Beyond carbon: benefits and trade-offs of woodland expansion for multifunctional landscapes

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With Andrea Baggio, Marie Castellazzi, Laura Poggio, Zisis Gagkas, Scott Newey, Jim McLeod, Matt Aitkenhead, Mark Wilkinson

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With Andrea Baggio, Marie Castellazzi, Laura Poggio, Zisis Gagkas,
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Talk Contents

- Context
- Models and MCA
- ***Indicative*** Priority 500 k ha
- Conclusions

Why expanding or creating woodlands?

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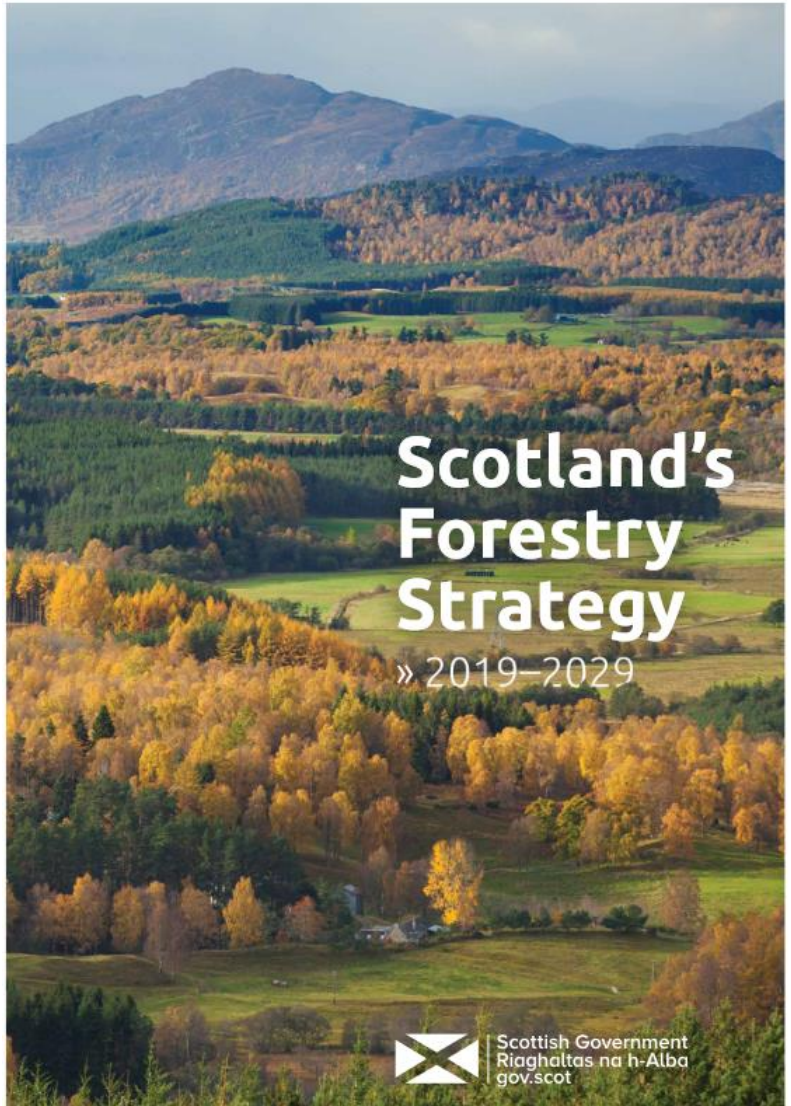
- Necessary for the UK **to meet its 2050 net zero** greenhouse gas emissions target.
- Potential to deliver **not only carbon storage** but also multiple other benefits

timber, biodiversity, prevention of erosions, reduced flooding…(depends on species & management)

Policy

Ca: 100k ha by 2025

CCC: ca 500 k by 2050



» BOX 1 – FORESTRY COMMITMENTS

Increase forest and woodland creation target[4]

- **10 000** ha in 2018
- **12 000** ha per year from 2020/21
- **14 000** ha per year from 2022/23
- **15 000** ha per year from 2024/25

Increase forest and woodland cover to **21%** of the **total area** of Scotland by 2032

Increase use of Scottish wood products in construction[4]

- **2.2** million m³ in 2018
- **2.6** million m³ by 2021/22
- **2.8** million m³ by 2026/27
- **3.0** million m³ by 2031/32

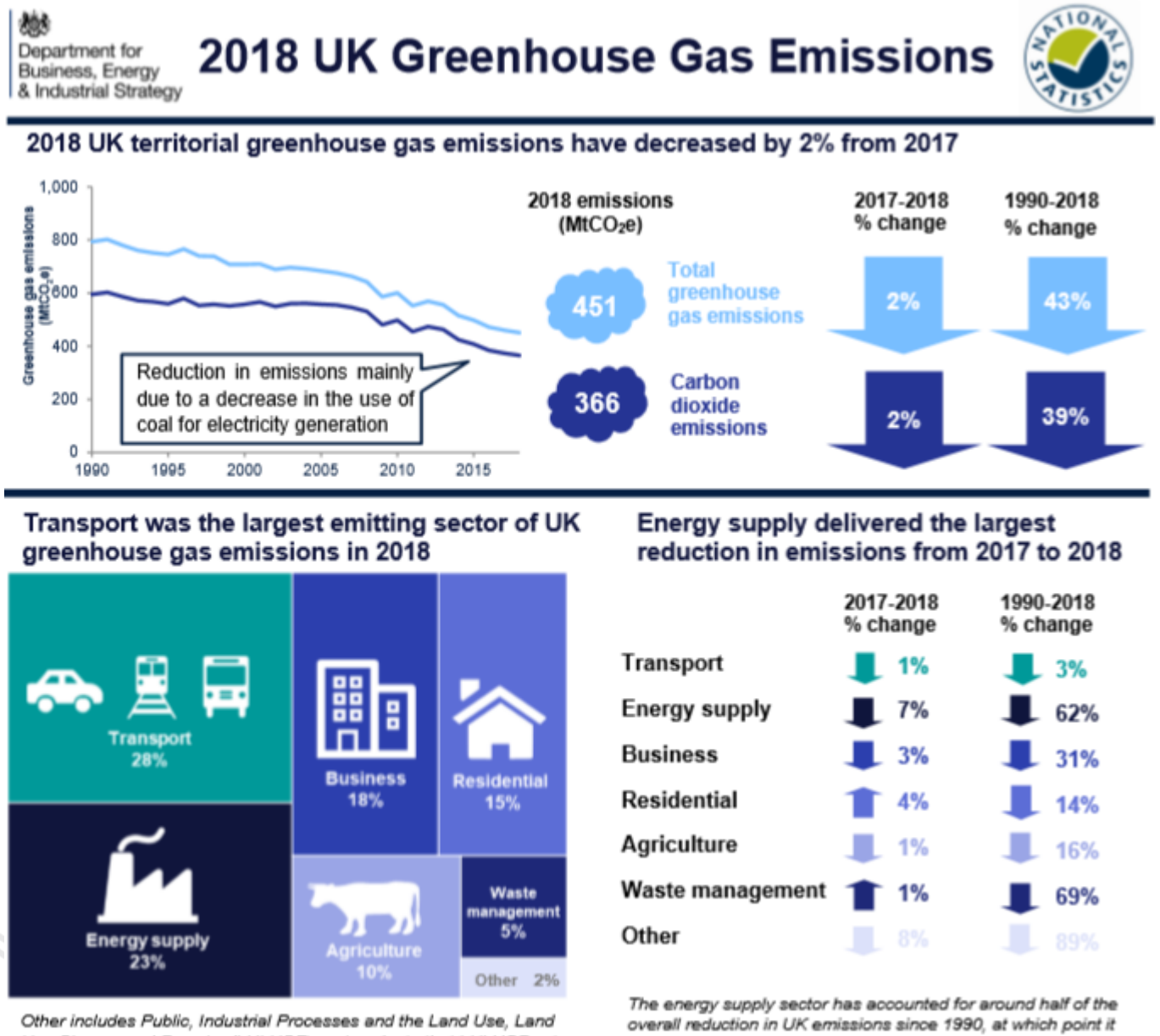
Native woodlands[5]

