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Is woodland expansion an economically efficient alternative for offsetting carbon?*

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Photo by VanVangelis/pixaby

CSIC Consejo Superior de Investigaciones Científicas

IPP Instituto de Políticas y Bienes Públicos

iesd

The James Hutton Institute

OUTLINE

1. Motivation and background
2. Materials and methods
3. Preliminary results
4. Some (preliminary) conclusions

MOTIVATION & BACKGROUND

the guardian .org

About this content

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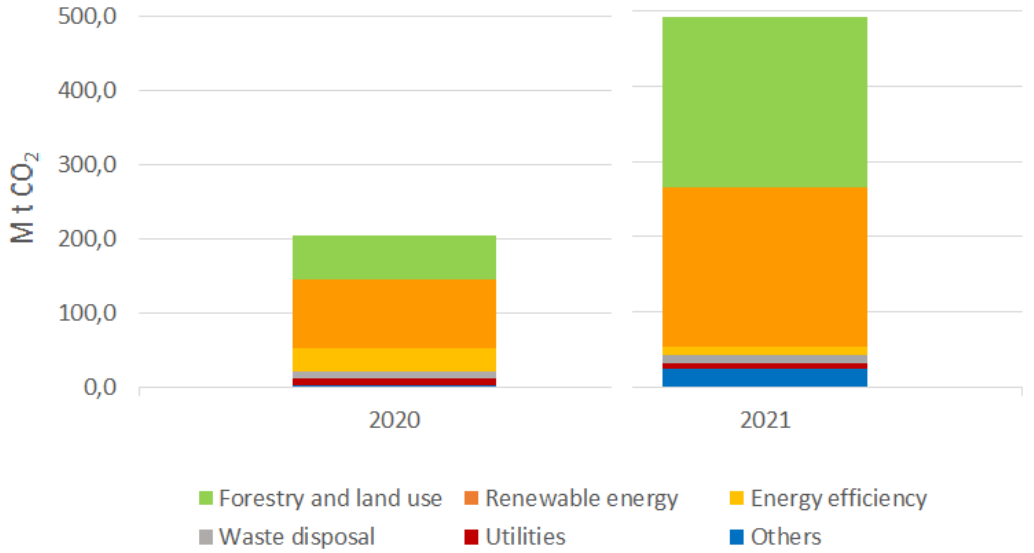
The age of extinction

Carbon credit speculators could lose billions as offsets deemed 'worthless'

Many credits in the voluntary market going unused, with study finding some offsetting could make global heating worse



Taken from: Ecosystem Marketplace (2022) The Art of Integrity. State of the Voluntary Carbon Markets

Area of Woodland Carbon Code Projects on the UK Land Carbon Registry – Interim statistics as of 30 June 2023

Area (hectares)	England	Wales	Scotland	Northern Ireland	UK
Under Development	6,535	1,932	36,216	793	**45,476**
Validated only	*1,901*	*723*	*19,848*	*67*	***22,538***
Verified at year 5	*705*	*131*	*3,796*	*9*	***4,640***
Total Validated	2,606	854	23,644	75	**27,178**
All Projects	**9,141**	**2,785**	**59,860**	**868**	**72,654**

Source: https://woodlandcarboncode.org.uk/uk-land-carbon-registry/wcc-statistics#area

About 15 ,000 ha validated by March 2021:

Δ 50% increase over the last 2 years

About 12 ,000 ha under development by March 2021:

Δ 280 % increase over the last 2 years

MOTIVATION & BACKGROUND

Offsetting carbon through forest/land investment is under scrutiny (*proliferation of voluntary offsetting schemes, over-crediting, permanence, additionality, leakage, pervert side effect*)

What is the **potential** to deliver **sustainable forest carbon offsets**?

This calls for a critical analysis of the potential of forest-based investments to generate carbon units that are **truly additional** and **long-lasting**.

Is woodland expansion an economically efficient alternative for offsetting carbon?

Add additional information layers to recent research (e.g. Baggio-Compagnucci et al. 2022) with focus on land use changes (i.e. land used for livestock breeding)

