Forest Research

PROVISIONAL RESULTS- subject to QA

Comparing Land Use Options: Wind, solar or forests?

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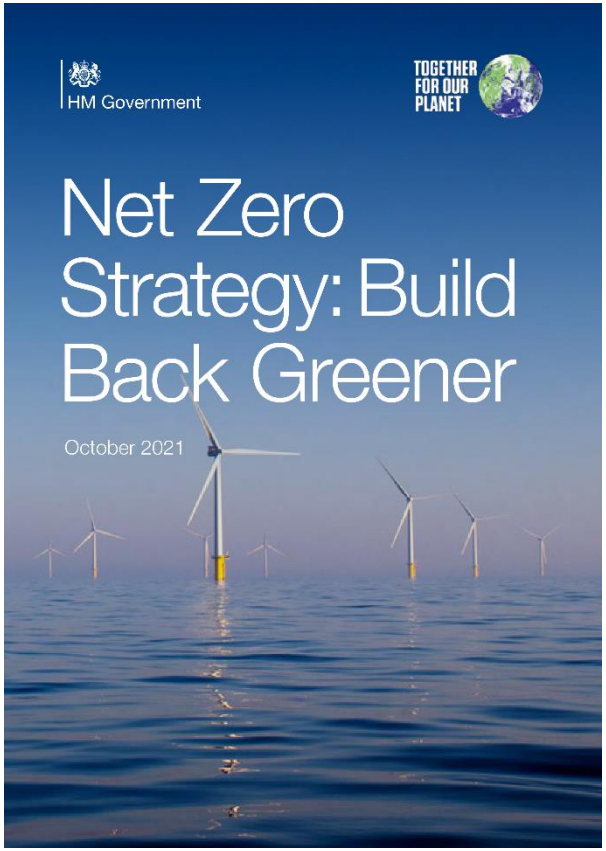

An Action Plan to decarbonise the energy system by 2030

27-29 GW of onshore wind

45-47 GW of solar power

Greenhouse gas removal ambition

5 Mt by 2030

Target to increase land-based carbon sequestration

Restore ~280,000 ha of peat in England by 2050

Treble woodland creation rates in England

All this requires land

How can we use LCA to inform land use policies in the context of net zero?

Forest Research

How can we compare different land use types?

POWER

WOOD PRODUCTS

BIOMASS FUEL for power or power BECCS

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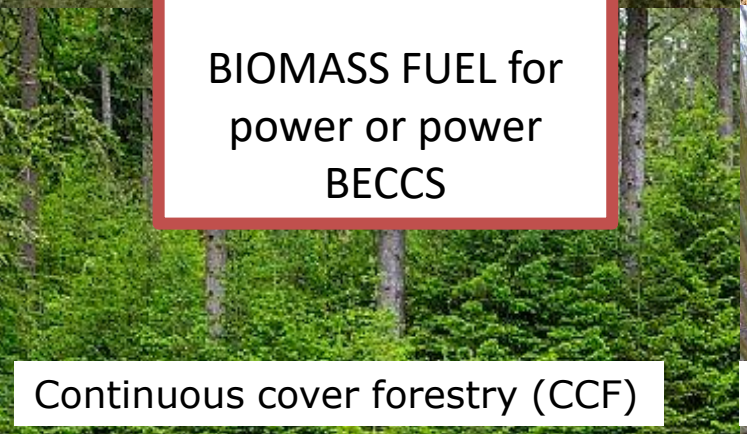
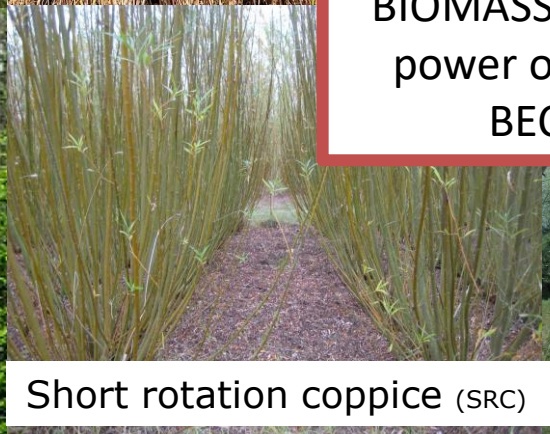
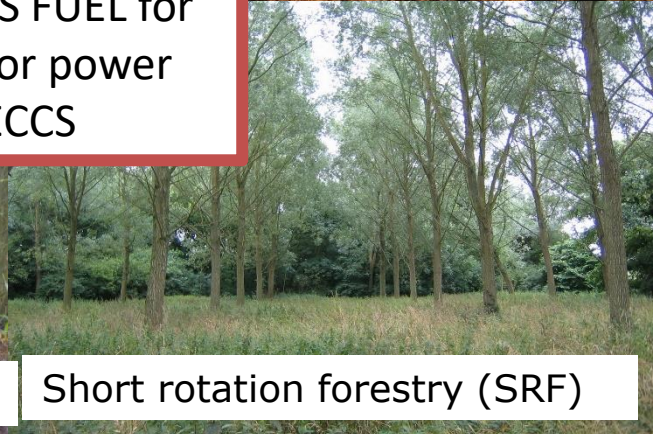
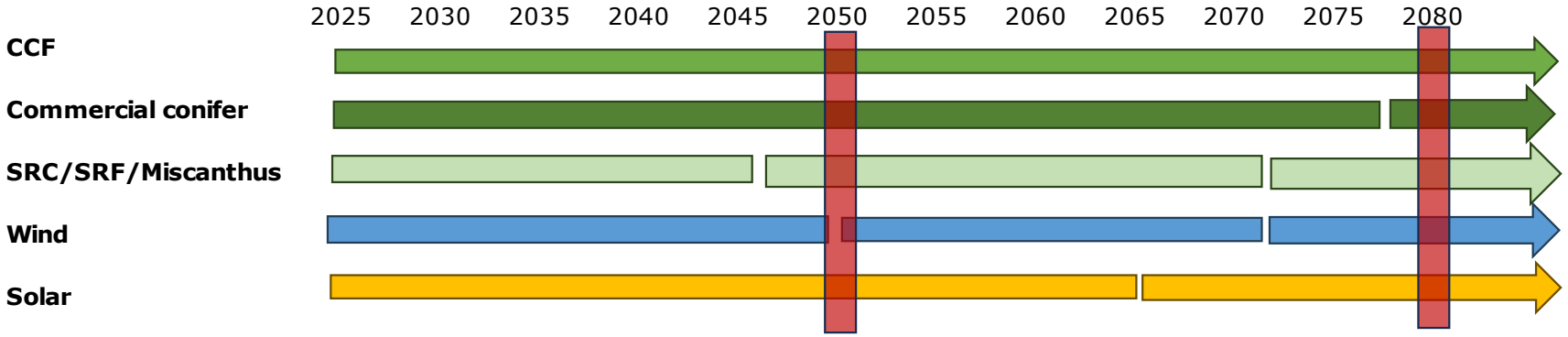




