Net-zero Agriculture & Land Use by 2050

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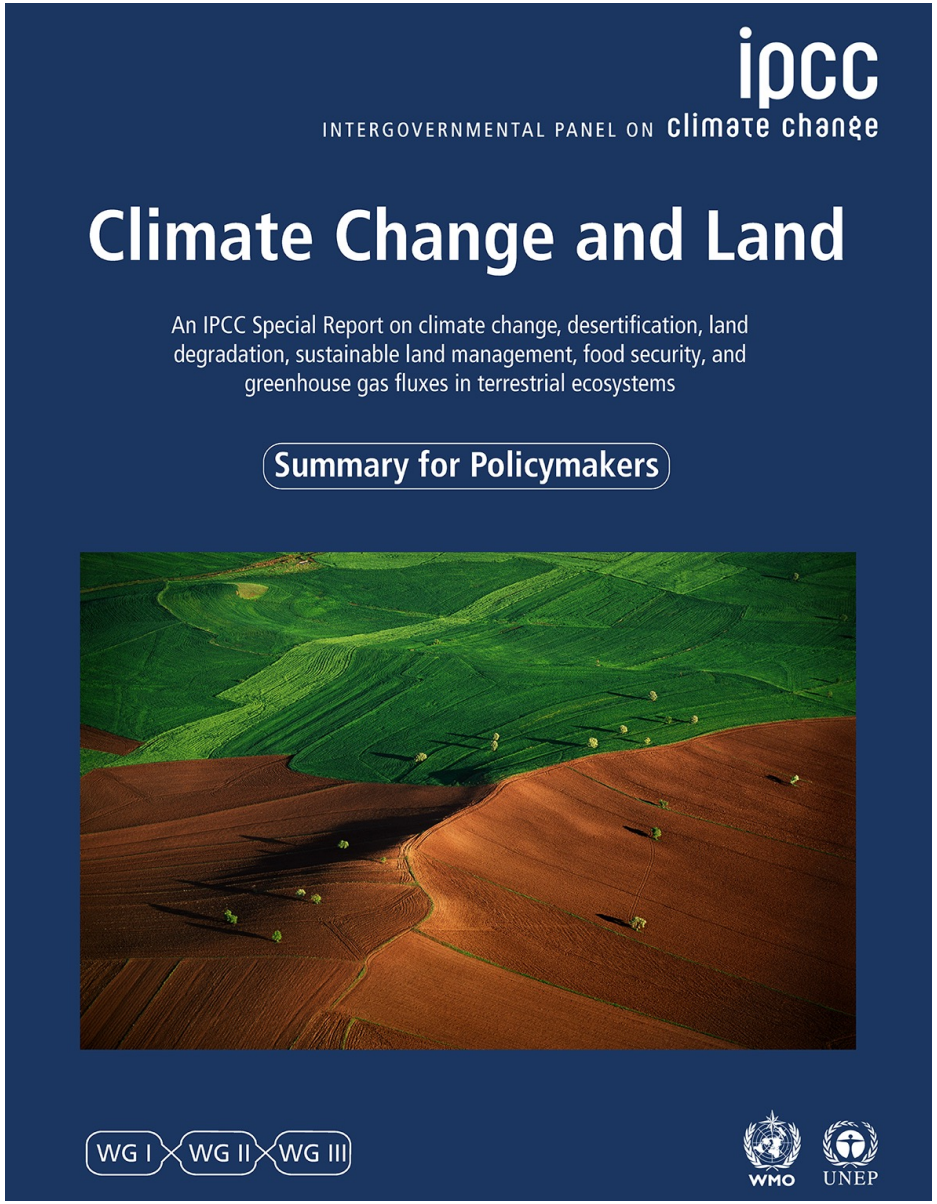