MATERIALS AND METHODS

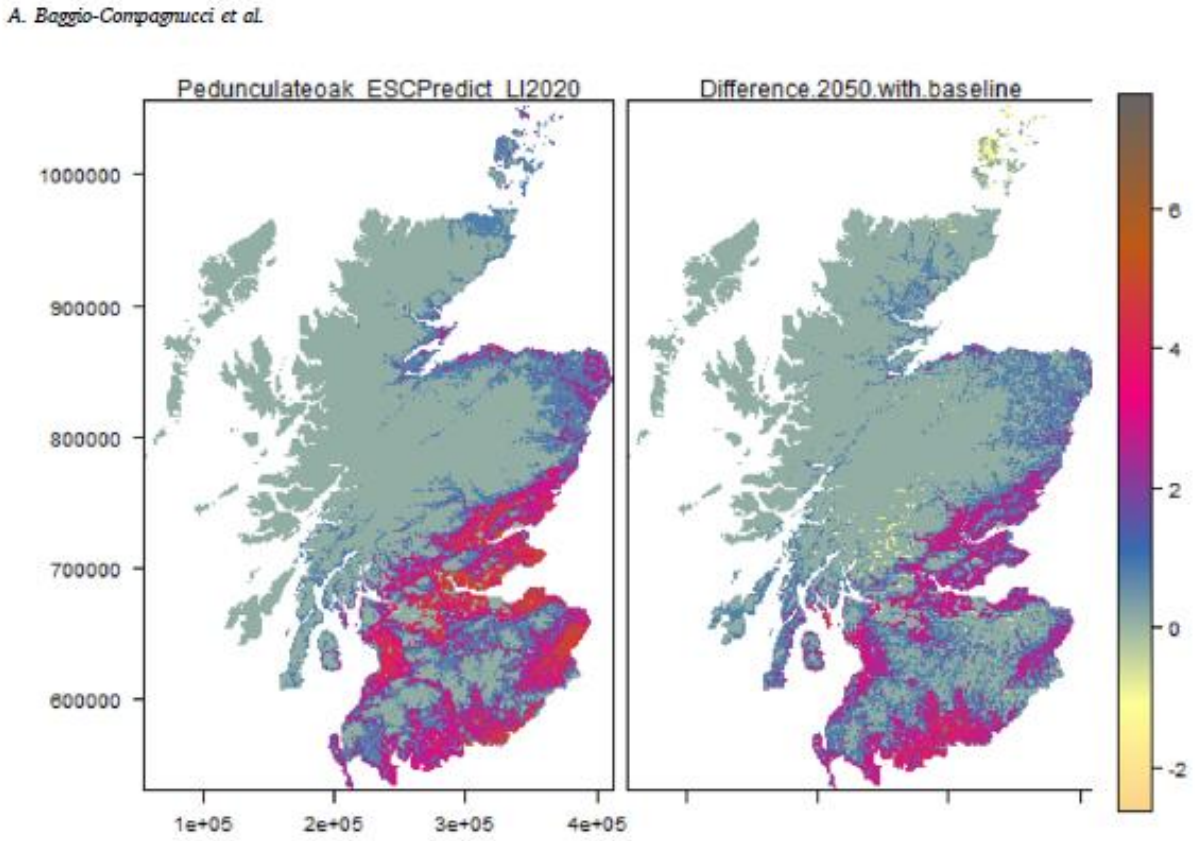
Net carbon sequestration and carbon balance

- Predicted yield class (timber growth / productivity potential) for 6 general type of species (Baggio-Compagnucci, et al. 2022) (expected changes in YC) (resolution 250 m x 250 m)

- Forest yield model production tables (Matthews et al. 2016) used to estimate timber growth exponential functions)* $v(t) = k(t \cdot YC)^{a} e^{-bt}$

- Carbon expansion factor (species-and UK specific) (tree biomass)*

- Soil carbon storage/release (soil debris/ground preparation and tree planting). Based on the Woodland carbon code estimates and guidelines (West 2011; 2018)



MATERIALS AND METHODS

Efficient decisions (only timber – livestock opportunity costs)

timber + carbon payment scenarios – livestock opportunity costs

$$NPV_{w+c} = \frac{(P_w v(T) e^{-rt} - C) + \int_0^T P_c \alpha\, v(t) e^{-rt} dt}{(1 - e^{-rT})}$$

C includes afforestation cost and the asset value of land opportunity costs (revenues forgone from livestock farming)

Efficient land use change decisions

$NPV_w > 0$ No additionality (not eligible for carbon finance)

$NPV_{w+c} > 0$ Woodland expansion is efficient through carbon finance

MATERIALS AND METHODS

Land use change decisions (maximizing benefits to land managers/owners)