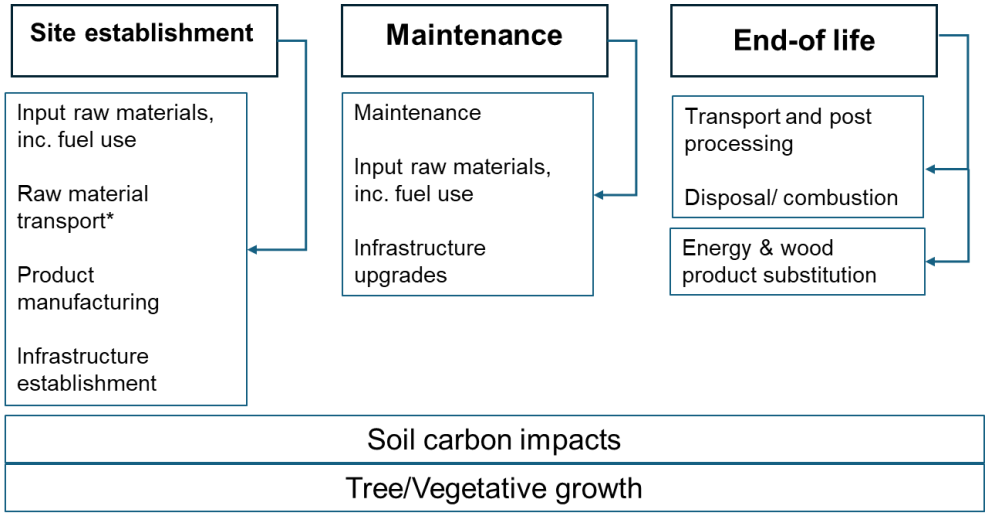


Research question

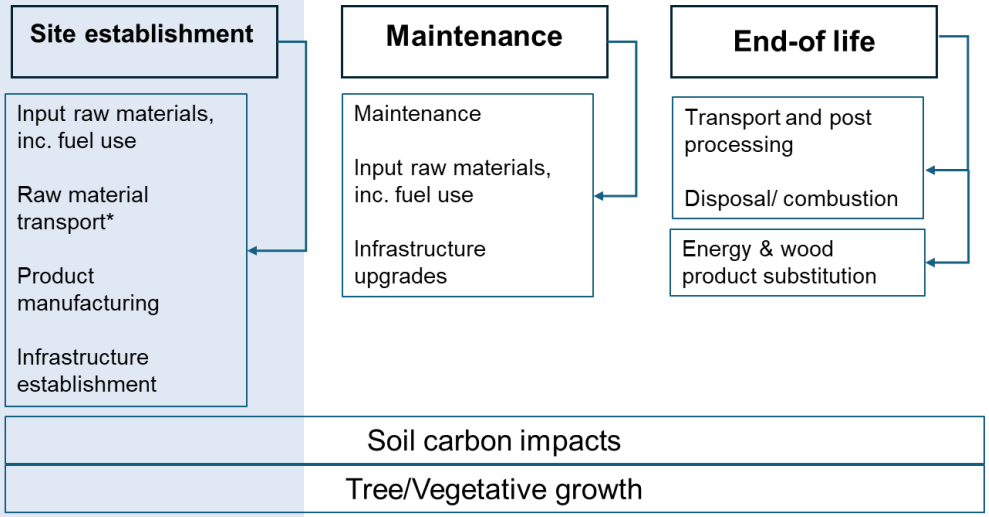
1. How can **GHG balances for different LUC options** be calculated consistently?
2. If an area is converted in 2025 - What is the **net GHG balance in 2050 and 2080?**
3. How do **GHG balances of LUC options vary** with geographical location, site characteristics, and climatic conditions?



