

Agri-food and Net Zero: Science-Policy-Society

A UK Case Study

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Outline:

- UK Agri-food
- Mitigation (carbon removal)
- UK Key Policy Questions (KPQs)
- Science-Policy-Society Interface
- Conditions for a Plausible Pathway
- Concluding Remarks

UK Agri-food Sector

- In 2018, total agriculture area was 19 million hectares (77% of total land area), 60% of which is used for livestock.
- 9.5 million cattle, 33.5 million sheep, 5 million pigs and 187 million poultry.
- FGP value – £12 billion per year.
- Imports £10 billion meat and milk per year / exports £4 billion / ~ 60-70% self-sufficient.
- Agriculture makes up 0.6% of the UK's GVA, wider agri-food sector contributing 6.6% GVA.

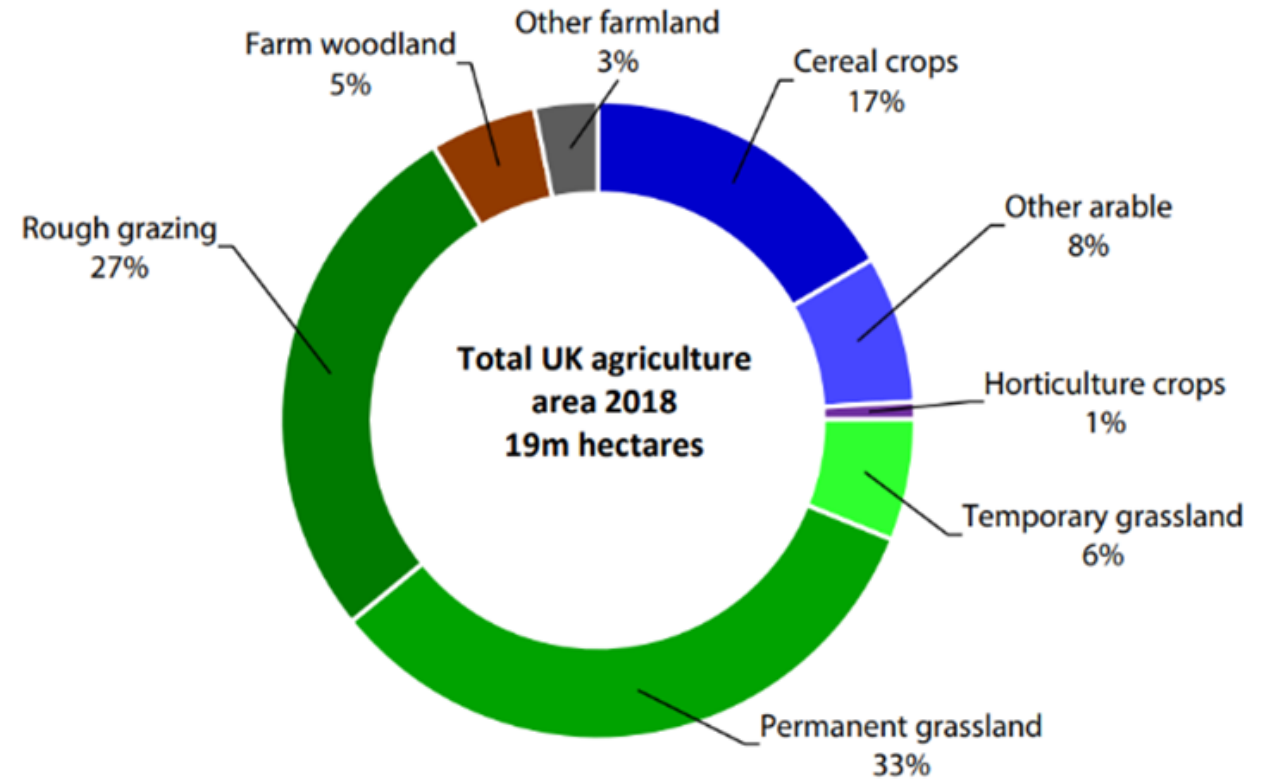


Figure 1: Distribution of land-use within UK Agriculture.