Afforestation costs and land use change opportunity costs

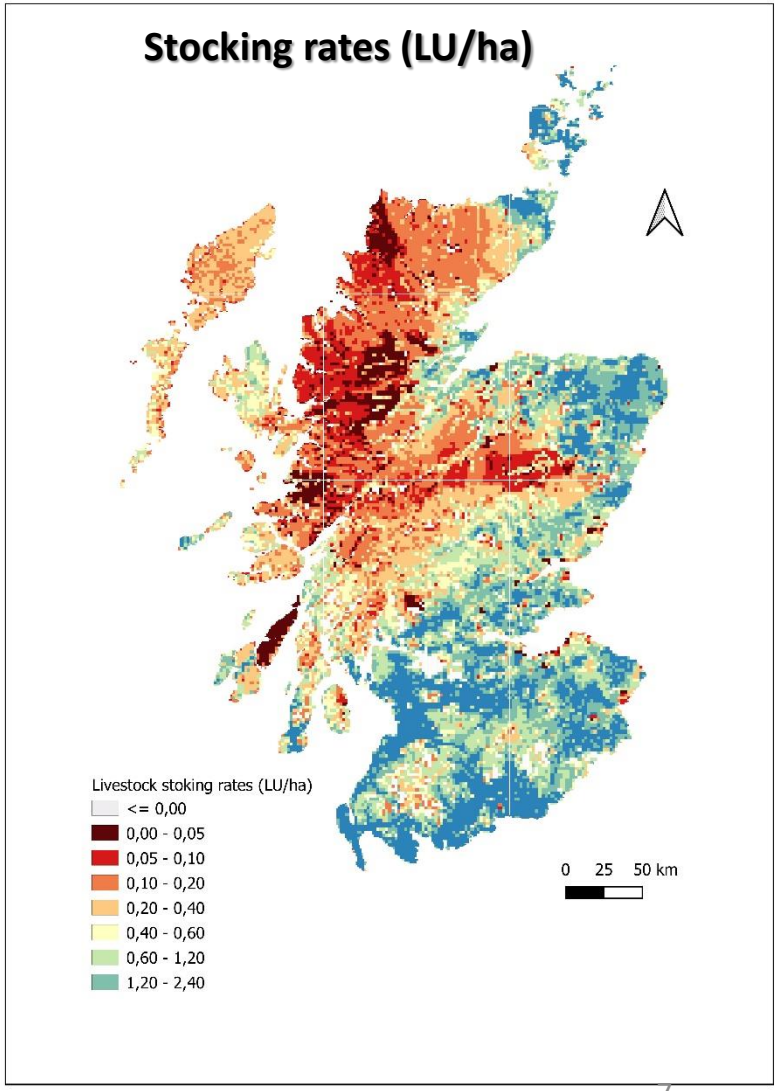
- *Estimated Farm Business income only for livestock enterprises: Total livestock output – total livestock costs + a share of subsidies and miscellaneous output and costs proportional to the direct production costs*.

- *Total breeders LU (total ewes + total suckle-cows + dairy cows + other cattle)*

Farm Income data (2009-2021)(£/female breeder LU, prices 2020)

	Specialist Sheep (LFA)	Specialist Beef (LFA)	Sheep and beef (LFA)	Lowland Cattle and Sheep	Dairy
Average	186,38	409,89	307,21	491,73	619,76
SD	34,61	59,49	37,42	135,79	193,60
LB IC95%	166,80	376,23	286,04	414,90	510,22
UB IC95%	205,96	443,55	328,38	568,56	729,30
MIN	-192,44	12,70	-9,74	-437,66	-205,29
MAX	835,22	881,32	659,03	1.423,04	1.334,77

Source: Scottish Government (various years). Farm Business incomes. Available online https://www.gov.scot/collections/scottish-farm-business-income-fbi-annual-estimates/)