LCA System Boundaries: Harmonised

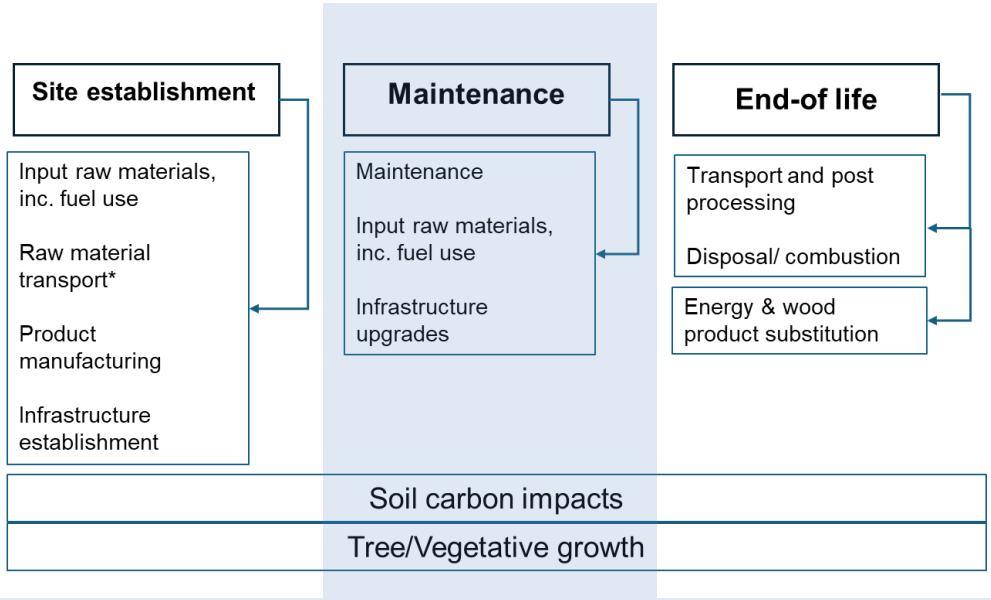


LCA System Boundaries: Harmonised



- Fuel combustion
- Material manufacture & delivery
- Soil carbon losses

LCA System Boundaries: Harmonised

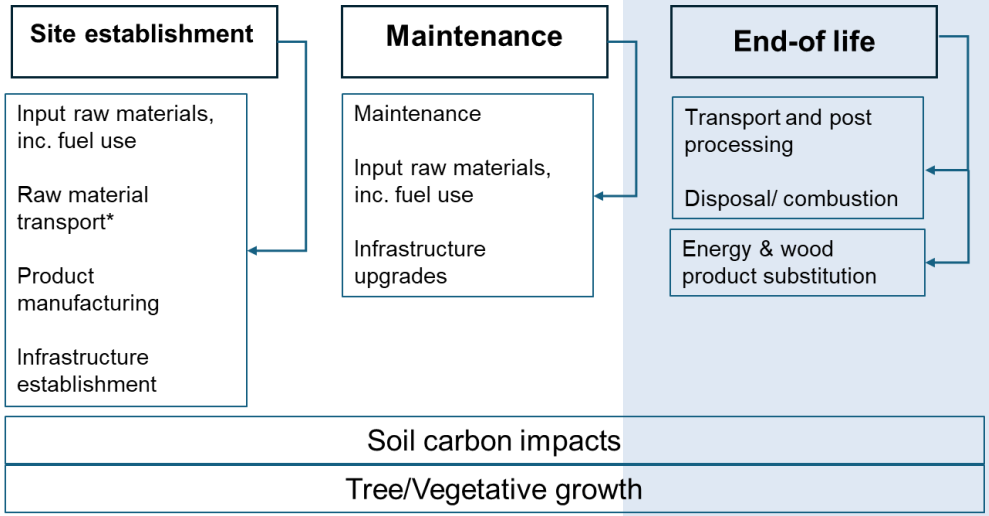


- Soil carbon losses through disturbance
- Fuel combustion
- Material consumption

- Tree & vegetation growth
- C Storage in wood products
- C storage in soil
- (C storage in BECCS)

Carbon avoided
Avoided electricity or wood products

LCA System Boundaries: Harmonised



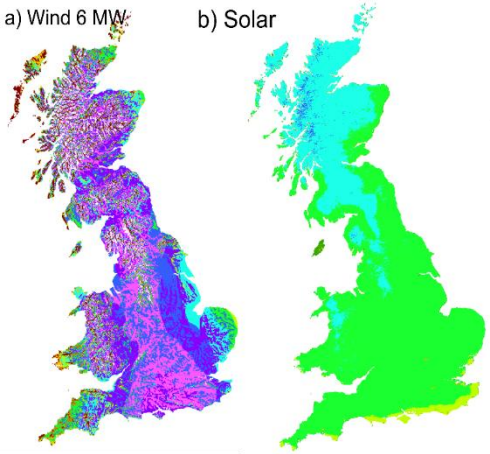
- Fuel combustion
- (Biomass delivery)
- Soil carbon losses
- Waste disposal
- Vegetation loss

Carbon avoided
Avoided electricity or wood products

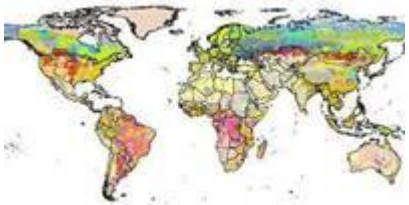
C Storage in wood products & soil (& BECCS)

How do GHG balances of LUC options vary with geographical location, site characteristics, and climatic conditions?