Increase
the amount of native woodland in **good condition**

Create
3000–5000 ha of new native woodland per year

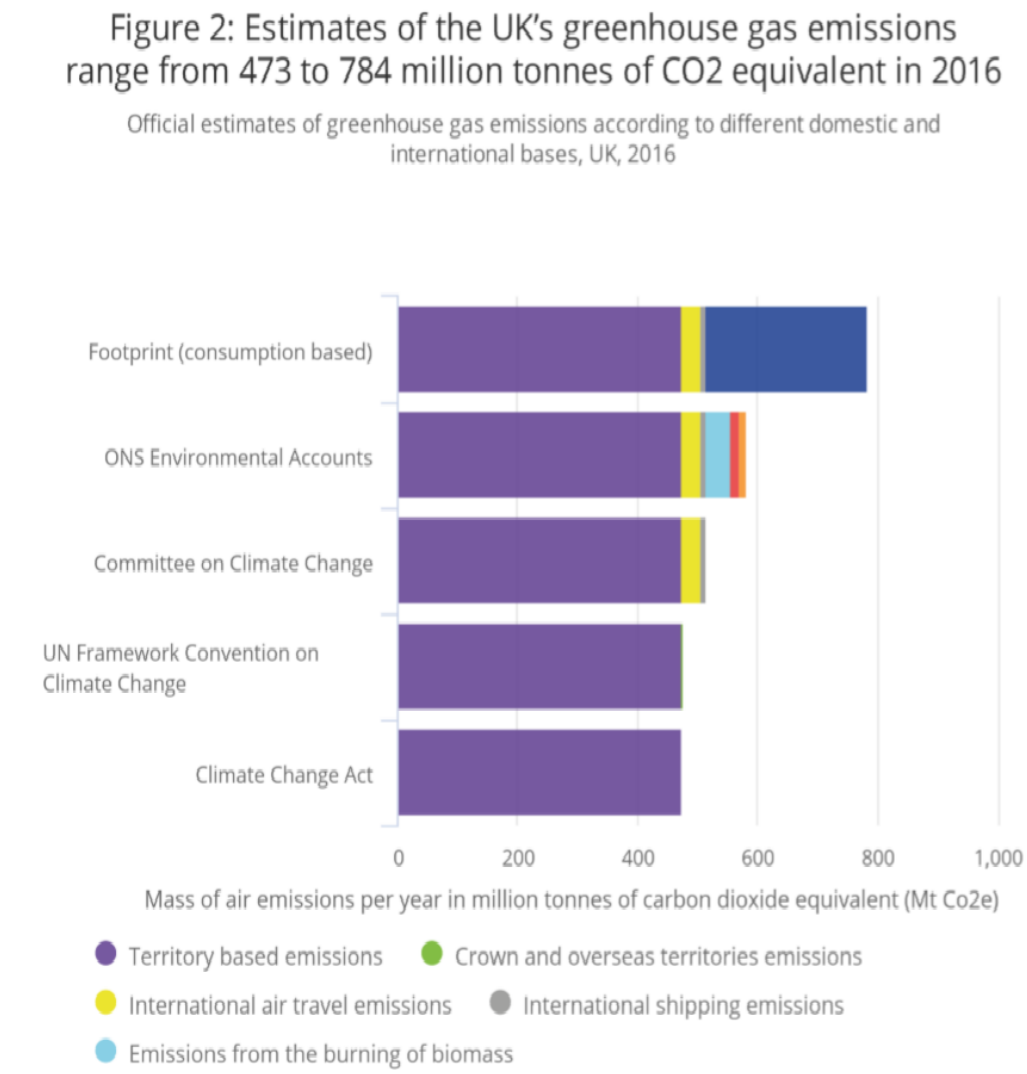
Restore
approximately 10 000 ha of new native woodland into satisfactory condition in partnership with private woodland owners through Deer Management Plans

Some context- UK emissions



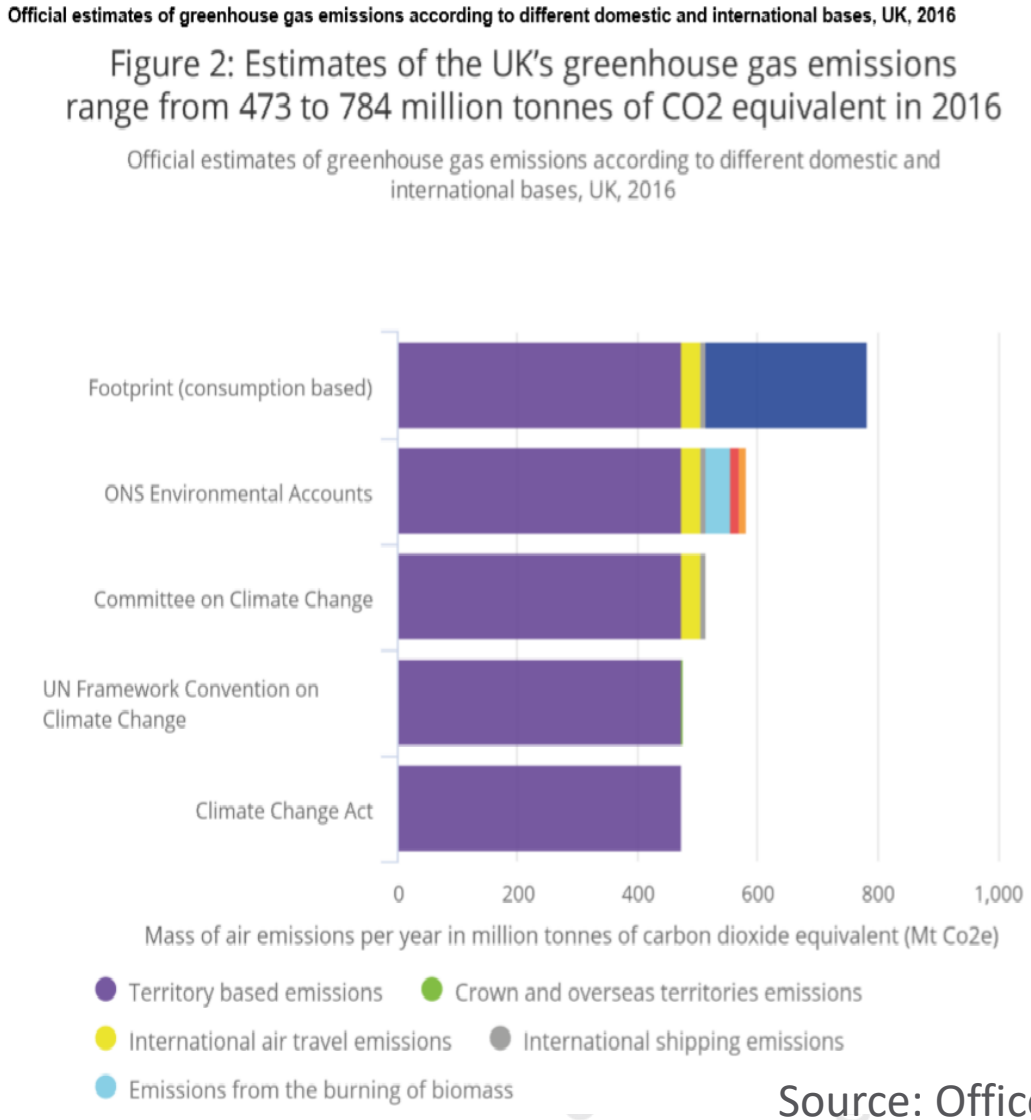
What is the contribution of trees to net-zero?

Official estimates of greenhouse gas emissions according to different domestic and international bases, UK, 2016



Source: Office for National Statistics –

What is the contribution of trees to net-zero?



UK, forest expansion: "The Widespread Engagement scenario…..sequesters **149** Mt CO2e **cumulative** GHGs by 2050". (source: CCC).

(the **total** over **30 yrs** is ca 20% of the present **yearly total emission** footprint…

..or about 1.2 yrs of transport emissions)

Source: Office for National Statistics –

Offset – Commercial vs Natives
Order of magnitude

- Compared to the BAU footprint, the cumulative (i.e. total over **30 yrs)** offset **difference** between a carbon intensive strategy (non native conifers) and native woodlands is of the **order of magnitude of 3-4 %.**

Where ? And where not ? Constraints and trade-offs

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Max benefits minimise constraints

Constraints

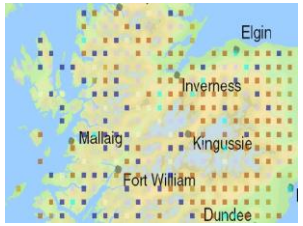
Bio-physical

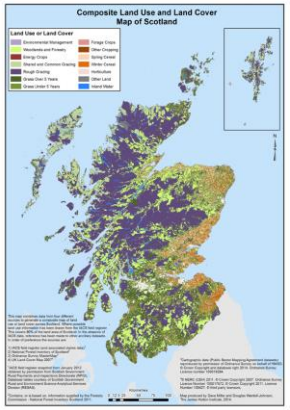
difficult growth in exposed locations and above 700 m

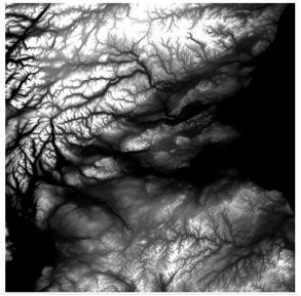
Social and economic and policy

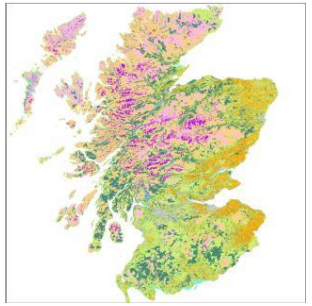
Undesirable on organic soils: carbon loss competition with other land uses : agriculture; biodiversity conservation; land tenure; economic viability…

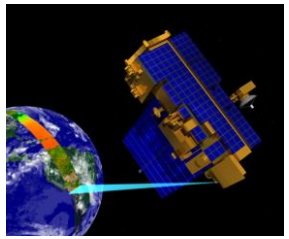
Data Integration











Soil
NSIS Soil Properties DB

Digital Terrain Model
50m to 5m

Land Cover/Use
LCM2007
Forest Inventories
IACS

Natural Heritage
Habitats
Protected areas
Spp. distributions
Cultural artefacts

Earth Observation
MODIS
Landsat
Sentinel1 (radar)
Sentinel2 (optical)