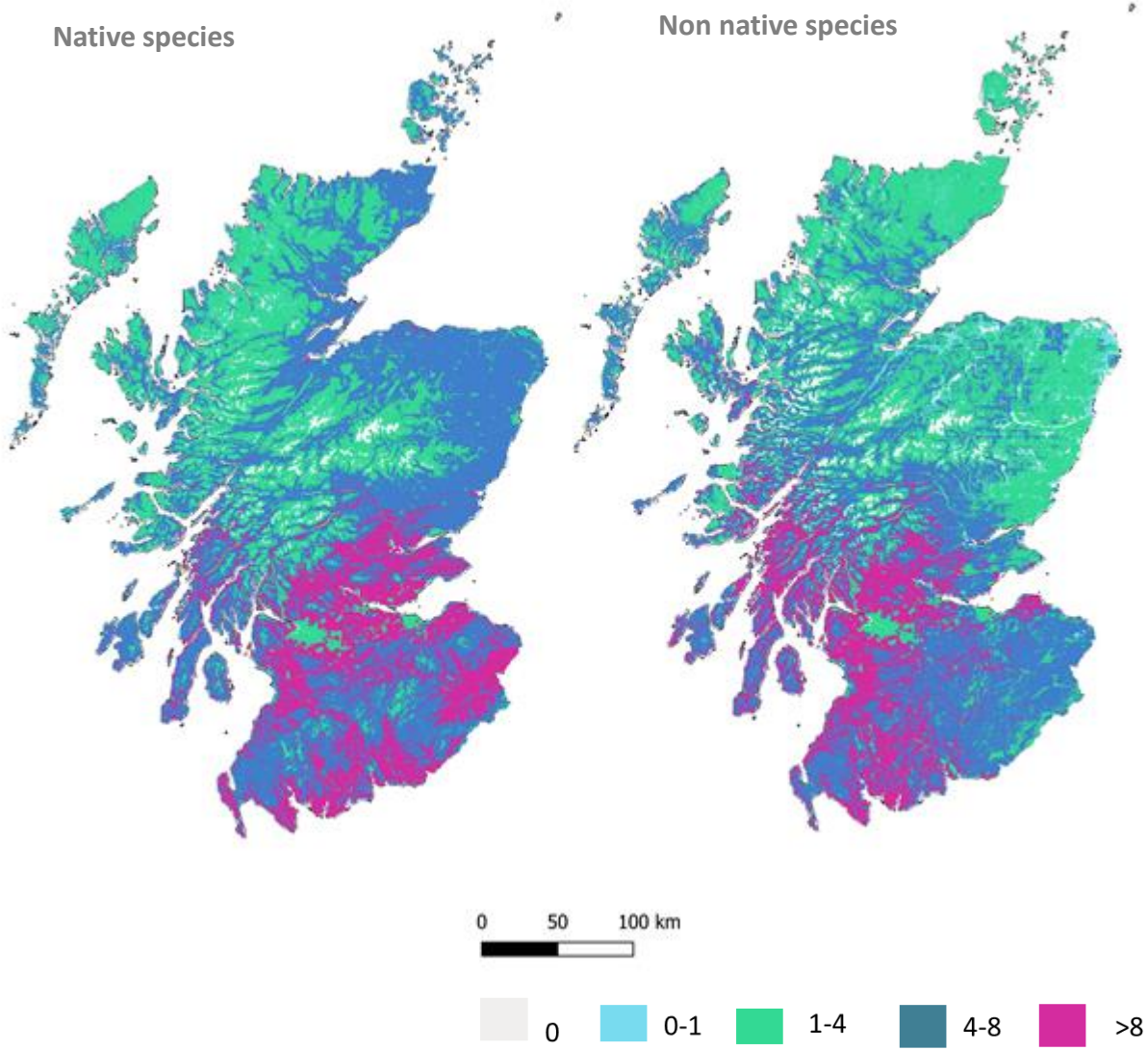


PRELIMINARY RESULTS: CO_2 SEQUESTRATION POTENTIAL

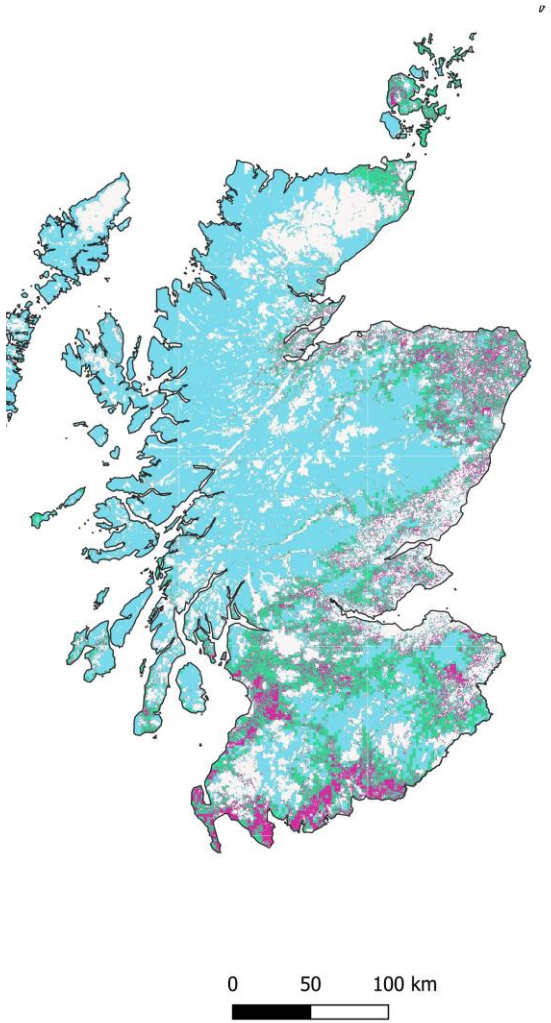
Carbon sequestration potential (average over 50 years, in tCO_2/ha and year)

