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COVER NOTE

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To:	Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council of the European Union
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	Additional information on the review of implementation of the green infrastructure strategy *accompanying the document* REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN AN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF REGIONS on the Review of progress on implementation of the EU green infrastructure strategy

Delegations will find attached document SWD(2019) 184 final.

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COMMISSION STAFF WORKING DOCUMENT

Additional information on the review of implementation of the green infrastructure strategy

Accompanying the document

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN AN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF REGIONS

Review of progress on implementation of the EU green infrastructure strategy

{COM(2019) 236 final}

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COMMISSION STAFF WORKING DOCUMENT

Additional information on the review of implementation of the green infrastructure strategy

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REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN AN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF REGIONS

Review of progress on implementation of the EU green infrastructure strategy

1. **PART I:** FURTHER DETAILS ON GI MAINSTREAMING IN OTHER EU POLICIES

2. **PART II**: SUMMARY REPORT ON IMPLEMENTATION IN THE EU MEMBER STATES OF THE GREEN INFRASTRUCTURE STRATEGY - IEEP-LED CONSORTIUM, WITH SUPPORT FROM TRINOMICS, IUCN AND WCMC

3. **PART III:** FURTHER RESOURCES AND PUBLICATIONS

1. Further details on GI mainstreaming in other EU policies

A. EU nature policy and ecosystem protection

The Natura 2000 network is at the core of the EU's GI strategy. A recent fitness check of the Nature Directives concluded that, although the Directives are key instruments for the EU 2020 biodiversity strategy, they cannot deliver alone on the EU 2020 goal of halting the loss of biodiversity, and they are less effective in relation to the maintenance of features outside Natura 2000. Additional measures through GI deployment, including GI projects at EU level, would improve the network's coherence and would help achieve the objectives of the Directives (which involve maintaining or restoring a favourable conservation status for all species and habitats of Community importance), while at the same time contribute to other targets of the EU 2020 biodiversity strategy.

Depending on the local situation, GI deployment will therefore require both the conservation of existing biodiverse ecosystems in good ecosystem condition, as well as the restoration of degraded ecosystems. The Birds and Habitats Directives already incorporate a clear conservation and restoration agenda. Where species and habitats have not yet attained a favourable conservation status at the level of individual Natura 2000 sites, Member States are required to formulate restoration objectives and measures for the sites. They also provide cost estimates for Natura 2000 restoration and maintenance measures through Prioritised Action Frameworks (PAFs) based on Article 8 of the Habitats Directive. The Commission has also published a study that clarifies the link between the conservation status assessment at national or national biogeographical region level and objectives and measures at site level, including for those needed for restoration[1]. Some of the conservation and restoration successes of the Nature Directives are the result of dedicated LIFE Nature projects carried out over the last 25 years; although more needs to be done in the coming years - both inside and outside of the Natura 2000 network - to fully exploit the potential of the Directives to achieve their overall objective.

The Commission published another study to help Member States prioritise the restoration of degraded ecosystems[2]. Although there are only a few comprehensive restoration strategies at national and sub-national level[3], some restoration activity is taking place - often in response to other relevant EU legislation beyond nature legislation, such as the Water Framework Directive and the Marine Strategy Framework Directive. To date, national restoration prioritisation frameworks have been developed and reported by three countries/regions: Flanders (Belgium), Germany and the Netherlands[4]. Finland has

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1 http://ec.europa.eu/environment/nature/knowledge/restauration_and_natura2000_en.htm
2 http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/RPF.pdf
3 Up to now, only Germany, the Netherlands and the region of Flanders (BE) have developed and submitted Restoration Prioritisation Frameworks (RPF).
4 The full names of these RPFs are as follows: Flanders (Belgium): Prioriteitenkader voor ecosysteemherstel in Vlaanderen (Prioritisation framework for ecosystem restoration in Flanders), 2016; Germany: Priorisierungsrahmen zur Wiederherstellung verschlechterter Ökosysteme in Deutschland (Prioritisation framework for the restoration of degraded ecosystems in Germany), 2015; and the Netherlands: Naar een strategisch kader voor ecosysteemherstel ('RPF') in Nederland (Towards a strategic framework for ecosystem restoration in the Netherlands), 2014.

established a national restoration prioritisation working group, which published its report in October 2015[5]. However, it was not endorsed by the government.

B. EU Common Agricultural policy

The GI concept is not included per se in the legislative instruments of the common agricultural policy (CAP). The mid-term review of the EU 2020 biodiversity strategy pointed to agriculture and human-induced modifications of natural conditions as the most prominent pressures on terrestrial ecosystems, and that there has been a substantial loss of biodiversity associated with agriculture in the EU over the last 50 years[6].

However, the two pillars of the CAP provide a set of instruments for addressing the sustainable management of natural resources and climate action. These can potentially contribute significantly to green infrastructure. As part of the cross-compliance mechanism, two good agricultural and environmental conditions (GAEC) directly involve green infrastructure: GAEC 1[7] and GAEC 7[8]. Under the CAP's first pillar, compulsory 'greening' practices introduced in 2015, including (a) crop diversification; (b) maintenance of permanent grassland including strict maintenance of environmentally sensitive permanent grassland in Natura 2000 areas; and (c) establishment of ecological focus areas (EFA)[9], have the potential to benefit both the environment and climate. As regards rural development policy (CAP 2d pillar), a wide menu of rural development measures is available to Member States and regions to contribute to the sustainable management of natural resources, such as: non-productive investments, agri-environment-climate measures, Natura 2000 and Water Framework Directive payments, organic farming payments or the forest environmental and climate services and forest conservation and measure for basic services and village renewal in rural areas, which provides support for the preparation of the Natura 2000 management plans and related actions.

The review of greening measures after one year and the review of EFAs[10] illustrated though that the potential of greening measures to contribute towards biodiversity has been harnessed only partially, even if 76% of the Utilised Agricultural Area (UAA) is covered by one greening practice. A comprehensive greening evaluation has been finalised. Qualitative information from the ground on implemented farm management using field data on biodiversity will be important to further evaluate the impact of greening measures on green infrastructure.

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5   https://helda.helsinki.fi/bitstream/handle/10138/156982/SY_8_2015.pdf
6   Study on 'Mapping and analysis of the implementation of the CAP'; Final Report; 2016, ISBN 978-92-79-54679-2 ISSN 2016.1365 doi 10.2762/147473 KF-04-16-021-EN-N.
7   GAEC 1: establishment of buffer strips along water courses.
8   GAEC 7: Retention of landscape features, including where appropriate, hedges, ponds, ditches, trees in line in group or isolated, field margins and terraces, and including a ban on cutting hedges and trees during the bird breeding and rearing season and, as an option, measures for avoiding invasive plant species.
9   Based on the Commission staff working document on the March 2017 report from the Commission on the implementation of EFA, 8 million ha of land was declared as EFA in 2015, which accounted for 13 % of the arable land.
10 https://ec.europa.eu/agriculture/direct-support/greening_en; COM(2017) 152 final: Report from the Commission to the European Parliament and the Council on the implementation of the ecological focus area obligation under the green direct payment scheme. While the minimum requirement of 5 % of EFAs in arable land has been exceeded (9 % after application of weighting factors), farmers mostly opted for the productive type of EFA: nitrogen-fixing crops (39 %), land lying fallow (38 %) and catch crops (15 %). The EFA element with the highest potential benefit for biodiversity — landscape features — was adopted at 5 % of the total EFA area.

The EU forest strategy11 contains a reference to green infrastructure (GI): 'Protection efforts should aim to maintain, enhance and restore forest ecosystems' resilience and multi-functionality as a core part of the EU's green infrastructure, providing key environmental services as well as raw materials.' The strategy's multiannual implementation plan identifies certain measures (e.g. the provision of guidance on green infrastructure and restoration) to establish the link with the GI strategy.

The main forestry-related measures in Regulation (EU) No 1305/2013 that can potentially support green infrastructure encourage investments in forest area development and improvement of the viability of forests (Article 21), afforestation and creation of woodland (Article 22); the establishment of agroforestry systems (Article 23); the prevention and restoration of damage to forests from forest fires and natural disasters and catastrophic events (Article 24); and investments improving the resilience and environmental value of forest ecosystems (Article 25).

In addition, the EU forest strategy's main objective is to develop sustainable forest management in the EU and abroad. It is also the key instrument for delivering multiple goods and services in a balanced way. The valuation of ecosystem services and the maintenance and enhancement of such services are among its strategic orientations, which are in line with the definition and objectives of green infrastructure.

For the 2014-2020 period, cross compliance, greening and around 52 % of the rural development budget are linked to environmental and climate priorities. In addition, under rural development programmes (RDPs) in the second pillar of the common agriculture policy (CAP):

- almost 25 % of EU farmland is under contract for more environmentally friendly management;
- 44 % (EUR 43.8 billion) of the total European Agricultural Fund for Rural Development (EAFRD) budget has been allocated to Priority 4 (restoring, preserving and enhancing ecosystems related to agriculture and forestry);
- 83 million ha of agricultural land and 7.9 million ha of forests will receive funding for restoring, preserving and enhancing ecosystems — a budget of around EUR 43 billion in total; and
- some EUR 2.2 billion of public expenditure is planned for the afforestation of 560 000 ha, contributing to long-term climate change mitigation and adaptation.

On the protection of ecosystems, agri-environment and climate measures will contribute to the increased sustainability of agricultural production on a large scale by covering around 18 % of agricultural land and 3.8 % of forest land under management contracts that support biodiversity and/or landscapes, including green infrastructure.

Total public contributions currently planned for afforestation amount to EUR 2.2 billion, for agroforestry EUR 115 million, for prevention and restoration EUR 2.3 billion, and for investments in ecosystems EUR 1.4 billion.

According to a recent study12, the EAFRD appears to be the fund that contributes most to green infrastructure in monetary terms, with EUR 4 967 million (77 % of the total EU funded green infrastructure) allocated to green infrastructure for the 2014-2020 period.

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11 COM(2013) 659 final.

12 Report (2016): Supporting the implementation of green infrastructure: http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructures/GI%20Final%20Report.pdf

In addition, the agricultural European Innovation Partnership (EIP-AGRI) includes a focus group on ecological focus areas 13 (EFAs). Its work includes information on the environmental benefits of EFAs, with the focus on:

- **field margins**: the spontaneously established strips of herbaceous plants at the edge of fields;
- **hedgerows**: composed of one or two rows of planted or naturally established shrubs and/or trees; and
- **grassy or flower strips**: intentionally sown, the former mostly with grasses and the latter with flowering plants.

Other focus groups14, including the Focus Group on Agriculture and Water, mention some environmental benefits of EFAs (e.g. cover crops and agroforestry): (https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_fg_water_and_agriculture_final-report_en.pdf

C. EU climate policy

On climate mitigation, Member States report each year on emissions and removals of carbon in the agriculture and forestry sector under the Land Use, Land-Use Change and Forestry Decision15 and the United Nations Framework Convention on Climate Change (UNFCCC). Green infrastructure impact on the carbon balance in these sectors may therefore be visible thanks to estimating greenhouse gas removals and emissions. The purpose of the current legislative framework is to improve the national systems for estimating these emissions and removals. After 2020, the land use, land-use change and forestry sector will contribute fully to achieving the reduction commitment under the Paris Agreement (40 % less greenhouse gas emissions by 2030 compared to 1990)16.

On climate adaptation, the EU adaptation strategy 17 adopted in 2013 specifically encourages green infrastructure and ecosystem-based approaches to adaptation. The Commission staff working document *Adapting infrastructure to climate change*18, which accompanied the strategy, emphasised green infrastructure as a cost-effective and low-maintenance way to enhance climate change adaptation for buildings and physical assets.

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13 https://ec.europa.eu/eip/agriculture/en/content/optimising-profitability-crop-production-through-ecological-focus-areas)

14 (https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eipagri_fg_water_and_agriculture_final-report_en.pdf)

The full list of focus groups can be found on: http://ec.europa.eu/eip/agriculture/en/content/focus-groups . Several of them refer to the respective EFAs. There is also a Focus Group on High Nature Value (HNV) profitability and a thematic network starting on HNV: http://www.hnvlink.eu/

15 Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities.

16 See European Council (23 and 24 October 2014) Conclusions on 2030 Climate and Energy Policy Framework.

17 COM(2013) 216. See also: https://ec.europa.eu/clima/policies/adaptation/what_en

18 SWD(2013) 137 final.

It also highlighted ancillary benefits such as better human health and climate change mitigation.

In the EU adaptation strategy, infrastructure is referred to as part of:

- Action 1 (Encourage all Member States to adopt comprehensive adaptation strategies);
- Action 2 (Provide LIFE funding to support capacity building and step up adaptation action);
- Action 3 (Introduce adaptation in the Covenant of Mayors framework);
- Action 5 (Further develop Climate-ADAPT as a one-stop shop for adaptation information in Europe);
- Action 6 (Facilitate the climate-proofing of the Common Agricultural Policy, the Cohesion Policy and the Common Fisheries Policy); and
- Action 7 (Ensuring more resilient infrastructure).

Green infrastructure is described as both an innovative and cost-effective form of adaptation.

As part of Action 1, a scoreboard was developed to measure Member States' level of adaptation readiness. One of the indicators looks at procedures or guidelines to assess the potential impact of climate change on major projects or programmes and facilitate the choice of alternative options, such as green infrastructure.

Action 6 aims to facilitate the climate proofing of the Common Agricultural Policy, the Cohesion policy and the Common fisheries policy,

As part of climate mainstreaming in general, 20 % of the EU budget is earmarked for climate change mitigation and adaptation objectives. Climate action is mainstreamed in the European Structural and Investment Funds 2014-2010, which represent around 42 % of the EU budget for 2014-2020 and will therefore contribute significantly to the 20 % goal mentioned above. 25 % (EUR 114 billion) of these funds are earmarked for climate change actions such as the development of green infrastructure, which includes renewable energy sources, sustainable urban mobility and climate-related innovation to name just a few. Detailed guidance 19 for the ERDF and the CF on how to promote green infrastructure has been issued for thematic objective 6 on environment and resource efficiency and thematic objective 5 on climate adaptation and risk management.

Thanks to the European Climate Adaptation Platform 20 (CLIMATE-ADAPT) and the Covenant of Mayors for Climate & Energy, the Commission has provided information on the role of green infrastructure in climate change adaptation and mitigation. These two activities respond to Actions 3 and 5 of the 2013 EU adaptation strategy mentioned above. The Commission has also carried out a study on ecosystem-based assessments for adaptation purposes, including green infrastructure, whose results will be available soon under CLIMATE-ADAPT. Finally, the Joint Research Centre (JRC) and DG CLIMA's work on PESETA III 21 has provided some draft results on the use of green infrastructure in the Mediterranean.

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19   http://ec.europa.eu/regional_policy/en/information/legislation/guidance/

20   http://climate-adapt.eea.europa.eu/

21   http://climate-adapt.eea.europa.eu/metadata/projects/projection-of-economic-impacts-of-climate-change-in-sectors-of-the-european-union-based-on-bottom-up-analysis

CLIMATE-ADAPT is the EU's climate change adaptation platform. A partnership between the Commission and the European Environment Agency (EEA), it aims to bridge the knowledge gap on adaptation options, helping users access and share data and information on e.g. expected climate change impacts in regions and economic sectors, case studies and planning tools.

The GI concept is cited as an adaptation option in several recent case studies, for example:

- social housing in London, UK[22];
- green roofs in Hamburg, Germany[23]; and
- green infrastructure is also cited[24] in the 'urban section' of CLIMATE-ADAPT, for example in the urban adaptation support tool or the urban vulnerability mapbook.

The important role of ecosystem-based approaches in enhancing the resilience of cities is recognised in the new Covenant of Mayors for Climate & Energy[25]. This initiative brings together thousands of local and regional authorities that are committed to implementing EU climate and energy objectives on their territory. New signatories pledge to address climate change mitigation and adaptation as well as access to clean energy in an integrated approach. By joining, local authorities obtain practical support and knowledge support, can exchange experiences, increase the visibility of their commitments and actions, increase financial opportunities for their projects and monitor the implementation of their action plans.

The reporting guidelines followed by Covenant members contain the possibility to account for emission reductions achieved by means of green infrastructure. Similarly, when planning and implementing adaptation plans, cities are encouraged to use green infrastructure such as green roofs and walls, green spaces, urban gardens etc. as a way to limit the negative effects of climate change.