Models

Spatial MCA

Combine to according to Policy Goals

Web Story

https://arcg.is/0v04WH

Indicators of Ecosystem Services in Scotland

A story map

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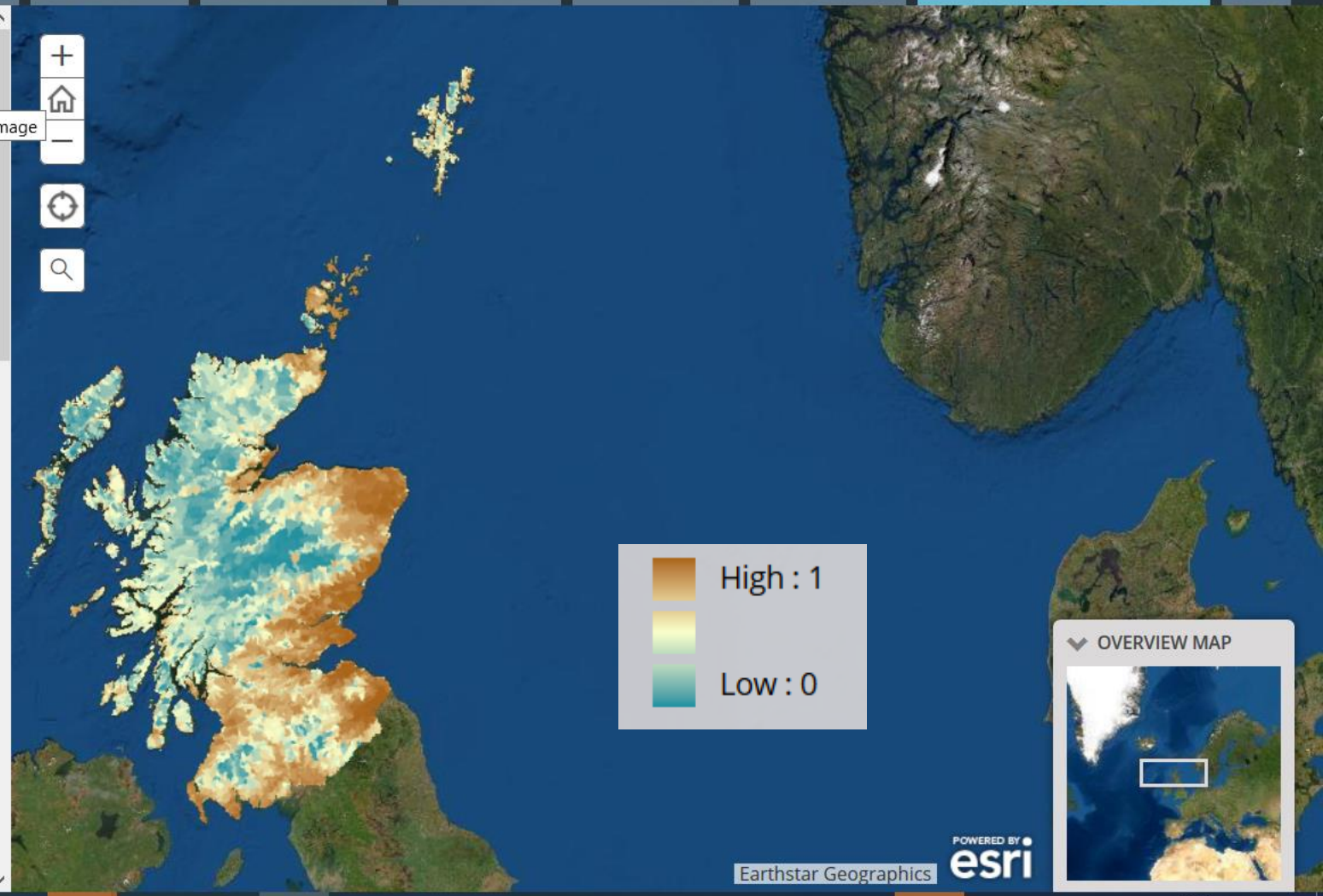
Water purification

Nitrogen Retention

The map, obtained using the InVEST nitrogen retention model, ranks Scottish catchments based on the total amount of nitrogen that runs off from the land but is retained before reaching the streams.

The model uses the amount of nitrogen loaded on each land use type, calculates the annual average water runoff, and then it computes the quantity of nitrogen retained by each pixel based on the land use and on how the water is routed through the landscape. By the routing process the model calculates how much of the nitrogen loaded on land reaches stream and how much is retained. It then aggregates the values to the sub-watershed level.



Indicators of Ecosystem Services in Scotland

A story map

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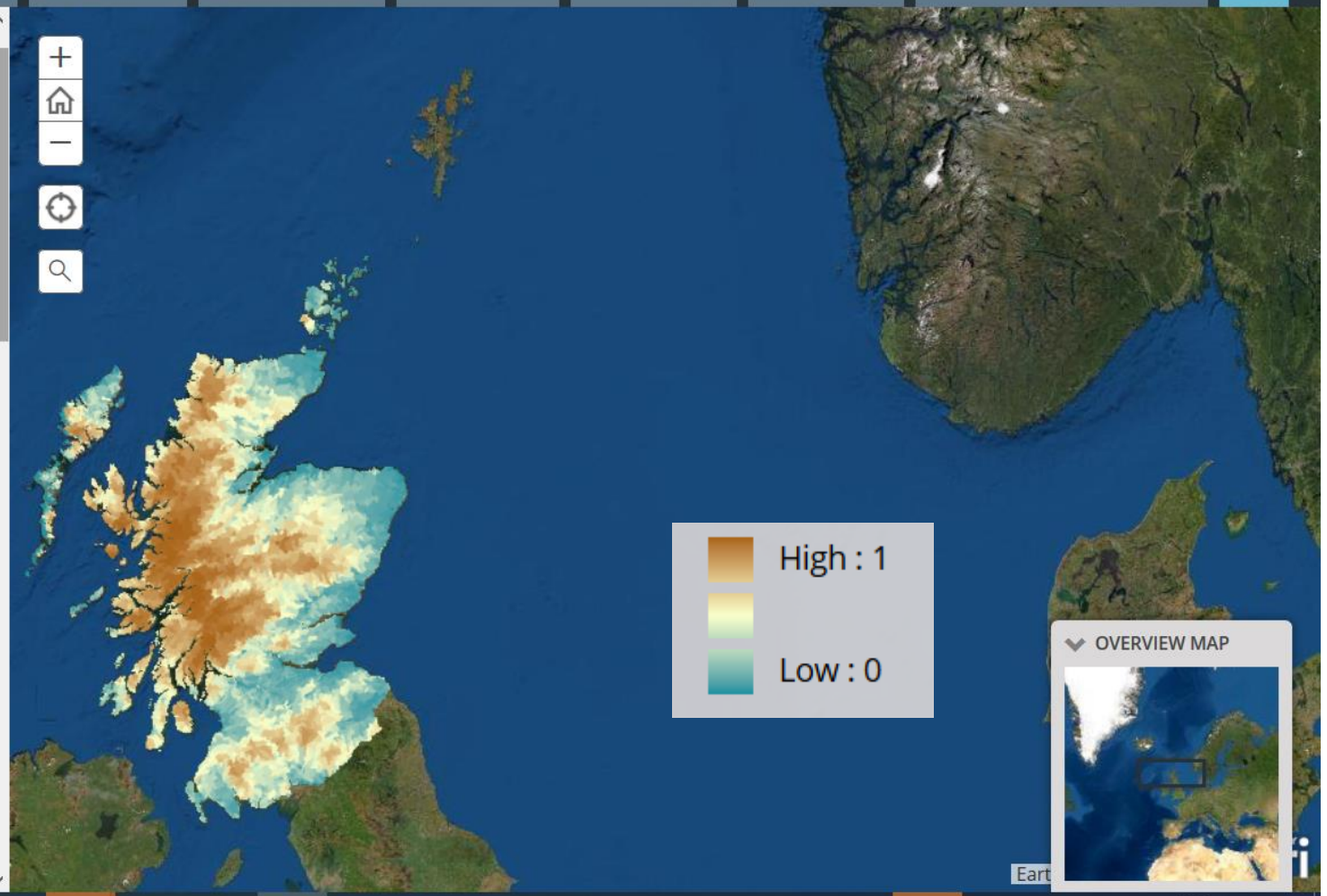
Soil Retention

Soil is associated with a wide range of essential functions, such as plant and crop growth, regulating the amount of water flowing into rivers, storing carbon. Vegetation provides a vital service by retaining soil. This benefits both terrestrial and aquatic systems.

The map, obtained using the InVEST soil and sediment retention model, ranks Scottish catchments based on the total amount of soil that is retained before reaching the streams, including soil that might be initially transported but is deposited later.

The retention service is higher where topography and climate pose more risk of erosion.



