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GRETA - “GReen infrastructure: Enhancing biodiversity and ecosysTem services for territoriAl development”

Applied Research

Central Scotland Green Network

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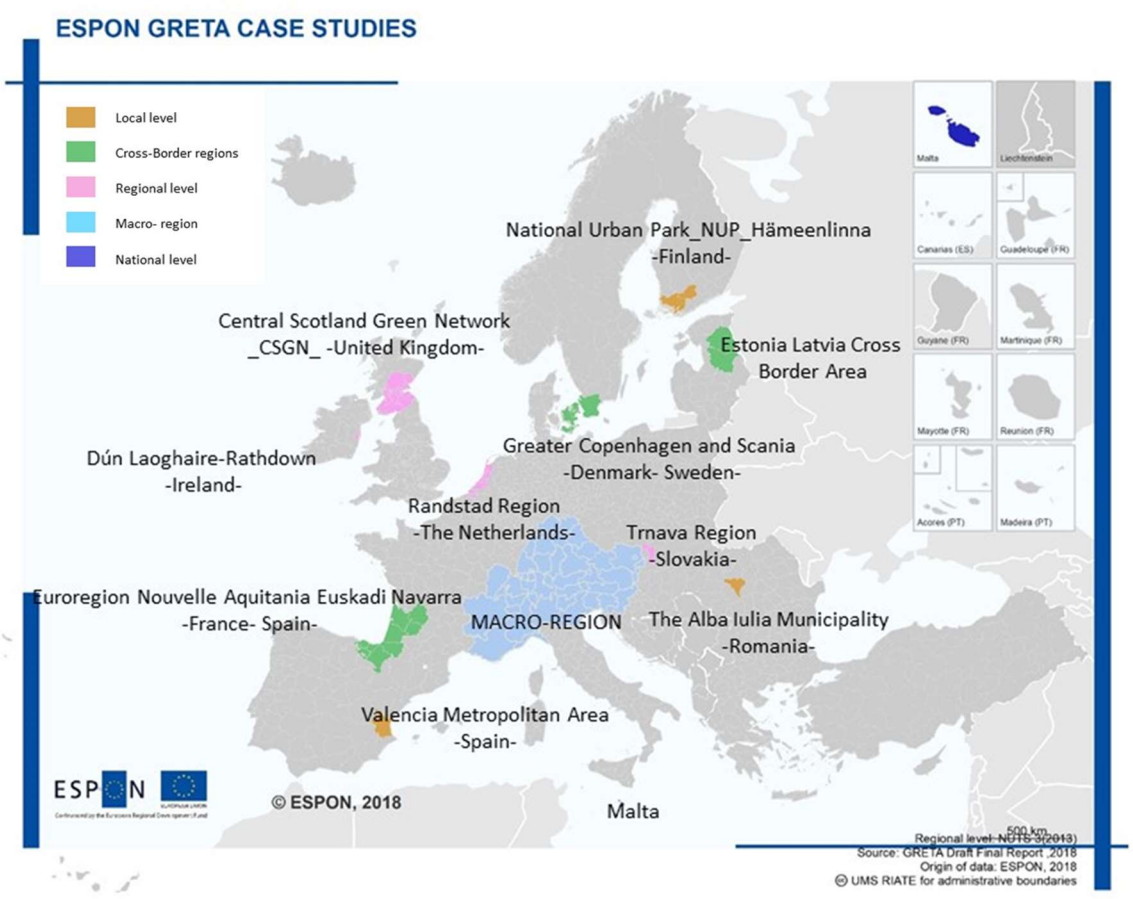
Abbreviations

CSGN	Central Scotland Green Network
CSGNT	The Central Scotland Green Network Trust
EC	European Commission
ES	Ecosystem Services
ESPON	European Territorial Observatory Network
EU	European Union
GI	Green Infrastructure
NUTS	Nomenclature of Territorial Units for Statistics
NPF3	The Scottish Government's Third National Planning Framework

1 Introduction

GRETA investigated 12 case studies that represented different spatial, institutional and governance settings and that ranged from urban centres to rural countryside. The case studies served to:

i. gain knowledge on implementation factors, drivers and constraints in different planning systems and territorial realities;
ii. gain insights on the use and applicability of economic methods in decision making; and
iii. gather knowledge for policy and practice as input and inspiration for the policy recommendations.



Map 1. ESPON GRETA selected case studies

Method

The activities undertaken at the case study level incorporated a combination of desk-based analysis alongside online questionnaires and pre-structured interviews to key actors in each of the case study areas, including: (i) decision and policy making representatives; and (ii) those involved in designing, planning, implementing and managing green infrastructure (GI).

A series of three consultations were developed to gather relevant information from case studies on different aspects of GI spatial analysis, policies, planning and implementation. The consultation process was seen as a combined approach of an online survey and or a telephone interview (which used the survey questions as the basis) with stakeholders to facilitate getting good engagement and to address any clarifications needed.

Consultation A – Economic Valuation

The questionnaire included 20 questions structured in 2 main parts. The first part aimed at understanding the current use and awareness of valuation methods by respondents while the second part aimed at identifying their perceived barriers and interest of using such methods. We used a mix of open-ended and closed-ended questions to combine comparable results as well as qualitative material; respondents also had the possibility to comment on their responses. Analysis of Consultation A is described in Annex III-C.

Access to Consultation A

https://survey.tecnalia.com/limesurvey/index.php/214247?lang=en

Consultation B – Characterising green infrastructure and ecosystem services characterisation

The objective of this consultation was to identify good practice guidelines, opportunities and challenges that could be useful for a variety of regions and cities. Responses to Consultation B were used to assess the usefulness of the GRETA methodology, a methodology specifically developed to delineate and map the main green infrastructure (GI) elements and their multifunctionality, as well as identifying their capacity to support three main policy domains: Biodiversity, Climate Change and Disaster Risk Reduction, and Water Management. Questions in Consultation B were designed to help us gain further insight into the enabling factors that exist in different regions and cities. We also sought to gather information on the challenges and barriers that may compromise the implementation of GI. The final set of questions focused on identifying the general benefits and potential synergies and trade-offs associated with GI projects.

The maps produced for Consultation B in the GRETA project were intended to provide a starting point for discussion about the applicability of the GRETA methodology from European to local application. As such they did not aim to be a substitute for the maps or other planning material that already exist at local case study level nor were they aiming to characterize the GI on regional or local level. They were not developed to be used as an output from case study levels.

The landscape elements in the maps are produced based on standardized European data sets with a minimum mapping unit of 25ha (i.e. CORINE Land Cover 2012) – smaller geographical features are not depicted. The Consultation B aimed at finding the gaps between datasets produced at the European level and any other data sets produced at regional and local scales.

Access to Consultation B

https://survey.tecnalia.com/limesurvey/index.php/614564?lang=en

Consultation C - Analysis of governance, policy and financial frameworks

The successful implementation of green infrastructure (GI) projects requires a combination of governance structures, integrated policies and financial support. This consultation therefore aimed to investigate the governance systems in place in each case study area in order to determine how policies and policy makers enable the implementation of GI projects in the case study areas.