Some examples of GI initiatives under this framework include:

- good practices[26];

- brochure on climate measures, including green infrastructure[27]; and

- Rouen case study[28].

On the Commission's study of the ecosystem-based assessment for adaptation purposes, initial results show that green infrastructure helps tackle wind erosion and damage, excessive heat, intense rainfall, flooding and drought or water scarcity. The study also

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22 http://climate-adapt.eea.europa.eu/metadata/case-studies/climate-proofing-social-housing-landscapes-2013-groundwork-london-and-hammersmith-fulham-council

http://climate-adapt.eea.europa.eu/metadata/case-studies/four-pillars-to-hamburg2019s-green-roof-strategy-financial-incentive-dialogue-regulation-and-science

24 http://climate-adapt.eea.europa.eu/knowledge/tools/urban-adaptation/climatic-threats/heat-waves/exposure

25 http://www.covenantofmayors.eu/The-Covenant-of-Mayors-for-Climate.html

26 http://www.eumayors.eu/media/case-studies_en.html

27 http://www.eumayors.eu/IMG/pdf/CovenantOfMayors_BestPracticePublication_web.pdf

28 http://climate-adapt.eea.europa.eu/metadata/case-studies/multifunctional-water-management-and-green-infrastructure-development-in-an-ecodistrict-in-rouen

aims to measure the frequency and type of co-benefits associated with green infrastructure compared with other ecosystem-based measures.

On PESETA III, some preliminary results are available on the impact of climate change on the Mediterranean climate domain (MCD), and in particular Natura 2000 areas under MCD. PESETA III tentatively recommends increasing support for GI projects, which can increase connectivity between areas where MCD prevails or expands and areas where MCD contracts. As climate change advances, this would make the natural migration of species easier and help preserve biodiversity.

Under the LIFE priority area 'climate change mitigation29', many financed projects help develop green infrastructure through the restoration of peatlands (e.g. LIFE Peat Restore, LIFE REstore), sustainably managed forests (e.g. LIFE+ MANFOR), agroforestry systems (e.g. LIFE OPERATION CO2), tree crops (e.g. LIFE ClimaTree, oLIVECLIMA) and the improvement and protection of carbon sinks in soils (e.g. LIFE CarbOnFarm, LIFE HELPSOIL).

Action 2 of the EU adaptation strategy deals with improving funding to Member States for adaptation purposes. Under the LIFE Climate Action sub-programme30, 'projects with demonstration and transferability potential will be encouraged, as will green infrastructure and ecosystem-based approaches to adaptation'. In 2014-2015, one third (8 out of 27) of the projects from the LIFE priority area 'climate change adaptation' involved green infrastructure measures, mostly in urban areas. For example:

- green infrastructure in the city of Rotterdam31;
- urban drainage systems in Spain, Portugal and Italy32; and
- sustainable management of water in Radom, Poland33.

The Natural Capital Financing Facility 34 (NCFF) implemented by the European Investment Bank (EIB) also includes a specific project category on green infrastructure, including green roofs, green walls, ecosystem-based rainwater collection/water reuse systems, flood protection and erosion control. For example, the EIB is currently developing a loan to support renaturalisation works covering a 20-km stretch of the Alzette River (from Luxembourg city centre to Mersch). It aims to reduce flood risk, improve water quality and protect biodiversity.

D. EU research policy and relevant research projects on nature-based solutions

EU research framework programmes FP7 and, since 2014, Horizon 2020, have been funding GI-relevant projects on ecosystem services, restoration and nature-based

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29
    http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/climate_change_mitig ation.pdf

30 https://ec.europa.eu/clima/policies/budget/life_en

31 www.urbanadapt.eu/en

32 http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5665

33 http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5356

34 http://www.eib.org/products/blending/ncff/index.htm

solutions, using GI to address societal challenges at large. Horizon 2020 provides support to demonstration projects for the deployment and assessment of nature-based solutions in real world conditions. This has been complemented by policy integration, indicator setting, information sharing, promotion and outreach to businesses and society. The aim is that evidence about the multiple benefits provided by nature-based solutions triggers upscaling and prioritisation of GI.

EU co-funding for projects implementing GI through nature-based solutions, and restoration in the 2014-15 calls under Horizon 2020 reaches EUR 38.6 million, and EUR 68 million for the calls in 2016, with further EUR 73 million in 2017. Co-funding for green infrastructure-related calls with national agencies is available through the BiodivERsA35 ERA-net co-fund. Its co-funding for GI-related projects amounted to an additional EUR 33 million in the 2015-2016 co-funding call (i.e. EUR 52 million in total for calls on 'Understanding and managing the biodiversity dynamics of soils and sediments to improve ecosystem functioning and delivery of ecosystem services' and 'Understanding and managing biodiversity dynamics in land-, river- and sea-scapes (habitat connectivity, green and blue infrastructures, and 'naturing' cities) to improve ecosystem functioning and delivery of ecosystem services)'. The Horizon 2020 work programme 2018-2036 foresees more than 110 million euro investments in nature-based solutions, ecosystems and their services. Other funding instruments such as structural funds could take up the results of GI-relevant research and innovation and add ambition in terms of scale of interventions and coherence among them, and apply them more widely, but this is not happening yet.

The FP7 project GreenSurge37 linking up green spaces, biodiversity, people and the green economy, provides amongst other, a typology of urban Green Infrastructure in Europe and a handbook on its implementation.

The list of projects below contains topics and results of the Horizon 2020 calls of 2014-2016:

- EKLIPSE, the science-policy-society mechanism, has produced an impact assessment framework for nature-based solutions38, which could be tested on, and applied to, any GI project;
- INSPIRATION is looking at new research models for GI-relevant topics;
- NAIAD focuses on the insurance value of ecosystems;
- Two projects, Nature4Cities and Naturvation, are developing innovative approaches and tools for nature-based solutions in cities;
- Four demonstration projects are testing, applying and investigating ways of upscaling nature-based solutions in cities to improve urban resilience to climate change and water (CONNECTING Nature, GROW GREEN, UrbanGreenUP, UNALAB);
- ESMERALDA is steering mapping ecosystem services in Europe;
- Two projects, MERCES and AMBER, are developing new approaches to ecosystem restoration; and

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35 http://www.biodiversa.org/

36 http://ec.europa.eu/programmes/horizon2020/en/climate-action-environment-resource-efficiency-and-raw-materials-work-programme-2018-2020

37 http://greensurge.eu/

38 http://www.eklipse-mechanism.eu/apps/Eklipse_data/website/EKLIPSE_Report1-NBS_FINAL_Complete-08022017_LowRes_4Web.pdf

- The BiodivERsA co-fund launched a call on green infrastructure with national authorities in 2015-16, resulting in 17 projects.
- ALICE (AcceLerate Innovation in urban wastewater management for Climate change)
- CuPESS (Catchments under Pressure: Ecosystem Service Solutions)
- LANDMARK (LAND Management: Assessment, Research, Knowledge base)
- AquaSpace (Ecosystem Approach to making Space for Aquaculture)
- InnoForESt (Smart information, governance and business innovations for sustainable supply and payment mechanisms for forest ecosystem services)
- SINCERE (Spurring INnovations for Forest ECosystem SERvices in Europe)
- SCALEFORES (Scaling Rules For Ecosystem Service Mapping)

The calls of 2017 have resulted in 4 additional projects on the testing, demonstrating and upscaling of NBS for inclusive urban regeneration, and 3 projects on demonstrating how NBS can reduce hydro-meteorological risks such as floods, landslides and droughts.

DG RTD is investing in improved access to information: all new projects should provide open access to project results; maximum coherence at EU level is proposed for ecosystem-based approaches hosted on the research-funded platforms for information sharing Oppla39 and networking ThinkNature40, which are open to GI-relevant stakeholders and businesses.

Through Oppla, a knowledge marketplace with GI-relevant information, the outputs of research and innovation are made accessible to end-users on natural capital, ecosystems services and the community of science for nature-based solutions, policy and practice. Oppla aims to become the European knowledge hub for nature-based solutions.

For more information, see
http://ec.europa.eu/research/environment/pdf/research_and_innovation_sc5_projects_2014-2016.pdf.

E. Green infrastructure and water policy

On mainstreaming green infrastructure into the water policy, natural water retention measures (NWRMs) have been identified as GI measures / nature-based solutions that can improve the state of aquatic ecosystems and help achieve the objectives of the Water Framework Directive41 as well as those of the Floods Directive. This also helps achieving other policy objectives such as biodiversity and adaptation to climate change. NWRMs are being promoted within the common implementation strategy for the Water Framework Directive (CIS). In 2014, the "Water Directors" agreed on an EU policy document on NWRMs, which explained their policy relevance and promoted their uptake in water management.

The Commission is currently carrying out an assessment of the 2nd River Basin Management Plans and 1st Flood River Management Plans, which should provide further information on how NWRMs can help achieve the EU water policy objectives. This assessment might provide further information on NWRMs. The findings could point however to an insufficient uptake of NWRMs compared to expectations. This could be due to the lack of a dedicated

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39 http://oppla.eu

40 https://www.think-nature.eu/

41 Directive 2000/60/EC.

funding mechanism, lack of expertise among practitioners in the field or lack of sufficient proof that there is a favourable cost/benefit ratio.

Following a pilot project on 'Atmospheric precipitation - protection and efficient use of fresh water: integration of natural water retention measures in river basin management (2013-2015)', a structured knowledge base on NWRM (www.nwrm.eu) was developed together with an active European 'community of NWRM practitioners' (including the launch of different regional networks and the development of a practical guide to support the practical design and implementation of NWRM). This database contains case studies, and could provide information on projects of strategic importance from the Water Framework Directive and the Floods Directive. A guide was also created to help select, design and implement NWRMs for the agriculture, urban, forestry and water/flood management sectors.

On the ground, green infrastructure / NWRMs are not being implemented to the extent needed. There can be many reasons for this, including lack of information on the benefits, lack of green engineering know-how, greater complexity in dealing with a large number of land owners etc. An instrument that allows for direct funding of strategically important green infrastructure is therefore considered highly relevant.

Transboundary river basins form an essential part of the Water Framework Directive. Strategic and integrated programmes across boundaries could be achieved by introducing GI projects at EU level. This would allow for the implementation of a coherent set of GI measures and NWRMs along river basins, improving for example continuity and connectivity by restoring floodplains (recreating functional and biodiverse wetlands) or removing physical barriers in rivers, which would help fish migration along rivers from source to sea. Well-established international river basin commissions and dedicated environment pillars of the macro-regional strategies could facilitate implementation of such GI projects at EU level.

F. Scientific GI-related work by the JRC

- More green infrastructure is required to maintain ecosystem services under current trends in land-use change in Europe[42]:

  This article https://link.springer.com/article/10.1007/s10980-014-0083-2 describes how Europe's GI and ecosystem services are expected to change under the EU reference scenario (LUISA model). The total number of ecosystem services is expected to decrease by 5 % by 2050 relative to 2010 (see figure 7) as a result of further growth in artificial areas. Although green infrastructure is projected to increase slightly due to afforestation, this increase cannot make up for the loss of ecosystem services. New green infrastructure (plus restoration of ecosystems) is therefore needed to maintain ecosystem services at 2010 levels. As a rule of thumb, each additional per cent increase in the proportion of artificial land needs to be offset by an increase of 2.2 % in land that qualifies as green infrastructure in order to maintain ecosystem services at 2010 levels.

- An article[43] presents a methodology for proposing and assessing green infrastructure based on two entry points: (i) the multiple delivery of ecosystem services (ES) (multi-functionality) and (ii) biodiversity conservation and functional connectivity.

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42 https://link.springer.com/article/10.1007/s10980-014-0083-2

43 doi:10.1016/j.envsci.2015.07.009

- The fourth MAES report 44 on urban ecosystems: this report provides guidance on mapping and assessing urban green infrastructure and the services it provides. It is being currently tested in the EnRoute project45.

- The Protected Connected indicator: Protected Connected (ProtConn) is an indicator of protected area (PA) connectivity recently developed by the JRC. ProtConn quantifies the percentage of a country or ecoregion covered by protected connected lands. It assesses how well the terrestrial PA systems (Natura 2000 and/or nationally designated sites) are designed for connectivity, taking into consideration how different categories of land (protected, unprotected, transboundary) contribute to connectivity. The ProtConn indicator has been recently presented in this article: http://dx.doi.org/10.1016/j.ecolind.2016.12.047

  The ProtConn values at ecoregion level are already available in the JRC's Digital Observatory for Protected Areas (DOPA) http://dopa.jrc.ec.europa.eu/en/mapsanddatasets. The ProtConn values at country level have already been calculated and are available internally and for any interested DGs; these results will be published in DOPA and presented in a new scientific article later this year. Further development of the indicator may include focusing on particular habitats or species of conservation value, or for which connectivity is a prominent conservation concern, as well as on the specific landscape features or green infrastructure elements from which they benefit.

- Connectivity of forests, a recommended GI component and their trends in Europe46:
  The pattern of forests, a recommended GI component, was mapped at landscape level and reported at national and European level in terms of forest morphological shapes (interior/core areas, edge, islet, linear), forest edge interface types (natural, artificial), immediate landscape surroundings (core natural, mixed, some natural) and functional connectivity based on three levels (forest poorly, medium or highly connected) for species dispersing 1 km on average within a 25 km landscape grid cell (Forest Europe, 2015; Saura et al, 2011). The heterogeneity of the landscape in between forest habitats was not accounted for; differences across countries and how they compare to the European average were highlighted for each specific variable. Similarly, the structural and functional connectivity of broadly defined natural and semi-natural vegetation and their immediate landscape surroundings could be assessed in Europe.
  Saura, S., Estreguil, C., Mouton, C., Rodríguez-Freire, M., 2011. Network analysis to assess landscape connectivity trends: Application to European forests (1990-2000). Ecological Indicators 11: 407-416.

- Continuity of natural/semi-natural lands in Europe47: Natural and semi-natural lands were considered GI components. The largest, most structurally connected green infrastructure networks and the most critical ones were identified, including the ones

44 http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/102.pdf

45 https://www.oppla.eu/enroute

46 Forest Europe, 2015. State of Europe's Forests 2015. Status and Trends in Sustainable Forest Management in Europe, Ministerial Conference on the Protection of Forests in Europe, Forest Europe, Liaison Unit Madrid, Madrid. http://foresteurope.org/state-europes-forests-2015-report/ (Indicator 4.7)

47 (Mubareka, S., Estreguil, C., Lavalle, C., Baranzelli C., Rocha Gomes C., 2013. Integrated modelling of the impact of Natural Water Retention Measures on Europe's Green Infrastructure. International Journal of Geographical Information Science. Special Issue on Land Change Modelling: Moving Beyond Projections. http://dx.doi.org/10.1080/13658816.2013.782408).

with cross-state boundaries Their dynamics were also studied according to policy scenarios of land use conversion for 2030 based on three NWRMs (increase of riparian areas, increase of grassland, afforestation); the riparian areas measure was found to increase the green infrastructure core area sizes the most, while all three measures helped merge two large networks. Clerici and Vogt[48] used the GuidosToolbox[49] to identify structural riparian corridors at EU level, and proposed a ranking of European regions as providers of corridors based on environmental pressure and degree of protection of riparian corridors.

- European and regional level connectivity of Natura 2000 sites [50] : the landscape surroundings, the structural continuity and functional connectivity of the Natura 2000 protected sites, as the recommended backbone component of green infrastructure, were assessed at macro-scale over the European territory and at a finer scale over a region of interest.

  Across Europe, the study applied the integrated modelling framework using functions from GuidosToolbox and Conefor software. The focus was on the protected network of Natura 2000 sites that host forest habitats. To reduce computational times, the assessment was deliberately kept generic by focusing on terrestrial species dispersing 1 km on average and accounting for a basic level of heterogeneity of the landscape matrix in between protected sites. Natural and semi-natural lands were considered GI components, i.e. favourable lands that facilitate connectivity and landscape permeability, which mirrors the dispersal of most species. Non-GI elements such as grey infrastructure (e.g. building urban areas and roads) and intensive agricultural land use, which often pose the biggest threats to or disturbances for biodiversity conservation, were set as major factors that reduce connectivity, permeability and therefore species dispersal. Some interesting differences were highlighted across European countries. Places well connected were identified due to a good permeability in the inter-site unprotected landscape. This is ensured by the presence of GI unprotected elements and other areas weakly connected due to GI antagonist components, which likely act as a bottleneck for the presence and movement of most species. The functional connectivity of the protected network was computed at landscape level, then aggregated on a national scale.