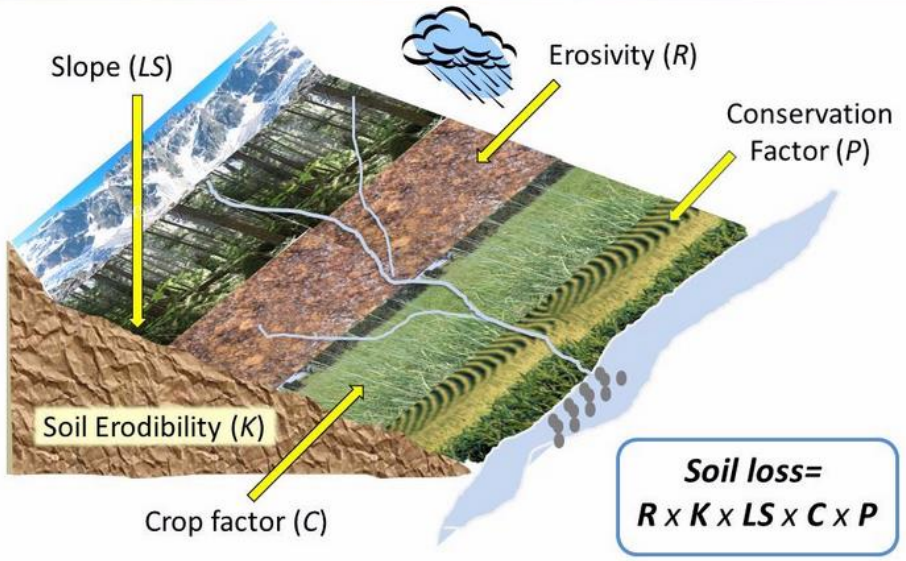
Indicators of Ecosystem Services in Scotland

A story map

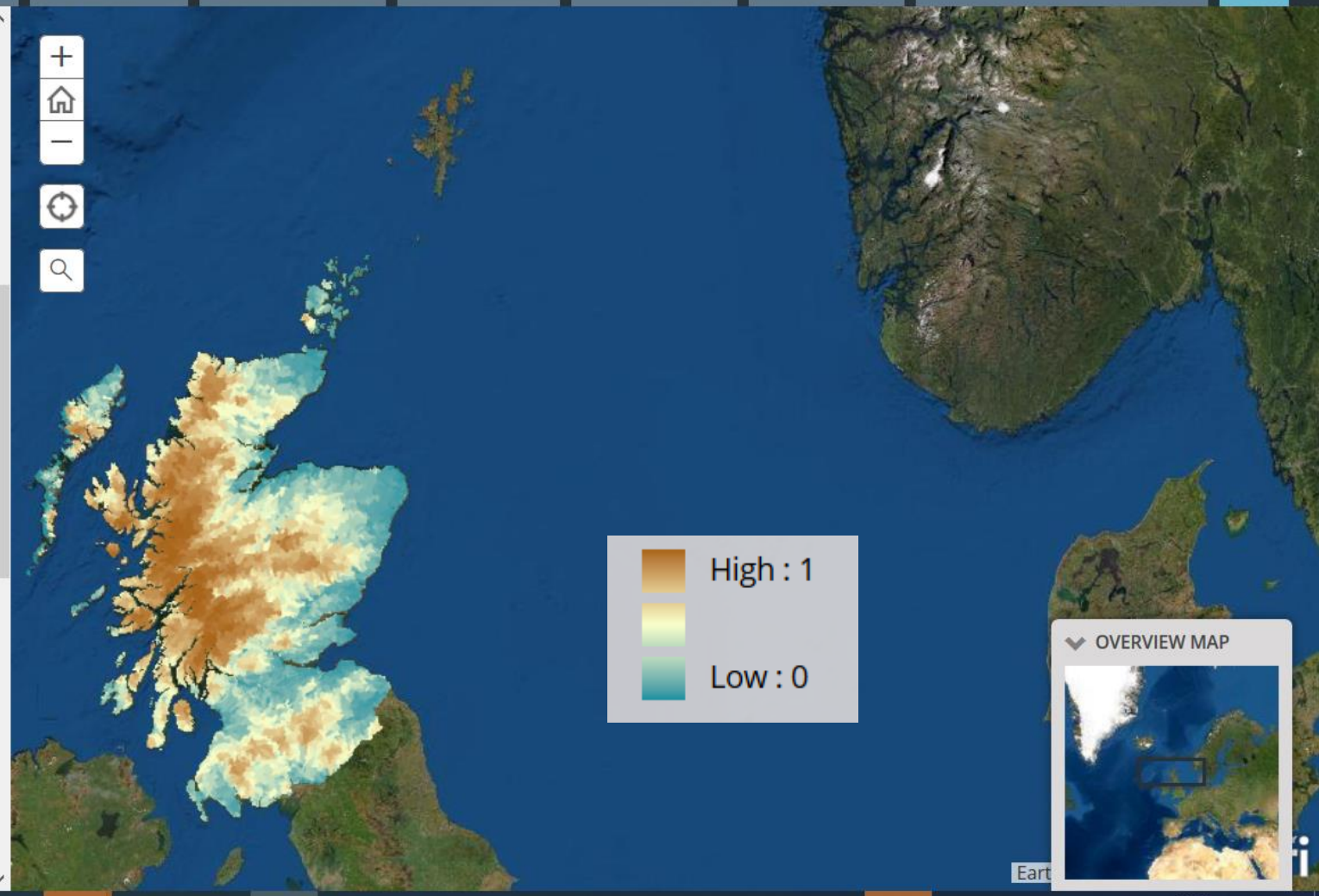
is deposited later.

The retention service is higher where topography and climate pose more risk of erosion.

InVEST Sediment Retention Model



Before estimating retention, the model uses the Universal Soil Loss Equation (USLE), which integrates information on



Indicators of Ecosystem Services in Scotland

A story map

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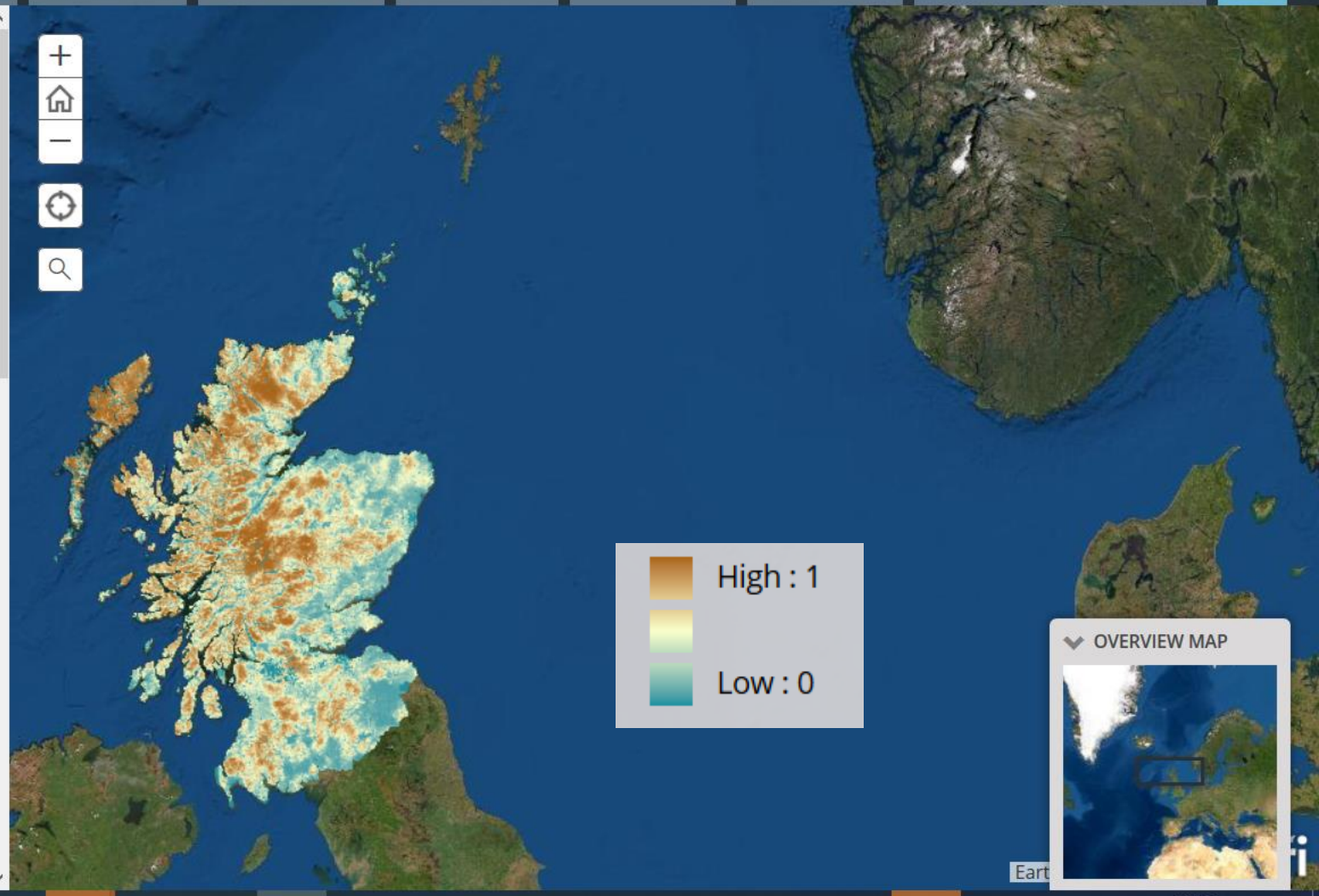
Soil Organic Carbon Stocks

Soil is an important carbon sink, and globally stores two to three times more carbon than the atmosphere. In Scotland, there is often 2-4 times more carbon in the soil than in the vegetation. By sequestering carbon that would otherwise contribute to greenhouse gases soil organic carbon contributes to mitigation of climate change.