Defra, 2018 / CCC analysis

UK Agri-food: GHG Emissions

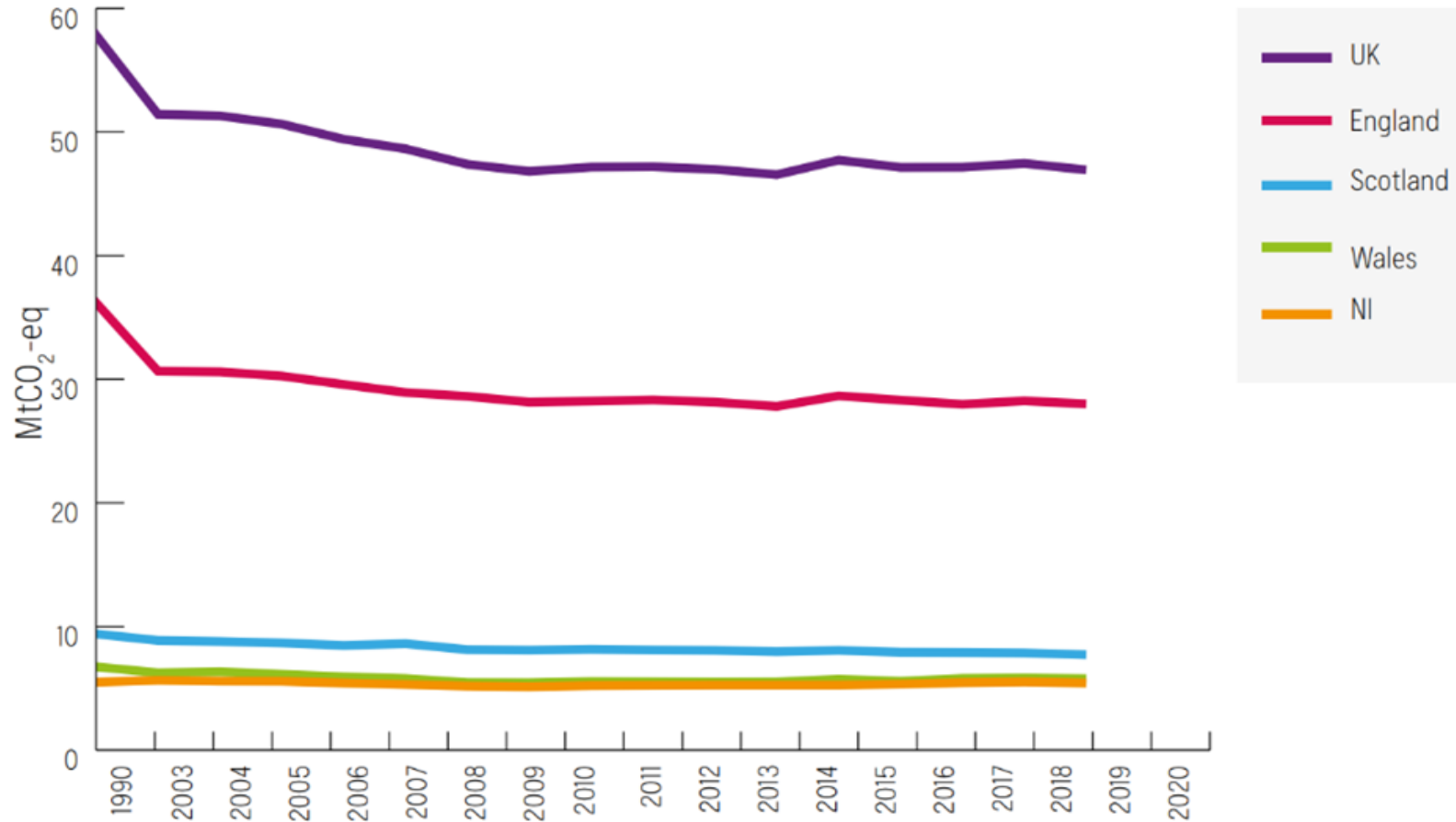