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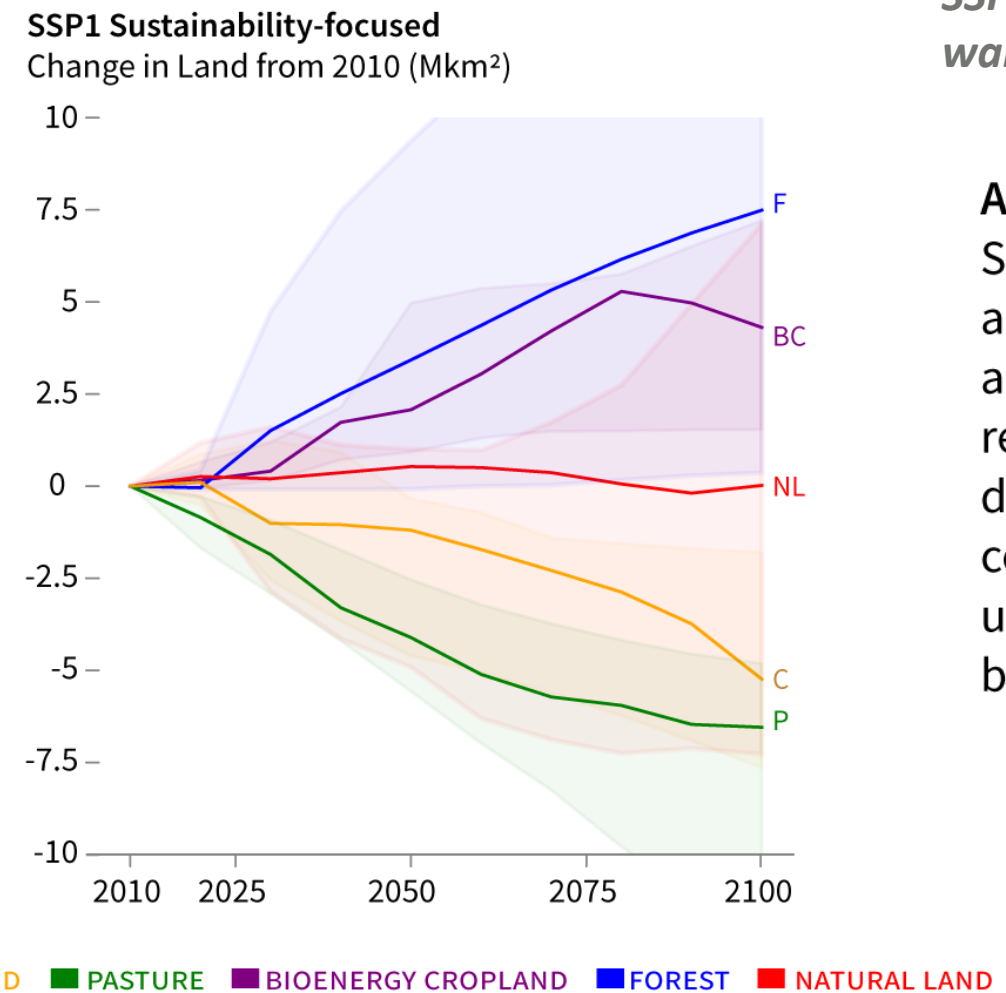
Pathways linking socioeconomic development, mitigation responses and land



SSP1 – under an RCP1.9 scenario ~ limiting warming to 1.5°C globally [Figure SPM.4A]

A. Sustainability-focused (SSP1)
Sustainability in land management, agricultural intensification, production and consumption patterns result in reduced need for agricultural land, despite increases in per capita food consumption. This land can instead be used for reforestation, afforestation, and bioenergy.

The Challenge: Net-zero Agriculture and Land Use in Ireland by 2050

Land Cover Ireland (2018)