Native species

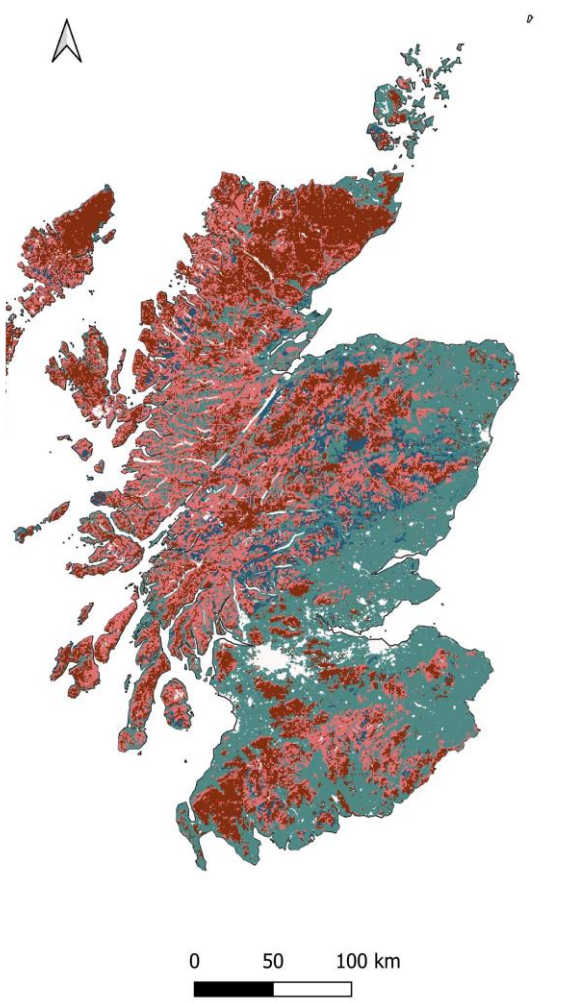
Non native species



Livestock emission (in tCO_2/ha, by 2015)



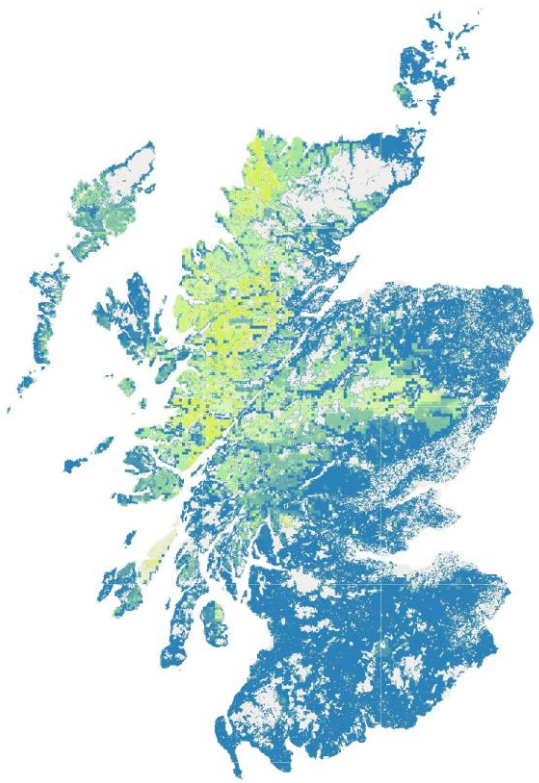
Soil typology



PRELIMINARY RESULTS: Net present values (£/ha)

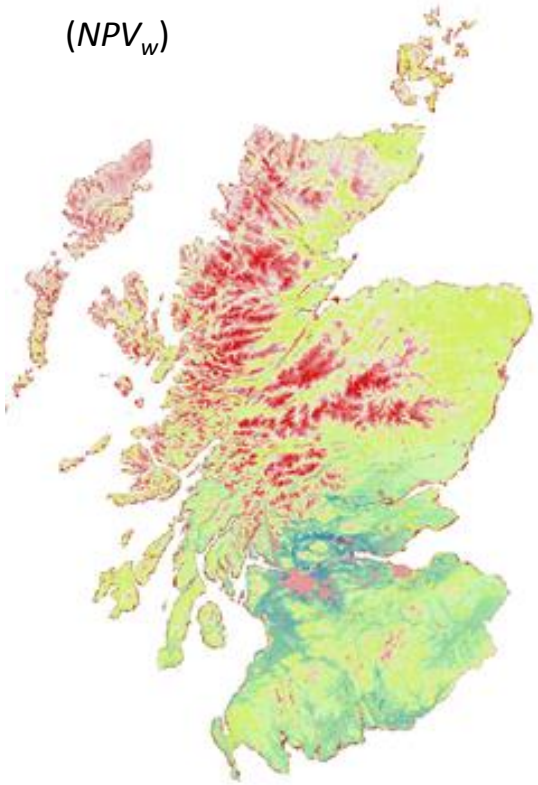
Net present values including afforestation revenues from timber and carbon minus afforestation and management cost and the asset value of livestock opportunity costs

NPV Opportunity Costs



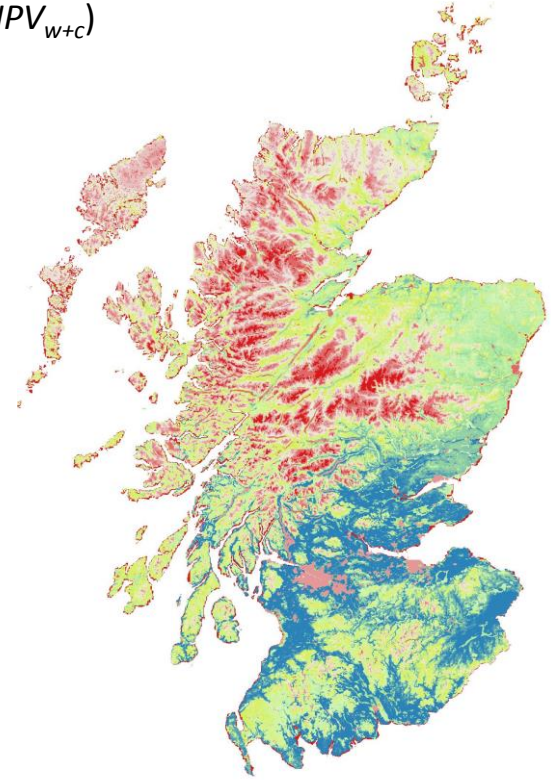
No carbon payment

(NPV_w)