  A regional case study was created for the region of Castile-Leon in Spain using detailed regional and national level maps. The continuity of the Natura 2000 network was compared to the average level in Europe. Functional least-cost paths most favourable to forest species dispersal in the unprotected space were mapped and their differences highlighted. The use of four forest ecoprofiles (generalist to specialist species) and four dispersal capabilities (short to long distance) led to the conclusion that a generic approach could be applied when selecting GI components and finding corridor solutions in order to prioritise forest conservation and restoration management efforts. Public utility forests and riversides were found to be key landscape components within corridors. Roads had a greater negative impact on connectivity than fire. Priority places

48 Clerici, N., Vogt, P., 2013. Ranking European regions as providers of structural riparian corridors for conservation and management purposes. International Journal of Applied Earth Observation and Geoinformation 21 (2013) 477-483.

49 http://forest.jrc.ec.europa.eu/download/software/guidos/

50 More information: Estreguil, C., Caudullo, G., San-Miguel-Ayanz, J. 2013. Connectivity of Natura 2000 Forest Sites. JRC scientific and policy report EUR 26087EN. Luxemburg: Publications Office of the European Union. doi: 10.2788/95065.

for defragmentation were proposed for the region of Castile-Leon. Outcomes for this region are spatially explicit maps of dispersal corridors between Natura 2000 sites, which identify preferential paths and GI components to conserve or restore forest areas in order to enhance connectivity. This analysis may be extended to other regions in Europe.

in support to the European Forest Data Centre'. Available for download at http://fise.jrc.ec.europa.eu/topics/ecosystem-services/

A case study that mapped and prioritised the linkages between Natura 2000 sites in Romania and Bulgaria, including transnational connectivity patterns, was presented at the EU technical workshop on knowledge base and spatial and technical data on GI and restoration in Brussels on 24-25 October 2016. The case study included:

- mapping the swaths of land of variable width able to function as corridors between Natura 2000 sites;
- identifying the bottlenecks (weak parts) along these corridors; and
- the spatial prioritisation of these corridors for restoration and conservation.

Results showed a remarkable polarisation and spatial segregation of the key areas for connectivity conservation and those of priority for restoration, which calls for an integrated perspective for green infrastructure planning that encompasses multiple sectors and landscape types. Similar analysis and results, obtained using similar methods, are also available (although not yet made public) for other Member States such as Spain and Portugal. This analysis may be extended to the entire EU in the future.

- Cost-benefit prioritisation of greening measures to improve GI connectivity[51]: This case study addresses the cost-effective spatial development of a well-connected green infrastructure relevant to the integration of forest, agri-environment and regional development policies. This is demonstrated by the region of Lombardy in Italy – at micro-scale to benefit pollinators and pest predators, and on a regional scale to benefit 'connectivity sensitive' terrestrial species. Corridors most favourable to species dispersal are mapped, and gaps in the connectivity of GI network components are identified. Spatially explicit solutions on where to convert agricultural areas into vegetation are then proposed to prioritise improvement actions based on their monetary cost by means of 'greening' subsidies and their benefit to connectivity. A schematic synoptic view of green infrastructure based on existing regional components and including its cost-effective potential improvement is proposed as a tool to help decision makers in particular to prioritise subsidies in terms of the best cost/benefit areas and to motivate land owners to implement biodiversity-friendly measures.

The methodology includes:

- mapping functional corridors that contain GI components;
- guiding how restoration priorities are set; and
- managing the interface between green and grey infrastructure at regional and local level.

It also covers the monetary cost involved in specific land reallocations to develop new corridors within a green infrastructure network. As such, this methodology could help establish a rapid and harmonised green infrastructure assessment across regions.

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[51] Christine Estreguil, Giovanni Caudullo, Carlo Rega, Maria-Luisa Paracchini, 2016. Enhancing Connectivity, Improving Green Infrastructure; EUR 28142 EN; doi:10.2788/170924

- JRC tools: JRC has developed dedicated digital image processing methodologies for mapping and assessing the land cover structure, in particular pattern and fragmentation; they are available via the free GuidosToolbox software. A presentation and half-day workshop on these tools was provided at the EU technical workshop on knowledge base and spatial and technical data on GI and restoration in Brussels on 24-25 October 2016. The analysis methods depend on the availability of digital land cover maps with appropriate spatial resolution and extent. While they are not specific to any species, they may address spatial land cover aspects that contribute to the description of green infrastructure.

  Conefor is a software package for quantifying the importance of habitat areas, linkages and other elements of green infrastructure in order to maintain or restore landscape connectivity. It is conceived as a tool for decision-making support in landscape planning, habitat conservation and the design of green infrastructure networks by identifying and prioritising critical sites for ecological connectivity. The connectivity metrics have been validated with empirical species data, most of them from Europe. http://www.conefor.org/empirical.html Conefor has discovered a large number of applications in Europe and elsewhere; these highlight its potential for supporting policy-making and for prioritising the restoration planning actions for green infrastructure, including its use in assessments performed by the JRC. Examples of the Conefor applications related to connectivity and green infrastructure include:

  - restoration planning and prioritisation;
  - protected area connectivity indicators;
  - assessments of ecosystem service provision;
  - green network planning in urban landscapes;
  - evaluation of the impact of roads on connectivity and prioritisation of defragmentation measures;
  - evaluation of the impact of climate change on species or protected areas; and
  - monitoring of the trends in the connectivity of forests, grasslands and other habitats.

  Further details on the Conefor applications are available at
  http://www.conefor.org/applications.html

JRC has developed a spatially explicit integrated modelling framework[52] using tools from Guidos Toolbox and Conefor as well as other GIS tools for corridor mapping. Its application at European and regional level provides methodological guidance for reporting and mapping the structural continuity, immediate surroundings and functional connectivity of any landscape components such as protected sites, natural/semi-natural habitats or/and any other GI components over large regions. This framework enables the automated integrated processing of large datasets, including their preparation and customisation for GI mapping and assessment, as well as reduced time computing for large regions.

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[52] Further information: Estreguil, C., de Rigo, D., Caudullo, G., 2013. A proposal for an integrated modelling framework to characterise habitat pattern. Environmental Modelling & Software, Vol. 52 (February 2014), pp. 176-191, ISSN 1364-8152, doi: 10.1016/j.envsoft.2013.10.011.

Estreguil, C., Caudullo, G., de Rigo,D., 2014. Connectivity of Natura 2000 forest sites in Europe. F1000Posters 2014, 5: 485. DOI: 10.6084/m9.figshare.1063300. ArXiv: 1406.1501

G. Green infrastructure and EU energy policy

The **Elia** project, in collaboration with the French transmission system operator RTE, several environmental NGOs (Solon, Carah) and the Walloon government in Belgium, has launched an EU-funded Life+ project to restore and/or create habitats in Natura 2000 sites under existing overhead lines. The overall objective of the project is to restore 130 km of corridors under overhead lines in Belgium and France. It aims to foster innovation in the management of forest corridors and demonstrate the innovative character. In addition, the project aims to prove that active management of biodiversity can reduce the costs of securing and maintaining corridors. RTE and Elia will share the experience with other transmission system operators. Part of the project also involves developing training modules for the maintenance teams and providing guidelines with favourable biodiversity actions. Thanks to its efforts, the LIFE Elia-RTE team managed to restore 20 ha of natural habitats and improve the biodiversity network by creating connecting zones between core areas of conservation. By relying on local partnerships, they also succeeded in improving acceptance for high-voltage grid lines.

The **Terna** project[53] developed an innovative methodology for installing marine cables. It minimises the environmental impact of submarine grid interconnections, protecting in particular vast meadows of the rare seagrass Posidonia oceanica.

H. EEA publications on green infrastructure

The European Environment Agency (EEA) has published reports on the usability of existing data and new methodologies for GI deployment, e.g. on spatial analysis of green infrastructure in Europe[54], on its role in mitigating the impacts of weather and climate change related to natural hazards[55], or for protection against floods[56] .

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[53] https://renewables-grid.eu/activities/best-practices/database.html?tx_browser_pi1%5BshowUid%5D=156&cHash=279ebaaf656d64e7d20b30ff5abadc66

[54] https://www.eea.europa.eu/publications/spatial-analysis-of-green-infrastructure

[55] https://www.eea.europa.eu/publications/exploring-nature-based-solutions-2014

[56] https://www.eea.europa.eu/highlights/restoring-floodplains-and-wetlands-offer

2. Summary report on implementation in the EU Member States of the green infrastructure strategy

(IEEP-led consortium, with support from Trinomics, IUCN and WCMC)

Disclaimer: this report is based on the information collected by the consultants until mid-October 2017.

Introduction

The EU's green infrastructure strategy

In May 2013, the European Commission adopted its green infrastructure (GI) strategy[57]. The strategy aims to create an enabling framework to promote and facilitate GI projects across the EU using existing legal, policy and financial instruments.

It defines green infrastructure as '*a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings.*'

The strategy provides for several actions to be carried out under the guidance of the Commission. These include:

- integrating green infrastructure into other policy areas;
- improving information sharing, strengthening the knowledge base and promoting innovation in relation to green infrastructure;
- improving access to finance for GI projects; and
- exploring opportunities for developing a trans-European network in green infrastructure (TEN-G).

Factsheets on the implementation of green infrastructure in the Member States[58]

As part of the service contract 'Technical support related to Target 2 of the EU biodiversity strategy to 2020 — maintaining and restoring ecosystems and their services', 28 country factsheets were created to provide an overview of the activities undertaken by the Member States that contribute to the implementation of the EU's GI strategy. For each Member State, the factsheets provide information on:

- the main policies relevant to green infrastructure;
- selected examples of recent or ongoing GI projects and initiatives;
- information on the integration of GI considerations in other policy areas;
- an overview of the funding sources available for green infrastructure;
- information on the methods, tools and research outputs that have been developed and successfully used for GI development; and
- information on the specific challenges and opportunities for GI implementation.

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57 Green Infrastructure (GI) — Enhancing Europe's Natural Capital, COM(2013) 249 final.

58 The full country fact sheets are available on BISE at: https://biodiversity.europa.eu/countries/gi

The factsheets used as a starting point the country-specific GI information available on the Biodiversity Information System for Europe (BISE) website[59], which was in turn based on a combination of information from the environmental implementation review country reports and 10 country factsheets produced in 2016 as part of the service contract 'Supporting the implementation of green infrastructure'.

An additional desk review of publicly available information was carried out and accompanied, where possible, by interviews with national experts in the International Union for Conservation of Nature's network. The resulting draft factsheets were circulated to national experts (members of the EU Green Infrastructure Implementation and Restoration Working Group and the Coordination Group on Biodiversity and Nature) for review and additions. Feedback was received from 17 Member States: Austria, Belgium (Flemish Region, Walloon Region and Brussels Capital Region), Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Lithuania, Malta, the Netherlands, Poland, Slovakia, Slovenia and the UK. The responses provided by national experts do not necessarily represent an official national position.

This report presents a consolidated overview of the information collected in the 28 country factsheets following the same structure as the individual Member State factsheets.

Green infrastructure policies in the Member States

- **National/regional strategies dedicated to green infrastructure**

With the exception of Germany, which adopted a 'national green infrastructure concept'[60] in early 2017 aimed at implementing the EU's GI strategy, Member States have not yet adopted national strategies dedicated to green infrastructure. Nevertheless, as outlined in the sections below, other policies and legislative instruments address *at least implicitly* the concept of green infrastructure as defined by the EU's GI strategy.

In Spain, the Natural Heritage and Biodiversity Law (Law 42/2007), which was updated in 2015 (Law 33/2015), provides for the development of a national green infrastructure strategy by 2018. The law also requires the autonomous communities to develop their own green infrastructure strategies by 2018, building on the national strategy[61].

Similarly, county administrative boards in Sweden are developing regional GI action plans, as provided for in Sweden's 2013 strategy for biodiversity and ecosystem services. These action plans are primarily intended to provide frameworks for public land use planning, a knowledge base (including maps of existing green infrastructure) for planning, management and the sustainable use of land, and the basis for planning and permitting processes.

- **National ecological networks**

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59 https://biodiversity.europa.eu/

60 http://www.bfn.de/bkgi.html

61 Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) 'Green Infrastructure in Spain', in *Supporting the Implementation of Green Infrastructure*, Final report to the European Commission under service contract ENV.B.2/SER/2014/0012, Annex I. http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_ES.pdf

Several Member States have established national ecological networks or equivalent instruments. These include:

- the Flemish Ecological Network (Belgium);

- the Ecological Network of the Brussels Capital Region (Belgium);

- the National Ecological Network of Bulgaria;

- the Territorial System of Ecological Stability of the Landscape, Czech Republic;
- the French 'green and blue network' (*trame verte et bleue*);
- the German National Ecological Network (*Biotopverbund*);
- the 'Green Network' in Estonia;
- the Hungarian National Ecological Network;

- the 'Nature Frame' in Lithuania;

- the National Nature Network in the Netherlands;

- the National Ecological Reserve in Portugal;
- the Territorial System of Ecological Stability of Slovakia;
- the 'Network of ecologically important areas' in Slovenia; and
- in Italy, several regions have established Regional Ecological Networks.

- **GI considerations in biodiversity and nature policies**

   In many Member States, objectives or requirements specifically related to green infrastructure are included in broader biodiversity and nature conservation policies and legislation. For example, several national biodiversity strategies and plans include references to green infrastructure (whether labelled as such or using other terminology reflecting the same concept). The box below includes some examples.

> **Box 1 — Examples of national biodiversity strategies and action plans that include GI objectives**
>
> The **French National Biodiversity Strategy (2011-2020)** includes a target to '*build a green infrastructure including a coherent network of protected areas*.'
>
> Similarly, the **Hungarian National Biodiversity Strategy (2015-2020)** comprises two objectives explicitly related to green infrastructure: '*Harmonised development of the elements of green infrastructure in order to maintain and enhance the operability of ecological systems and to promote the adaptation to the effects of climate change, including the improvement of the connections between areas of ecological and landscape ecological function, as well as the reconstruction of potential landscape elements together with the restoration of degraded ecosystems*'; and '*Integrate conservation and biological and landscape diversity enhancement aspects into comprehensive and related sectoral policies, with the tools of green infrastructure and ecosystem services, with special focus on spatial planning*.'
>
> The **Finnish Biodiversity Strategy and Action Plan for 2020** states that '*… detrimental impacts on biodiversity due to the fragmentation of natural areas must be prevented or reduced, by developing so-called green and blue infrastructure*.'
>
> **Malta's National Biodiversity Strategy and Action Plan (2012-2020)** sets outs measures such as (i) the further uptake of community initiatives for urban green infrastructure using linear landscape features as ecological corridors between fragmented

and protected areas; and (ii) implementing green infrastructure to improve the coherence of the Natura 2000 network while providing other functions.

Luxembourg's National Nature Protection Plan (2017), which also includes the national biodiversity strategy, mentions green infrastructure and ecosystem restoration, including actions such as reducing fragmentation and improving connectivity of Natura 2000 sites and other nature areas.

Other examples of national biodiversity strategies containing explicit references to green infrastructure are those of Greece and Slovakia.

A number of other national biodiversity strategies and action plans do not specifically mention green infrastructure, but do address the underlying concept. For example, **Romania's National Biodiversity Strategy and Action Plan** (2014-2020) includes actions such as '*analysing the coherence of the natural protected areas and ecological corridors*' and '*evaluating the way in which the current road transport network fragments natural habitats and habitats of wild species of conservation interest and proposing solutions to reduce or eliminate fragmentation*'.

Green infrastructure is also implicitly addressed in instruments related to particular ecosystems such as:

- Finland's national strategy for the sustainable and responsible use of mires and peatlands;
- Ireland's National Peatlands Strategy;
- National Action Plan for Conservation of Wetlands of High Significance in Bulgaria, 2013-2022;
- National Strategy for River Restoration in Spain and strategic plan for the conservation and rational use of wetlands; and
- Germany's 'Blue Belt' programme (which aims to develop a national system of interlinked biotopes along the federal waterways and their associated floodplains).

More generally, national policies and legislation on nature conservation help maintain and enhance green infrastructure and its components by regulating, for example, the protection of species and habitats as well as the designation and management of protected areas and the Natura 2000 network.

