

## What is Green Infrastructure?

Green Infrastructure “is 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.” Linked together, these strategically planned networks of green elements are able to provide multiple benefits in the form of supporting a green economy, improving quality of life, protecting biodiversity and enhancing the ability of ecosystems to deliver services such as disaster risk reduction, water purification, air quality, space for recreation and climate change mitigation and adaptation.

## The European Green Infrastructure Strategy

The Green Infrastructure Strategy proposed by the European Commission, promotes the development of Green Infrastructure across the EU delivering economic, social and ecological benefits and contributing to sustainable growth. It guides the implementation of Green Infrastructure at EU, regional, national and local levels. A main feature of the Green Infrastructure Strategy is its integration into relevant policies through: ecosystem-based adaptation into climate change policies; nature-based solutions into research and innovation policies; natural water retention measures into water policies; and through its focus on delivering multiple ecosystem services and their underlying factor - a rich biodiversity - into nature policies. The Natura

2000 network in particular plays a major role in protecting many of the core areas with healthy ecosystems.

As Green Infrastructure can make a significant contribution to many sectors and EU policy objectives, Green Infrastructure is being integrated into many funding streams including Structural Funds (the European Regional Development Fund (ERDF); European Social Fund (ESF)), the Cohesion Fund (CF), the European Maritime and Fisheries Fund (EMFF), the European Agricultural Fund for Rural Development (EAFRD), LIFE+ and Horizon 2020 project funds and the Natural Capital Financing Facility (NCFF) of the European Investment Bank (EIB).

## Costs & benefits of Green Infrastructure

Green Infrastructure can often provide more benefits at less cost than single-purpose grey infrastructure. A growing body of research and experience demonstrates Green Infrastructure’s high potential due to its multi-functionality, i.e., its ability to perform several functions and to provide several benefits in the same spatial area. These functions can be social (providing healthy environment or green space for leisure and sports), environmental (conserving biodiversity or adapting to climate change and related water issues), and economic (supplying jobs, raising property prices and reducing damage recovery costs). These benefits will however only be fully delivered if Green Infrastructure elements are functional: they need to be big enough, at the right place and well connected. At the same time, these multiple benefits need to be weighed against the costs of establishing and maintaining Green Infrastructure, ideally over the expected life cycle.

## Green Infrastructure and the European Semester

Green Infrastructure can play a role in the European Semester, for instance through natural flood prevention or job creation. Floods are among the most common and most costly natural disasters in Europe, and flooding events are likely to become more frequent with climate change. Benefiting from nature’s own capacity to absorb large quantities of excess water is cost-effective and can play a major role in sustainable flood risk management. Investing in Green Infrastructure for flood protection typically yields benefits 6-8 times the costs. Investments in Green Infrastructure can help boost new markets in services, such as planning, implementing and monitoring Green Infrastructure.

## Green Infrastructure in Denmark

For a long time, Danish Green Infrastructure was largely equivalent to ecological corridors and networks (in Danish: “økologiske forbindelser”, “grønne korridorer” or “grønne strukturer”). In the early 1980s, national directives facilitated species conservation. Since then, the development of ecological corridors/networks has been integrated into the spatial planning system and the Spatial Planning Act (IEEP, 2010). In recent years, Danish municipalities have started creating green and sustainable cities using Green Infrastructure as a broader concept. For example, Copenhagen has a leading role in climate adaptation planning with Green Infrastructure becoming an integral part of its protection against floods and rising water levels.



## Policy setting & ongoing implementation

In 2014, Danish Green Infrastructure policy was boosted with the launch of a new nature strategy in which “More and better interconnected nature” is one of three priority areas. The “Danish Nature Policy” (Naturplan Danmark) sets the direction for Danish environmental policy up to 2020. According to the plan, 25,300 ha of “nature” are to be established to promote a more connected environment, carbon sequestration, and more recreational areas for the public: 8,000 ha for restoring wetlands; 4,500 ha for recovering organic soil; 1,300 ha for more robust and connected nature in Natura 2000 areas; 3,400 ha for new forests; 5,000 ha for new nature through the Danish Nature Fund (Den Danske Naturfond); 1,500 ha for green climate adaptation projects; 600 ha for new EU LIFE projects; and 1,000 ha for new water projects. The plan is unique since it is the first time Denmark proposes such a long-term holistic approach to environmental policy and management in this manner and the connectivity priority clearly shows that Green Infrastructure is gaining attention among policy-makers.