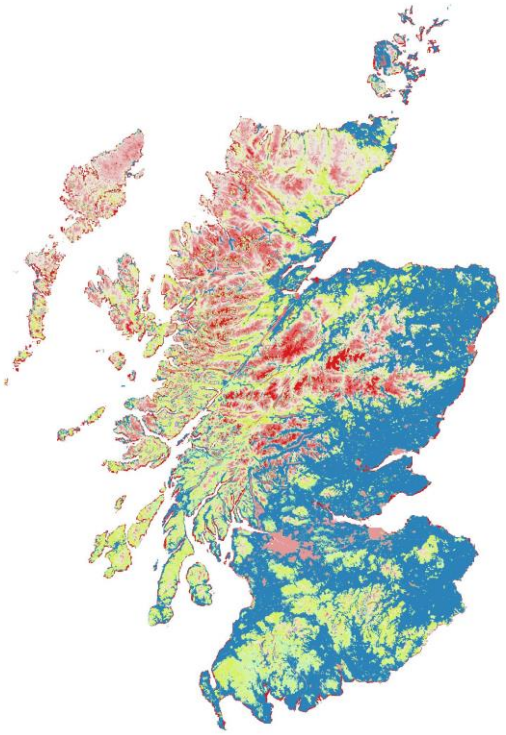
Carbon payment £ 25/ t CO_2

(NPV_{w+c})



Carbon payment £ 100/ t CO_2

(NPV_{w+c})



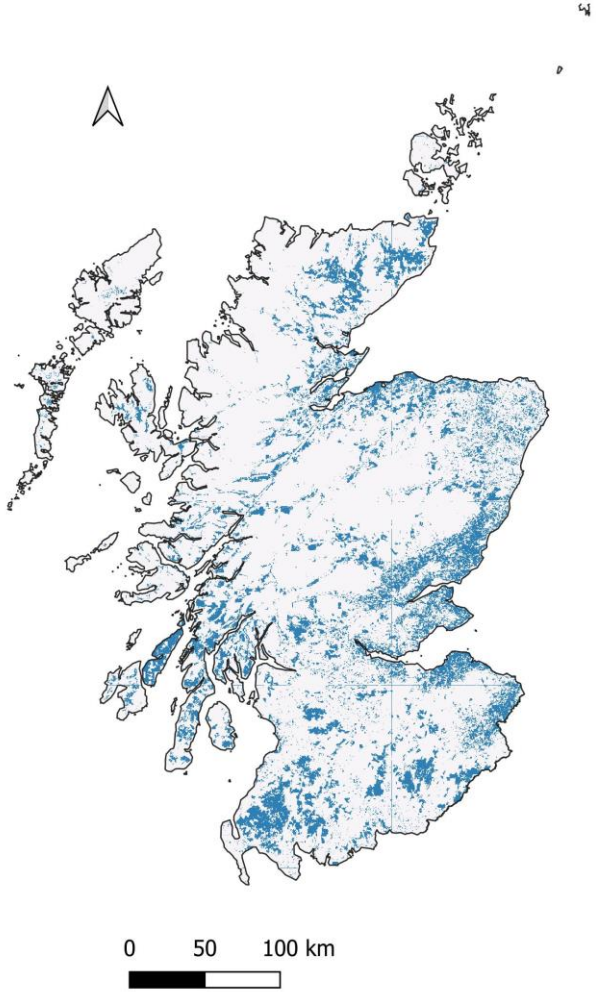
NPV(£/ha): < 0 | 0 | 1-50 | 51-100 | 101-250 | >250

**Discount rate 3%, considering a time horizon of 50 years. Potential carbon taxes to livestock emissions not integrated*