- **Other relevant policies**

  Another policy area that contributes to GI implementation is spatial planning and development. For example, the Finnish Land Use and Building Act and National Land Use Guidelines include GI-related considerations such as (i) maintaining ecological connectivity between protected areas and/or between protected areas and the broader landscape; (ii) preventing fragmentation of uniform and ecologically/recreationally important areas; (iii) ensuring the protection of areas with cultural significance and natural beauty; (iv) maintaining the quality of water resources; and (v) establishing national urban parks62.

  The concept of a green map of Denmark ('*Grønt Danmarkskort*') introduced in the Danish Spatial Planning Act in 2015 aims, among other things, to ensure that the most valuable nature in Denmark is sufficiently interconnected to allow species to spread and

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62 IEEP (2010) *Green infrastructure country file: Finland*, prepared in the context of the project 'Green infrastructure implementation and efficiency' (ENV.B.2./SER/2010/0059).

thrive. Although the term 'green infrastructure' is not explicitly mentioned in the document, 'more and better interconnected nature' is its main objective. The green map is intended to provide the strategic framework for Denmark's nature policy by ensuring that both existing and new measures and new natural areas are located where they will have the most effect. The map is also intended to function as a detailed map of existing natural areas in order to support land use planning processes and the location of new green infrastructure. According to the Danish Spatial Planning Act, municipalities should designate areas to the green map based on a common base map and common criteria, and include these in municipal plans from 2017 onwards [63]. Before this date, the municipalities had to plan for national nature priorities by designating and formulating guidelines for the administration of valuable nature areas and ecological corridors[64]. The plans are to be further developed and gradually implemented until 2050.

In Sweden, the National Board of Housing, Building and Planning, which develops guidance on implementing the Planning and Building Act (2010), is currently drawing up guidance on planning and building ecosystem services and green infrastructure for 2017-2018. In Ireland, GI implementation is currently advanced through local governments, who also develop county and city development plans. The Regional Planning Guidelines for the Greater Dublin Area include a model for a GI network for the area[65]. In the UK, national planning policy at the level of the devolved governments provides specific guidance on the integration of green infrastructure principles. References to GI-related aspects can also be found in Slovenia's spatial development strategy[66], Germany's landscape planning policy[67], and the Estonian Planning Act and spatial plan 'Estonia 2030+'[68].

Programmes focused on defragmentation in relation to transport are underway in Germany and the Netherlands. Germany's Federal Defragmentation Programme[69] was adopted in 2012 to maintain, restore and develop green infrastructure across the national German road network so that habitat corridors for flora and fauna are reconnected. Implementation of the programme by the various federal states is currently at different stages. The Multiannual Defragmentation Plan[70] in the Netherlands is a national programme in which the national government, the rail operator ProRail and provinces work together to resolve ecological bottlenecks (e.g. by creating wildlife passages or

63 Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) 'Green Infrastructure in Denmark', in *Supporting the Implementation of Green Infrastructure*, Final report to the European Commission under service contract ENV.B.2/SER/2014/0012, Annex I. http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_DK.pdf

   IEEP (2010) *Green infrastructure country file: Denmark*, prepared in the context of the project 'Green infrastructure implementation and efficiency' (ENV.B.2./SER/2010/0059).

65 Dublin Regional Authority and Mid-East Regional Authority (2010) *Regional Planning Guidelines for the Greater Dublin Area 2010-2022*. The Regional Planning Guidelines Office, Ireland.

66 http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/zakonodaja/en/sprs_eng.pdf

67 https://www.bfn.de/0312_landsch_planung.html

68 European Commission (2017), *The EU Environmental Implementation Review Country Report — Estonia*. http://ec.europa.eu/environment/eir/pdf/report_ee_en.pdf

69 Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), (2012) http://www.bmub.bund.de/themen/natur-biologische-vielfalt-arten/naturschutz-biologische-vielfalt/gebietsschutz-und-vernetzung/biotopverbund/

70 http://www.mjpo.nl/over-mjpo/

tunnels), often in dialogue with municipalities, regional water authorities and nature conservation organisations.

Other examples of broader strategic documents containing GI-related objectives include Latvia's National Development Plan 2014-2020 [71] and Sustainable Development Strategy until 2030[72], Ireland's framework for promoting sustainable development and the green economy[73], and Romania's Territorial Development Strategy[74].

An overview of the integration of GI considerations in other relevant policy areas, from agriculture to health, is presented in section 3.

- **National policies related to green infrastructure in cities**

  National policies specifically related to green infrastructure in cities include:

  - **Italy**: The national law on the development of green urban areas (Law no 10, 14.1.2013), aimed at promoting green areas for the provision of ecosystem services (air quality, hydrological risks, soil protection and cultural dimensions). The law identifies a set of measures including green urban planning and monitoring, support to local-level initiatives and the safeguarding of trees and tree lines as significant features for landscape, heritage, nature, history and culture[75].

  - **Germany**: The 2015 green paper *Green in cities — for a liveable future*, which discusses the multiple functions of urban green infrastructure, current challenges and perspectives, recommended a series of actions to improve green infrastructure in urban areas. The green paper was followed by the adoption of a white paper in May 2017, which contained concrete measures to support municipalities in enhancing urban green infrastructure[76].

  - **Ireland**'s previous biodiversity plan — Actions for Biodiversity 2011-2016 — required each local authority to publish a local biodiversity action plan or review existing plans. These plans address GI issues to some extent. For example, the Dublin City Biodiversity Action Plan defines four themes to structure actions, one of which involves green infrastructure[77].

- **National restoration prioritisation frameworks**

  To date, national restoration prioritisation frameworks have been developed and reported by four countries/regions:

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71 https://rio.jrc.ec.europa.eu/en/library/national-development-plan-latvia-2014-2020

72 http://www.pkc.gov.lv/sites/default/files/images-legacy/LV2030/LIAS_2030_parluks_en.pdf

73 https://www.dccae.gov.ie/en-ie/environment/topics/sustainable-development/our-sustainable-future/Pages/default.aspx

74 http://www.sdtr.ro/

75 Italian Ministry for the Environment and the Protection of Land and Sea and Italian Botanical Society (2016) *Greening Rome. The Urban Green of the Metropolitan Area of Rome in the Context of the Italian MAES Process.* https://circabc.europa.eu/webdav/CircaBC/env/ecosystem_assesment/Library/2016 %20event%20on%20Evidence%20based%20policy%20 making%20for%20sustainable%20cities/Annexes%204th%20 mAES%20report%20Urban%20Pilot/3_9_Annex_Rome%20.pdf

76 http://www.bmub.bund.de/service/publikationen/downloads/details/artikel/weissbuch-stadtgruen/

77 http://www.dublincity.ie/sites/default/files/content/RecreationandCulture/DublinCityParks/Biodiversity/Documents/DublinCityBiodiversityActionPlan2015-2020.pdf

- **Flanders (Belgium):** *Prioriteitenkader voor ecosysteemherstel in Vlaanderen* (Prioritisation framework for ecosystem restoration in Flanders), 2016;

- **Germany:** *Priorisierungsrahmen zur Wiederherstellung verschlechterter Ökosysteme in Deutschland* (Prioritisation framework for the restoration of degraded ecosystems in Germany), 2015;

- **The Netherlands:** *Naar een strategisch kader voor ecosysteemherstel ('RPF') in Nederland* (Towards a strategic framework for ecosystem restoration in the Netherlands), 2014; and

- **Finland** has established a national restoration prioritisation working group, which published its report in October 2015[78].

- **GI-related policies at city level**

  Some European cities have adopted strategies and plans specifically dedicated to green infrastructure (e.g. Barcelona, Manchester), while many others have integrated GI aspects into broader city plans and strategies. Several examples are presented in more detail in Box 2 below.

  A prime example of EU-level facilitation of action at city level is the ongoing EnRoute project 'Enhancing Resilience of Urban Ecosystems through Green Infrastructure'[79]. Following the MAES pilot study on urban ecosystems and their services completed in 2015, the two-year EnRoute project was launched in 2017. It aims to introduce the MAES approach into the local policy arena, connecting the governance levels horizontally and vertically, in order to contribute to the further deployment of green infrastructure in cities and in urban contexts. The envisaged outcomes include:

  - an accepted common framework for the spatially explicit multi-scale assessment of urban green infrastructure and urban ecosystem services;

  - an overview of policy opportunities and needs for connecting urban green infrastructure to the local policy arena; and
  - a network of organisations involved in the further development and use of green infrastructure at various governance levels in the EU.

  The project will include detailed analyses of a set of case studies or 'city labs', where the URBAN-MAES framework will be implemented using local data, involving local stakeholders in the process and focusing on specific issues. Participating 'city labs' include Antwerp (Belgium); Helsinki (Finland); Limmasol (Cyprus); Lisbon (Portugal); Oslo (Norway); Padova (Italy); Poznan (Poland); Karlovo (Bulgaria); Tallinn (Estonia); Rome (Italy); The Hague (The Netherlands); Utrecht (the Netherlands); Trento (Italy); Valetta (Malta); Leipzig (Germany); Dublin (Ireland); Glasgow (UK); Manchester (UK) and Lyon (France).

  Green infrastructure is promoted as part of Europe's urban policy. One of the topics of the Urban Agenda for the EU[80], launched in 2016, is 'Sustainable Use of Land and

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78 https://helda.helsinki.fi/bitstream/handle/10138/156982/SY_8_2015.pdf

79 Zulian, G., Thijssen, M., Günther, S. Maes, J., Enhancing Resilience Of Urban Ecosystems through Green Infrastructure (EnRoute). Progress report, EUR 29048 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-77697-7, doi:10.2760/958542, JRC110402; Website: http://oppla.eu/enroute

80 http://www.urbanagendaforthe.eu/

Nature-Based Solutions', which includes a focus on green infrastructure. A partnership on this topic will be set up in 2017, bringing cities together with the Commission, Member States and stakeholders to develop and implement concrete actions to tackle challenges of cities in this area. 'Sustainable Use of Land and Nature-Based Solutions' will also be included in one of the upcoming calls for the Urban Innovative Actions, which provide funding to cities to test novel solutions for selected sustainable urban development themes81.

Box 2 — Examples of GI-related policies at city level across Member States

Barcelona's green infrastructure and biodiversity plan 202082 , which was adopted in 2013, sets out a plan of actions to make Barcelona by 2050 'a city where nature and urbanity interact and enhance one another by ensuring the connectivity of green infrastructure.' The plan is organised into ten strategic lines of action based on two key concepts — connectivity and renaturalisation — and is defined by means of two instruments:

- urban green corridors intended to constitute a real, robust and functional network of green infrastructure; and
- 'opportunity areas' of varying kinds and sizes, ranging from unoccupied plots to green roofs and balconies, which can be identified in all neighbourhoods in Barcelona and are likely to be subject to renaturalisation and revitalisation.

Manchester's Great Outdoors — a Green and Blue Infrastructure Strategy for Manchester (2015-2025)83 frames the city's GI actions in the context of its plans for growth up to 2025. The strategy is structured around four objectives:

1. Improve the quality and function of existing green and blue infrastructure, to maximise the benefits it delivers;
2. Use appropriate green and blue infrastructure as a key component of new developments to help create successful neighbourhoods and support the city's growth;
3. Improve connectivity and accessibility to green and blue infrastructure within the city and beyond;
4. Improve and promote a wider understanding and awareness of the benefits that green and blue infrastructure provides to residents, the economy and the local environment.

It also sets out a stakeholder implementation plan and identifies funding and delivery mechanisms.

The **Lisbon Strategy for 2010-2024** sets out three main objectives for the city, all of which are linked to green infrastructure:

1. City regeneration — including rehabilitation of vacant buildings, degraded city districts and green spaces;

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81 http://www.uia-initiative.eu

82
http://ajuntament.barcelona.cat/ecologiaurbana/sites/default/files/Barcelona%20green%20infrastructure%20and%20biodiversity%20plan%202020.pdf

83 http://www.manchester.gov.uk/downloads/download/6314/manchester_green_and_blue_strategy

2. Climate change adaptation — with a focus on natural vulnerabilities (such as flooding), energy efficiency, reducing traffic and increasing the area of green spaces; and
3. Connectivity of green spaces — implementation of a network of green spaces and corridors for recreational activities and protection.

As a result of this strategy, the number of green spaces in Lisbon significantly increased[84]. In addition, the **Master Development Plan** includes the ecological structure as a key factor in the city's planning strategy. The ecological structure aims to ensure the continuity and complementarity of natural and semi-natural systems in the urban territory, which is constrained by the dense urban fabric, especially in the city centre[85].

Based on a commitment made in the **Urban Nature in Copenhagen** — Strategy for **2015-2025**, Copenhagen adopted a new policy for trees in the city — **Copenhagen tree planting policy** ('*Københavns Kommunes træpolitik*') 2016-2025. The policy — outlining five policy principles for the management of urban trees — aims to make trees a greater priority in the city without hampering city development and ultimately achieving a 20 % coverage of canopy in the city[86].

The region of **Stockholm** has gradually introduced the concept of ecosystem services into planning at various levels; barely mentioned in the 2010 regional development plan, it has become a central part of the most recent plan up to 2050, for example in terms of green structure, blue structure and countryside. The region is also using the **MatrixGreen planning tool** developed by the Stockholm Resilience Centre and the Swedish University of Agricultural Sciences to e.g. assess connectivity between various habitats and biotopes in the region[87].

The **London Plan**, which outlines the strategic plan for the city up to 2031, provides a policy framework that encourages the protection and maintenance of trees and the planting of new trees and woodlands. New versions of the plan are published every year; in the latest (2016), policy 2.18 focuses on green infrastructure and sets out commitments for management and implementation, including the need to develop action plans at the level of boroughs[88]. Policies 7.16-7.22 set out further actions for habitat protection and restoration in line with the Mayor's biodiversity strategy, as well as protection of London's green belt and agricultural land. The **London Infrastructure Plan 2050**[89] is accompanied by a supporting document on enabling infrastructure, with a section focusing on green infrastructure. Supporting green

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84 GREEN SURGE (2015) Lisbon, Portugal. Case Study City Portrait; part of a GREEN SURGE study on urban green infrastructure planning and governance in 20 European cities. http://greensurge.eu/products/case-studies/Case_Study_Portrait_Lisbon.pdf

85 Ibid.

86 http://www.kk.dk/artikel/koebenhavns-kommunes-traepolitik-2016-2025

87 http://www.rufs.se/rufs-2050/en-ny-plan/

88 GLA (2016a) *The London Plan*. Greater London Authority, London, UK.

89 https://www.london.gov.uk/what-we-do/business-and-economy/better-infrastructure/london-infrastructure-plan-2050#acc-i-43214

> infrastructure is also listed as a current focus area of the plan; to implement this, a Green Infrastructure Task Force [90] was established. This has produced a range of outputs, including a 2015 report called 'Natural Capital: Investing in a Green Infrastructure for a Future City'. The **All London Green Grid**[91] is a policy framework that promotes the design and delivery of green infrastructure across London.
>
> The **Bristol Local Plan 2011-26** [92] includes policies on the protection and enhancement of green space, as does Policy BCS9 of the **Bristol Development Framework Core Strategy93**. The latter also introduces further stipulations to restrict the conditions under which the loss of green infrastructure is acceptable.

- **Other relevant policy initiatives in preparation**

  A number of initiatives related to green infrastructure are currently being developed in various Member States:

  - **Belgium, Flemish Region:** The Agency for Nature and Forests is currently developing a new long-term vision on urban greenery and urban forestry. The vision is intended to lead to a strategy that seeks to drastically increase the amount, quality and linkages of nature and greenery in the built-up environment (urban and peri-urban areas).
  - **Ireland:** A new national planning framework, **Ireland 2040 — Our Plan94**, is being prepared.
  - **Sweden:** Regional GI action plans are being developed by the county administrative boards.
  - **Slovenia:** A new Spatial Development Strategy of Slovenia 2050 is being prepared. It will include significant national infrastructure, including green infrastructure, as a strategically planned multifunctional system of different spatial/landscape elements at national level, with guidelines for development at regional and local level.
  In addition, the Ministry of Environment and Spatial Planning is currently preparing a proposal for the new National Environmental Action Programme 2017-2030 (NEAP), which will also include a new National Nature Conservation Programme (NNCP). Green infrastructure objectives and measures — with special emphasis on the Natura 2000 network and achieving the nature conservation objectives on state property (forests, agricultural land and waters) — are set to be included in these two programmes.