Responses to Consultation C aimed to help us identify: (i) how much funding (money and personnel) is currently used for GI in the case study regions; (ii) if this funding is sufficient for implementing and maintaining GI; and (iii) the main sources of funding (public tax-based funds, private investments, NGOs or others). Consultation C also examined whether policies compliment or conflict with GI and assesses policy makers' knowledge needs for making full use of GI development potential.

Access to Consultation C

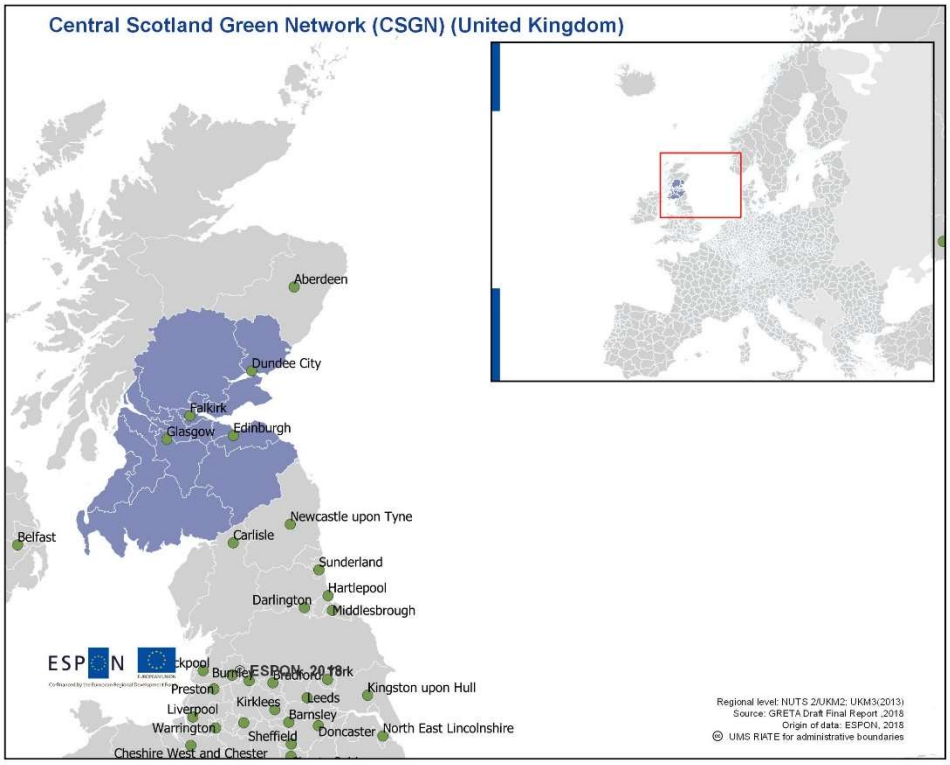
https://survey.tecnalia.com/limesurvey/index.php/129674?lang=en

The content in this report is based on a mixed-method approach. The results presented are interpretations of semi-structured interviews, responses to a questionnaire on national policy and planning, responses to three consultations (Consultation A, B and C) via email, document analysis of plans and strategies (via desk-based analysis), and statistics.and spatial analysis using GIS resulting from the GRETA project. For all case studies, telephone conversations (and for some cases face-to-face meetings i.e. Copenhagen and Scania, Alpine region, Euroregion Aquitania- Euskadi-Navarra) allowed the completion of the consultations B and C.

The respondents who have contributed to this case study are people working in the public administration in the CSGN.

2 (Geographic) description of the Central Scotland Green Network Case Study

The Central Scotland Green Network (CSGN; see Map 2) area covers just under 10,000km^2 and has 3.5 million residents[1]. The geography is diverse including upland (moors and woodland), lowland woodland (rural, urban and peri-urban), derelict land (urban and post-industrial peri-urban), riperian (canals and rivers), coastal, and urban greenspaces. The geology, and the resulting natural resources (for example: coal, ironstone, and limestone), of the CSGN area has profoundly influenced human activities over time. The CSGN area is now characterised by mixed agriculture on naturally poorly drained soils, particularly South and West of the Glasgow conurbation; however, diverse agricultural and pastoral farming is present where drainage has been successfully implemented (CSGN Baseline, 2010). The CSGN area is rich in cultural, industrial, and natural assets; however, past land use has resulted in some areas of disused land, poor quality greenspace, and fragmented habitats (Scottish Government, 2014).



Map 2 Central Scotland Green Network (CSGN)

The CSGN vision is that by 2050, Central Scotland has been transformed into a place where the environment adds value to the economy and where people's lives are enriched by its quality (CSGN, 2017). The CSGN is one of the 14 'national developments'[2] for Scotland, which are

[1] http://www.centralscotlandgreennetwork.org/delivering/visualising-the-csgn/the-landscape-of-central-scotland

[2] National developments are strategically important development opportunities in Scotland, that are identified by the National Planning Framework.

outlined in the Scotish Government's third National Planning Framework (NPF3) (Scottish Government, 2014). The CSGN aims to make a significant contribution to Scotland's sustainable economic development and involves public agencies and stakeholders working together to align their policies, programmes, and actions to achieve common aims[3].

2.1 Case study outline

Region: The CSGN includes a number of NUTS[4] 3 regions and is spread across two NUTS 2 regions (UKM2 Eastern Scotland and UKM3 South Western Scotland).

Area: Just under 10,000 km^2.

Population: 3,500,000 inhabitants in the CSGN. 5,424,800 inhabitants in Scotland. Approximately 65% of Scotland's population lives in the CSGN area.

Population density: 360 people/km^2.

Economy: The CSGN area is very important to the Scottish economy. GDP of Scotland: £27,750/person (onshore), £29,300/person (if offshore is included). GDP of CSGN: unknown.

2.2 Territorial challenges

The main territorial challenges include: a legacy of disused land, poor quality greenspace, and fragmented habitats. The main focus of the CSGN is on environmental quality, sustaining and enhancing biodiversity, landscape and wider ecosystem quality while also attracting investment and delivering development. This is all within a lens of the five CSGN themes:

- A Place for Growth: creating an environment for sustainable economic growth.
- A Place in Balance: creating an environment more in balance, to thrive in a changing climate.
- A Place to Feel Good: creating an environment which supports healthy lifestyles and well-being.
- A Place to Belong: creating an environment that people can enjoy and where they choose to live.
- A Place for Nature: creating an environment where nature can flourish.

The Central Scotland Green Network region has been heavily influenced by human activities that have adapted and used the areas natural resources. See CSGN (2010) for an overview of the geology, freshwater and coastal areas, forestry and farming, human settlement, industry, and population of the area.

[3] http://www.centralscotlandgreennetwork.org/

[4] Nomenclature des unités territoriales statistiques (NUTS) Classification of Territorial Units for Statistics.

3 The green infrastructure network and its potentialities for territorial development in the Central Scotland Green Network

3.1 What is the approach to green infrastructure and Ecosystem Services

The Central Scotland Green Network Trust (CSGNT) was established in 2014 to provide capacity to help realise the vision for the CSGN. The CSGNT has a greenspace and green infrastructure (GI) work stream that aims to:

- Create greenspace in existing urban areas;
- Enhance existing greenspace;
- Create greenspace in new residential areas;
- Deliver GI in new residential areas;
- Deliver GI in new commercial/industrial developments; and
- Retrofit GI into existing urban areas.