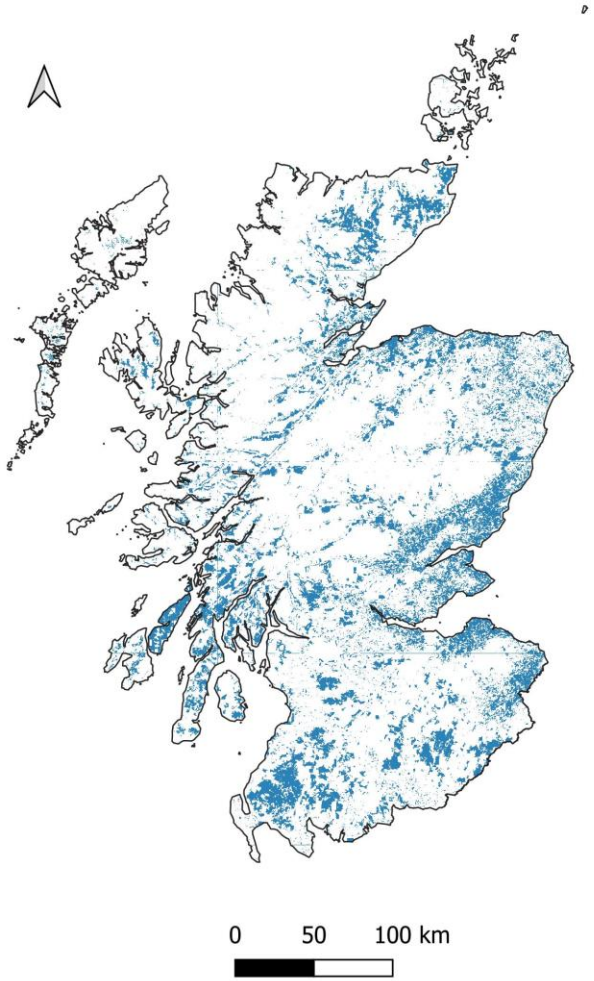
PRELIMINARY RESULTS: Potential woodland expansion

Species that maximise the net present discounted values over a 50-years time horizon*

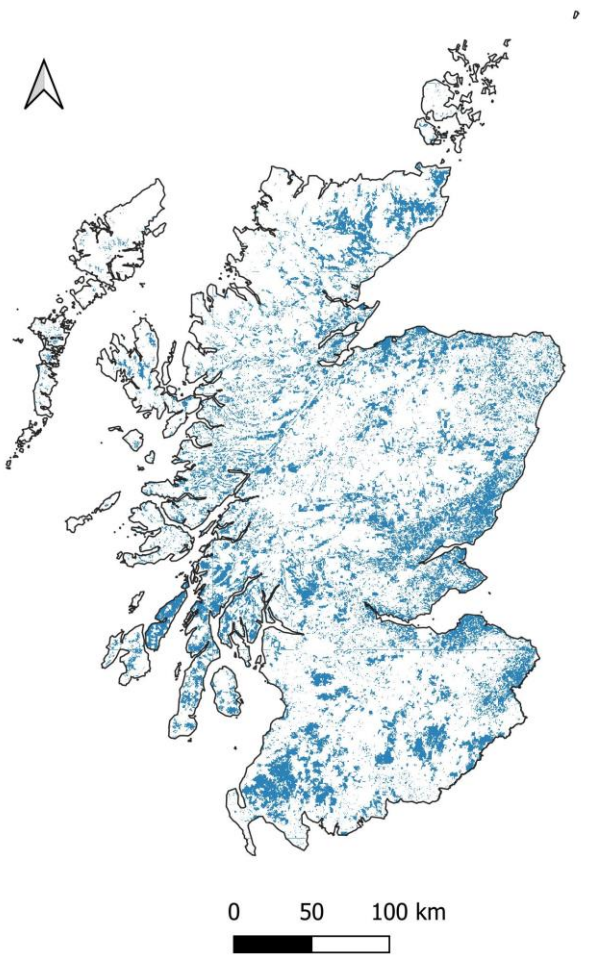
No carbon payment (17%)



Carbon payment £ 25/ t CO_2 (18%)



Carbon payment £ 100/ t CO_2 (21%)



Potential woodland expansion ($NPV_{w+c} > 0$)

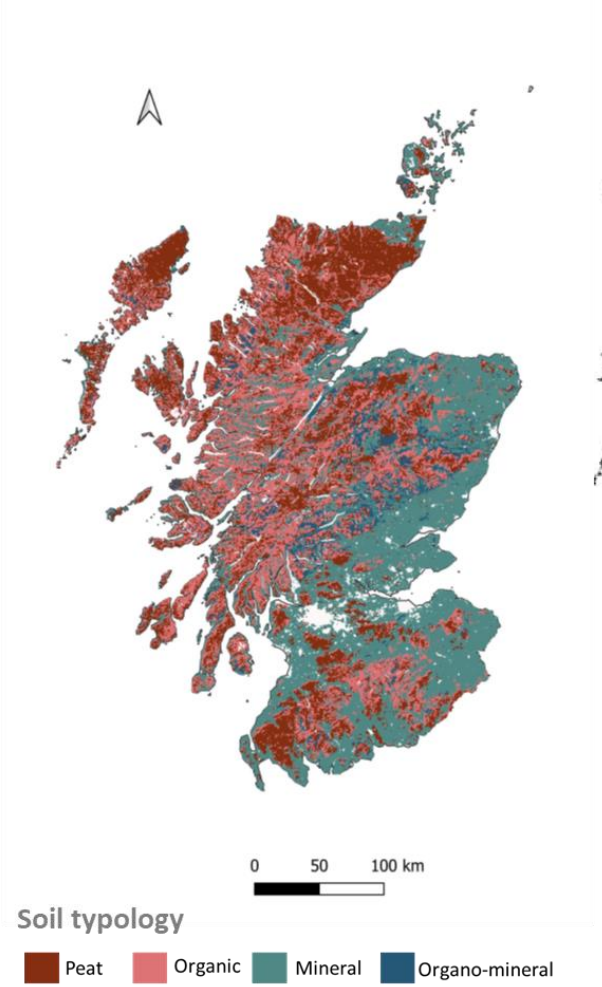
*Discount rate 3%. Potential carbon taxes to livestock emissions not integrated