Another innovation is a “Green Map” of Denmark which will provide both a strategic framework for nature policy and will function as an actual map for planning purposes. As a strategic framework, the Green Map of Denmark will contribute to targeting ongoing and new initiatives with the greatest impact in terms of ecosystem services such as reduced greenhouse gas emissions, cleaner aquatic environments, CO<sub>2</sub> storage in the soil, better recreational opportunities and improved conditions for storing water after extreme rainfall. The Green Map of Denmark will show where existing valuable nature is and where new potential areas that can create connectivity could be. By 2017, municipalities must designate areas of the Green Map of Denmark, based on a common base map and common criteria. Areas on the Green Map of Denmark will be included in municipal plans for the first time in 2017 and gradually refined and implemented until 2050.

Action 5 of the EU Biodiversity Strategy to 2020 calls Member States to work on the “Mapping and Assess the state of Ecosystems and their Services” (MAES). In 2014, Denmark accomplished a full-scale mapping of its ecosystems and provided an overview of the status of ecosystem service mapping for 16 ecosystem services. In 2015, Denmark will continue by illustrating different scenarios based on data for one sixth of Denmark in order to show how prioritising land use will affect ecosystem services and biodiversity. It is inter alia Denmark’s intention to illustrate scenarios that focus on creating connectivity between general protected areas and on restoring at least 15% of degraded land at local scale.

## Good practices in Denmark

### Hedgerow planting

Hedgerows are natural features acting as wildlife corridors or stepping stones. These elements of Green Infrastructure provide multiple benefits. Hedgerow planting reduces soil erosion through windbreaks which also provide habitats for various species. The practice has a long tradition in Denmark going back to the 1880s (Levin, Langer, and Frederiksen, 2006) with the support of subsidies. Recent reports calculate that over 1,200 km of hedgerows are planted each year (Busck, 2003). The subsidy scheme is based on a partial reimbursement of the costs incurred by the farmer (IEEP, 2011). Farmers can ask for reimbursement of 40–





60% of the cost for establishing 1–7 rowed hedges or woodlots smaller than 0.5 ha, and at least 75% of the plantings should be broadleaved (IEEP, 2011, p.108). Besides the subsidy, the success of the hedgerow planting scheme (Denmark has a very low soil erosion rate compared to other European countries) has been attributed to farmers' participation, good products and governmental action with a windbreak law that has been revised multiple times.

## Copenhagen Climate Adaptation Plan

Copenhagen scores high among Europe's capitals when it comes to climate adaptation and mitigation. According to its 2011 climate plan (CPH 2025 Climate Plan), in 2025 the city should become Europe's first carbon neutral city. The plan contains over 50 actions, including making green roofs mandatory for all new flat (slopes less than 30°) roofs built after 2010. Green roofs are an example of artificial Green Infrastructure features that enhance ecosystem services: greening about 325,000 m<sup>2</sup> of roof-tops is estimated to save 218 tonnes of CO<sub>2</sub> emissions annually. It also helps to divert and delay excess water during rainy periods. The climate plan includes mainly mitigation measures and has been followed up by an adaptation plan, the Copenhagen Adaptation Plan, which identifies the main climate vulnerabilities of the city. EUR 1 billion has been allocated to adaptation measures, but the breakdown of the expenditure has not yet been determined. Green Infrastructure plays an integral part of the adaptation plan, in particular to combat adverse urban heat island effects and extreme temperatures. Joint planning between green spaces, building management, traffic management, and landscapes are expected to foster Green Infrastructure options to mitigate extreme heat effects such as the use of water, shade, air circulation and balancing surface temperatures.