Energy generation potential

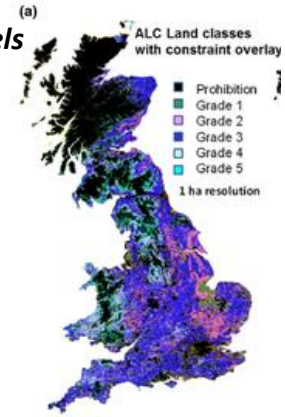


Harmonised world soil database

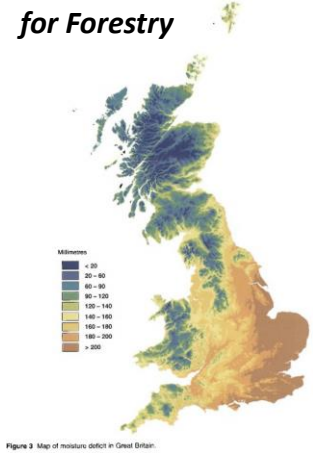


"Map by Vemaps.com"

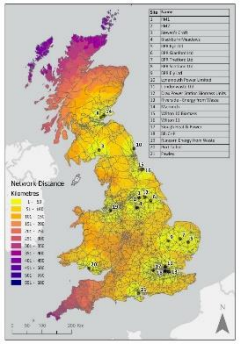
Energy crop growth models



Ecological Site Classification for Forestry



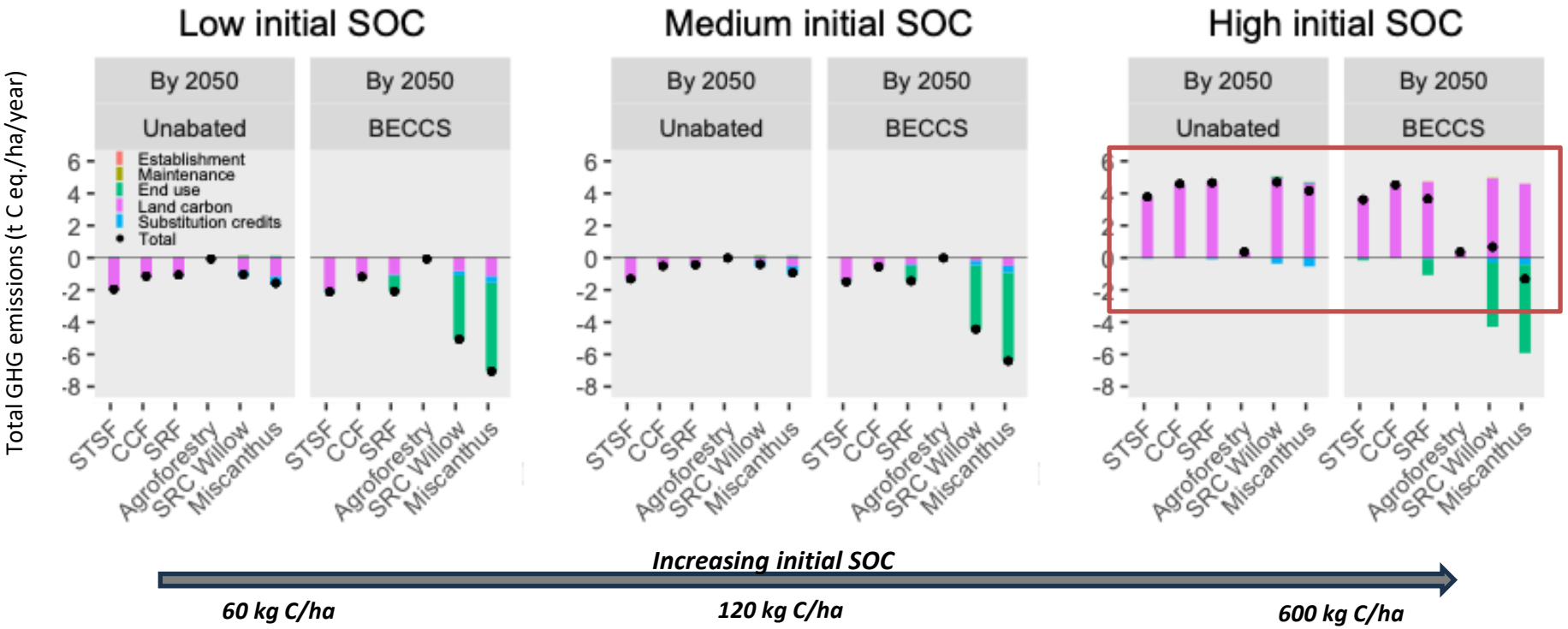
Transport distances to nearest biomass plant



RESULTS

Afforestation can remove carbon in the land use sector **in 2050 timescales,** but this is **highly sensitive to initial soil organic carbon content**

- Avoid high carbon soils



The GHG balance of afforestation is sensitive to:

Tree growth rate

- Faster growing conifers give best outcome

Management

- Rotation forestry gives faster "carbon returns" than CCF

Rotation length

- Longer rotations have longer to build up tree and soil carbon

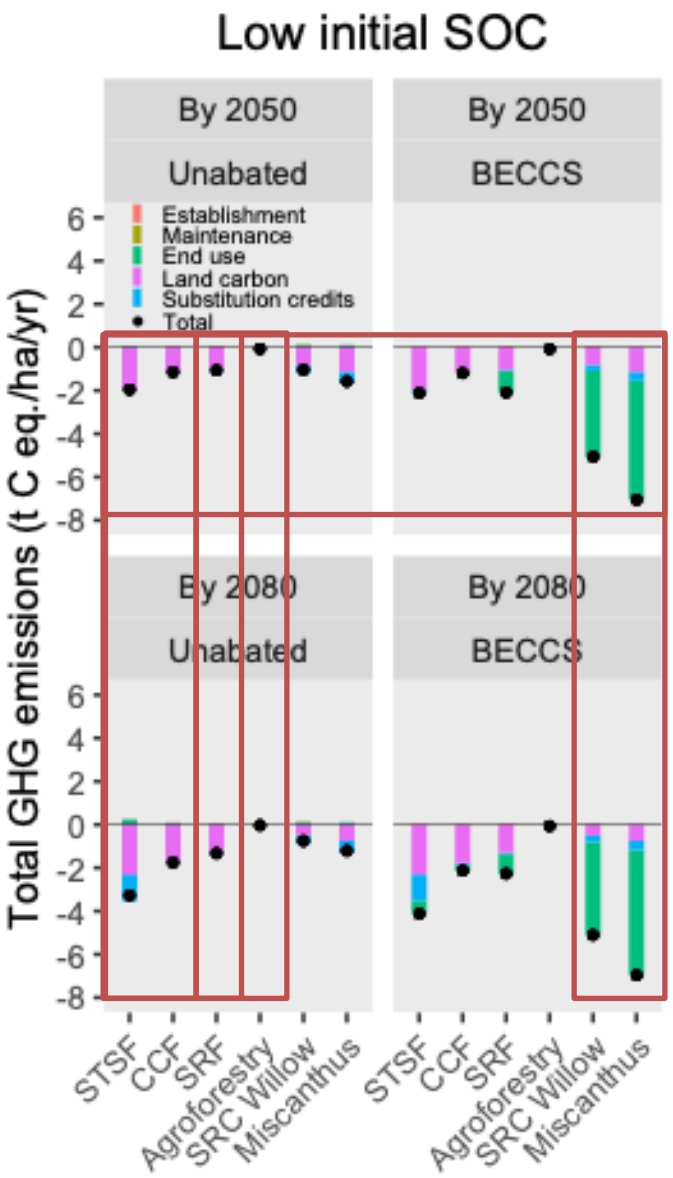
Tree stocking density

- Higher densities give greater carbon sequestration

Biomass end use

- BECCS can deliver carbon removal

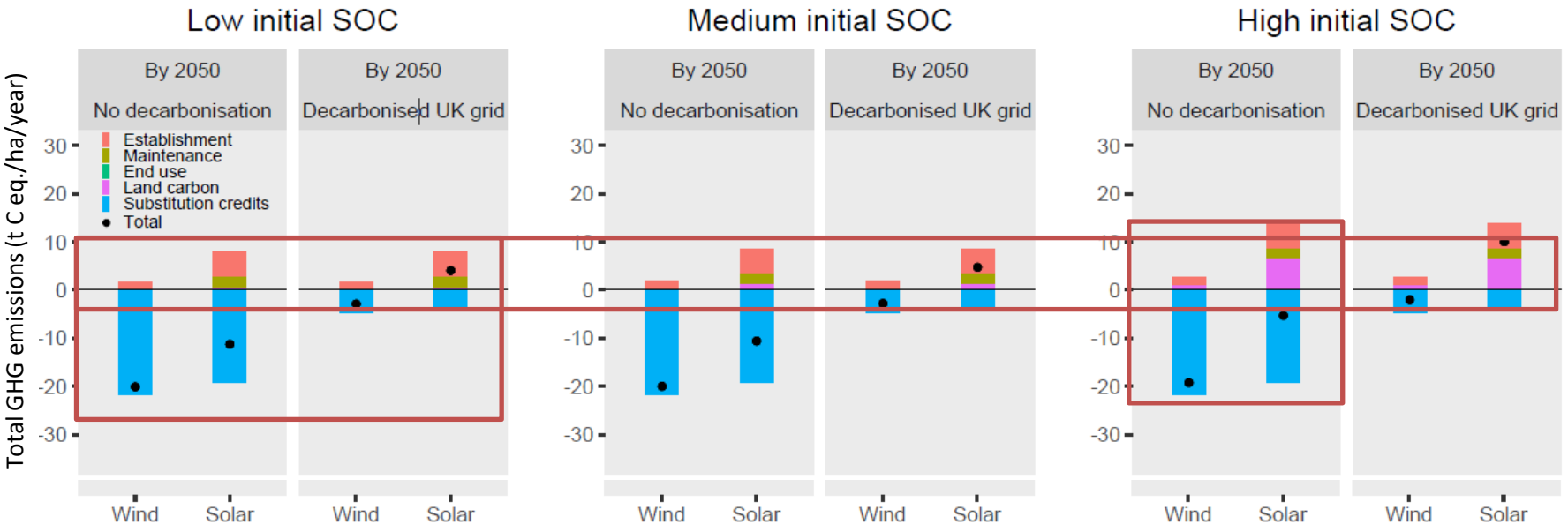
GHG emissions from establishment and maintenance negligible



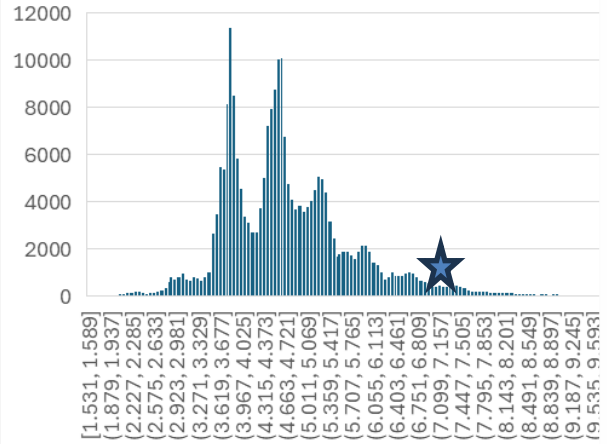
The supply chain emissions are relatively large- from the perspective of the land sector they only emit carbon: Solar loses more SOC than wind due to shading of panels (though this is based on modelled impacts- not observed in literature).