Flood Risk

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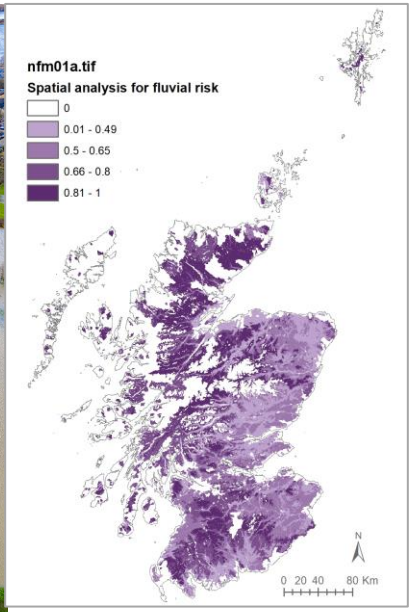
1) Concentration time (used 1/T)

The time needed for water to flow from the most remote point in a watershed to the watershed outlet. It is a function of topography (slope, distance) we used the Kirpich index.

Sub-catchments with rapid flow prioritised



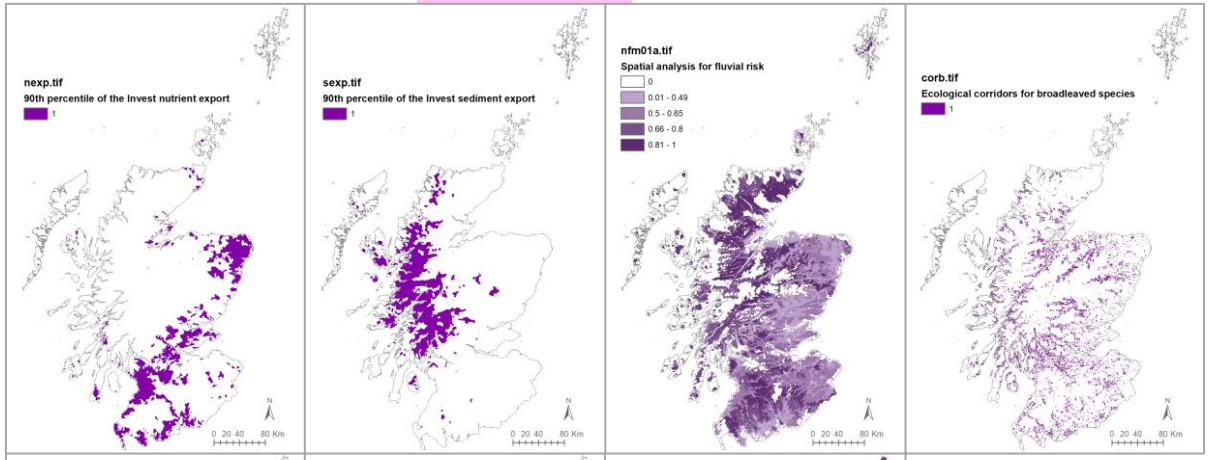
2) **Soil Hydrology**

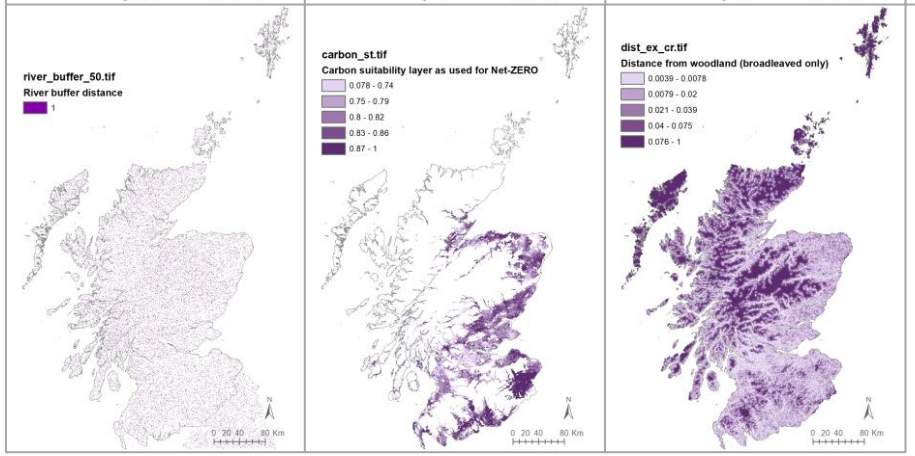
Slow Infiltration soils prioritised

3) **Risk** for **Assets**

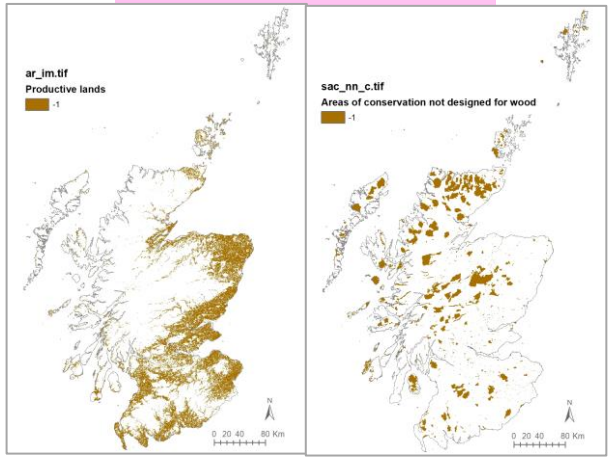
Areas draining towards “assets at risk” prioritised