The other CSGN work streams will also make relevant contributions as follows:

- Vacant and Derelict Land (VDL) – treating VDL to deliver GI;
- Community Growing – increasing access and urban biodiversity especially in areas of deficit in terms of orchards, growing areas and allotments;
- Active Travel – focus on Green Active Travel so that access and GI can be combined;
- Woodland Creation – including urban woodlands to improve connectivity as well as area of new woodlands;
- Non-woodland Habitats – including peatland management to support water management and slow down flows into urban areas; and
- Pan CSGN – research, policy and communications to promote GI and support GI delivery.

There have been a number of important studies that provide detailed information about the CSGN areas approach to GI and ecosystem services, including:

- Green Infrastructure Policies in the CSGN: A Review of Local Authority Policies on Green Infrastructure in Built Development (Hislop and Corbett, 2018).
- Benefits of the CSGN. A valuation estimate of six major potential benefits of the CSGN (Hume, 2015).
- Resourcing the CSGN. Potential sources of funding for the capital costs of the CSGN (Hislop, 2016).

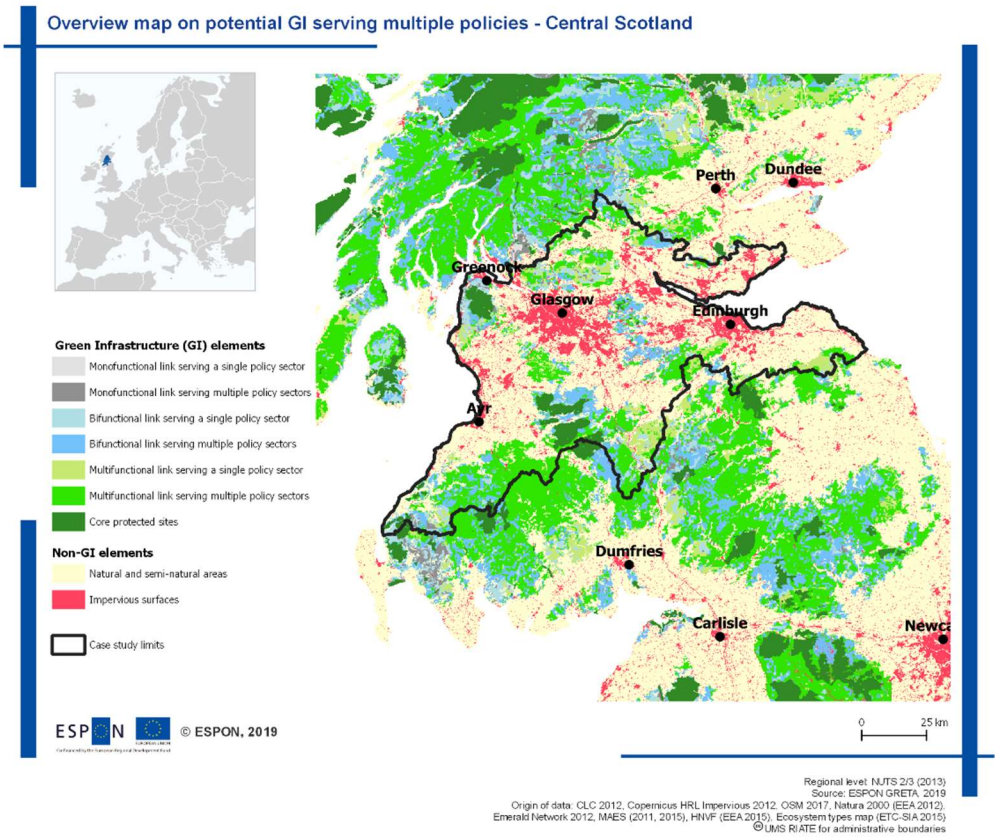
- Costing the CSGN. Capital cost estimates for the major components of the CSGN (Hislop and Corbett, 2014).
- CSGN Baseline Report 2010 (CSGN, 2010).
- CSGN Baseline Monitoring Report 2015 Update (CSGN, 2015).

These studies and reports help to evidence the advanced thinking and knowledge that exists within the CSGN area on planning, resourcing, and implementing GI projects.

3.2 Benefits of green infrastructure and ecosystem services for smart, sustainable and inclusive territorial development

The Central Scotland Green Network (CSGN) is spread across two NUTS 2 regions (UKM7 Eastern Scotland and UKM8 South Western Scotland). Boundary data can be downloaded here: http://www.centralscotlandgreennetwork.org/resources/data/data-download

This section describes the potential green infrastructure (GI) network in the CSGN area as delineated by the GRETA spatial analysis methodology. The analyses of synergies and trade-offs between the ecosystem services (ES) provided by the GI network and its potential for serving several policy objectives is also provided. This includes an analysis of the CSGN region relative to general EU patterns (Map 3, Table 1).



Map 3 Central Scotland Green Network GRETA case study area. Overview map of potential green infrastructure serving multiple policies.

Table 1 Potentialities for green infrastructure network in Central Scotland Green Network.

Questions related to maps	Description of phenomena in the case study	Implication for management
Extent of GI	Potential green infrastructure (GI) covers about 40% of the region, mainly following a N-S pattern. Therefore, on the two extremes of the W-E axes (i.e. around Ayr and East of Edimburgh) the coverage is very low.	GI has a relatively even distribution, serving a substantial part of the territory. However, there are large areas around Ayr and East of Edinbrugh with poor coverage at landscape level. Fragmentation is the main constraint for extending GI in these two areas.
Integration of protected areas	All protected areas are integrated and connected to the potential GI. About 35% of the GI is covered by protected areas.	Potential GI is well structured in the sense that it ensures connectivity of protected areas. Therefore, GI could be a valuable instrument to ensure connectivity in the whole region. On the other hand, a large part of the potential GI is unprotected, which requires special attention to preserve its functionaluity.
Support to policies related to: **Biodiversity, Climate Change and Disaster Risk Reduction, and Water Management**	The potential GI, and related ecosystem services (ES), are able to support the three policy objectives, the one with highest multifunctionality is biodiversity. Soil erosion control and water purification.	In terms of multifunctionality, all the area is capable of supporting at least two of the three policy objectives. The limited capacity to support water policies related to flood prevention, erosion control and limitation of soil erosion is of special concern.
Synergies and trade-offs	Most of the ES have a neutral relationship, i.e. there is no interaction or no influence between ES.	There are no spatial issues related to synergies or trade-offs. It is not expected that improving certain conditions would have side effects on other ES.
City level	tHe share of green urban areas inside the city and in peri-urban area is relatively high (about 65% on average), except in Glasgow (35%). However, this is counterbalanced by the larger coverage of GI on the peri-urban area. Green urban areas remained stable between 2006 and 2012.	There is a need to ensure a good connection between the core city and the peri-urban areas, in particular in Glasglow. On the other hand, the GI on the peri-urban areas already provides a good connection with GI at landscape level ensuring good accessiblity.

The three key respondents that replied to the GRETA consultation on mapping potential green infrastructure differed in their opinions about the usefulness of the spatial analysis methodology at the CSGN scale. One respondent believed that the maps were useful in providing a strategic context to inform more local scale GI planning within the CSGN, and stated that it would be interesting to compare the GRETA analysis with maps produced at a lower scale to see where there are overlaps and where there are gaps. They also felt as though the clear distinction between the built environmental and natural habitats is useful when communicating to stakeholders, like planners, and it is important to make the maps and information easy to interpret.