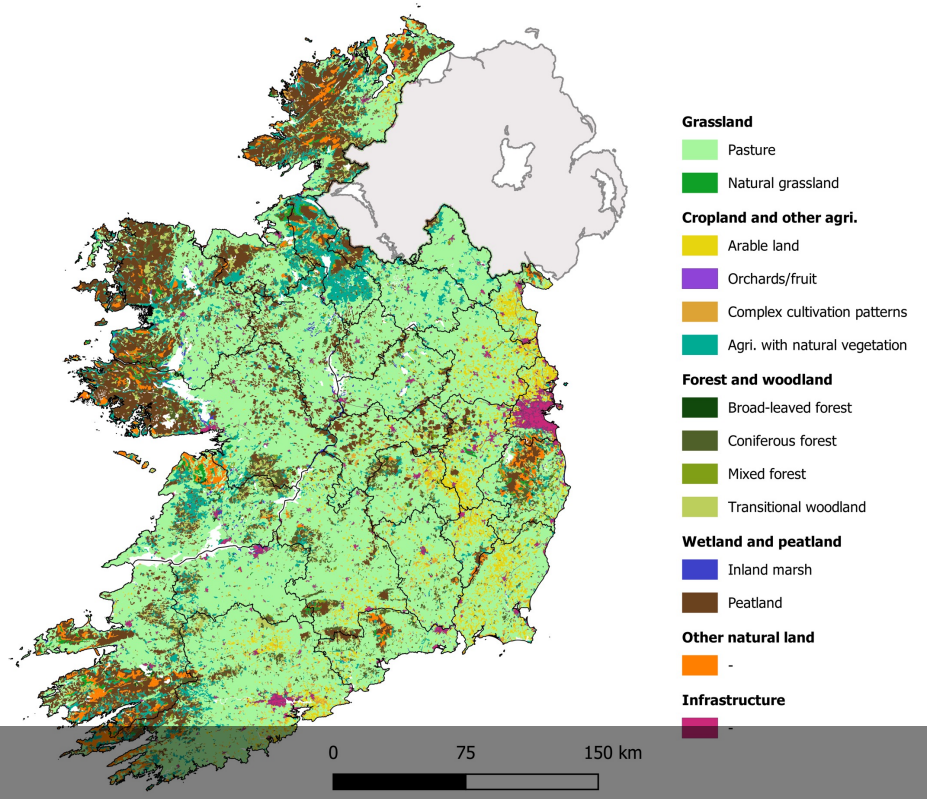


Figure 1.3, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

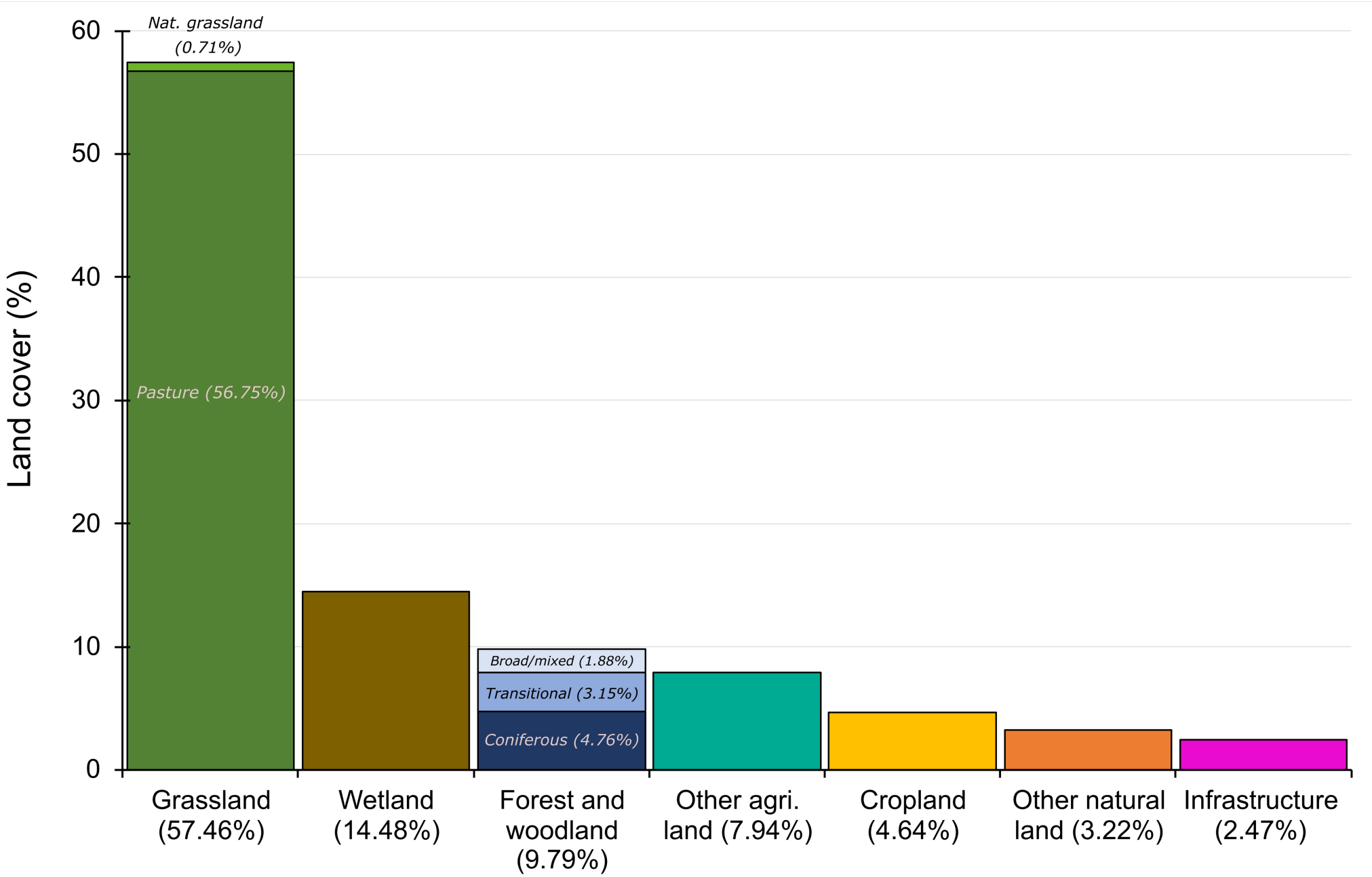


Figure 1.4, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

GHG Fluxes Agriculture Forestry and Other Land Use (AFOLU)