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90   https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/green-infrastructure-task-force-report

91   https://www.london.gov.uk/WHAT-WE-DO/environment/parks-green-spaces-and-biodiversity/all-london-green-grid

92   https://www.bristol.gov.uk/planning-and-building-regulations/local-plan

93
     https://www.bristol.gov.uk/documents/20182/34540/Core%20Strategy%20WEB%20PDF%20(low%20res%20with%20links)_0.pdf/f350d129-d39c-4d48-9451-1f84713a0ed8

94 http://npf.ie/

- **United Kingdom:** The UK government is developing a 25-year environment plan together with the Natural Capital Committee95. The plan should have been published in 2016, but has been delayed in part as a result of Brexit.

- **Implementation of green infrastructure in the Member States**

   A range of GI projects and initiatives have been implemented in the Member States in recent years. These cover different scales (local, national, regional, transboundary/international) and intervention types, such as;

   - habitat restoration or creation;
   - conservation of important ecosystems (e.g. through designation and management of protected areas and Natura 2000 sites);
   - sustainable management of natural resources (e.g. forests, agricultural land);
   - measures to enhance connectivity; and
   - urban greening measures.

   The following boxes provide examples of the initiatives identified at various levels.

Box 3 — Examples of local GI initiatives

Belgium: Greening public space in the Brussels Capital Region

Since 2000, the **Green Neighbourhoods** programme96 has supported more than 200 local greening initiatives in the Brussels Capital Region. It consists of small-scale initiatives by individuals to green public space.

Denmark: Green roofs in Copenhagen97

Green roofs are part of Copenhagen's **Climat98e Adaptation Plan** as well as its biodiversity strategy. The Municipality Plan 2015 makes green roofs mandatory for all new buildings in new planned areas where buildings are suitable and include a flat roof (up to 30 degree angle).

Germany: GI interventions in Leipzig

The city of Leipzig has implemented a series of local interventions, including the creation of green corridors, the 'Green Ring', management of the Parthe Floodplain and investments in developing parks and converting derelict areas into green urban spaces. In the Paunsdorf area, a 'Green Arc' (a chain of green spaces surrounding a large high-density housing area) was developed, and water buffalo are now part of a landscape of ponds and swamps99.

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95   https://www.gov.uk/government/publications/natural-capital-committee-advice-on-governments-25-year-environment-plan

96 http://www.quartiersverts.be/; http://www.quartiersverts.be/IMG/pdf/guids_gw2015.pdf

97 http://en.klimatilpasning.dk/media/568851/copenhagen_adaption_plan.pdf

98 https://kp15.kk.dk/artikel/municipal-plan-2015

99 Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) 'Green Infrastructure in Germany', in *Supporting the Implementation of Green Infrastructure*, Final report to the European Commission under service contract

Italy: Vertical Forest of Milan

The **Bosco Verticale**[100] is an innovative project consisting of two residential towers — one 110 m high, the other 76 m — in the city's central business district. The towers are planted with 900 trees (each measuring 3 m, 6 m or 9 m) and over 20 000 plants from a wide range of shrubs and floral plants distributed according to the sun exposure of the facade. On flat land, each vertical forest is equivalent to an area of roughly 20 000 m^2 of forest.

The Netherlands: Sand Motor

The **Sand Motor**[101] on the Delfland Coast was created in 2011 as an artificial sandbank in the form of a peninsula covering 128 ha. Natural processes (wind and currents) redistribute the sand gradually along the shore face, beach and dunes. It is an innovative pilot project for coastline management whose aim is to contribute to coastal protection in the long term. The aim was also to create another attractive area for nature and leisure activities and to boost current knowledge on coastline management.

An evaluation carried out in 2016 reveals that the Sand Motor has created a wider coastal zone, and a variety of plants, birds and other animals have settled in the new, attractive coastal landscape. The area also plays a major role as a leisure location for nature lovers and sporty types[102].

Slovakia: Green infrastructure for climate change adaptation in Bratislava

The city of Bratislava is implementing several climate adaptation measures, including a green roof of 1 000 m^2 on a retirement home and the planting of trees along two avenues to provide cool corridors. A new 1 000 m^2 park will be created in an area without green public spaces and will contain a variety of water retention measures. On the Námestie hraničiarov square measuring some 1 ha, the pavement will be replaced by grass areas, trees and flower beds, and a rainwater collection and irrigation system will build resilience against drought. In the Nové Mesto district, which used to be industrialised, a former velodrome (of around 3 ha) on a brownfield site will be transformed into a multifunctional leisure area, and a new green space will be created on a former chestnut plantation[103].

ENV.B.2/SER/2014/0012, Annex I.
http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_DE.pdf

100   Oppla (2017) *Milan: Bosco verticale (vertical garden)*. http://oppla.eu/casestudy/17625

101   http://www.dezandmotor.nl/en/the-sand-motor/introduction/

102   Ministry of Infrastructure and the Environment (2016), Interim results 2011-2015, The Sand Motor: driver of innovative coast maintenance. http://www.dezandmotor.nl/uploads/2016/09/1300005-brochure-sandmotor-a4-eng.pdf

103   CLIMATE-ADAPT (2016) *EEA grants supporting the city of Bratislava to implement climate adaptation measures (2016),* http://climate-adapt.eea.europa.eu/metadata/case-studies/eea-grants-supporting-the-city-of-bratislava-to-implement-climate-adaptation-measures

Spain: Sustainable drainage systems in Benaguasil

The municipality of Benaguasil is promoting a more sustainable method of managing rainwater by using sustainable drainage systems — green infrastructure that encourages the retention, detention and infiltration of surface water runoff. To this end, it has renovated urban spaces by constructing a vegetation cover, drainage ditches, permeable pavements, rain gardens, detention rafts and rainwater harvesting depots.

The monitoring results confirm their efficiency in urban water management, and have highlighted additional benefits such as greater resilience to the effects of climate change, reduction of energy consumption, avoiding sediment entry in the sewage network, and the multi-functionality of public spaces[104].

Box 4 — Examples of regional GI initiatives

Austria: LIFE+ Wilderness Wetland Wachau

This LIFE+ project[105], which runs from January 2015 to December 2020, aims to restore alluvial and riparian forests in the Wachau Valley, one of the last free-flowing sections of the Austrian Danube, and improve the conservation status of several species protected under the Habitat and Birds Directives.

Finland: NATNET — Increasing the ecological connections and coherence of the Natura 2000 network in south-west Lapland

Implemented between February 2012 and December 2017, this LIFE+ project[106] aims to increase ecological connectivity and establish green infrastructure that will improve the vitality and coherence of the Natura 2000 network in south-western Lapland and raise the biodiversity of the forests in the project area. The project area covers 32 Natura 2000 sites with a total area of 363 000 ha.

A series of actions target the species and habitats of Community importance within the project area to improve and restore their conservation status or, in some cases, maintain a 'favourable' conservation status. Another objective is to increase biodiversity in the commercial forests and protect important areas around and between the Natura 2000 sites. The ecological connections between the Natura 2000 area and other existing

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104   Ayuntamiento de Benaguasil (2016) *La apuesta por la infraestructura verde urbana para la gestión de pluviales tiene premio*.
http://www.conama2016.org/web/generico.php?idpaginas=&lang=es&menu=406&id=1230&op=view

105   LIFE+ Wilderness Wetland Wachau:
http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4917&docType=pdf

106   European Commission (undated) *NATNET — Increasing the ecological connections and coherence of the Natura 2000 network in south-west Lapland*. LIFE10 NAT/FI/000047
http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4071

protection areas in south-west Lapland are established by voluntary permanent protection agreements on privately owned land107.

France: LIFE Jura peatlands — Functional rehabilitation of the Jura mountains peatlands of Franche-Comté

Implemented between June 2014 and November 2020, the project108 aims to improve the conservation status of habitats listed in the annexes of the Habitats Directive in the peat bogs of the Jura Mountains. It is developing conservation management plans and implementing hydrology restoration and other supporting works on land accounting for 37 % of the Franche-Comté Natura 2000 network.

Italy: Turin's 'Green Crown' (*Corona Verde*)

Corona Verde is a strategic project implemented in the metropolitan and surrounding area of Turin and involves 93 municipalities. Initiated by the Piedmont Region and the Politecnico di Torino University, the project aims to establish a green infrastructure that integrates the 'Crown of delights' (*Corona di Delitie*) — a system of royal residences from the sixteenth and seventeenth century spread out across the city of Turin — with the city's green belt, including metropolitan parks, rivers and rural areas.

The project covers an area of 164 883 ha and includes 1 865 ha of special protected areas. EUR 13 147 665 was invested by different parties, including the EU.

The objective is to provide — in a cost-effective manner — the metropolitan area of Turin with many social, environmental and economic benefits for the city and its population. These include protecting against soil erosion, reducing adverse impacts of grey infrastructure projects, enhancing tourism and reducing pollution109.

Romania: Connect Carpathians — Enhancing landscape connectivity for brown bear and wolf through a regional network of NATURA 2000 sites

This LIFE project110 aims to enhance landscape connectivity within an ecological corridor located in western Romania. This corridor consists of a network of Natura 2000 sites situated between the Apuseni Mountains and the Southern Carpathians, and is the only route through which flagship species such as bears and wolves can move between the two areas. The project runs from September 2013 to February 2019.

Project activities aimed at enhancing functional connectivity include:

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107   NATNET project website, http://en.natnet.fi/

108
        http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=486
        1&docType=pdf

109   Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional
        Environmental Centre (2016) 'Green Infrastructure in Italy', in *Supporting the Implementation of Green
        Infrastructure*, Final report to the European Commission under service contract ENV.B.2/SER/2014/0012,
        Annex I. http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_IT.pdf

110   Connect Carpathians (2014) LIFE Connect Carpathians. Project website:
        http://connectcarpathians.ro/?lang=en

- building the capacity of responsible agencies and Natura 2000 site administrators in landscape scale conservation;
- involving local stakeholders in connectivity management;
- securing land to develop linkage corridors; and
- managing corridors to create carnivore-permeable landscape.

Slovenia: Sečovlje Salina Nature Park and Natura 2000 site

Sečovlje Salina, a 650 ha area along the estuary of the Dragonja River on the southernmost stretch of the Slovenian coastline, is the first state-designated protected area to be managed by a private company (Soline; a salt producer). It is a prime example of multifunctional green infrastructure that combines salt production, tourism, recreational activities and education whilst at the same time conserving unique habitats for salt-loving vegetation.

The LIFE+ project **MANSALT — Man and Nature in Sečovlje salt-pans[111]** (2010-2015) improved the conservation status of target species and habitat types in the Natura 2000 site Sečovlje Salina. Specific actions included:

- ensuring control and effectively managing the water regime;
- enhancing the conservation status of numerous species and habitats in the area; and
- raising public awareness among the local population and wider public[112].

Sweden: ReBorN — Restoration of Boreal Nordic Rivers

This LIFE project[113] aims to enhance previously modified water bodies in northern Sweden to improve the conservation status of habitats and species of Community interest, as defined in the Habitats Directive, and to achieve good environmental status of these bodies of water, in accordance with the Water Framework Directive.

The project has a budget of just over EUR 13 million and runs from 2016 to 2021.

UK: The Seven Lochs Wetland Park in Scotland

The Seven Lochs Wetland Park[114] is an example of a large-scale project that is part of the Central Scotland Green Network (a national development whose aims include an integrated habitat network and improved landscape quality).

111
http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=3854&docType=pdf

112   Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) 'Green Infrastructure in Slovenia', in *Supporting the Implementation of Green Infrastructure*, Final report to the European Commission under service contract ENV.B.2/SER/2014/0012, Annex I. http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_SL.pdf

113
http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5864&docType=pdf

114 http://sevenlochs.org/

Located on the north-east outskirts of Glasgow and North Lanarkshire, the project links the lochs with other wetland areas as well as peatland and woodland habitat, and develops community access to the natural and historic environment in the area.

Box 5 — Examples of national initiatives

Czech Republic: Complex approach to the protection of fauna of terrestrial ecosystems from landscape fragmentation

Financed by EEA Grants and Norway Grants, this project[115], which runs from 2015-2017, focuses on the identification of biotopes of specially protected large mammal species (lynx, bear, wolf and moose). The biotopes consist of core areas, migration biotopes and critical barrier sites. The main output is a polygon layer, which is to be incorporated into obligatory urban planning processes.

Finland: Boreal peatland life: Restoring the Natura 2000 network of boreal peatland ecosystems

This LIFE project[116], which was implemented from 2010 to 2014, aimed to improve the habitat quality of 54 Natura 2000 sites in the unique Finnish peatland network. Almost 600 ha of valuable peatlands were acquired for nature conservation, with some 4 700 ha of drained peatlands in 51 Natura 2000 sites restored.

Ireland: LIFE Irish raised bogs: Restoring active raised bog in Ireland's SAC network (2016 – 2020)

The project aims to improve the conservation status of active raised bog habitat by protecting and restoring 12 Natura 2000 network sites in the midlands of Ireland[117].

Malta: Alter Aqua Water Programme

The programme[118] aims to mobilise non-conventional water resources in order to secure water availability and facilitate sustainable development. It is a multi-stakeholder initiative, financed by Maltese Ministries and The Coca Cola Foundation. It was launched in November 2011 in Gozo and expanded to the Island of Malta in

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115   http://www.eeagrants.cz/en/programmes/eea-grants-2009-2014/cz02-environment/cz02-approved-projects/complex-approach-to-the-protection-of-fa-1716

116   Boreal Peatland LIFE Project. Working for the Finnish Peatlands. Layman's report: http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE08_NAT_FIN_000596_LAYMAN.pdf

117   http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5321

118   Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) 'Green Infrastructure in Malta', in *Supporting the Implementation of Green Infrastructure*, Final report to the European Commission under service contract ENV.B.2/SER/2014/0012, Annex I. http://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_MT.pdf

January 2014.

The programme's activities include rainwater harvesting, greywater reuse systems and storm water management in the Ramla Valley. The latter involves reconstructing rubble walls to increase water availability for irrigation, allow aquifer replenishment and prevent soil erosion. Rubble walls also serve as an important ecological corridor and a refuge for a number of endangered terrestrial fauna.

Project benefits include increased water availability, prevention of soil erosion and increase in connectivity and biodiversity.

The Netherlands: Room for the River Programme

Thanks to interventions at more than 30 locations, the programme[119] uses technical and natural solutions to accommodate higher water levels and flows. The measures are also designed in such a way that they improve the quality of the immediate surroundings.

Sweden: The system of forest 'eco-parks'

Sveaskog, the state-owned forestry company, has a system of eco-parks that cover large, connected forested areas of particular ecological value. It currently owns and manages 36 eco-parks in Sweden, ranging from 1 000 ha to 21 000 ha. The first park was established in 2003.

In an eco-park, at least 50 % of the productive forest must be used for conservation purposes, more specifically to protect and actively support the function of its natural values. Practical management measures include, for instance, reintroducing grazing cattle to old pastoral forests and cutting coniferous forest to support deciduous forest growth. Management plans are designed in collaboration with relevant stakeholders across different sectors[120].

UK: Nature Improvement Areas

12 Nature Improvement Areas[121] were established in England in 2012 (in response to a review of the adequacy of the protected areas in England) to create joined up networks of individual parcels of land recognised for the value of their nature[122].

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119   https://www.ruimtevoorderivier.nl/english/

120
        http://www.sveaskog.se/Documents/Trycksaker/Ekoparksmaterial/V%C3 %A5ra%20ekoparker%20sve.pdf

121   https://www.gov.uk/government/publications/nature-improvement-areas-improved-ecological-networks

122   https://www.gov.uk/government/publications/nature-improvement-areas-improved-ecological-networks/nature-improvement-areas-about-the-programme

Box 6 — Examples of cross-border and transnational initiatives

European Green Belt

The European Green Belt[123] forms a transcontinental axis of the European ecological network. With a total length of 12 500 km along the former Iron Curtain, it passes through eight biogeographic regions and 24 countries (Finland, Norway, Russia, Estonia, Latvia, Lithuania, Poland, Germany, Czech Republic, Austria, Slovakia, Hungary, Slovenia, Italy, Croatia, Romania, Serbia, Montenegro, Albania, Greece, Macedonia, Bulgaria, Kosovo and Turkey).

The Green Belt connects national parks, nature parks, biosphere reserves and transboundary protected areas as well as non-protected areas along or across borders. It also promotes regional development initiatives in the field of nature conservation.