Another respondent felt as though it was important to be clear about the applicability/useablity of the findings, what can decision-makers do with the information? This respondent also stated that GRETA should be clear about what capacity/skills are needed for local level stakeholders to make use of the methodology and how it might help them do their job(s) if they were able to use it. The respondent recommended a trial or pilot of the methodology, as was done for the Scottish Land-use Strategy (in Aberdeenshire and the Scottish Borders)[5], to consider what types of information and analysis were useful and how people reacted to it.

The third respondent felt that although the policy areas that GRETA chose were highly relevant to green infrastructure in the CSGN area, the broad brush approach to correlating particular land-use types with certain ecosystem services might be less useful. This respondent made an important distinction between the central functions of green infrastructure (habitat enhancements, water management, open space, and access networks) and the outcomes (both direct and indirect) from those functions – such as health, climate change mitigation/adaptation. The respondent questioned what could be learned from the maps that they did not already know or do, which suggests that those operating within the CSGN may already have good skills and data. They felt as thought the scale of analysis (1 hectare) misses out on urban activities and is therefore too coarse for the CSGN area. They fet it was important to be clear about the problem and the solution offered by the analysis/findings from the methodology. They also suggested that it was important to acknowledge that in some places that have not done this kind of analysis, the GRETA methodology could be quite revealing and useful. The analysis provides a starting point to have a conversation about how decision makers can embrace GI and ES in their decision making in a way that they have not before.

[5] https://www2.gov.scot/Topics/Environment/Countryside/Landusestrategy/regional

4 Capacity of GI network to meet the demand of ES in the Central Scotland Green Network

The key respondent that replied to the GRETA consultation on economic valuation methods indicated that cost-benefit analyses are used in decision-making processes related to green infrastructure (GI) and that this is typically done before the GI intervention (ex-ante). The respondent had heard of all of the valuation methods, but had only used 'cost avoided'. The main benefits that were included in the cost-benefit analyses were flood mitigation, climate change mitigation or adaptation, health, and crime reduction. The six main benefits valued were: crime reduction, improved physical health, improved mental health, peatland carbon sequestration, forest carbon sequestration, and reduced flood damage. The respondent indicated that the work was "*carried out by Scottish Government economists drawing on research and on existing data sets. The study acknowledges that it provides a very conservative measure of benefits and that many additional benefits have not been valued*". The benefits were described using socio-economic information on benefits in non-monetary terms, and socio-economic information on benefits in monetary terms. The specific methods used to assess benefits can be found in the CSGN report on the 'Benefits of the CSGN' (Hume, 2015), and include:

1. The crime reduction achievable through providing attractive natural features throughout urbanised areas;
2. The physical health benefits of providing high-quality greenspace within a five-minute walk of all homes;
3. The mental health benefits of providing high-quality greenspace within a five-minute walk of all homes;
4. The carbon sequestered by restoring all the 62,000 hectares of restorable peatland across the CSGN;
5. The carbon sequestered by planting 85,500 hectares of new broadleaf woodland; and
6. The flooding damage averted by installing green infrastructure networks across the CSGN.

Another report, 'Costing the CSGN' estimates the capital costs of the major components of the CSGN, (Hislop and Corbett, 2014) identified constraints to GI development. the main constraints and challenges were that there were some areas where "*a lack of research evidence makes assessment difficult (e.g. around greenspace quality and its effects on healthy activities). Recognition that many (possibly most?) aspects of value have not yet been addressed*".

Key identified benefits of using these methods noted in this same report were identified as follows:

> *This study has helped by drawing new partners and interested parties into discussion of CSGN and green infrastructure. However, the relatively narrow definition of value*

has made it difficult to make a strong cost-benefit case. We are now looking for ways to address more of a comparative costing approach (comparing planned interventions against the status quo and against non-GI approaches) and to explore the role of Green Infrastructure in 'preventative spend.

The economic valuation results were used to develop a case for the CSGN and to promote supportive policy. The respondent indicated that the most helpful thing for their organisation would be access to data from valuation studies implemented for other GI.

4.1 What do GRETA analysis on ES supply and demand reveal?

GRETA have explored the capacity of GI network to meet the demand of ES where:

ES supply is defined as the capacity of ecosystems to provide ES, irrespective of them being used.

ES demand can be defined as the amount of a service required or desired by society in a given location and time. This demand depends on several factors such as socio-economic conditions, cultural/behavioural norms, technological innovations, availability of alternatives, among others.

	ES Supply – benefits provided	ES Demand -specific definitions	Approaches to quantify Demand
Regulating services	Benefits are provided by maintaining desirable environmental conditions	Amount of regulation needed to meet target conditions	Reduction of risk
Cultural services	Benefits are provided by experiencing the natural environment	Desired total use (if rival service) or individual use (if nonrival service)	Preference and values // direct use
Provisioning services	Benefits are derived from consumption of final goods	Amount of goods obtained per unit of space and time or per capita	Direct use // Consumption

Table 2 Relation between benefits provided by ES supply and the corresponding ES demand definitions and operationalisation approaches. Adapted from: Villamagna et al., 2013 and Wolff et al., 2015.

Demand for **regulating services** can be defined as the amount of those environmental conditions that ensure the provision of a desired regulation level. A reduction of risk approach has been usually applied to quantify demands for these services. Vulnerability to potential changes in regulating services may provide valuable insight into society's needs capturing main linkages from the socio-ecological system.

Demand for **cultural services** has been mostly assessed by preferences and values for attributes of certain landscapes, ecosystems or heritage sites. Preferences may be either quantified through stated preferences that relate to the desired level of services, or through revealed preferences (a proxy for the actual use of the service). Demand for cultural services has also been assessed by the direct use of a specific ecosystem, e.g. for recreation. This can

be quantified by total visitor days per year or the number of fishing/hunting licenses, the presence of tourists or accounting the accessibility or proximity to recreational areas.

Demand for **provisioning services** has been quantified based on direct use and consumption of final. It is worthy to note that there is normally a spatial mismatch between the area where the service is provided and the area where the service is consumed, especially true for provisioning services. For this reason, interregional linkages have to be considered in order to properly identify faraway dependencies and assess magnitude of potential impacts

Following the proposed conceptual framework, we have combined demand and supply for each of the selected ES. The focus of this approach was to highlight those areas where there is a high demand and a low supply, i.e. those areas where GI is unable to cover the ES demand. It should be noted that these results are of a more exploratory nature in the whole GRETA project considering the following limitations:

- This is a research area still under development;
- There is need for a higher resolution of the data sources given the nature of the phenomena analysed;
- Balance between supply and demand is semiquantitative; and
- In some cases, a more sophisticated modelling would be required to have an appropriate quantitative balance.

Therefore, these results should be seen as illustration on how this demand and balance could be approached.