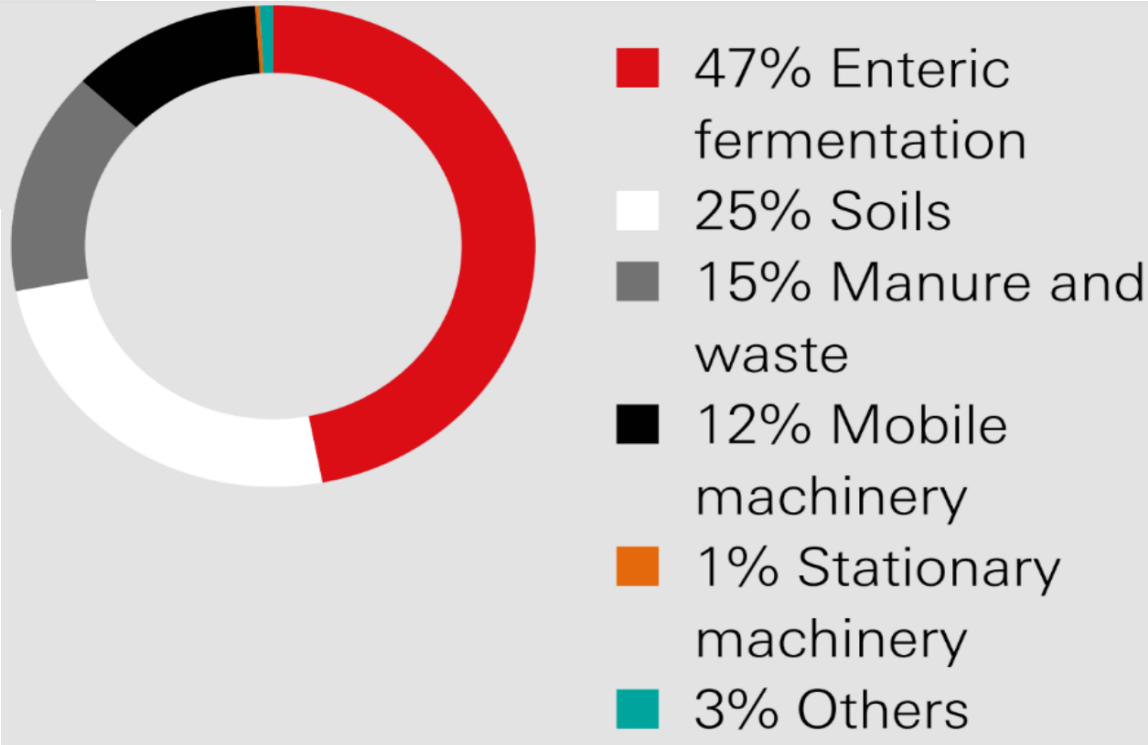
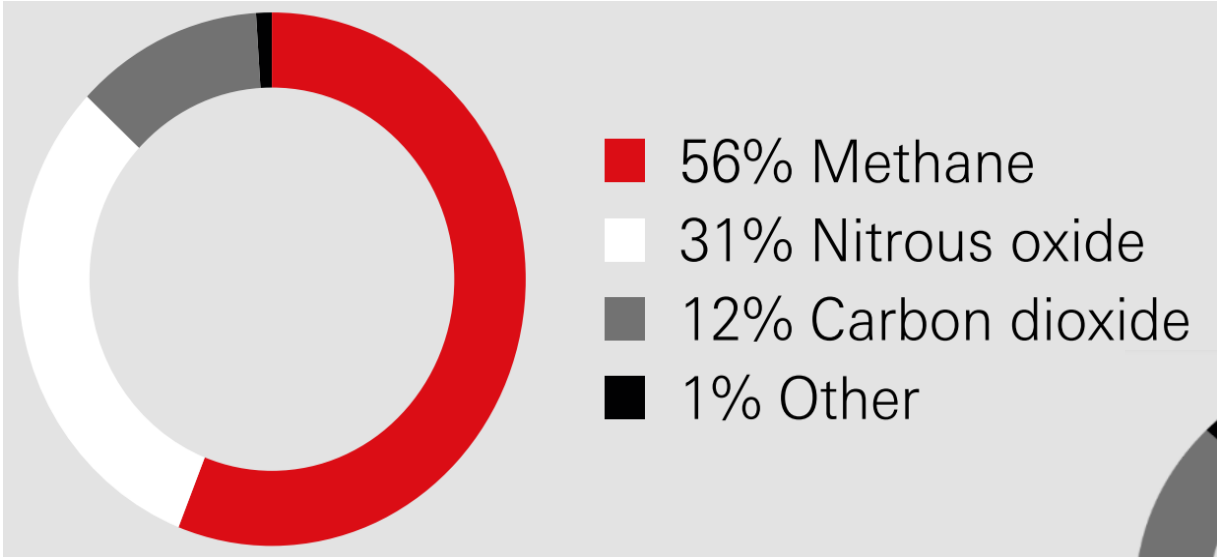