The Lower Danube Green Corridor

The Lower Danube Green Corridor[124] aims to coordinate national efforts and cross-border cooperation among the Lower Danube countries (Romania, Bulgaria, Ukraine and Moldova) in order to protect and restore wetlands and floodplain habitats. A large-scale ecological corridor of up to 1 million ha of existing and new protected areas and 223 608 ha of areas was proposed to be restored to natural floodplains.

TRANSGREEN — Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature

This Interreg project[125] aims to better connect the Carpathian region with transport infrastructure that takes nature conservation into account. It will do so by improving planning frameworks and developing concrete environmentally friendly and safe road and rail transport solutions, taking into account elements of green infrastructure, in particular ecological corridors.

The project's pilot areas are located in Hungary, Slovakia, Romania, Czech Republic and Ukraine. The project will run from 2017 to 2019 and will cost EUR 2.5 million, EUR 2.1 million of which will come from the European Regional Development Fund (ERDF).

PROTOMEDEA — Towards the establishment of Marine Protected Area Networks in the Eastern Mediterranean

The goal of this DG MARE-funded project[126] (2015-2018) is to design a Marine Protected Area network in Greece and Cyprus, taking into account the protection of ecological characteristics and essential fish habitats, significant areas for fisheries as

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123   http://www.europeangreenbelt.org/

124   http://climate-adapt.eea.europa.eu/metadata/case-studies/lower-danube-green-corridor-floodplain-restoration-for-flood-protection

125   http://www.interreg-danube.eu/approved-projects/transgreen

126   http://msp-platform.eu/projects/protomedea-towards-establishment-marine-protected-area-networks-eastern-mediterranean

well as their socio-economic impact through a participatory bottom-up process.

Protected GI and water bodies in Zemale Region and North Lithuania

Nine municipalities in Latvia and Lithuania came together to jointly implement the motto 'Let's make our cities greener'. The project[127] focuses on urban areas and on improving their green infrastructure. Emphasis was placed on the collaboration between architects and city planners of both countries in trying to find the best way to balance the aesthetics, ecology and functionality of the green areas.

Alpine Space: Alpine Ecosystem Services — mapping, maintenance and management (AlpES)

The objectives of this INTERREG project[128], which runs from December 2015 to December 2018 and covers Slovenia, Austria, France, Germany, Italy and Liechtenstein, are to introduce ecosystem services as a regional/transnational environmental governance framework and to train and support the AlpES target groups in understanding, valuing and managing them.

Danube floodplains: Restoration and management of Danube floodplain habitats

This LIFE project[129], which is located in Slovakia and Hungary, aims to restore the key natural habitats of Danube floodplains and to introduce sound sustainable management in order to control future flooding in the region.

Habitat restoration will be achieved by improving the water regime in the vast river branch system and by introducing direct interventions to secure favourable conservation status of targeted habitats. The project runs from August 2015 to January 2022.

SustainBaltic: ICZM Plans for Sustaining Coastal and Marine Human-ecological Networks in the Baltic Region

This ERDF-funded project[130] (2016-2018) focuses on improving the share of managed coastal networks in the Central Baltic region by increasing cross-border planning, preparation and co-evaluation of the integrated coastal zone management (ICZM) plans in order to ensure that sea-land interfaces are preserved and further developed.

The project targets four ICZM case studies areas from Estonia and Finland, with four ICZM plans produced based on the current spatial data on ecological, land use and

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127   Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) 'Green Infrastructure in Latvia', in *Supporting the Implementation of Green Infrastructure*, Final report to the European Commission under service contract ENV.B.2/SER/2014/0012, Annex I.

128   http://www.cipra.org/en/cipra/international/projects/current/alpes

129   http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5341&docType=pdf

130   http://database.centralbaltic.eu/project/51

human activities. The novelty of the SustainBaltic approach involves working closely together to define the most crucial planning criteria to be utilised and implemented further in the Central Baltic programme area.

The Green Infrastructure Network (GreenInfraNet)

The aim of this Interreg project131 (2012-2015) was to strengthen the development and implementation of green infrastructure in 11 EU regions by exchanging experiences, expertise and good practices.

GREEN SURGE: Green Infrastructure and Urban Biodiversity for Sustainable Urban Development and the Green Economy

Funded by the Seventh Framework Programme and running from 2013 to 2017, the project132 aims to identify and develop ways of linking green spaces, biodiversity, people and the green economy in order to meet the major urban challenges related to land use conflicts, climate change adaptation, demographic changes and human health and well-being.

It will provide a basis for urban green infrastructure planning and implementation, exploring the potential for innovation to better link environmental, social and economic ecosystem services with local communities.

E²STORMED

Co-funded by the ERDF and completed in 2015, the E²STORMED project133 aimed to improve energy efficiency in the urban water cycle and in buildings by promoting the use of innovative stormwater solutions such as sustainable drainage systems in Mediterranean cities.

The project was implemented in Greece, Spain, Croatia, Italy, Malta and Montenegro. One of its outputs was a decision support tool designed to include energy efficiency and environmental criteria in urban stormwater management decisions.

Many of the GI initiatives identified (some of which have been illustrated in the text boxes above) consist of restoration activities and therefore contribute to achieving the EU target of restoring 15 % of degraded ecosystems by 2020. However, estimates of the aggregate contribution that existing GI initiatives generate towards the 15 % restoration target are not available.

Numerous initiatives (including many of the restoration ones) are linked to Natura 2000 sites. Implementation of the EU's GI strategy therefore contributes to the goals of the EU Nature Directives, and vice versa.

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131   http://www.greeninfranet.org/

132   http://greensurge.eu/

133   http://www.e2stormed.eu/project/

Mainstreaming green infrastructure in other policy areas

Based on the information collected in the country factsheets, *some integration* of GI considerations into other relevant policy areas has taken place in most Member States, although the range of policy areas and the extent of the integration varies widely. In many cases, green infrastructure is not mentioned directly in the respective policies, and it is the broader areas of biodiversity and nature conservation that have been integrated. However, it is worth noting that the information collected in the factsheets does not represent an exhaustive list of GI mainstreaming initiatives, but rather the best available information that could be acquired from online public sources, complemented by information from national experts (if submitted). As such, it is difficult to draw comparisons between countries or policy areas.

The sections below outline the most relevant available examples of how GI considerations have been integrated into other policy areas across different Member States.

- **Agricultural policy**

    In terms of agricultural policy, several country factsheets highlight the fact that rural development programmes (RDPs) contribute to GI objectives through measures that support the conservation, restoration and creation of habitats. For example, 1.2 million ha of high nature value grasslands in Romania (out of a total of 2.4 million ha identified in the country) were protected under the previous RDP by granting financial compensation to farmers who undertook commitments to apply management requirements [134]. In Germany, the RDPs of several federal states explicitly mention green infrastructure. This is also the case for several regional RDPs in Italy[135].

    In Sweden, various actions performed by the Swedish Board of Agriculture (government agency responsible for agriculture) contribute to GI implementation. For example, the Board worked together with several other government agencies in 2016 on transition zones between forestry and agricultural land to support biodiversity, GI and ecosystem services. The Board emphasises the value of connectivity between natural areas in the agricultural landscape and offers guidance to land owners on how to achieve a varied and connected landscape to support pollinators, birds, and hunting and game management. A number of farms in Sweden are used as demonstration examples of agricultural systems that benefit biodiversity.

    In Flanders (Belgium), the Department of Agriculture and Fisheries and the Department of Environment, Nature and Energy launched the AGNABIO[136] initiative in 2009. Its aim was to strengthen policy coordination and knowledge exchange in the fields of agricultural nature management and agrobiodiversity. Among the actions taken was the development of a practical guidance on 'Agriculture and Nature'.

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134 BISE (2015) Romania — Contribution to the mid-term review of the EU biodiversity strategy to 2020 based on the 5th national report to CBD. http://biodiversity.europa.eu/mtr/countries/romania/

135 ISMEA (2016) PSR 2014-2020 Il paesaggio rurale e le misure dei PSR 2014-2020. http://www.terrainnova.it/wp-content/uploads/sites/3/2016/12/RRN_Analisi_PSR_2014_20_Paesaggio_2016.pdf

136 http://lv.vlaanderen.be/nl/voorlichting-info/voorlichting/agnabio-en-fab-0#Agnabio

Malta's Rural Policy and Design Guidance (2014)[137] aims to protect landscape features and ecological corridors such as rubble walls, natural ponds and stands of indigenous trees in agricultural areas.

- **Forestry**

  Another area where links to green infrastructure were found in several Member States is forestry. Forests are one of the physical building blocks of green infrastructure and, if healthy and managed sustainably, provide multiple ecosystem services. The multifunctionality of forests and the importance of sustainable use/management are recognised in the EU Forest Strategy and in many national forest programmes, strategies or acts.

  For example, the Austrian Forest Programme launched in 2007 consists of seven thematic areas that reflect the different ecosystem services of forests and their part in green infrastructure:

  - the contribution of forests to climate mitigation and adaptation;
  - health and sustainability of the forests;
  - productivity and economic aspects of the forests;
  - biodiversity;
  - protection against disasters and extreme weather events;
  - social and economic aspects of the forest; and
  - international responsibility for sustainable forestry.

  A large part of Austrian forests (around 20 %) is classified as 'protection forest', for which the objective is to safeguard the benefits they provide to human well-being, especially their protective function (e.g. controlling natural hazards), their value for recreation and tourism and general socio-economic functions). Protection of these forests and their ecosystem services remains a priority within forestry policy. Protection forests also exist in Croatia.

  Germany's Forest Strategy 2020 and the National Biodiversity Strategy emphasise the multifunctionality of forests as a guiding concept. GI-related measures include increasing the area of forests and maintaining or increasing the ecological value of forests. Germany has also set a target for the area, with natural forest development to reach 5 % of the total forest area by 2020.

  The non-productive role of forests is also recognised, for example, in the Polish Forest Act (1991) and Latvian forest policy.

  In Finland, the process of ecosystem-based natural resources planning (ENRP) aims to reconcile different land uses in a sustainable manner, including nature conservation, forestry, recreation, ecotourism, real estate development and the sale of soil resources. The key aim of the process is to ensure the sustainable, multiple use of land by harmonising ecological, economic and socio-cultural objectives of forest management. Landscape ecological planning (LEP) is the ecological component of the ENRP process that aims to ensure:

  - the survival of the area's native species as viable populations;
  - conservation of existing valuable habitats; and

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137 https://era.org.mt/en/Pages/RURAL-POLICY-AND-DESIGN-GUIDANCE-2014.aspx

- improved connectivity of the protected area network in surrounding production forests.

The ENRP/LEP process includes a range of elements integral to the GI concept, including key biotopes and areas with threatened species (e.g. protected areas), areas important for ecological connectivity, areas in need of restoration and/or enhancement of biodiversity, game reserves, areas important for their scenic or cultural value and special areas for traditional livelihoods.

In Denmark's 2016 Nature Package, the government pledged to set aside 13 300 ha of state forest to protect biodiversity. A new national forestry programme will be launched, and all forests with particularly high biological value will be mapped and registered, with land owners encouraged to voluntarily protect such forests.

The Spanish Forest Plan (2002-2032) aims to introduce reforestation programmes to increase the amount of carbon stored in forests. These programmes include:

- hydrological-forest restoration;
- the CAP agricultural land reforestation programme;
- reforestation within the Natura 2000 network; and
- planting 19.5 million trees (which were planted by 2011, leading to reforestation of an area of more than 29 000 ha).

- **Spatial planning and urban policy**

  As outlined in Section 1, GI objectives have been integrated into the spatial planning policies of several Member States, e.g. by means of requirements on ecological connectivity, the prevention of fragmentation, the establishment of national ecological networks (and consideration of these networks in development plans and projects) etc.

  In addition, GI considerations have been integrated into urban policy by means of specific requirements on the extent and/or quality of urban green areas (see e.g. Lithuania's Law on Green Plots, Slovenia's Spatial Planning Act and the sustainable urban strategies adopted by Slovenian urban municipalities in 2015) as well as government funding for green roofs (e.g. in the Czech Republic).

  Another example of GI integration in urban policy is the German National Urban Development Policy, which has been in place since 2007. In its latest update (2015), increasing vegetation, especially in densely populated neighbourhoods, is an opportunity to improve quality of life. The creation of water retention basins and reduction in soil sealing are seen as important measures for adapting cities to climate change.

  The green paper *Green in cities — for a liveable future* published in 2015 acknowledges the many functions of nature (health, well-being, climate adaptation and risk reduction, environmental conditions, biodiversity, social, cultural and educational functions, production of food and resources) in different forms and shapes (from natural areas to green roofs, as separate building blocks or connected). In Hungary, the Green City Calls under the Territorial and Settlement Development Operational Programme (2014-2020)[138] provide financial support for the setting up of green infrastructure development and maintenance plans. As outlined in Section 1, several cities have developed GI-related strategies and policy initiatives.

- **Transport policy**

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[138] https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/policy-document/alfold-es-eszak/territorial-and-settlement-development-operational-programme

In the transport sector, the main means of integrating green infrastructure have been measures to maintain or increase the permeability of transport infrastructure for wildlife as well as environmental impact assessments of transport projects (to identify and reduce negative impacts on nature and biodiversity, rather than green infrastructure specifically).

In Austria, it has been mandatory since 2007 to establish a wildlife corridor every third kilometre when a newly developed road or railway poses a threat to wildlife[139]. A working group was set up to address this issue. It developed a guidance document 'Defragmentation of habitats: Guidance for reducing the effects of roads and railways'[140]. The guide can help various levels of administration identify the critical zones affected and select appropriate measures to address defragmentation. The working group also developed a guide on how to identify areas to be defragmented (2014) as well as a guide on how to design wildlife crossings and fences (2015).

The Swedish Transport Administration published a report in 2016 on the adaptation of transport infrastructure as a contribution to well-functioning green infrastructure[141]. The report states, for example, that the agency is working to complete plans and measures to adapt transport land use in order to help achieve the Swedish environmental quality objectives and well-functioning green infrastructure. The agency identifies and focuses on four key factors in relation to green infrastructure: safe passages for animals, noise, biodiversity-rich infrastructure environments, and invasive alien species.

Romania's General Transport Master Plan mentions the need to respect conservation measures in future projects, including integrating non-structural and green infrastructure measures and avoiding negative impacts on protected areas, forested areas and non-protected areas where species of community interest are identified by reconsidering route plans[142].

In the UK, the National Policy Statement for National Networks[143] states that as a general principle, transport network developments 'should avoid significant harm to biodiversity and geological conservation interests, included through mitigation and consideration of reasonable alternatives' and highlights the importance of appropriate green infrastructure as an integral part of proposed developments. The Linear Infrastructure Network[144], which comprises members from over 70 organisations with

139   Büro für Wildökologie und Forstwirtschaft (2015) *Grüne Infrastruktur: Lebensraumvernetzung. Status Quo und Umsetzungsmöglichkeiten*. Winterausgabe Natur und Land, 101. JG. -Heft 4. http://www.zobodat.at/pdf/nat-land_2015_4_0032-0036.pdf

140   Ministerio de Agricultura, Alimentación y Medio Ambiente (2013) *Desfragmentación de hábitats. Orientaciones para reducir los efectos de las infraestructuras de transporte en funcionamiento*. Documentos para la reducción de la fragmentación de hábitats causada por infraestructuras de transporte, numero 5. O.A. Parques Nacionales.

141   Trafikverket (2016) *'Anpassning av transportinfrastrukturen som ett bidrag till en fungerande grön infrastruktur. Planera, bygga och sköta'*, Publikation 2016:133.

142   Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) 'Green Infrastructure in Romania', in *Supporting the Implementation of Green Infrastructure*, Final report to the European Commission under service contract ENV.B.2/SER/2014/0012, Annex I.

143   Department for Transport (2014) *National policy statement for national networks*. Department for Transport, UK Government.

144   https://www.tcpa.org.uk/linear-infrastructure-network

an interest in linear infrastructure, aims to demonstrate the benefits that well designed and maintained green infrastructure can deliver alongside grey infrastructure assets.

Poland's Transport Development Strategy until 2020 provides for, among other things, GI-related measures such as the development and application of innovative solutions to protect wildlife against collisions with vehicles, maintenance of existing wildlife passages, and implementation of best available practices while designing new wildlife passages.

Other examples include Germany's Federal Defragmentation Programme and the Dutch Multiannual Programme Defragmentation, which were both described in Section 1.