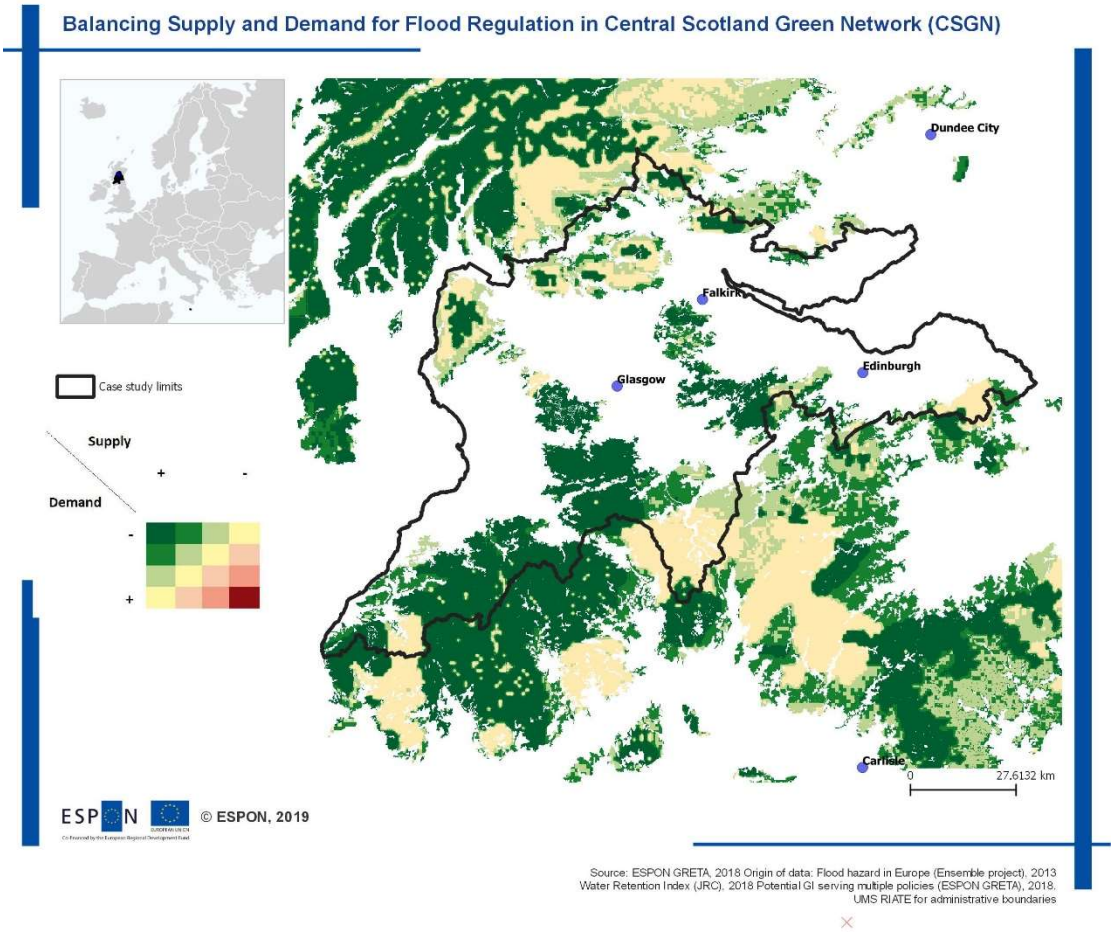
4.1.1 Analysis of supply and demand for Flood Regulation in the Central Scotland Green Network

We have quantified demand for flood regulation based on the potential flood hazard. Exposure is described by the projected potential flooding risk[6]. On the other hand, benefits are provided by the water storage capacity of land to regulate floods. The supply for flood regulation is quantified by the Water Retention Index, which assesses the capacity of landscape to retain and regulate water passing through. This index is dimensionless and considers the role of interception by vegetation, the water-holding capacity of the soil, and the relative capacity of both the soil and the bedrock to allow percolation of water. The influence of soil sealing and slope gradient are additionally considered.

Map 4 presents a semi-quantitative analysis of the balance between supply and demand for flood regulation in Central Scotland Green Network. Dark green areas are predominant showing those with maximum capacity of supply and demand is very low. The other parts that are still green could be considered areas where the balance tend to be positive, in the sense that the supply is slightly higher than the demand. In practical terms it would mean that improving or

[6] for the period 2011-2044 that results after applying the LISFLOOD model from the ENSEMBLES project

reinforcing GI with the objective of water retention will have a substantial benefit. The southern part of the study area is in yellow showing an stable situation where supply meets the demand.



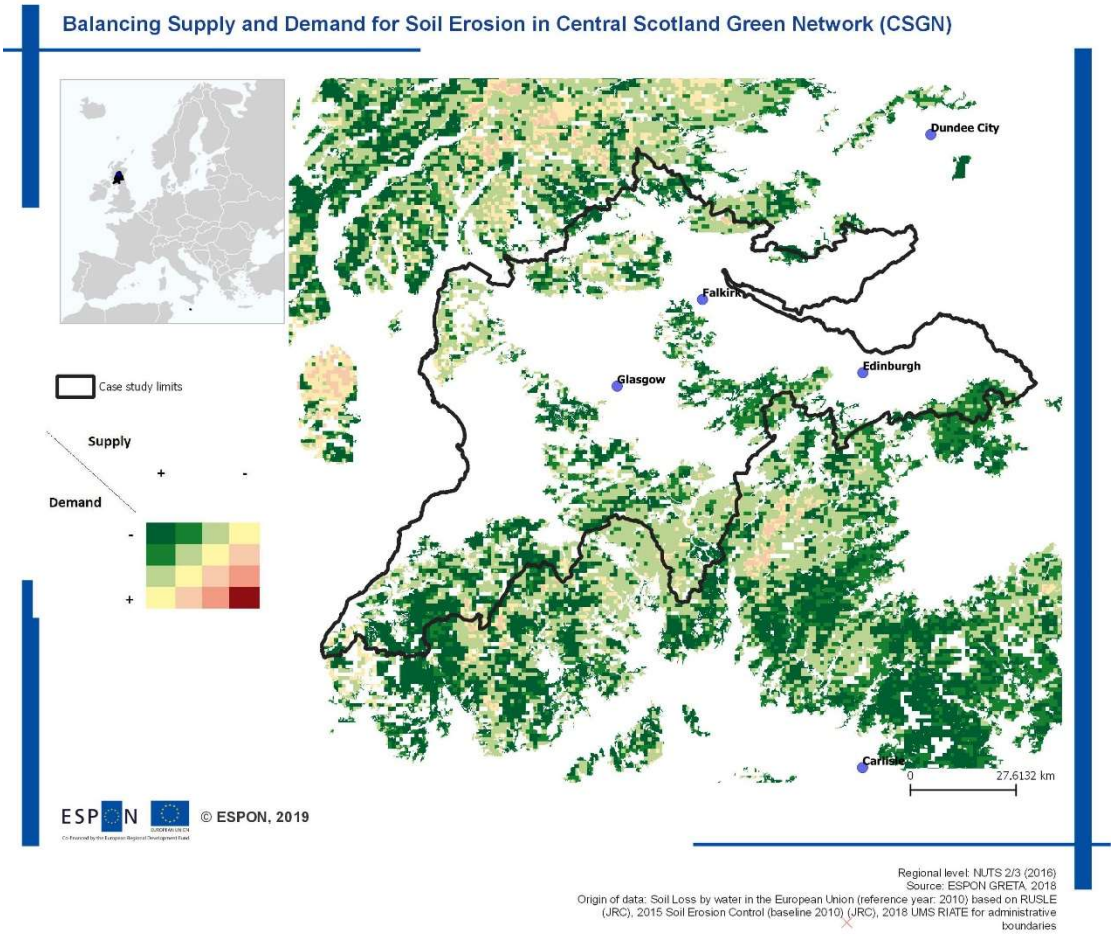
Map 4 Balancing Supply and Demand for Flood Regulation in the Central Scotland Green Network.