## Ecological networks

Building ecological networks and corridors has a long tradition in Denmark. Their establishment has been part of the transposition of the Birds and Habitats Directives and Green Infrastructure is thus foreseen in national legislation. Green



Nature restoration at Bøjden Nor

corridors are part of the national and local planning processes; they are also complemented with other policy instruments to support their implementation. For instance, agro-environment payments promote sustainable management of agricultural land, afforestation and meadows. Similarly, the Danish forest policy aims at increasing the forest cover of the country and promoting the establishment of forest corridors taking county level plans into account. Since 2006, after a large public administration reform involving a sweeping decentralisation of executive responsibility, municipalities took over a large part of establishing and managing ecological corridors. In 2012, the Danish Environment Agency (Skov- & Naturstyrelsen) issued a report and a set of recommendations to improve the administration of ecological connections. It noted that leadership competencies, cross-border municipal cooperation, varied and innovative financial models, scale of the project and local anchoring of the projects are all essential attributes for a successful policy implementation.

## Danish LIFE+ projects on restoration of habitats

The EU's LIFE+ programme has funded a number of Green Infrastructure related projects to promote restoration in different habitats. For instance, CONNECT HABITATS (LIFE09 NAT/DK/000371) aimed at restoring dry grasslands at Bøjden Nor on the island of Fyn. The goal was to positively affect the vulnerable coastal lagoon habitat status by buying 25 ha of land



Green Roofs

to establish 5 ha of wetlands and two bird-islands. The project started in 2010 and ended in 2013; its total budget was DKR 8.6 million (about EUR 1.15 million). Another example is the LIFE+ project "Life70", which aims at restoring rare wet habitats in eight Danish environmental authorities by 2018. The project covers 790 ha in 11 Natura 2000 areas, mainly on the island of Fyn, but also on Langeland and central Jutland. Similar to the CONNECT HABITATS project, private owners - who own about half of the land on which the project takes place - are to be compensated before the restoration plans begin. The total budget of the project is EUR 4.4 million, -about half of which is from the EU. Both LIFE projects aim at restoring core areas of high biodiversity value, which act as hubs for Green Infrastructure, providing multiple benefits.

## Challenges and opportunities

- A key opportunity is the renewed political and administrative impetus to Green Infrastructure given by the Naturplan. Ensuring its successful implementation would be a first step towards a more comprehensive Green Infrastructure policy. It can also serve as a good example for other European countries wishing to engage in more holistic environmental planning, for which Green Infrastructure is an essential step.
- Responsibility for planning at the local level is a potential threat to the functionality and coherence of ecological corridors.

## References

- Copenhagen City (2011) Copenhagen climate adaptation plan. Available in English via: [http://en.klimatilpasning.dk/media/568851/copenhagen\\_adaption\\_plan.pdf](http://en.klimatilpasning.dk/media/568851/copenhagen_adaption_plan.pdf)
- COWI (2010) Changing city rooftops into green landscapes. <http://www.cowi.com/menu/NewsandMedia/News/Newsarchive/Pages/Cityrooftopsbecomelandscapes.aspx>
- EEB (2008) Building green infrastructure for Europe: Special Report. European Environmental Bureau (EEB), Federation of Environmental Citizens Organisations
- Gravsholt Busck, A. (2003) Hedgerow planting analysed as a social system—interaction between farmers and other actors in Denmark. *Journal of Environmental Management*. Vol. 68, Issue 2, pp. 161–171
- IEEP (2010) Green infrastructure country file: Denmark. Project for DG Environment, Green infrastructure implementation and efficiency. ENV.B.2/SER/2010/0059
- IEEP (2011) Green infrastructure implementation and efficiency. Final report to the European Commissions. ENV.B.2/SER/2010/0059
- Levin, G. V. Langer, and P. Frederiksen (2006) Structural development in Danish agriculture and its implications for farmland nature. In: Langeveld, H. and N. Röling, *Changing European farming systems for a better future: New visions for rural areas*. Wageningen Academic Publishers, the Netherlands. 2006
- MIM (2014) Naturplan Danmark: Vores fælles natur. Oktober, 2014. Danish Government.
- Veihe, A. and B. Hasholt (2006) Denmark. In: Boardman, J. and J. Poesen (eds.) *Soil erosion in Europe*. John Wiley and Sons, Ltd. West Sussex, England.
- Vejre, H. (2012) Planlægning og forvaltning af økologiske forbindelser – Planlægning og forvaltning af økologiske forbindelser. Skov & Landskab, Københavns Universitet.

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**Presented by:** Trinomics, Alterra, Arcadis, Regional Environment Centre, Risk & Policy Analysis, Stella Consulting.

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