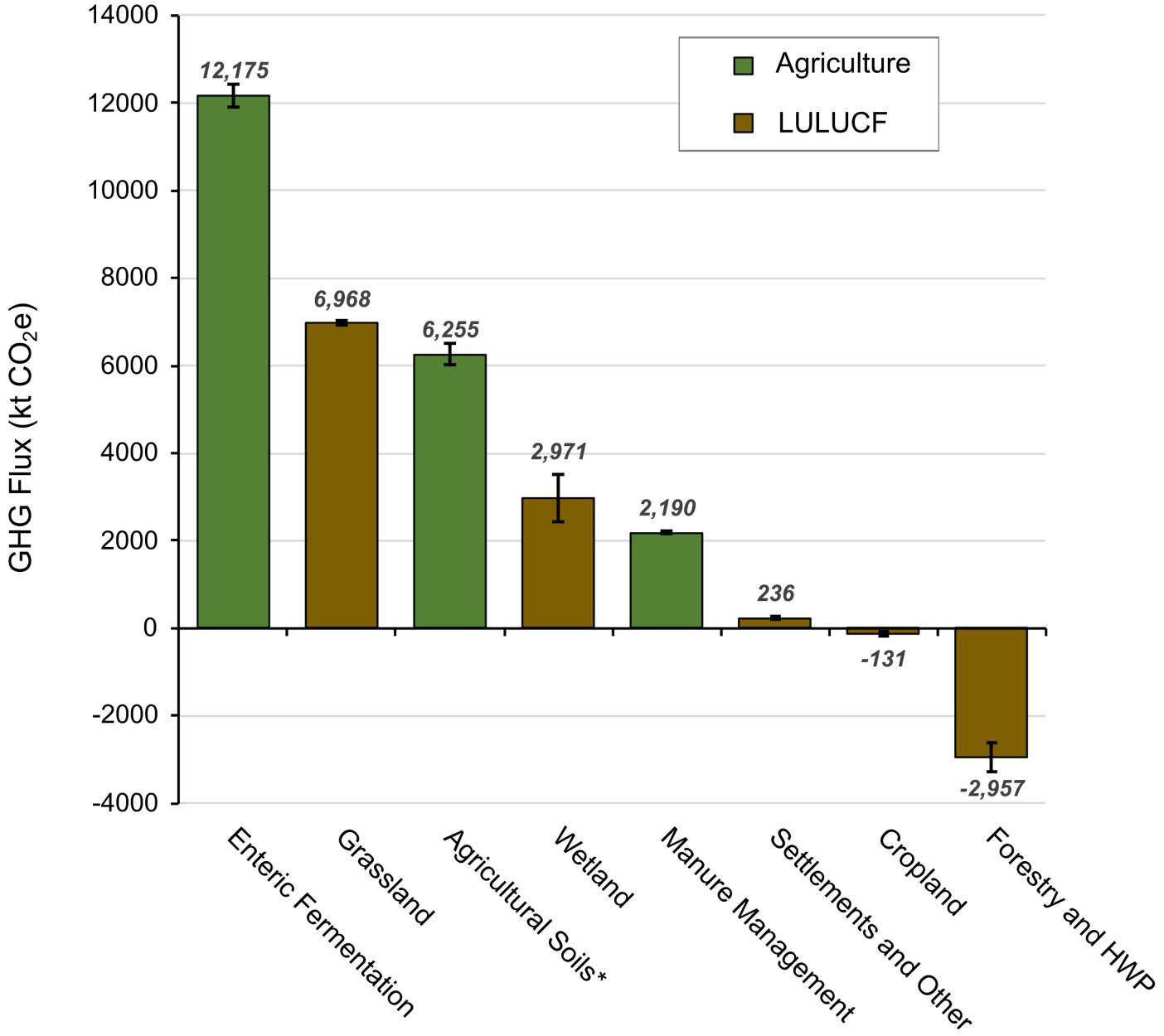


Figure 2.2, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

Net-Zero AFOLU by 2050: Scenarios

- Simplified land use change scenarios (see Duffy et al 2022)
- **S1 – afforestation** (up to 875,000 ha of new forest by 2050 considered)
- **S2 – peatland restoration** (degraded raised bogs, organic soils, up to 90% by 2050 considered under grassland)
- **S3 – agriculture optimisation** (a 30% increase in production efficiency and a 30% livestock reduction by 2050 considered)
- **S4 – various combinations** of S1, S2, S3
- **S5, S6, S7 – additional scenarios** with more room for nature, bioenergy production, cropland