4.1.2 Analysis of supply and demand for Reducing Soil Erosion in the Central Scotland Green Network

We have assessed the demand for the reduction of soil erosion by water producing a negative impact on several ES; in particular to the ones related to crop production, drinking water and carbon stocks. Soil erosion by water is mainly affected by precipitation, soil type, topography, land use and land management. Exposure is described by the soil loss rate[7] (t ha^{-1} yr^{-1}). Benefits are provided by the capacity of vegetation to control or reduce erosion rates. The supply is quantified by the Soil Erosion Control dataset (JRC) that describes the capacity of ecosystems to avoid soil erosion.

[7] as estimated by the modified version of the Revised Universal Soil Loss Equation (RUSLE) model

Despite the limited capacity for soil erosion control assessed in previous section, Map 5, shows a positive pattern with predominant green cells those with maximum capacity of supply and low demand.



Map 5. Balancing Supply and Demand for Soil Erosion in the Central Scotland Green Network

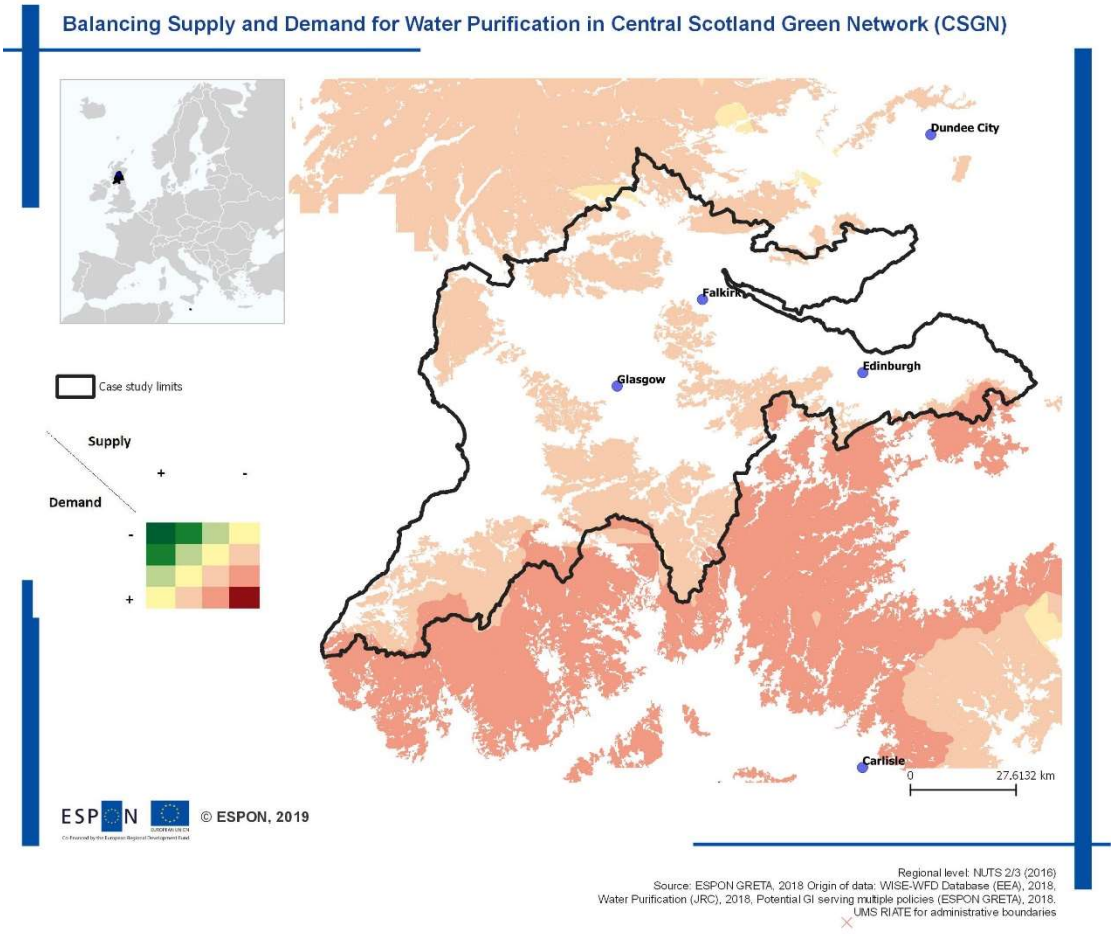
4.1.3 Analysis of supply and demand for Water Purification in the Central Scotland Green Network

We have quantified demand for water purification based on the level of pollutants emitted to freshwater ecosystems by polluting sectors, primarily agriculture and waste water treatment discharges from industry and households. Exposure is described by mean annual concentration of nitrates in water [8](. The supply is quantified by the Water Purification dataset (JRC) that assesses the in-stream retention efficiency of ecosystems to dilute or degrade nutrients.

Resulting Map 6 shows that water pollution is still a big challenge and substantial increase on the provision of water purification is still required under current status in most of the area. In

[8] tonne per year) captured in monitoring stations and aggregated by rivers (the WISE-WFD database)

practical terms this means that policy efforts for increasing GI capacity for water puriticaiton will potentially have a possitive impact.