- **Energy policy**

    There are relatively few examples of GI integration in the energy policy sector. In Germany, the independent Competence Centre for Nature Conservation and Energy Transition145 (*Kompetenzzentrum Naturschutz und Energiewende*) was established in 2016. It collects and disseminates information on how nature protection issues can be integrated into decision processes on energy transition.

    The Swedish Board of Agriculture carried out a project linked to the national environmental quality objective 'A varied agricultural landscape'. It developed a handbook and recommendations on how to benefit biodiversity around rural wind energy infrastructure. The publication discusses the concept of '*kreotop*', which is defined as a natural environment built on a general model for how different ecological structures can benefit biodiversity146.

    In Hungary, the 'Accessible Sky' agreement between distribution companies, governmental and non-governmental conservation organisations was signed in 2008 to minimise bird mortality along power lines.

- **Climate change and disaster risk reduction policies**

    The role of green infrastructure is recognised in the climate change and disaster risk reduction policies of some Member States. For example, Romania's National Climate Change Strategy (2016-2030) mentions that biodiversity conservation and the restoration of degraded ecosystems can help reduce vulnerability and increase resilience to climate change. Specific measures include:

    - restoring vegetation, which can reduce climate extremes by means of soil formation and retention;
    - increasing soil permeability and reducing surface temperatures; and
    - sustainable use of natural resources to prevent extreme events such as floods.

    The strategy also sets the objective of increasing the capacity of biodiversity to adapt to climate change by improving conservation status, restoring degraded ecosystems, establishing and developing ecological corridors and refuge areas further both within and between Natura 2000 sites, and implementing in-situ conservation measures.

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145 https://www.naturschutz-energiewende.de/ueber-uns/about-us-english-version/

146   Nilsson, E., Arnesson, M. & Ericsson, A. (2011) '*Vindkraft i slättlandskapet: så gynnar anläggning av naturmiljöer den biologiska mångfalden'*. Jönköping: Jordbruksverket.

Spain's Third Work Programme for Adaptation to Climate Change[147] includes action lines related to the development of an ecosystem-based approach for adaptation to climate change as well as the development of guidance for integrating climate change adaptation within ecological restoration and connectivity initiatives.

The National Flood Protection Programme adopted by Germany in 2014 includes three categories of priority, supra-regional effective flood protection measures: controlled flood retention, dike relocations and elimination of weak points. The plans provide for 1 180 million m^3 of controlled retention volume and more than 20 000 ha of active floodplains to be recovered by dike relocations. The Sigma Plan in Flanders[148], which aims to protect against flooding of the Scheldt and tributaries while boosting natural values, recreation and economy, is another example of GI integration in flood control policy. The mainstreaming of sustainable development principle in the ESIF has led to an increased use of green infrastructure solutions for risk prevention and management supported by the ERDF and the CF.

Italy's Partnership Agreement for the 2014-2020 programming period[149] includes actions that specifically mention GI measures for disaster risk reduction[150].

A recent review[151] of the urban climate adaptation plans of 14 European cities[152] found that all the cities affected by water scarcity included at least one ecosystem-based adaptation (EbA) measure in their plans to cope with this challenge. This was also the case for cities affected by floods. All but one city proposed EbA measures to cope with heat waves. The most common EbA measures across the 14 cities examined were maintaining/enhancing urban green (e.g., ecological corridors, trees, gardens) and maintaining and managing green areas for flood retention and water storage. Green walls and roofs were mentioned in more than half of the cities. Measures such as avoiding/reducing impervious surfaces, ensuring ventilation from cooler areas outside the city through waterways and green areas, and promoting the use of vegetation adapted to local climate and drought conditions were less common in the urban adaptation plans examined. The authors identified the implementation component as a main gap; in many cases, the plans do not set out how the proposed EbA measures will be implemented.

- **Water management**

  On GI integration in water management beyond flood protection, several country factsheets mention the role of river basin management plans adopted under the Water

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147   Ministerio de la Agricultura, Alimentación y Medio Ambiente (2014) *Plan Nacional de Adaptación al Cambio Climatico: Tercer Programa de Trabajo 2014-2020*. http://www.mapama.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/3PT-PNACC-enero-2014_tcm7-316456.pdf

148 http://climate-adapt.eea.europa.eu/metadata/case-studies/an-integrated-plan-incorporating-flood-protection-the-sigma-plan-scheldt-estuary-belgium

149 https://ec.europa.eu/info/sites/info/files/partnership-agreement-italy-summary-oct2014_en.pdf

150   See actions 5.1.2 and 5.1.3, http://www.agenziacoesione.gov.it/opencms/export/sites/dps/it/documentazione/AccordoPartenariato/Accordo_di_Partenariato__ALL__I__Risultati-Azioni.pdf

151   Geneletti, D. and Zardo, L. (2016) Ecosystem-based adaptation in cities: An analysis of European urban climate adaptation plans. *Land Use Policy* 50, pp. 38-47.

152   Amsterdam, Athens, Barcelona, Berlin, Copenhagen, Heidelberg, London, Madrid, Milan, Paris, Rome, Rotterdam, Stockholm, Venice and Warsaw.

Framework Directive as well as concrete measures carried out such as restoration of water bodies.

- **Marine and coastal policy**

  Evidence of GI integration in marine and coastal policy is scarcer compared to other policy areas. Relevant aspects include the designation of marine Natura 2000 sites and national marine protected areas as well as specific projects implemented in the Member States, such as:

  - PROTOMEDEA – whose goal is to design a Marine Protected Area network in Greece and Cyprus; and
  - SustainBaltic – which focuses on developing integrated coastal zone management plans for sustaining coastal and marine human-ecological networks in the Baltic region.

- **Tourism and leisure policy**

  Based on the information collected in the country factsheets, the specific integration of GI aspects in tourism and leisure policy appears limited apart from recognition of the importance of natural areas in Member States' tourism strategies and policies to protect GI areas for their scenic and historic value. One relevant example (although not explicitly referring to green infrastructure) is Romania's Territorial Development Strategy, which includes a measure on developing tourism networks to harness the potential of unique Natura 2000 sites. It underscores the importance of Natura 2000 sites for regions and mentions that they should be used, for example, to attract more visitors and develop eco-tourism activities. A related measure in the strategy provides for the development of management plans to regulate, among other things, tourism activities within protected areas and in their vicinity in order to stop landscape degradation.

  The Swedish Parliament adopted 10 objectives in 2012 for policies related to outdoor leisure activities[153]. One of these goals states that all Swedes should have the possibility to visit and enjoy nature. The 2015 evaluation of the progress towards achieving this goal showed that the number of municipalities that have adopted plans for green structure and nature has increased.

  An interesting initiative is underway in Denmark; summer house owners are encouraged to allow nature to 'move into' their properties in order to increase the amount of habitat for vulnerable species. The Danish Government has set aside DKK 2 million to fund a communications campaign providing inspiration and guidance to summer house owners.

- **Health policy**

  The health-related benefits of green infrastructure are becoming recognised more and more[154], although little information was available on concrete initiatives to mainstream green infrastructure in national health policies. However, there are numerous examples of projects carried out by various stakeholders whose aim is to realise health and social

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[153] https://www.riksdagen.se/sv/dokument-lagar/dokument/skrivelse/mal-for-friluftslivspolitiken_H00351

[154] See for example the 'Evidence Statement on the links between natural environments and health' published by the Department for Environment, Food & Rural Affairs (Defra), UK, http://randd.defra.gov.uk/Document.aspx?Document=14042_EvidenceStatementonnaturalenvironmentsandhealth.pdf

benefits by working with and in nature155. As an example of policy integration, the Swedish authorities acknowledge that spending time in nature is good for public health. One of the 2012 objectives for policies related to outdoor leisure activities is to ensure that all Swedes have the ability to be physically active in the natural and cultural landscape156.

In Finland, several initiatives related to nature-based solutions in healthcare have been implemented. For example, Green Care Finland, which was established in 2010, coordinates, develops and promotes the use of nature-based and animal-based methods in combination with well-being and health services in Finland. In its current strategy, Parks & Wildlife Finland157, which manages all the state-owned protected areas including 39 national parks, refers to the promotion of health and well-being through nature as one of its four key priorities. Its health promotion activities are guided by the Healthy Parks Healthy People Finland programme 158. The goal is to improve public health by encouraging people to get out into natural settings, enjoy positive and genuine experiences, and improve their health through a wide range of outdoor activities159.

- **Financing green infrastructure**

  The factsheets gathered information on several finance-related aspects, including the types of funds available for GI implementation in each Member State, estimates of the total amounts available and the relative contribution of different sources (i.e. EU, national, sub-national, and private sector financing), as well as information on the (potential) financing gap for achieving GI policy goals.

  However, for most Member States little information was available specifically on the funding of GI actions. No dedicated estimates of the overall funding requirements or actual allocations for green infrastructure are available, apart from information on the amounts allocated to some specific GI programmes and projects (see for example the factsheets developed for the Netherlands, Spain, Sweden and the UK).

  In general, green infrastructure is primarily financed by the funds dedicated to nature conservation and funding under different sectors (e.g. agriculture, forestry).

  EU funding sources

  Although limited information was available on the relative contribution of different funding sources (EU, national, sub-national, and private sector financing), EU funds were identified as an important source of (co)-funding in most country factsheets. In

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155   See for example the case examples collected in ten Brink P., Mutafoglu K., Schweitzer J-P., Kettunen M., Twigger-Ross C., Baker J., Kuipers Y., Emonts M., Tyrväinen L., Hujala T., and Ojala A. (2016) *The Health and Social Benefits of Nature and Biodiversity Protection.* A report for the European Commission (ENV.B.3/ETU/2014/0039), Institute for European Environmental Policy, London/Brussels.

156   https://www.riksdagen.se/sv/dokument-lagar/dokument/skrivelse/mal-for-friluftslivspolitiken_H00351

157 http://www.metsa.fi/web/en/parksandwildlifefinland

158 https://www.iucn.org/sites/dev/files/content/documents/healthy_parks_finland.pdf

159   ten Brink P., Mutafoglu K., Schweitzer J-P., Kettunen M., Twigger-Ross C., Baker J., Kuipers Y., Emonts M., Tyrväinen L., Hujala T., and Ojala A. (2016) *The Health and Social Benefits of Nature and Biodiversity Protection*. A report for the European Commission (ENV.B.3/ETU/2014/0039), Institute for European Environmental Policy, London/Brussels.

particular, the **LIFE Programme for the Environment and Climate Action** [160] supports a range of GI-related projects in the Member States (see for example the projects identified in Section 2). During the 2014-2020 period, the programme is divided into two sub-programmes: environment and climate action. LIFE Environment covers three priority areas: (i) environment and resource efficiency; (ii) nature and biodiversity; and (iii) environmental governance and information. LIFE Climate Action covers (i) climate change mitigation; (ii) climate change adaptation; and (iii) climate change governance and information. GI-related projects are mainly funded under the nature and biodiversity component (which supports, for example, projects related to Natura 2000, ecosystem restoration), although other priority areas are also relevant to green infrastructure.

In addition, the **European Structural and Investment Funds (ESIF)** are another important source of EU funding for green infrastructure. The European Agricultural Fund for Rural Development (EAFRD), the European Regional Development Fund (ERDF) and the Cohesion Fund contribute in particular to GI implementation.

Box 7 provides a few examples of how these funds are used in the Member States.

Box 7 — Using ESIF to finance green infrastructure

Bulgaria: Under the **Operational Programme Environment 2014-2020** [161], a call for proposals entitled 'Identifying and complementing the establishment of marine Natura 2000 sites' was launched in December 2015. The eligible activities include:

- development/update of methodologies for mapping and for conservation status assessment of marine species and natural habitats;
- research, studies and mapping of marine natural habitats and species;
- development of documentation pursuant to Art. 8 of the Biodiversity Act with proposals for new Natura 2000 sites or for amending the existing Natura 2000 sites;
- upgrade and update the existing information system for Natura 2000 sites etc.

Czech Republic: The **Operational Programme Environment** has financed a range of structures to support the continuity of watercourses. The current focus of this programme is on: (i) improving water quality and reducing flood risks; (ii) improving air quality in towns and cities; and (iii) protection and care for nature and landscape.

Specific measures include:

- planting and regeneration of isolating green covers to separate residential built-up areas from industrial buildings or commercial premises or busy traffic corridors;
- measures to preserve and improve the natural conditions in forests and specially protected areas;
- construction and renewal of retention areas, revitalisation of watercourses and wetlands, construction of polders; and

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160 https://ec.europa.eu/clima/policies/budget/life_en

161 https://www.eufunds.bg/index.php/en/programming-period-2014-2020/operational-programmes-2014-2020/operational-programme-environment-2014-2020

- establishing and revitalising significant residential green areas, individual management and renewal of parks, tree stands, cemeteries, urban and community forested parks.

Slovakia: The implementation of the **Territorial System of Ecological Stability at regional level (RÚSES)** was supported by financial contributions from the Operational Programme Environment 2007-2013 162 . Within the project 'Encouraging the protection of NATURA 2000 sites in integrating territorial system of ecological stability', 22 RÚSES documents were developed. The development of such documents in another 50 districts will be financed by the Operational Programme Quality of the Environment 2014-2020163.

Slovenia: EU cohesion policy is a major source of financing for Natura 2000 projects in the 2014-2020 period. EUR 45 million has been allocated through ERDF to Natura 2000 restoration projects according to the Operational Programme for the Implementation of EU Cohesion Policy in the period 2014-2020 period164, priority area 'Protecting and restoring biodiversity and soil and promoting ecosystem services, including through Natura 2000, and green infrastructure'. These funds will finance some 15 projects from 2017 to 2020.

UK: Agri-environment measures funded by CAP rural development programmes are by far the largest source of public funding for the management and restoration of semi-natural habitats in protected areas (such as grassland habitats and lowland in upland heathland habitats) as well as farmland in the wider countryside. Rural development programmes also support forest measures that support green infrastructure, such as the Forest Grant Scheme165 in Scotland, which supports the creation of new woodlands and sustainable management of existing woodlands.

In Scotland, the Green Infrastructure Fund is available through the 2014-20 ERDF as part of the £ 37.5 million Green Infrastructure Strategic Intervention166, led by Scottish Natural Heritage. £ 6 million has so far been awarded to seven projects to improve greenspace in deprived areas. There is also the £ 0.5 million ERDF Green Infrastructure Community Engagement Fund, which aims to deliver at least 10 projects to help urban communities understand and engage with their green places.

A number of GI-related projects have been financed through the **European Territorial Cooperation programmes (Interreg) 167** , which are funded by the ERDF.. Such programmes foster cross-border, interregional and transnational cooperation in Europe. In addition, the promotion of green infrastructure should be taken into account in the definition of projects at macro-regional scale. For example, the project TRANSGREEN

162   http://ec.europa.eu/regional_policy/en/atlas/programmes/2007-2013/slovakia/operational-programme-environment-4

163 https://www.minv.sk/?operational-programme-quality-of-environment-2014-2020

164 http://ec.europa.eu/regional_policy/en/atlas/programmes/2014-2020/slovenia/2014si16maop001

165 http://scotland.forestry.gov.uk/supporting/grants-and-regulations/forestry-grants

166 https://www.greeninfrastructurescotland.org.uk/

167 http://ec.europa.eu/regional_policy/en/policy/cooperation/european-territorial/

(Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature), which runs from January 2017 to June 2019, is being implemented under the Interreg Danube Transnational Programme168.

As part of a study for the European Commission, the overall levels of LIFE and ESIF funding for green infrastructure for the 2007-2013 period were estimated in 2016169. Based on an analysis of project databases and (in the case of EAFRD) annual financial reports, EU funding of green infrastructure in the programming period 2007-2013 was estimated to be EUR 6 579 million (average of almost EUR 940 million per year). This includes funding from LIFE+, the ERDF, the European Social Fund (ESF), the Cohesion Fund, the EAFRD, and the European Fisheries Fund (EFF). The most important contribution (EUR 5 631 million, or 86 % of total EU funding for green infrastructure) was estimated to come from the EAFRD. Funding from LIFE amounted to almost EUR 774 million (representing 12 % of the total EU funding for GI and 36 % of the total LIFE budget). The ERDF, Cohesion Fund and ESF together contributed EUR 141 million to the financing of GI projects, and the EFF EUR 33 million. The analysis also revealed that in 2007-2013, EU funding was primarily allocated to the conservation of core areas (EUR 5 960 million; 91 % of all GI funding) and restoration (EUR 463 million; 7 % of all GI funding). By contrast, GI funding of sustainable use zones, green urban and peri-urban areas, and natural and artificial connectivity features each amounted to less than 1 % of all GI funding.