Chapter 4, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

Net-Zero AFOLU Challenge: Outcomes

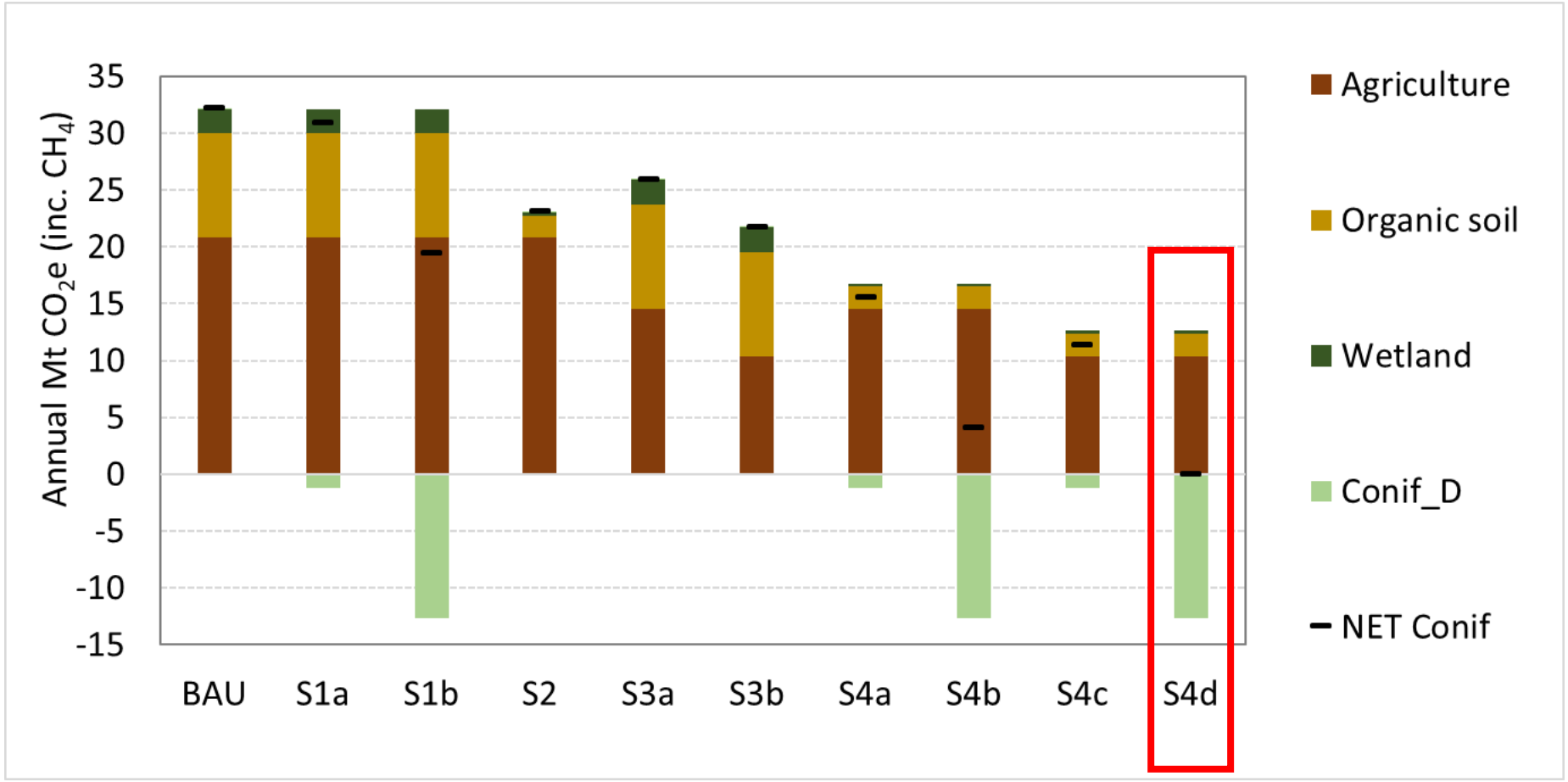
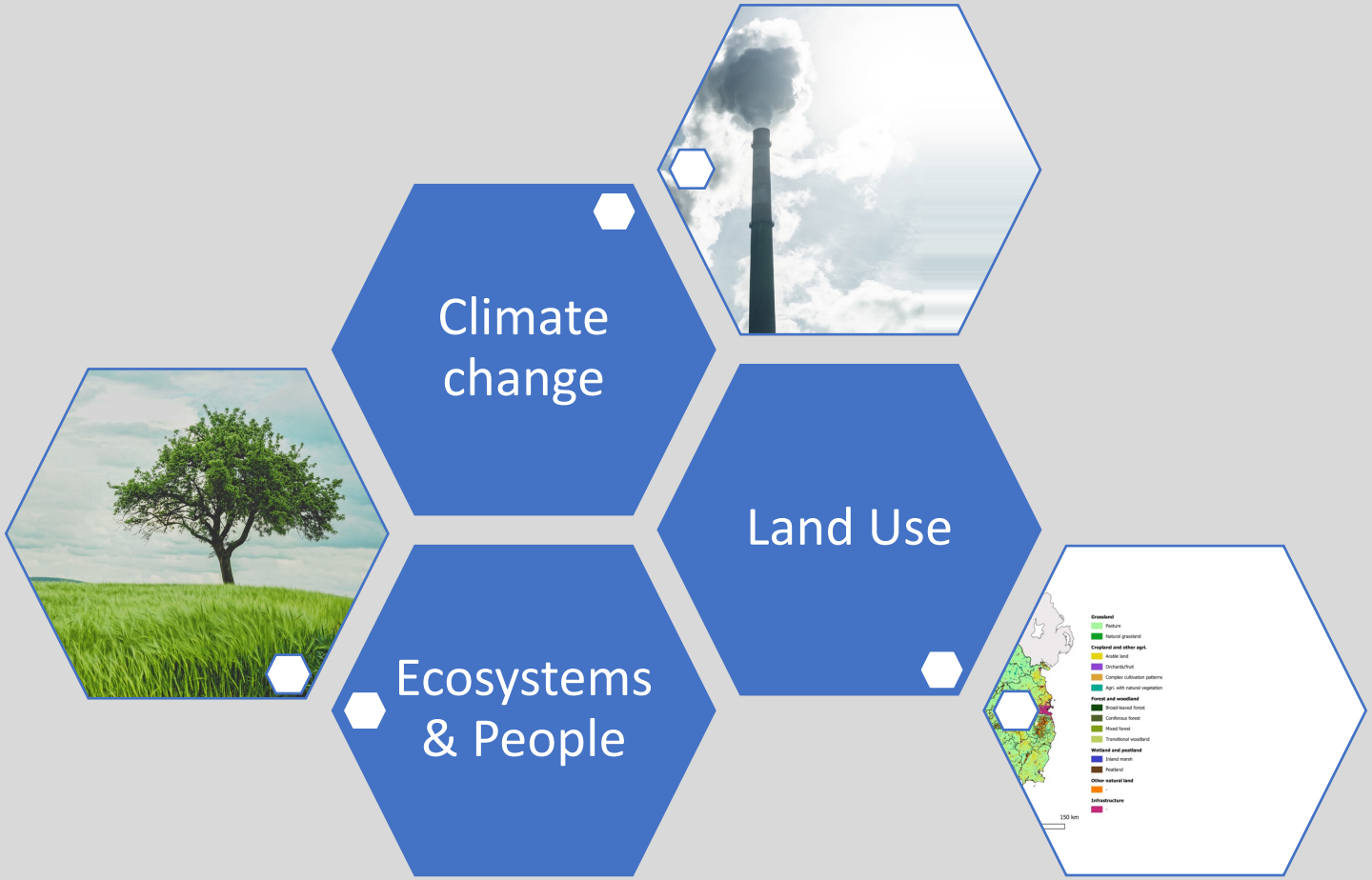


Figure 4.1, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

Only the combination of ambitious afforestation + peatland restoration + agri. optimisation = reached net zero

Synergies, trade-offs and the need for an integrated approach



Assessment of synergies and trade-offs

- Most land use changes have the potential for synergistic impacts depending on scale and implementation
- But – some have the potential to impact negatively on biodiversity and water quality
- Actions need to be targeted and matched to the lands capacity
- **No analysis of socioeconomic impacts included in this science focused evidence review**