GHG balance of wind and solar can be negative if system boundaries include <u>avoided emissions:</u> But this is highly sensitive to the substitution credit assumed- will decrease as the grid decarbonises.

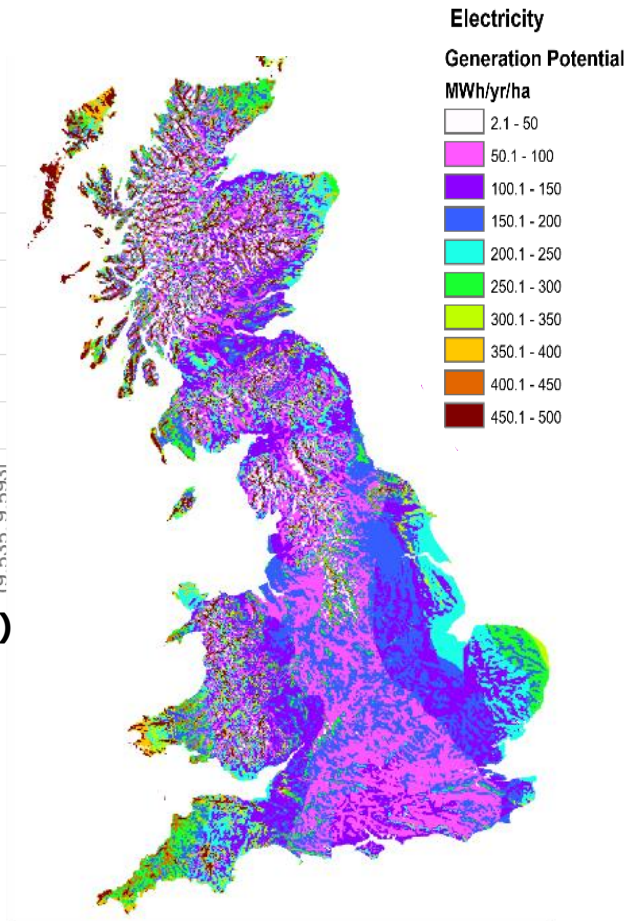
…. But does this show wind turbines on peat can lead to savings?
2 Factors affect this: wind speed and SOC change



Case study vs. geographical variation



Average wind speed at 10 (m/s)