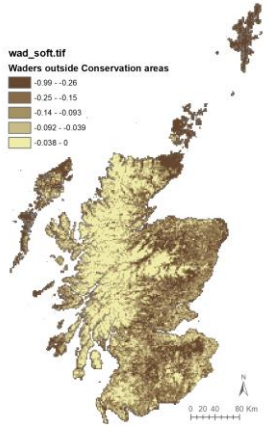
7 criteria



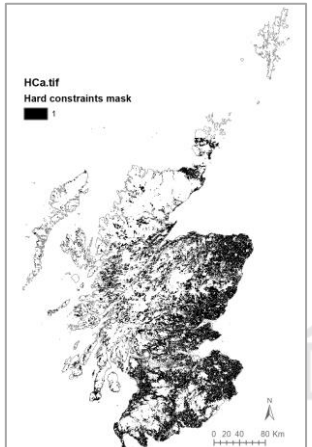


3 Soft constraints





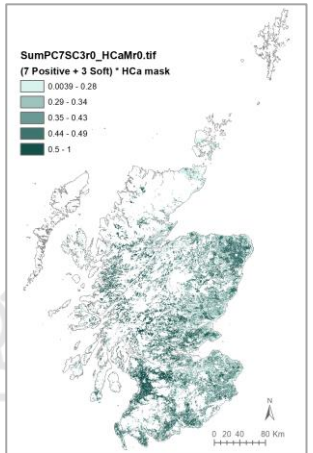
1 mask



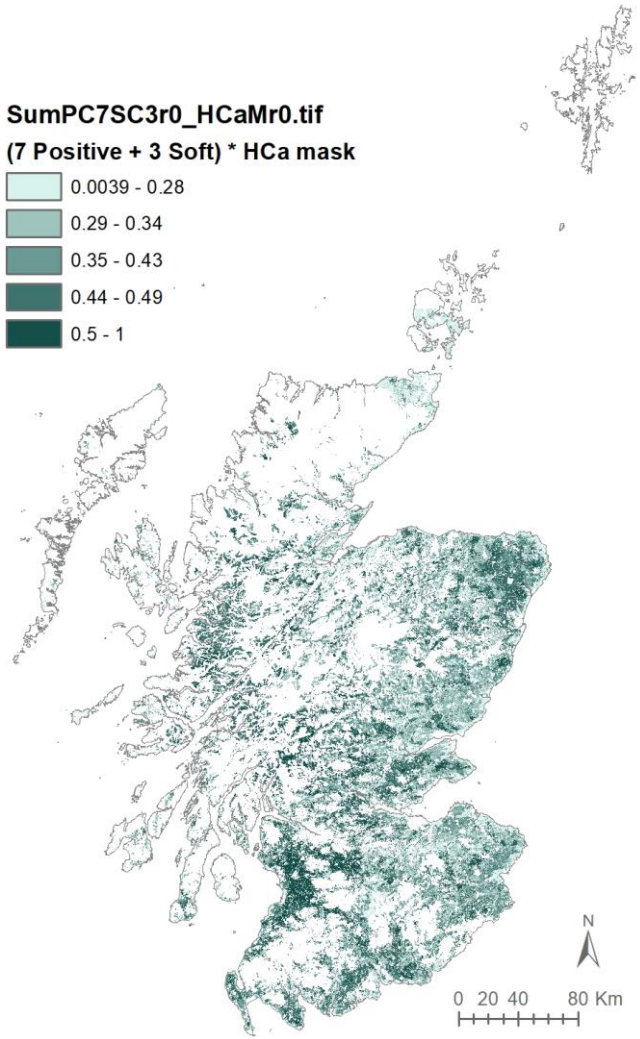
sMCA

1 Final map

Ranked available areas for expansion



Ranked area available for expansions



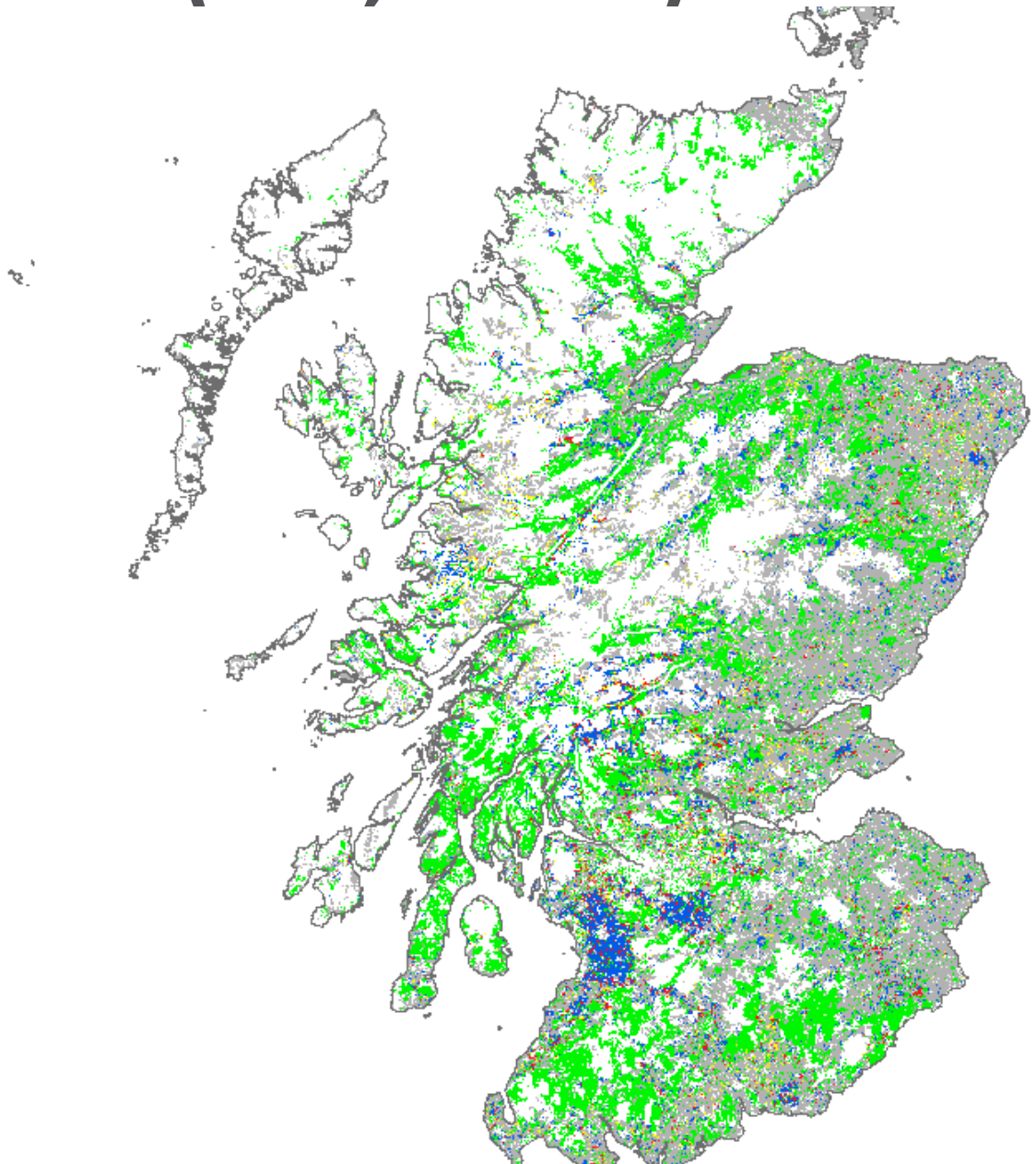
Score cell (i) = Sum(Layer1:Layer10) → Rescale 0 to1

Area *theoretically* available : >> 500 k hectares

-Scotland Level -**Preliminary** Results for best 500 k ha

(all criteria equally weighted)

Priority areas (500,000 ha)



- Stepping stones for wildlife movement;
- riparian in high N export & lower carbon areas;
- on high N export grasslands;
- enlarge existing