Figure 2: UK agricultural greenhouse gas emissions from 1990 to 2018 (BEIS, 1990 - 2018)

- **Agriculture was responsible for 10% of UK's emissions in 2018 (45.4Mt CO₂-eq)**

UK Agri-food: GHG Emissions (by source)



Figures' 3 & 4: UK agricultural emissions by GHG type and source (BEIS, 1990 - 2018)

Challenges for the Science – Policy – Society Interface

- The Definition of Net Zero & its Interpretation
- National Targets, vis a vis, where is “my” business on this Journey.... “the disconnect”
- The LCA Penalties of “Averaging,” the Desire for “Accuracy” at TIER 3
- Will my Positive Change be picked up by National Inventory, or by Scope 3 Declarations
- The necessity to “Inset” my carbon within my own legal business
- The Imperative to deliver other Public Goods, as well as Net Zero



Water Quality and Biodiversity.....



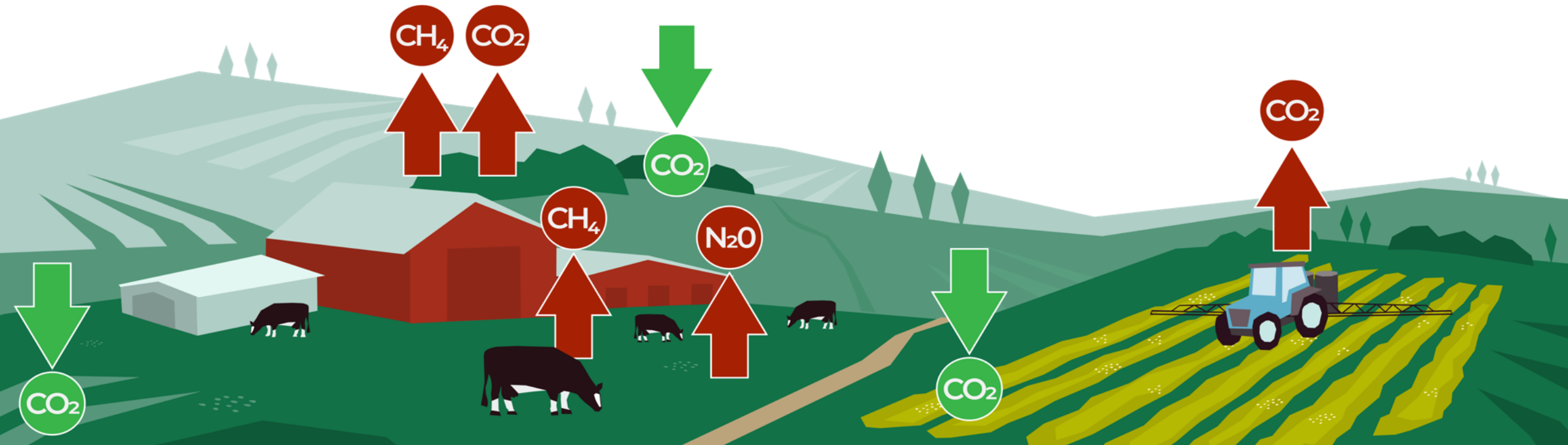
The need to recognise “Insets....”