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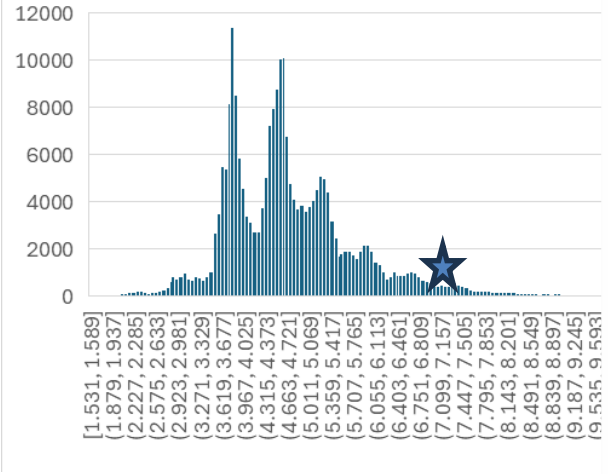
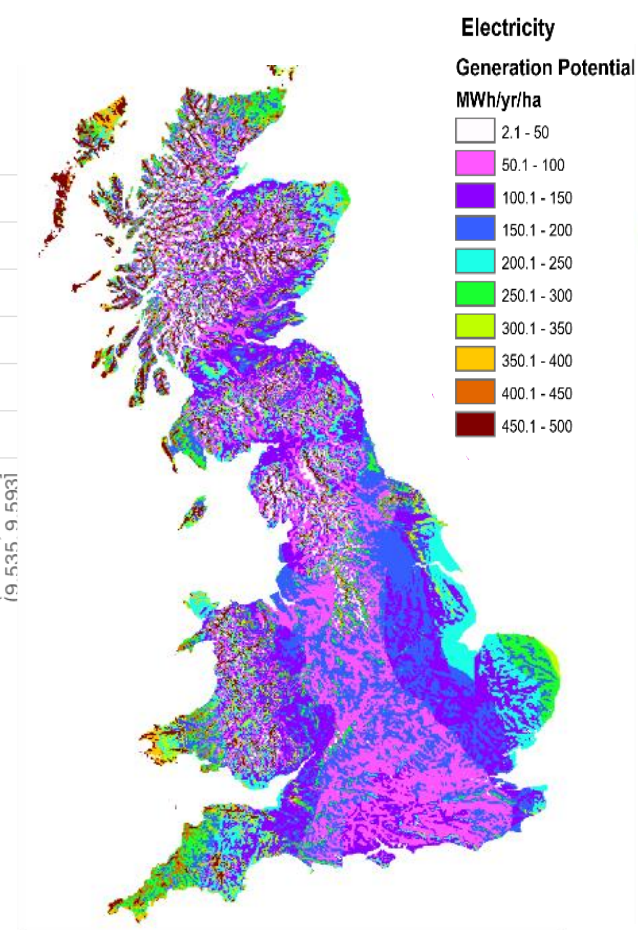
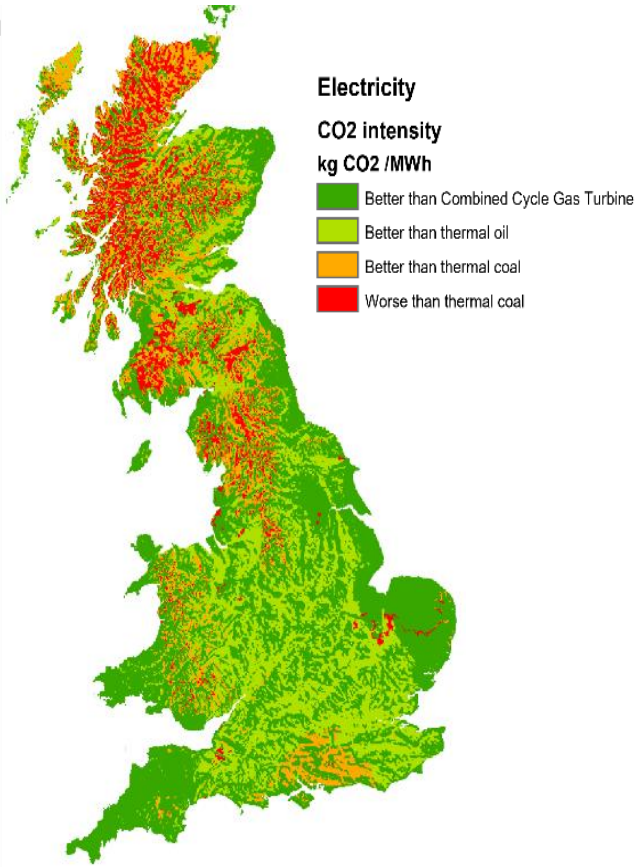
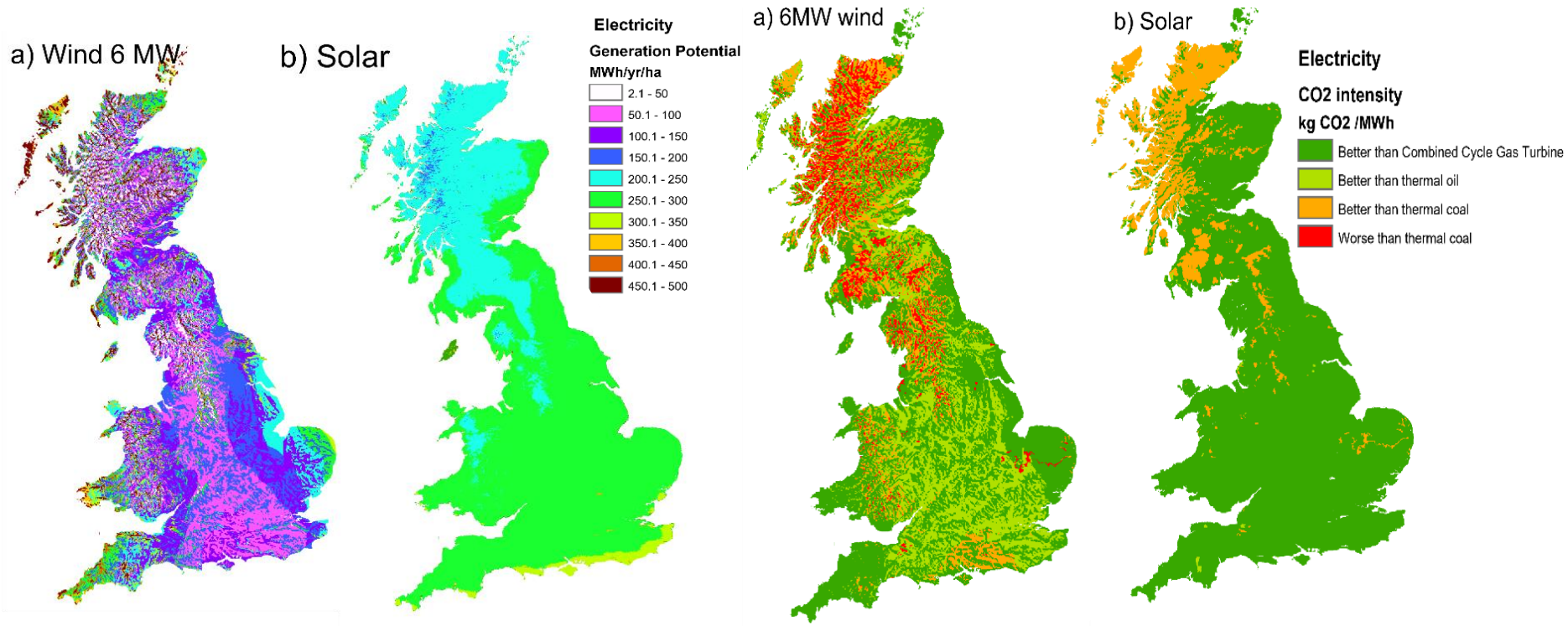