Table indicator notes

Indicator	Description
+++	Large positive – synergy
++	Moderate positive – synergy
+	Small positive – synergy
=	Neutral or low confidence in direction
−	Small negative – trade-off
−−	Moderate negative
−−−	Large negative
±	Variable – may be positive or negative

Land use change	Mitigation	Adaptation	Biodiversity	Water quality
Afforestation				
Conifer dominated	+++	±	±	±
Broadleaf dominated	++	++	++	+
Agriculture optimisation				
Increased production efficiency	++	++	=	++
Increased livestock density on grasslands	=	−	−	−−
Decreased livestock density on grasslands	=	±	±	+
Peatland restoration				
Exploited peatlands	+++	+++	+++	+++
Organic soils under grasslands	+++	++	++	++
Additional land options				
Space for nature (S5)	++	++	+++	+++
Bioenergy from grasslands (S6)	++	±	±	±
Additional croplands (S7)	−−	++	±	±

Table 5.2, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

Uneven Spread of Land Cover

- **Especially for forestry, wetland, and areas of high nature value**
- **Potential for very uneven distribution of land use change related impacts**

Table 1.1. Regional breakdown of land cover categories as a proportion (%) of the total area of each category (using the NUTS3 classification)

Category	Regional distribution of land cover categories (%)							Category total area ('000 ha)
	Border	Mid-east and Dublin	Midlands	Mid-west	South-east	South-west	West	
Infrastructure	9.1	40.9	6.7	10.8	9.7	14.1	8.7	168.7
Croplands	1.3	40.5	8	6.3	30.1	13.4	0.4	320.2
Other agricultural land	32.6	6	5.6	12	4.8	17.7	21.3	544.8
Grasslands	12.8	10.8	11.5	18	12.4	17.3	17.2	3942.1
Forest and woodland	17.1	9	9.9	17.9	9	18.6	18.5	672.2
Other natural land	23.8	11.3	0.3	9.2	4.6	32.1	18.7	217.4
Wetlands (including peatlands)	25.7	3.5	6.7	5.5	1.4	17.4	39.8	992.7

Table 1.1, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

Farm-level Socioeconomic Data – Complex Picture

Type of farm	Number of farms ('000)	Share of total farms (%)[1]	Average farm size (hectares)	Average farm income	Average direct grant aid as % of income	Average direct grant aid per hectare	GHG emissions (t CO_2 eq) per hectare
Cattle – Total	94.4	68.7	-	-	-	-	-
Cattle – dairy	(16.1)	(11.7)	60 ha	€74,236	28%	€338	8.69
Cattle – beef	(78.3)	(57.0)	31 ha	€9,037	157%	€461	4.20
Sheep	15.1	11.0	44 ha	€18,383	103%	€429	3.30
Mixed livestock	11.6	8.4	-	-	-	-	-
Tillage[2]	4.7	3.4	62 ha	€32,525	79%	€416	2.10
Mixed tillage & livestock	2.1	1.5	-	-	-	-	-
Mixed field crops	8.2	6.0	-	-	-	-	-
Other	1.3	0.9	-	-	-	-	-

