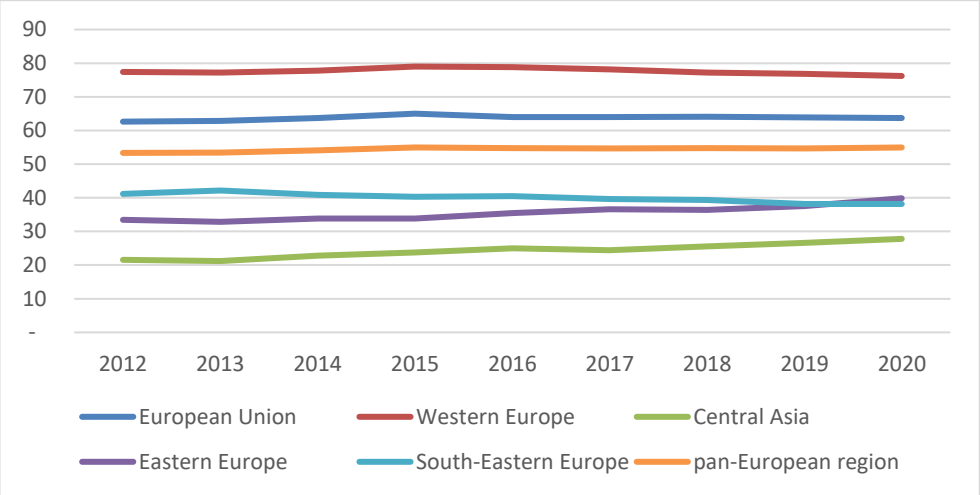
Notes: Insufficient 2G data for Central Asia, Eastern Europe, South-Eastern Europe (and the region as a whole) in 2012; no 3G data for the Russian Federation in 2012, among others; and insufficient 4G data in South-Eastern Europe in 2012, among others. For population data, figures for Monaco only in 2016, latest figures for the Russian Federation 2013, and for Turkmenistan 2009.

48. 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.

49. 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.

V. Case study

Naples-Bari (Italy) railway line: the first-ever sustainability-certified project in Europe by Envision rating system

50. 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,[23] as one of the most widely applied methodologies for quantifying infrastructure sustainability and its application to the first Envision-certified project in Europe, the Naples-Bari (Italy) railway line.

51. The Naples-Bari (Italy) route is part of the Scandinavia-Mediterranean railway corridor of the Trans-European Transport Network.[24] 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.[25]

52. 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.[26] 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".[27]

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[23] 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.

[24] 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).

[25] 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).

[26] ISI (2019).

[27] Stantec, "La linea ferroviaria Napoli-Bari è la prima infrastruttura in Europa certificate Envison per la sostenibilità.