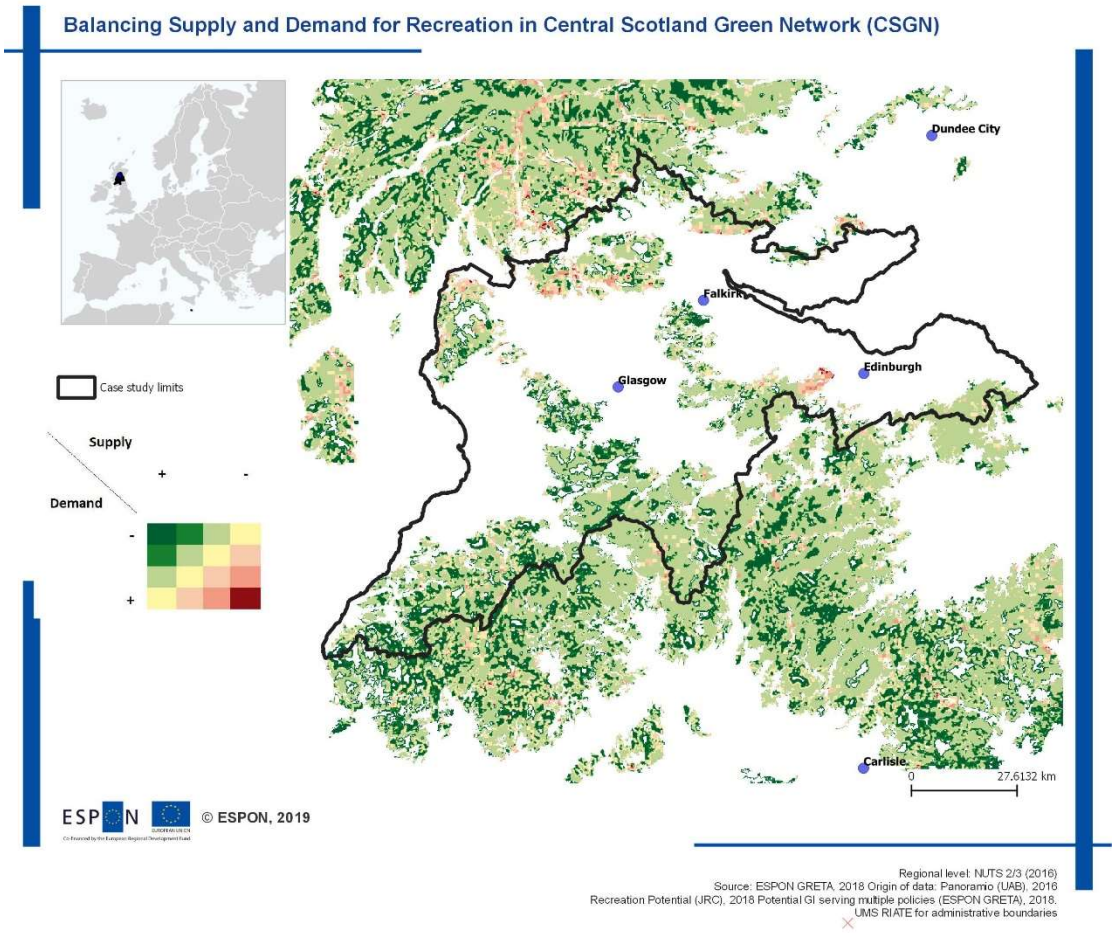


Map 6. Balancing Supply and Demand for Water Purification in the Central Scotland Green Network

4.1.4 Analysis of supply and demand for Recreation in the Central Scotland Green Network

We have described demand for recreation by means of a proxy for visitation. Recreation and tourism are important elements for national and local economies, that also contribute to other intangible benefits. Recreation directly depends on environmental attributes like species richness, diversity of habitats, and climate. The usability of crowd-sourced information by means of location photographs has already been shown to be as a reliable proxy for visitation rates to recreational sites. We have used the location of photographs in Panoramio as a proxy for landscape attractiveness for visitors. Demand is quantified by the number of pictures per square km. On the other hand, supply is described by the Recreation Potential dataset (JRC) that quantifies the potential for citizens for outdoor recreation.

The resulting Map 7 shows a well balance pattern where supply meet the demand together with some dispersed areas in need for reinforcing supply that could be partly explained as direct link with population density.



Map 7. Balancing Supply and Demand for Recreation in the Central Scotland Green Network

5 Governance practices, policy and planning instruments to implement green infrastructure and enhance ecosystem services in Central Scotland Green Network

As described thus far, the Central Scotland Green Network (CSGN) is one of 14 national developments outlined in the NPF3, which nests under the Scottish Government's National Performance Framework and alongside the Scottish Government's Programme for Government (Scottish Government, 2018). The Scottish planning system is closely related to a variety of environmental regulations that are relevant to green infrastructure (see Scottish Government (2006) for an overview).

The Scottish Government Environment and Economy Leaders Group (EELG) is the highest level governance structure for the CSGN. The CSGN comprises four sub regions – Ayrshire, Glasgow & the Clyde Valley (GVC), Forth Valley, and the Lothians & Fife. Two of these areas benefit from a regional green network partner: (i) GCV Green Network Partnership; and (ii) the Lothians & Fife Green Network Partnership. There is an Ayrshire Green Network, however, it is not formalised or staffed. In the Forth Valley sub region, the three local authorities (Falkirk,

Clackmannanshire and Stirling) currently have no ambition to set up a regional Green Network body.

The CSGN documents the progress of the projects they support through their workplans and annual review reporting. Workplan documents are publicly available for 2010-2015, 2012-2015 and 2013 – 2016. Annual review reports are publicly available from 2011/2012 onwards.

Policy and planning instruments in the CSGN area are closely related to development planning. Scottish Government (2009) describes the hierarchy of development planning as:

1. National Developments
2. Major Developments
3. Local Developments
    - Strategic Development Plan
    - Local Development Plan
    - Supplementary Planning Guidance
    - Masterplan

Hislop and Corbett (2018) provide a comprehensive review of local authority policies on green infrastructure (GI) in built development. They also propose model components for GI policies (Hislop and Corbett, 2018, p.54), which should include the main GI function of:

- Habitat enhancement: development proposals should conserve and enhance on-site biodiversity, and habitat networks within and adjacent to the site.
- Access networks: development proposals should maintain and enhance the quality and connectivity of access networks, integrating active travel routes (linking work places, schools, community facilities and and public transport hubs) and recreation routes into GI.
- Water management: development proposals should integrate naturalised Sustainable Drainage Systems (SuDS) features into the design of GI, and where they are part of open space obligations should be safe and accessible creating an attractive and distinctive setting for new developments.
- Open space: development proposals should meet local accessibility, quality and quantity standards for open space, and be designed to cater for the needs of the community.
- Stewardship: developers should provide details of the GI functions and maintenance requirements, and the party responsible for these, and demonstrate funding arrangements for their long-term delivery to the satisfaction of the local authority before construction starts.

There are a myriad of funding opportunities in the CSGN area, many of them are outlined and discussed in ‘Resourcing the CSGN’ (Hislop, 2016). The study identified 21 funding sources available, which have the potential to provide approximately £50.2m per year toward an annual

target budget of £80.8m per year for the delivery of all CSGN capital cost components. There is therefore an annual shortfall of £30.7m per year which is approximately 38% of the required annual target budget.

The study categorises the identified funding sources into the following funding sectors:

- Public (SG): Largely mainstream funding from Scottish Government programmes, but might include some local government funding;
- Public (EU): Funding from the European Union (EU) either through support of Scottish Government programmes, or directly from an EU programme;
- Private: Funding from private organisations, which includes funding programmes derived from tax initiatives such as landfill tax and the plastic bag tax; and
- Other: Funding from other sources, such as the National Lottery.

This shortfall in resources to deliver the CSGN vision is a limitation and challenge, in addition to the lack of capacity necessary to capture and spend the funding identified.

The key respondent that replied to the GRETA consultation on governance, policy, and financial frameworks made a comparison between delivering a national development like the CSGN versus a national development like building a bridge. For the bridge, the money is obtained all at once with specific funding dedicated to project management and a clear project outcome that needs to be completed by a specific date. For the CSGN, there is a lack of resources (financial and human) to deliver the vision, and this equates to building half a bridge; however, achieving half of the CSGN is still a very good outcome despite missing some opportunities and benefits.

The CSGN operates within a complex planning context with many planning authorities who have their own policies and priorities (Hislop and Corbett, 2018). Certain policies trump others, and GI is often seen as a softer target while others are an imperative such asroad infrastructure, school infrastructure, housing infrastructure, and sewage infrastructure. The key respondent stated that the largest funding stream for GI in the CSGN is channeled through the planning system from private development, which highlights the potential of the planning system to fund GI.