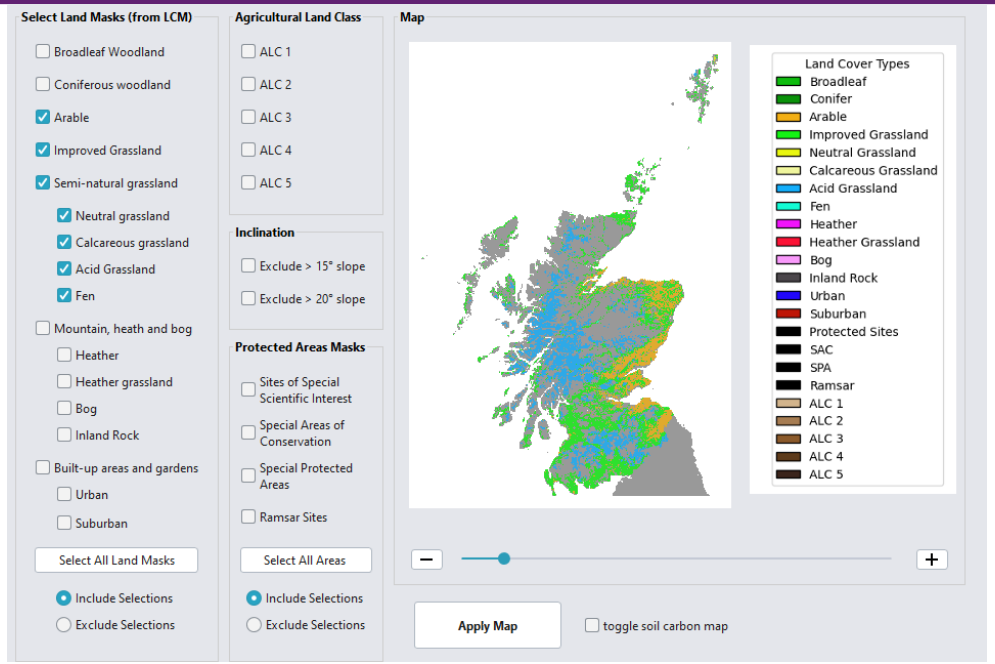
Overall GHG impacts are balance between SOC changes and generation potential.

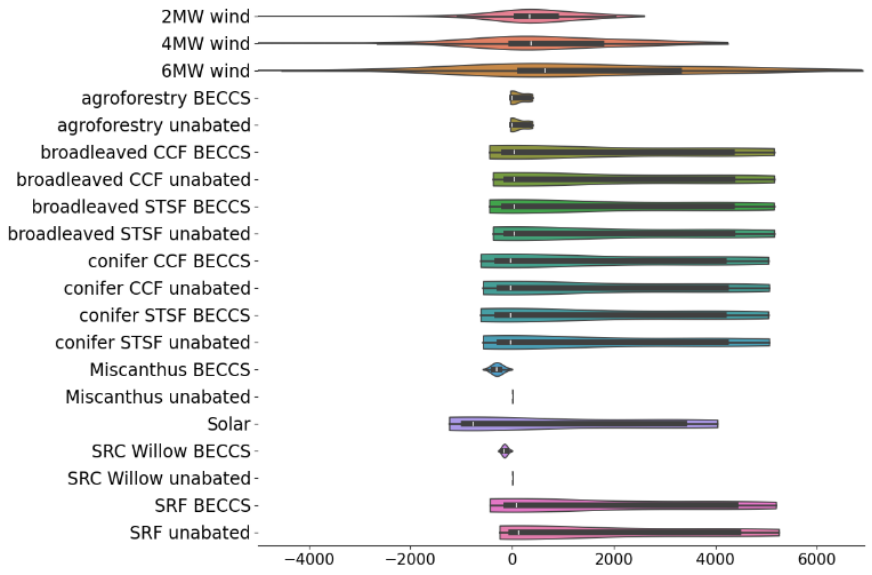


Results indicate that solar is less sensitive to location.

LUNA Tool

- To illustrate the impacts of each LUC across GB, the Land Use Net-Zero Advisor (**LUNA**) software tool was developed.
- Provides downloadable data and shows violin graphs to directly compare range of impacts for a given area.
  - Changes in **land-sector carbon**
  - Changes across **whole system** (LCA)
  - **Energy generation** potential
- Can apply land masks to block out certain land types (e.g. agricultural land types)
- Defra EVID report will contain transparent LCA data
- **<u>Not sure where LUNA will be hosted</u>**





e.g. Wales

Main conclusions and policy implications

- There is a need for consideration of cross-sector benefits when designing government policy, particularly energy and land use policy and Net Zero policies.
- **Any conversion of peatland should be avoided-** any GHG "benefit" seen in in land use change on high carbon soils is sensitive to model assumptions.
- There is a difficult circular argument regarding the GHG benefits of renewables- they are needed to decarbonise the electricity grid, but their benefit diminishes over time- therefore life cycle assessment studies that include **substitution benefits** should be transparent about methodology and assumptions made to determine those benefits.
- **Land carbon impacts** from renewables can be significant if not sited appropriately can have a greater carbon intensity compared to some fossil fuels.
- **Afforestation** can lead to carbon sequestration in the land sector, but it takes a long time, and the fastest return is probably not the type of forestry that meets other objectives such as biodiversity.
- **Energy crops** for power does not make sense, but for power BECCS they could provide valuable carbon removal.

Thank you

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