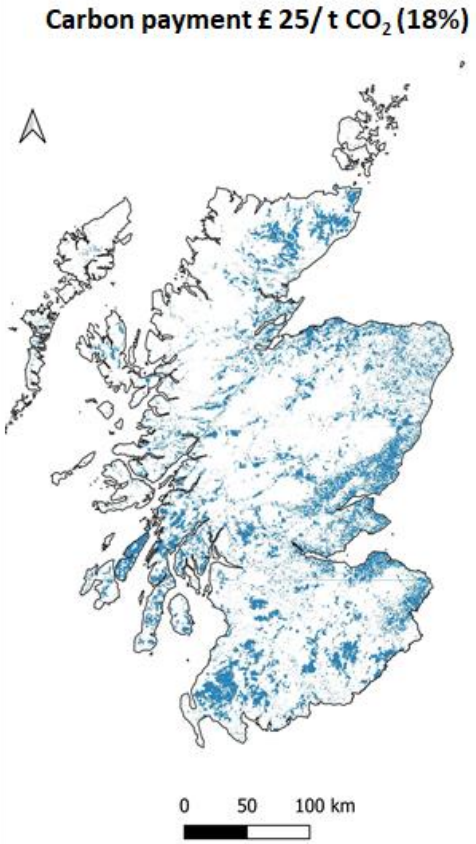
SOME (PRELIMINARY) REFLEXION

C sequestration potential much lower when:

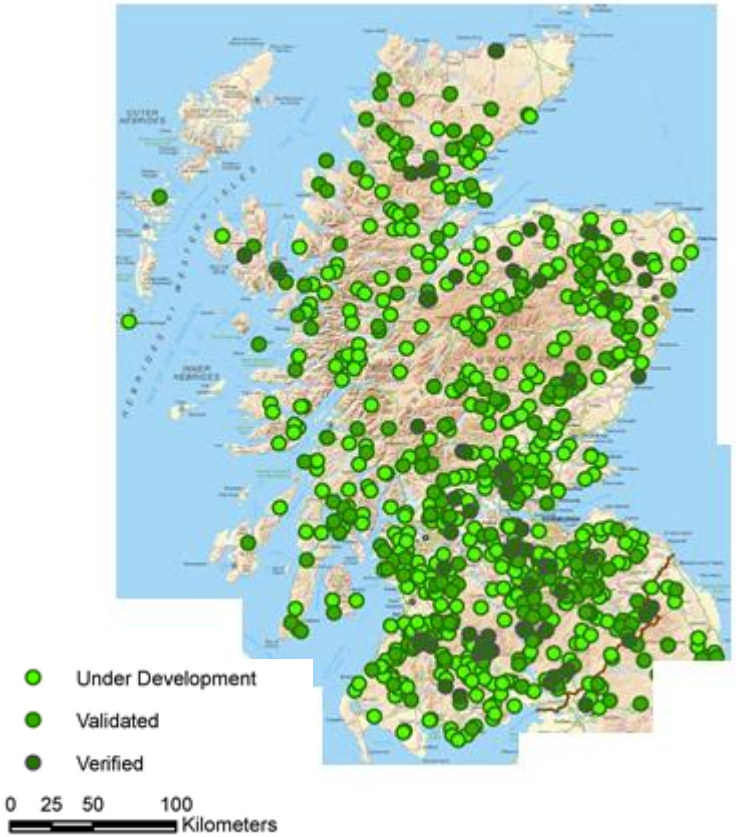
(1) Soil restrictions (peat & organic): true additionality

(2) The opportunity cost are integrated (land managers perspective)





BUT….



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RESEARCH LINE ON "FOREST CARBON"

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Funding entities:

MINISTERIO DE CIENCIA E INNOVACIÓN

Financiado por la Unión Europea NextGenerationEU

Plan de Recuperación, Transformación y Resiliencia

AGENCIA ESTATAL DE INVESTIGACIÓN

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