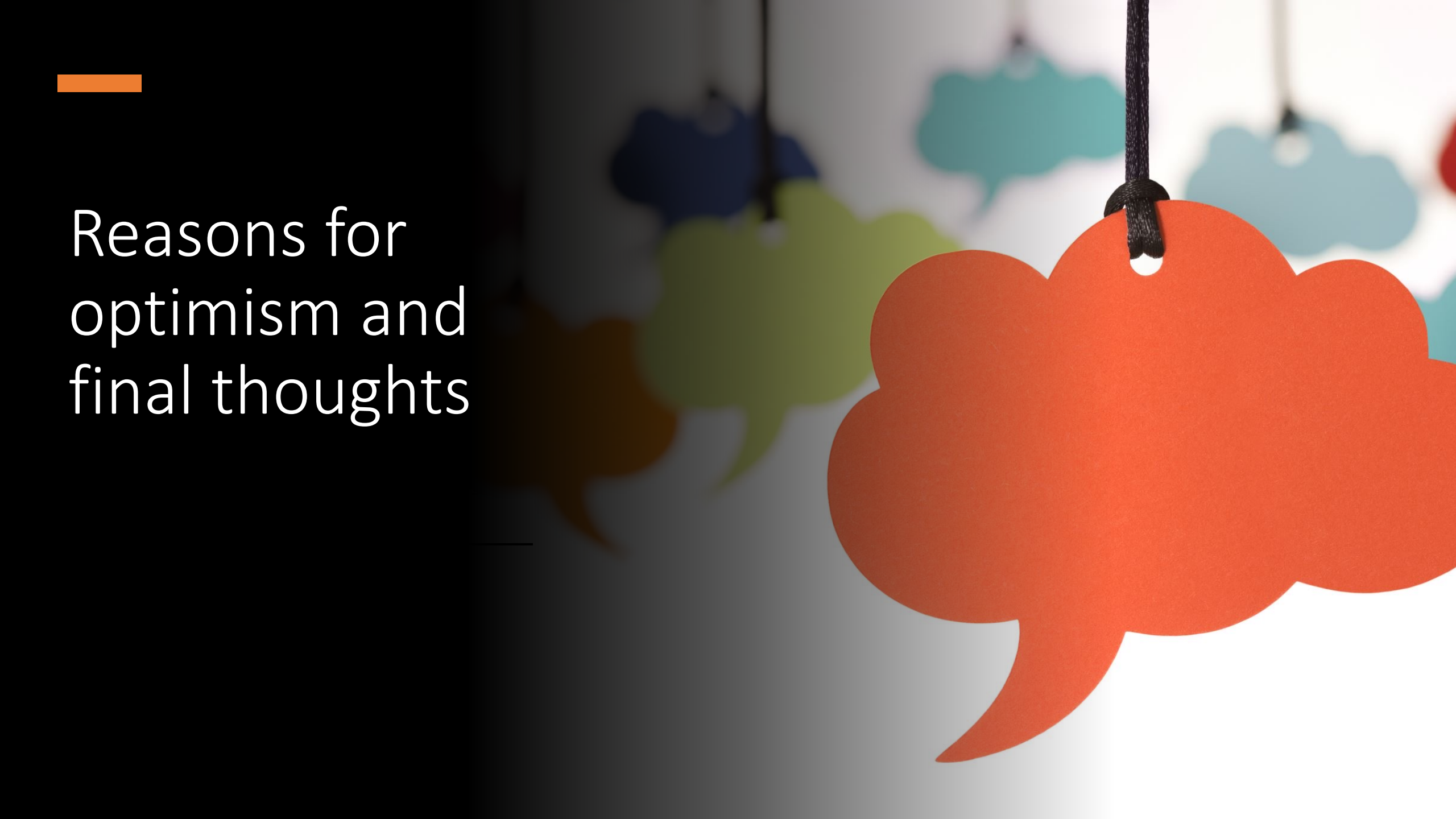
1 There were a total of 137,500 farms in Ireland in 2016 , CSO.

2 Refers to specialist tillage farms (in most cases GHG emissions are from on farm livestock)

Notes:

- Farm number data are for 2016 – CSO
- Data on farm size, income and direct grant aid are for 2020 – Dillon et al 2021
- Data on GHG emissions are farming system averages for 2019, source Buckley and Donnellan 2020

Reasons for optimism and final thoughts



Some Reasons for Optimism

- The challenge is a global one – Ireland is not alone or unique!
- Better climate models (at regional and national scale)
- Better data on soils, carbon and other GHG fluxes in the land system
- A new high resolution Land Cover Map for Ireland
- Developments in modelling capacity mean advanced policy tools within reach – using all of this new data

Chapter 6, Haughey et al., 2023 Land Use Review: Fluxes, Scenarios, Capacity

Many Options – Available Now!

Response Category	*Response Option*
Demand management	Dietary Change
	Reduced food waste
Agricultural land management	Increased food productivity
	Improved grazing land management
	Improved livestock management
	Agroforestry
	Agricultural diversification
Land management for CO_2 removal	Bioenergy and BECCS
Forest management	Afforestation
Other ecosystem land management	Reduced pollution including acidification
	Restoration / reduced use of peatlands
	Biodiversity conservation

Adapted, Table 4.2, Haughey 2021 Climate Change and Land Use in Ireland

Final thoughts

- The land system in Ireland can play a highly significant role in meeting climate change objectives but there are limits
- Changes targeted at climate mitigation require an integrated approach or there is serious risk of negative effects on biodiversity and water quality
- Urgently need ways to achieve integrated land management and planning, at national, regional and local scales…
- AND need detailed analyses of socioeconomic impacts of land use change

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Thanks for your attention!

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