For the 2014-2020 period a legal provisions on horizontal mainstreaming of sustainable development – including environmental protection requirements and biodiversity – is included in the ESIF legal basis . Green infrastructure measures could be seen as one of the ways to translate the sustainable development principle into practice. The European Commission included in its guidance to the Member States, particu and in the discussions of the draft operational programmes explanations that ecosystem-based adaptation should be one of the preferred options for investments, as a cost-effective alternative or a complementary measure to 'grey' infrastructure and intensive land use change.

This has led to an increased uptake of green infrastructure measures by Member States. For example, for the ERDF and CF the direct allocations to biodiversity, nature and green infrastructure are, with EUR 3.7 billion, more than one billion higher than in the 2007-2013 period. Green infrastructure is also further supported as part of investments in, for example, flood protection, water purification, renovation of buildings. The horizontal integration is confirmed by the fact that these investments are included in several funding priorities (so called Thematic Objectives), covering not only environmental protection but also low-carbon economy, climate change adaptation and risk prevention, transport and social inclusion.

About EUR 600 million of the investments for nature and green infrastructure cited above are delivered through European Territorial Cooperation programmes. Furthermore, the EU's Macro-regional Strategies (for the Adriatic-Ionian Region, Alpine Region, Baltic Sea Region and Danube Region) are useful platforms for conceiving and implementing infrastructure projects that embed the concept of green infrastructure.

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168   http://www.interreg-danube.eu/approved-projects/transgreen

169   Trinomics, ALTERRA, Arcadis, Risk & Policy Analysis, STELLA Consulting, and Regional Environmental Centre (2016) *Supporting the Implementation of Green Infrastructure.* Final report to the European Commission under service contract ENV.B.2/SER/2014/0012.

Countries (EU and non-EU), regions and stakeholders involved in these Strategies will be encouraged to develop projects and initiatives with a macro-regional relevance on nature protection in the regions covered.

Horizon 2020 (and its predecessor, FP7), the EU framework programme for research and innovation, also supports research on and innovation in green infrastructure. For example, the 2016-2017 Horizon 2020 work programme included several calls for 'Nature-based solutions for territorial resilience'. In addition, the cross-cutting call 'Smart and Sustainable Cities' covers innovation actions under the theme 'Sustainable cities through nature-based solutions'. In mid-2017, for example, four projects funded under the call 'SCC-02-2016-2017: Demonstrating innovative nature-based solutions in cities' were launched; their aim is to improve urban resilience to climate change and enhance water resources management sustainability through the deployment of nature-based solutions[170].

In some Member States, GI-related projects (or biodiversity and nature in broader terms) can also be financed by **EEA Grants and Norway Grants**. Their goal is to reduce economic and social disparities and strengthen bilateral relations with Central and Southern European countries. Beneficiary countries comprise the Member States that joined in 2004, 2007 and 2014, as well as Greece, Portugal and Spain.

Innovative financing mechanisms and private sector investment

Only limited information is available on **innovative financing mechanisms and private sector investment** in GI initiatives. In the UK, a few initiatives have been developed by water companies to promote land use management that largely improves water quality in a cost-effective manner, while also providing co-benefits in terms of habitat condition and carbon sequestration and storage. For example, United Utilities' sustainable catchment management programme[171] successfully trialled such measures on its own land. South West Water set up the 'Upstream Thinking' catchment management scheme[172], which provides grants to help farmers improve land management and water quality.

In Croatia, the 'Contribution of forests to common good' mechanism requires companies to contribute 0.0265 % of their total income in a calendar year to maintaining, restoring and managing forests.

An interesting innovative financing instrument in Germany is MoorFutures [173], a voluntary carbon credits market launched in 2011 to support peatland restoration. It currently supports projects in Mecklenburg-Vorpommern, Brandenburg and Schleswig-Holstein.

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170   COproductioN with NaturE for City Transitioning, INnovation and Governance — CONNECTING Nature (https://sc5.easme-web.eu/?p=730222); Green Cities for Climate and Water Resilience, Sustainable Economic Growth, Healthy Citizens and Environments — GROW GREEN (https://sc5.easme-web.eu/?p=730283); New Strategy for Re-Naturing Cities through Nature-Based Solutions — URBAN GreenUP (https://sc5.easme-web.eu/?p=730426); Urban Nature Labs — UNALAB (https://sc5.easme-web.eu/?p=730052).

171   https://www.unitedutilities.com/corporate/responsibility/environment/catchment-management/

172   http://upstreamthinking.org/index.cfm?articleid=8692

173   http://www.moorfutures.de/

In 2013,the city of Gothenburg issued green bonds earmarked for investment in 'green' projects, including various GI-related projects174. It was the world's first initiative of this kind at municipal level.175

The independent Danish Nature Fund launched in January 2015 is an impressive example of a public-private partnership. The Danish government and two private foundations, VILLUM FONDEN and Aage V. Jensen Naturfond, joined forces to improve terrestrial and marine environmental quality in Denmark. The fund supports among other things projects that help expand and/or improve natural areas.

In the UK, the Department for Environment, Food & Rural Affairs commissioned a series of payments for ecosystem services (PES) pilot projects between 2012 and 2015 to test the practical application of the concept in new contexts176.

- **Developing the knowledge base**

Further development of the knowledge base on green infrastructure is considered an important component of the EU's GI strategy implementation. In this respect, both progress in mapping and assessment and the development of new tools and research is vital.

All Member States except Cyprus have started to map and assess the state of ecosystems and their services in their national territory (MAES report); some Member States have made more progress than others177.

A range of GI-related tools have been developed in recent years, including tools for mapping, valuation and decision support. A few selected examples:

- The Danish Spatial Act required municipalities to designate areas to the green map of Denmark based on a common base map and common criteria. To help the municipalities develop the green map and improve land use planning, a new digital mapping service of biodiversity in Denmark was developed. It provides information about the distribution of threatened and vulnerable species and an overview of high-value natural areas. It is part of a suite of mapping services known as the Nature Map.
- The Finnish 'Green Infra' project178 developed a new GIS-based tool to guide decision-making on land use and green infrastructure. The tool aims to identify the key areas for green infrastructure.
- SITxell179 is a decision support tool based on different layers of geographical information that aims to evaluate the non-built-up areas of the province of Barcelona.

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174   https://stadsutveckling.goteborg.se/sv/nyheterreportage/groan-obligationer/

175 http://ddnf.dk/english/

176   https://www.gov.uk/government/publications/payments-for-ecosystem-services-review-of-pilot-projects-2011-to-2013

177 An overview of progress and results in each Member State can be found on the MAES country pages on the   Biodiversity   Information   System   for   Europe   (BISE)   website, http://biodiversity.europa.eu/maes/maes_countries

178 http://www.syke.fi/projects/greeninfra

179   http://www.sitxell.eu/en/

It resolves to influence land planning processes in the province by providing socio-economic and ecological information.

- The Nature Value Explorer180 developed in Flanders is a web-based tool that allows users to estimate the impact that various land use scenarios will have on the value of ecosystem services.

- Padua's tree database has been collecting information on street trees since 1999. Data are collected on the ground by trained and experienced surveyors using mobile devices and paper forms, and all records are checked for accuracy. Each tree is spatially identified, with detailed data on size, health status and maintenance needed. This information has many potential applications related to MAES and urban management, e.g. deriving estimates for services such as air quality regulation and micro-climate regulation. The data are also very useful for validating models based on land cover and land use alone, which helps reduce uncertainty181.

- In the UK, the Forest Research and the Forestry Commission has used the BEETLE (Biological and Environmental Evaluation Tools for Landscape Ecology) suite of tools182 to plan forest habitat networks.

- Several tools have been developed in the UK to assess the economic value of green infrastructure, e.g. CAVAT183, the Green Infrastructure Valuation Toolkit184 and InVEST185. Additional tools to assess the environmental and social benefits include GRaBS (Adaptation Action Planning Toolkit)186, STAR tools187, NEAT (National Ecosystem Approach Toolkit) 188 , EVT (Ecosystem Valuation Toolkit) 189 and TESSA (Toolkit for Ecosystem Service Site-based Assessment)190.

- The ORVal191 (Outdoor Recreation Valuation) tool is map-based and allows users to explore the distribution of accessible greenspace across England, plotting out the locations of existing recreation sites or drawing new ones. It presents economic welfare values and visit estimates that are derived from a sophisticated model of recreational demand.

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180   https://www.natuurwaardeverkenner.be/

181   European Commission (2016) *Mapping and Assessment of Ecosystems and their Services. Urban ecosystems.* 4th MAES Report. Technical Report — 2016 – 102. Luxembourg: Office for Official Publications of the European Communities.

182   https://www.forestry.gov.uk/fr/beetletools

183   http://www.cavattv.org/

184   http://www.greeninfrastructurenw.co.uk/html/index.php?page=projects&GreenInfrastructureValuationToolkit=true

185   https://www.naturalcapitalproject.org/invest/

186   http://www.ppgis.manchester.ac.uk/grabs/

187   http://maps.merseyforest.org.uk/grabs/

188   http://neat.ecosystemsknowledge.net/

189   http://www.eartheconomics.org/ecosystem-valuation-toolkit/

190   http://tessa.tools/

191   http://leep.exeter.ac.uk/orval/

- The statutory advisor in Wales has developed a GIS tool for implementing the Environment (Wales) Act: SCCAN192 (Natural Resource Planning Support System). The mapping system will be used to identify 'opportunity spaces' for nature-based solutions in order to implement the natural resource policy through the area statement regional evidence bases.

- The region of Stockholm uses the MatrixGreen planning tool193 developed by the Stockholm Resilience Centre and the Swedish University of Agricultural Sciences to assess connectivity between various habitats and biotopes in the region.

- The city of Umeå in Sweden has developed the 'Green Target' tool, which is used as a quality control in the planning process. It aims to ensure that all citizens have access to facilities such as playgrounds, small groves, lawns etc. within 250 m of their homes.

- **Challenges and opportunities for GI development**

  While the challenges identified differ among Member States, there are a few common themes. The limited availability of financial resources is a constraint highlighted in several Member States, which points to the need for additional investment (including private sector finance) as well as better uptake of existing funding opportunities such as ESIF.

  The lack of understanding or awareness of the potential benefits of green infrastructure (and its links to economic growth) is perceived as one of the reasons for underinvestment in green infrastructure, particularly in South-Eastern Europe.

  On the other hand, recognition of the value of green infrastructure is growing in other Member States, and this is seen as a key opportunity. For example, there is a growing appreciation in the UK of the economic case for improving the sustainability of land use in the wider environment, e.g. to maintain soil carbon stocks and improve raw water quality, which may encourage further GI deployment. In Denmark, there seems to be an interest among policy-makers in the concept of connectivity between natural areas,and in increasing the amount and quality of nature in the landscape for the benefit of both nature conservation and human well-being. Similarly, local authorities in Ireland are actively promoting green infrastructure.

  Limited technical know-how and capacity are identified as yet another common barrier in a few Member States. Insufficient mainstreaming of green infrastructure across relevant sectors (in particular in spatial planning) is another challenge facing several Member States. Another factor identified as hampering GI development is competition between different land uses, together with tendencies towards trade-offs between cultural/regulating services and provisioning services.

  On the other hand, the opportunities listed tend to be more country-specific depending on the Member State's stage of GI development, geographic factors etc. However, several country factsheets indicate that there is a particular focus on two opportunity areas:

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192 http://www.goodpractice.wales/casestudy-3368

193   http://www.rufs.se/rufs-2050/en-ny-plan/

- highlighting the economic, social and other co-benefits of green infrastructure to encourage the further uptake of green infrastructure over other infrastructure alternatives;
- strong integration and coordination with other policy areas and urban policy / spatial planning in particular.

3. Detailed GI-related country fiches

Those country fiches are available on the BISE website

(at https://biodiversity.europa.eu/countries/gi)

4. Further resources and publications

- DG Environment website on green infrastructure: http://ec.europa.eu/environment/nature/ecosystems/index_en.htm

- Supporting the Implementation of Green Infrastructure (2016 report): http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructures/GI%20Final%20Report.pdf

- Mapping and Assessment of Ecosystems and their Services (MAES): http://biodiversity.europa.eu/maes

- Disaster risk reduction portal: http://ec.europa.eu/echo/what/humanitarian-aid/risk-reduction_en

- Exploring nature-based solutions — the role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards (2015): https://www.eea.europa.eu/publications/exploring-nature-based-solutions-2014

- Spatial analysis of green infrastructure in Europe (2014): https://www.eea.europa.eu/publications/spatial-analysis-of-green-infrastructure

- Green infrastructure: better living through nature-based solutions (2015): https://www.eea.europa.eu/articles/green-infrastructure-better-living-through

- Synthesis paper on green infrastructure by the OpenNESS project: http://www.openness-project.eu/library/reference-book/sp-green-infrastructure

- Mapping green infrastructure based on ecosystem services and ecological networks: A Pan-European case study (2015): http://www.sciencedirect.com/science/article/pii/S1462901115300356

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- Estreguil, C., Caudullo, G., San-Miguel-Ayanz, J., 2013. Connectivity of Natura 2000 Forest Sites. JRC scientific and policy report EUR 26087EN. Luxembourg: Publications Office of the European Union. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC83104/lbna26087enn.pdf

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Available for download at http://fise.jrc.ec.europa.eu/topics/ecosystem-services; /http://fise.jrc.ec.europa.eu/media/filer_public/46/b7/46b721b4-ff50-4512-a4b5-58a72a8e97a3/pilot_connectivity_n2000_spain2.pdf

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- Environment Life programme: Article on looking to nature for environmental solutions (2015): http://ec.europa.eu/environment/life/features/2015/nat_solutions.htm

- Indicators for urban green infrastructure: https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment/urban-green-infrastructure/indicators_for_urban-green-infrastructure

- What is green infrastructure?: https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment/urban-green-infrastructure/what-is-green-infrastructure

- Urban Green Infrastructure (GI) typology: https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment/urban-green-infrastructure/typology-for-urban-green-infrastructure

- Climate change adaptation and the role of green infrastructure: http://climate-adapt.eea.europa.eu/

- 'Building resilient cities key tackling effects of climate change': https://www.eea.europa.eu/highlights/cities-taking-action-learning-from; https://www.eea.europa.eu/highlights/building-resilient-cities-key-to

- 'Restoring European rivers and lakes in cities improves quality of life' https://www.eea.europa.eu/highlights/restoring-european-rivers-and-lakes

- Information on green infrastructure in Europe (BISE website): http://biodiversity.europa.eu/topics/green-infrastructure

- Urban adaptation to climate change in Europe 2016 — Transforming cities in a changing climate: European Environment Agency, 2016. This report maps urban adaptation to climate change in Europe, including green infrastructure, and in particular progress achieved since the last report in 2012: https://www.eea.europa.eu/publications/urban-adaptation-2016. The report highlights in particular that, in European cities' adaptation plans, the most frequently used measure is green infrastructure. Examples of green infrastructure as a key element of urban planning e.g. in Karlstad (Sweden) and Barcelona (Spain).

- CLIMATE-ADAPT resources on green infrastructure (search results):

- http://climate-adapt.eea.europa.eu/data-and-downloads?SearchableText=green+infrastructure#SearchableText=green+infrastructure&b_start=0

- Cohesion policy support to the environment: http://ec.europa.eu/regional_policy/en/policy/themes/environment/

- ESIF Open Data Portal (allocations and expected results for environmental investments): https://cohesiondata.ec.europa.eu/themes/6

- Guide to Multi-Benefit Cohesion Policy Investments in Nature and Green Infrastructure: http://ec.europa.eu/regional_policy/en/information/publications/guides/2013/guide-to-multi-benefit-cohesion-policy-investments-in-nature-and-green-infrastructure

- ENEA-MA working group report on mainstreaming the environment in cohesion policy: http://ec.europa.eu/environment/integration/pdf/enea/ENEAMA_eport_April_2017_24.pdf

- Cohesion policy project database: http://ec.europa.eu/regional_policy/en/projects/

- Fifth EIONET meeting National Reference Centres Land Use and Spatial Planning (NRC LUSP): Workshop on green infrastructure and planning (03/10/2016 to 04/10/2016). Link to the minutes: https://forum.eionet.europa.eu/nrc-landuse/library/5th-eionet-meeting-land-use-and-spatial-planning/meeting-documents

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