Priority for new woodlands

- High
- Medium
- Low

- Existing

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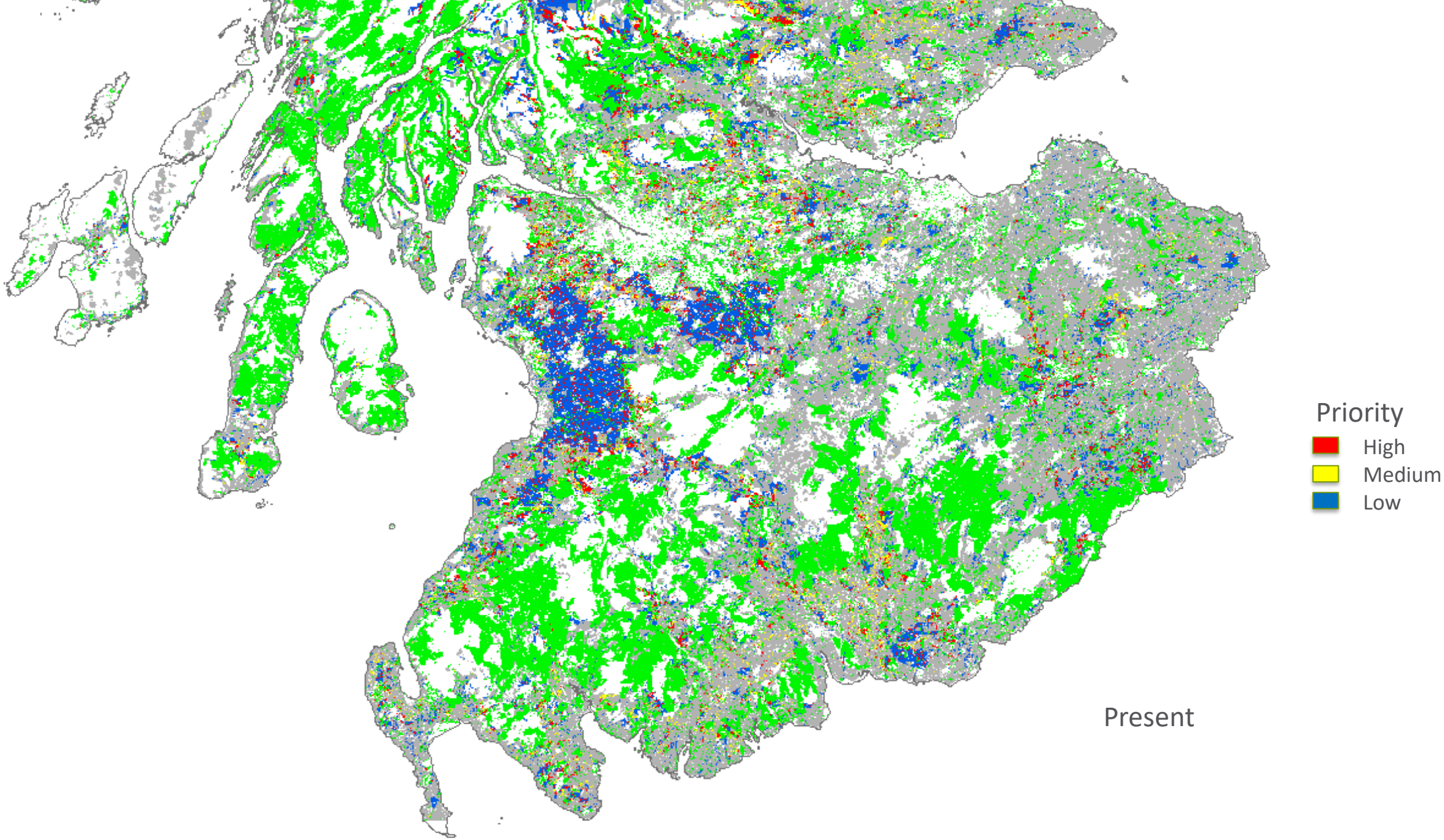
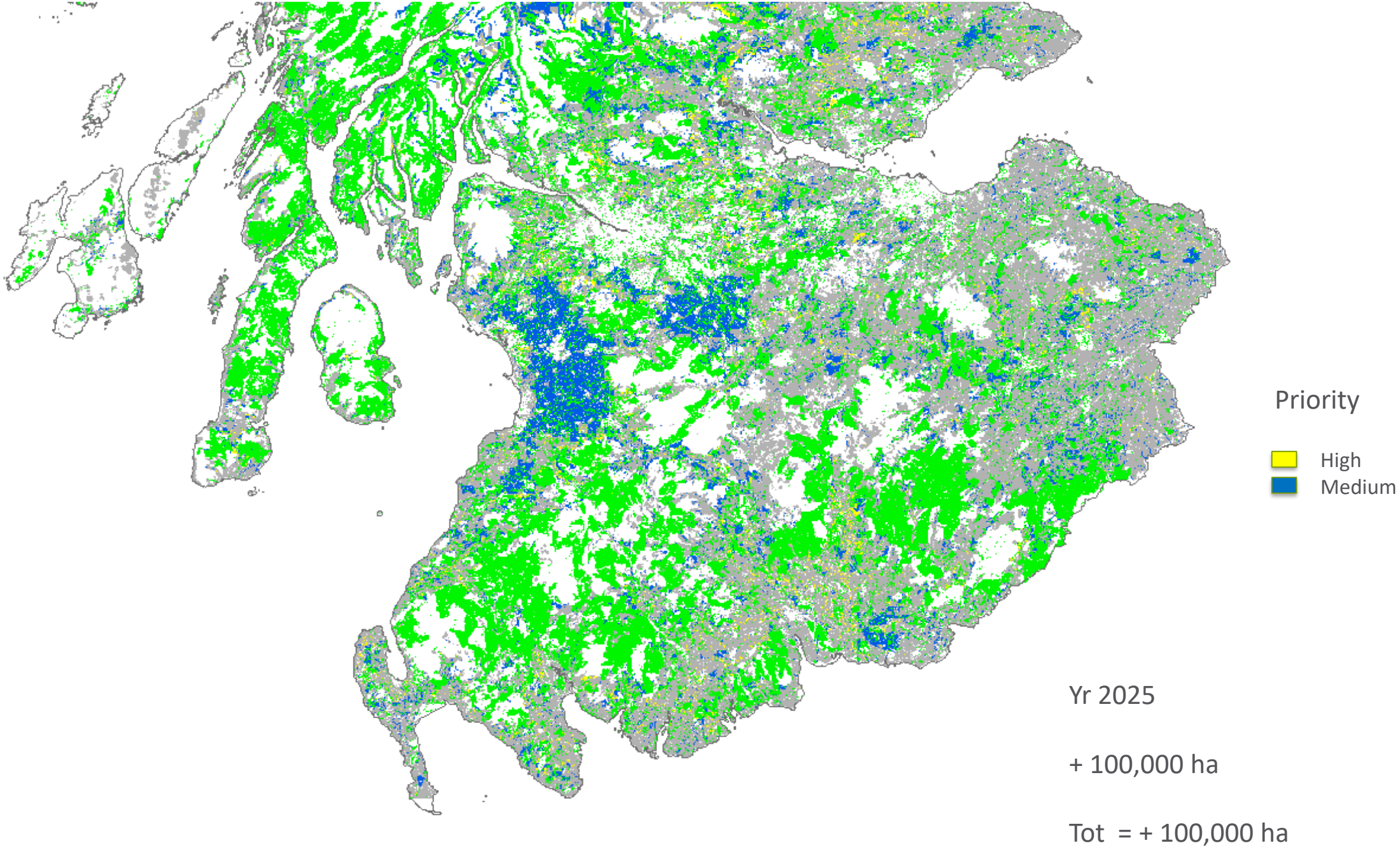
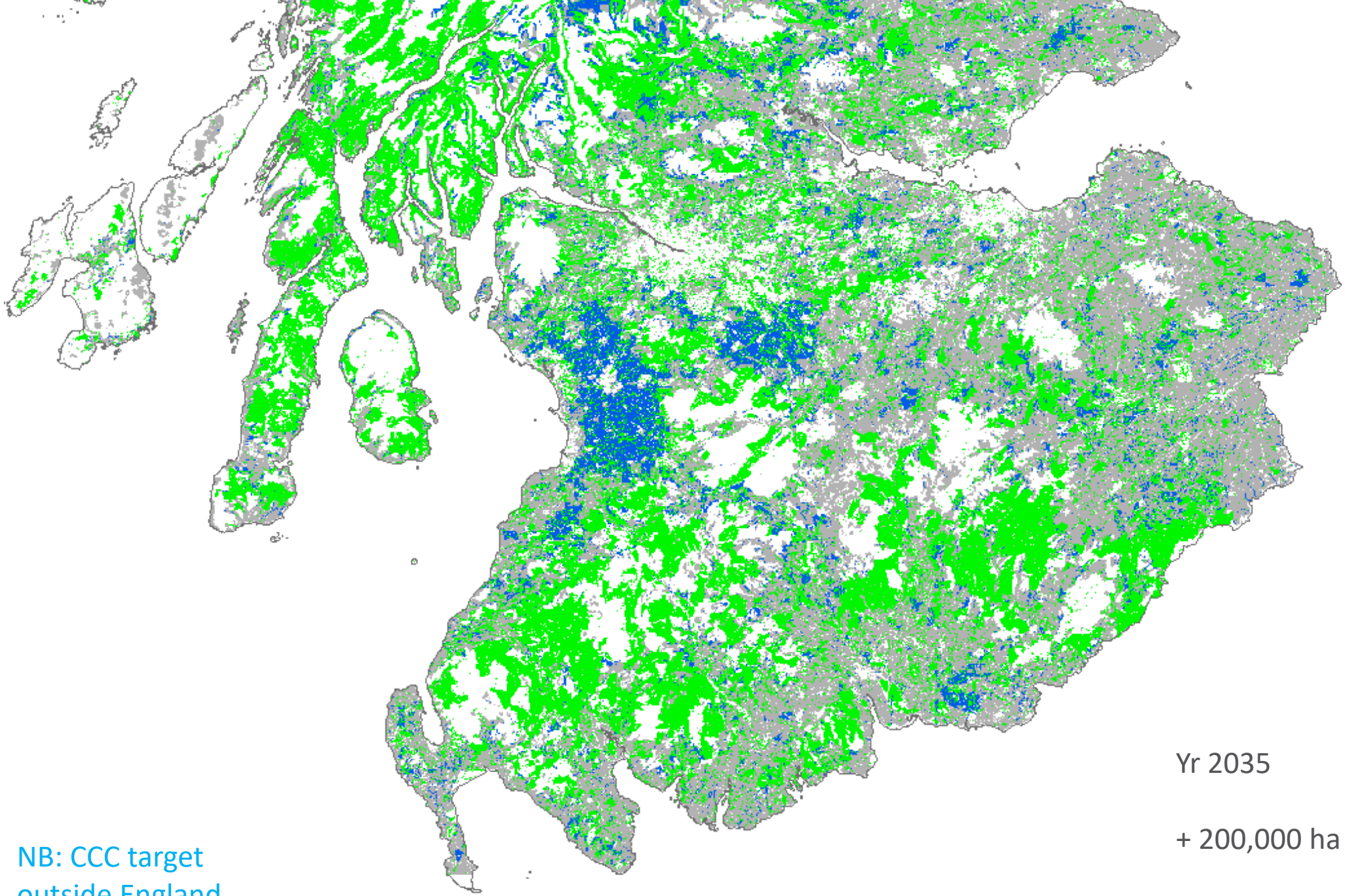
Potential time sequence of expansion

(In order of cell score)