The respondent noted that funding GI at the time of development is much more cost efficient than retrofitting, which needs to be delivered as a planning requirement that makes investing in GI in the best interest of the private sector. There are challenges related to enabling development (such as houses) and ensuring high quality greenspace as there will be more costs in the future if sustainable places are not developed – this is the difference between short-term vs. long-term thinking. In the CSGN area, it is important to acknowlege and discuss ‘open

space' strategies[9], which helps to define what GI local authorities have. Local authorities then need to know what they want to see in their area (in terms of quality and quantity) in order to then direct development to meet the needs of people in their places. One of the main challenges is that local authorities are strapped for resources and the few people who remain do not often have time to think strategically. It is thus important to get beyond seeing the environment (GI) as a constraint to development and only focusing on mitigating damage, rather than bringing about improvements.

The key respondent indicated that there are gaps in understanding, particularly in relation to trade-offs with other land uses, and natural capital planning tools[10] could help decision makers to weigh up the different options available. There is a need for more information and examples to help ensure GI will deliver benefits and that we can account for benefits against the costs. Using the example of an engineer designing a solution to water retention, this key respondent noted that an engineer knows that when they invest in a concrete box to retain water they can reasonably estimate costs and maintenance needs, and they know what function it serves. Conversely, a solution that utilises GI to address the same problem is harder to estimate. This highlights one ofthe main challenges facing the implemetnation of GI, i.e. that of valuation.e.

6 Lessons learned and good practice examples from the Central Scotland Green Network

The GRETA project showcased the Seven Lochs Wetland Park as a good practice example from the CSGN area (see Good Practice Example 17, in Annex IV-D). There were other instances of good practice that were suggested by respondents and discovered through additional desk based research, including:

- Scotland's Environment Web[11] as a source of effective open access environmental and land-use information and data.
- Greenspace Scotland map[12], first published in 2011, was the world's first national greenspace map. It is a free interactive digital map, updated and extended to include parks, public gardens, playing fields, sports areas, play spaces, allotments and community gardens.
- The Scottish Land-use Strategy pilot process in Aberdeenshire[13] and the Scottish Boarders[14].

[9] See the Scottish Green Space Map - https://www.greenspacescotland.org.uk/greenspace-map

[10] http://ncptool.com/

[11] https://www.environment.gov.scot/

[12] https://www.greenspacescotland.org.uk/greenspace-map

[13] https://www.aberdeenshire.gov.uk/environment/energy-conservation/aberdeenshire-land-use-strategy-pilot/ for the Aberdeenshire Land Use Strategy Pilot.

[14] https://www.scotborders.gov.uk/info/20016/have_your_say/331/land_use_strategy_pilot_project/1 for the Scottish Borders Land Use Strategy Pilot

- Glasgow & Clyde Valley (GCV) Green Network Blueprint[15] as a strategic masterplan to guide partner action. Making sure that effort and resources are targeted effectively, creating or enhancing the right Green Network component in the right place.
- Cuningar Loop Woodland Park[16] created on a long neglected area of vacant and derelict shrub land on the banks of the Clyde river.
- Natural Capital Planning Tool[17] for an indicative but systematic assessment of impacts on natural capital and ecosystem services.
- The green network partnerships (GCV Green Network Partnership, the Lothians & Fife Green Network Partnership, and the Ayrshire Green Network) as examples of governance structures to support GI planning and implementation.

The CSGN area is quite advanced in terms of the information, knowledge, skills, and capacity for GI planning and implementation. The CSGN benefits from the existence of the CSGNT, which has evolved significantly over the years. The CSGNT and its partners have high capacity for spatial analysis, economic valuation, communications, and fundraising, which has contributed to the concept of GI being well understood and attracting both high level top-down buy-in and bottom-up project implementation. This could in itself be a 'good practice example' in terms of how to build momentum and support for GI projects in a polycentric metropolitan area.

7 Policy messages and recomendations in the Central Scotland Green Network

Policy messages and recommendations that have emerged from the GRETA project that are relevant to inform green infrastructure (GI) at the case study level include Policy messages and recommendations that have emerged from the GRETA project that are relevant to inform green infrastructure (GI) at the case study level.

- A respondent stated that it is important to make the maps and information easy to interpret.
- Another respondent felt as though it was important to be clear about the applicability/useablity of the GRETA findings, what can the case study level decision-makers do with the information?
- Recommendation to target new engineers at the earliest stages to be the deliverers of future green infrastructure – this will help to mainstream green infrastructure rather than viewing it as a project here and there. It should become just like putting in a footpath

[15] https://www.gcvgreennetwork.gov.uk/what-we-do/our-blueprint

[16] https://scotland.forestry.gov.uk/visit/cuningar-loop

[17] http://ncptool.com/

or a sewage system and be integral to how we build our urban environments. Not as a nice to have, but as a must have.

Policy messages and recommendations applicable to the EU policy guidelines that can be upscaled from lessons learned at the case study level.

- GCV Green Network Blueprint, masterplan strategy for GI. Could be an upscaled recommendation from case study to EU level, based upon the model GI policy.
- Policy is the most important driver for private sector investment (linked to development planning permission). Much easier to fund green infrastructure at the time of development rather that retrofitting. The largest funding stream for green infrastructure in the CSGN is channeled through the planning system from private development, which highlights the potential of the planning system to fund green infrastructure.
- Quote from respondent: *"Policy is the most important driver for private sector investment*". Important to highlight/understand examples of private sector financing of green infrastructure projects – linked to development planning.

8 Annex

Consultation (type of interaction)	**Type of Stakeholder**	**Type of Organisation**	**Timeline**
Preliminary outreach / baseline information	Technical expert	NGO	15/03/18
A – Econ valuation	Technical expert	NGO	31/07/18
B – Maps	Practitioner	National Government	11/10/18
	Technical expert	NGO	Reviewed material, still awaiting a time to speak.
	Practitioner	NGO	02/11/18
	Researcher	Research institute	24/10/18
C – Governance	Practitioner	NGO	01/10/18

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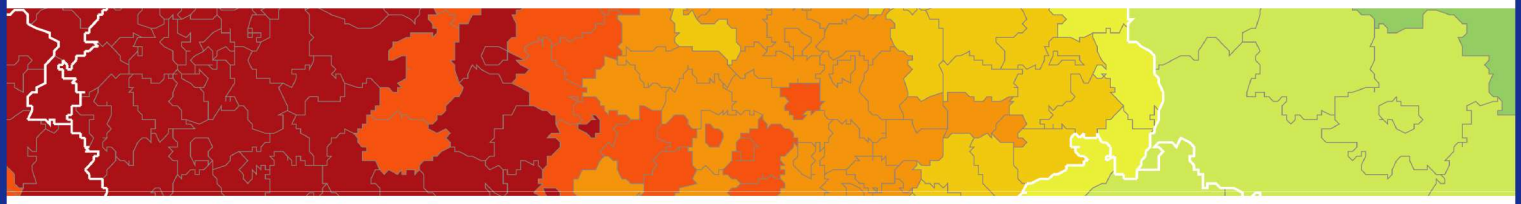

ESPON 2020 – More information

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