Priority
High
Medium
Low
Present


Priority
High
Medium
Yr 2025
+ 100,000 ha
Tot = + 100,000 ha

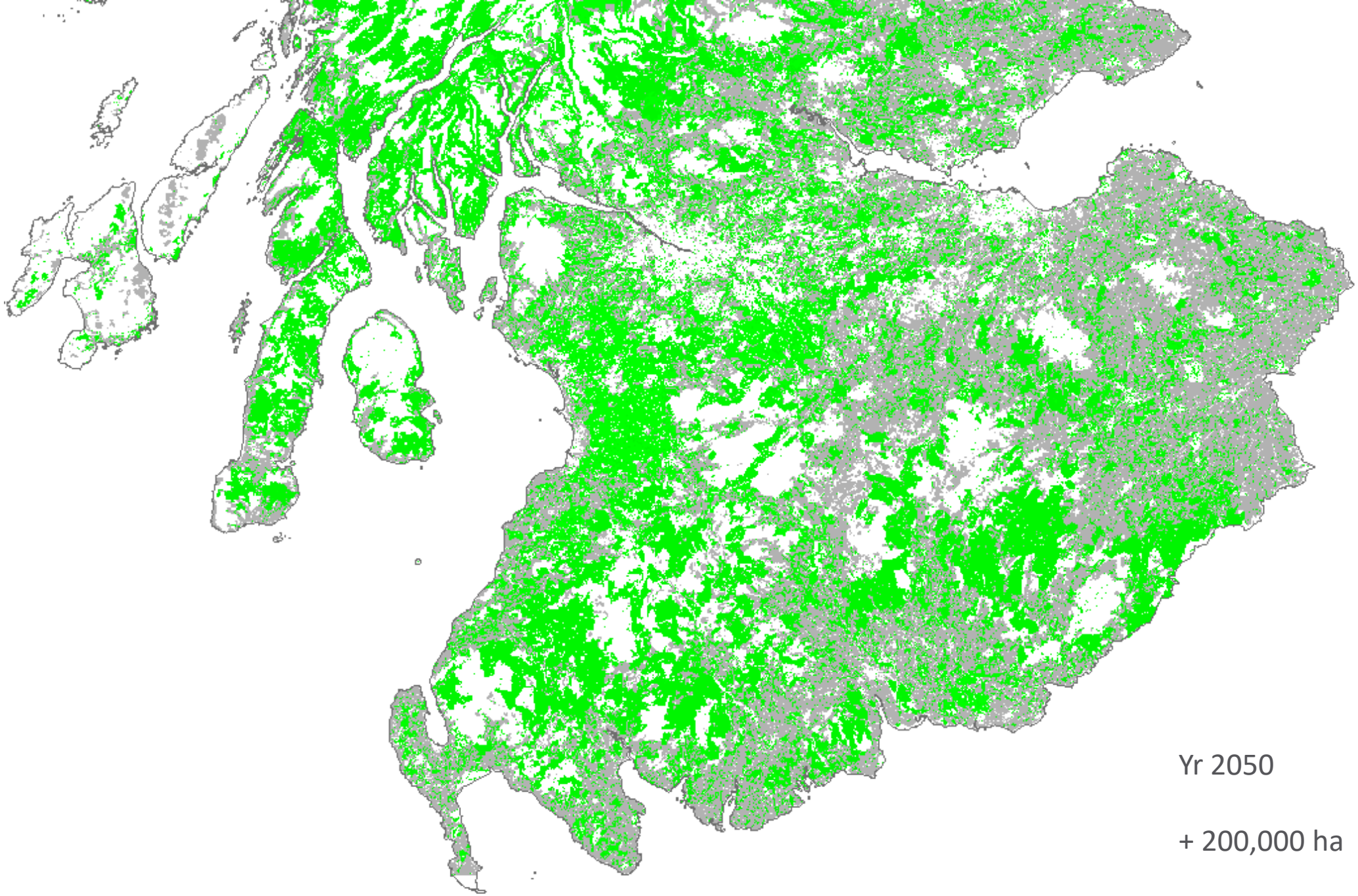


Yr 2035

+ 200,000 ha

Tot = + 300,000 ha

NB: CCC target outside England

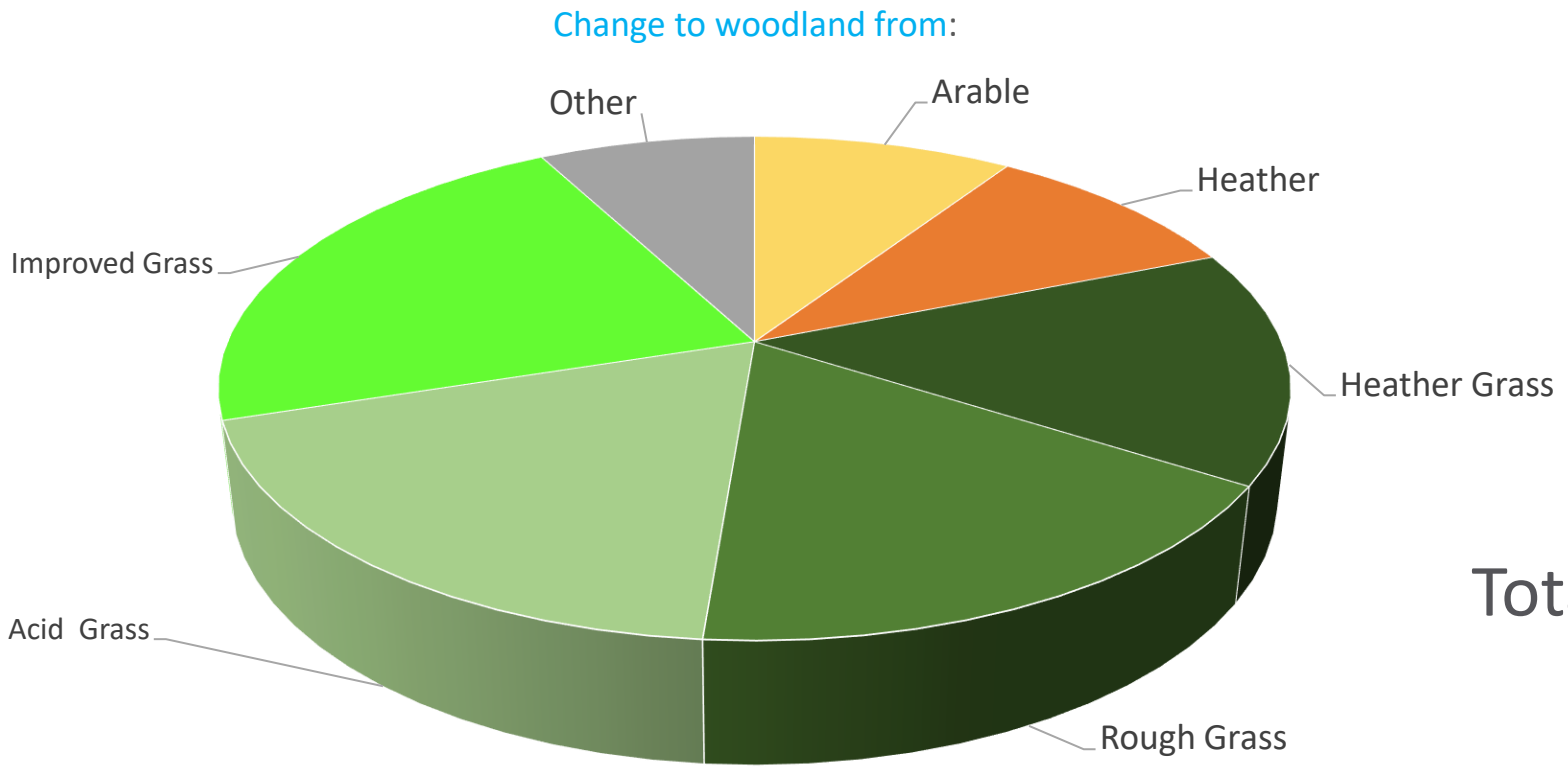


Yr 2050

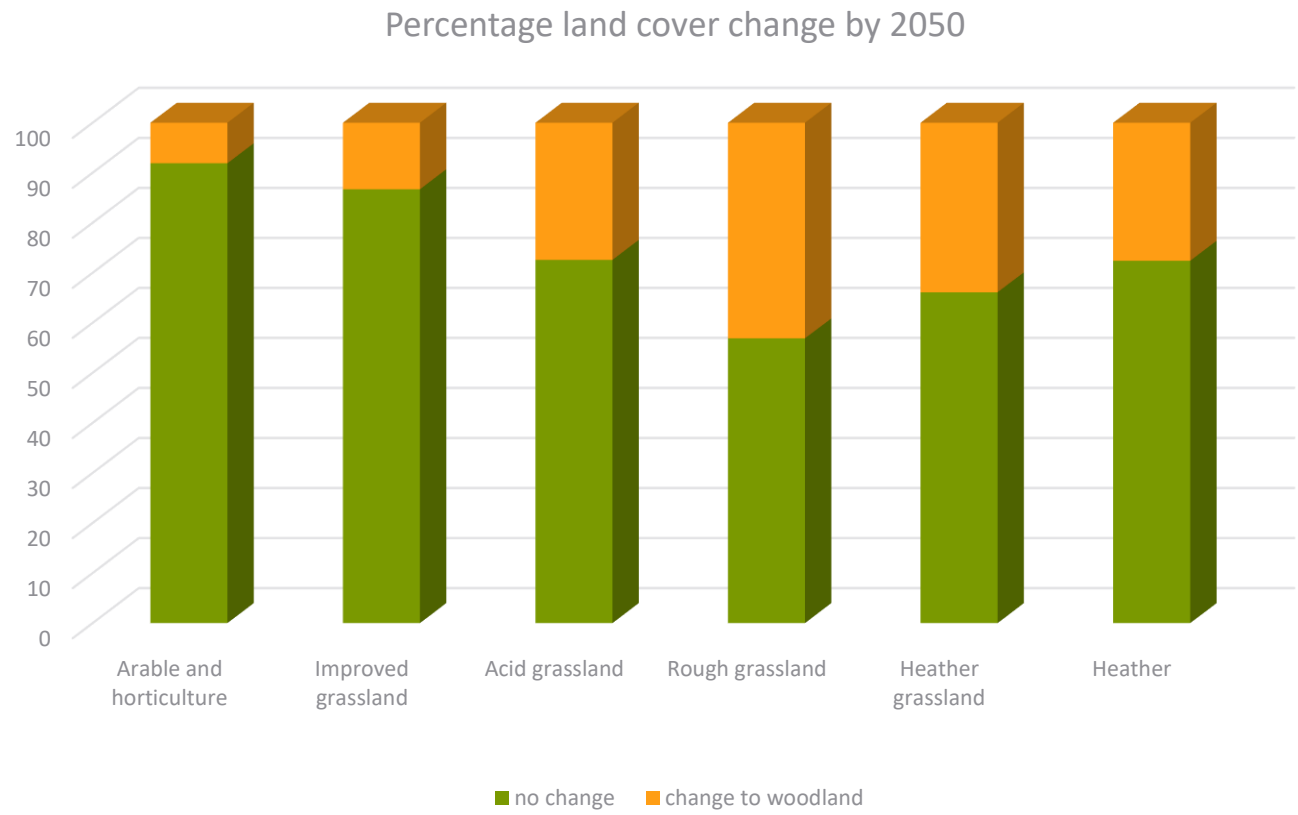
+ 200,000 ha

Tot = + 500,000 ha

Breakdown of potential land use change



Total = 500,000 ha


Percentage land cover change by 2050
100
90
80
70
60
50
40
30
20
10
0
Arable and horticulture
Improved grassland
Acid grassland
Rough grassland
Heather grassland
Heather
no change
change to woodland

Summary- main messages

- **Land requirements of woodland expansion**

  manageable ..carbon gains in the lowlands but potential conflicts with agriculture

- **Contribution to offset** of species options

  best appreciated in the context of UK total footprint & multiple benefits

- **Biodiversity benefits**

  higher with BL forests than plantations of exotics

- **Considerably more 'available' land for woodland expansion than 'needed' to meet targets** – exact location depends on benefits prioritised

- **sMCA allows assessment of relative adavantage/disadvantage of locating new woodlands in different places** – can include any criteria that have spatial data; can use weighting; can add/remove/change data and re-run to make new maps…

- **Key issue –indicative strategic** map – local surveys still needed for decisions

Thank you

For queries contact:
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Stonewall DIVERSITY CHAMPION SCOTLAND

Athena SWAN Bronze Award