IPCC SOURCE AND SINK CATEGORIES	CO ₂	CH ₄	N ₂ O		CS, D, T1, T2, T3	D, T1, T2	D, T1, T2
1. Energy	M T1, T2, T3	M, T1, T2, T3	M, T1, T2, T3	4. Land-Use, Land-Use Change and Forestry			
A. Fuel Combustion (Sectoral Approach)	M, T1, T2, T3	M, T1, T2, T3	M, T1, T2, T3	A. Forest Land	CS, T1, T2, T3	D, T1	D, T1
1. Energy Industries	T1, T3	T1, T2	T1, T2	B. Cropland	CS, D	D, T1	D, T1
2. Manufacturing Industries and Construction	T1, T2, T3	T1	T1	C. Grassland	D, T1, T2, T3	D, T1	D, T1
3. Transport	M, T2, T3	M, T1, T3	M, T1, T3	D. Wetlands	D, T1, T2, T3	D, T2	D, T2
4. Other Sectors	T1, T2	T1	T1	E. Settlements	D, T1, T3	NA	T1
5. Other				F. Other Land	T1, T3	NA	T1
B. Fugitive Emissions from Fuels	CS, T3	CS, T1, T3	CS, T3	G. Harvested wood products	T2		
1. Solid Fuels	NA	T1	NA	H. Other	NA	NA	NA
2. Oil and Natural Gas	CS, T3	CS, T1, T3	CS, T3	5. Waste	T1	T1, T2	T1
C. Carbon Dioxide Transport and Storage	NA			A. Solid Waste Disposal	NA	T2	NA
3. Agriculture	T1	CS, T1, T2	T1, T2	B. Biological treatment of solid waste	NA	T1	T1
A. Enteric Fermentation		CS, T1, T2	NA	C. Incineration and open burning of waste	T1	T1	T1
B. Manure Management		T1, T2	T2	D. Wastewater treatment and discharge	NA	T1, T2	T1
C. Rice Cultivation		NA	NA	E. Other	NA	NA	NA
D. Agricultural Soils		NA	T1				
E. Prescribed Burning of Savannas		NA	NA				
F. Field Burning of Agricultural Residues		NA	NA				
G. Liming	T1						
H. Urea Application	T1						
I. Other	NA						

Farm Businesses don't fit within the GHG Inventory, as they are multifaceted, they are split between a possibility of four different Silos, which do not allow recognition of each other...

Net Zero : Where the Sum of Emissions equals Sum of Sequestration

Adjusted for any fossil fuel CO₂ emissions displaced by Renewables
for any methane emissions reduced by any waste management



It is not about Zero Emissions.....

Carbon Removals/Sequestration: Soil Organic Carbon

UK

9.8 billion tonnes of carbon stored in GB soils

15.5 MtCO₂e sequestered in 2013

Peatlands store ~40% of SOC—sequestering carbon 100 times faster than it is emitted



Global

Improved SOC levels = ~1.3 Gt CO₂e/year sequestered

5–10% of annual global GHG emissions.

SOC | food security: +SOC by 1 MgC/ha = yield increase of 100–300 kg/ha for maize. ~30–50 million tonnes of food production/year in NDCs.

TABLE 1 A profile of key soil management practices and the significance of their potential impact on indicators of environmental, economic and social sustainability

Soil management practice	Environmental (climate)				Economic		Societal	
	Climate change mitigation	Improved crop yield	Better animal performance	Natural capital	Resource-use efficiency	Net income	Public health	Global food demands
1. MRV (measure, report verification)	++	++	++	+	++	++	+	++
2. Reduced tillage	++	+	+	+	+	+	+	+
3. N ₂ -fixing legumes	++	+	+	+	+	++	+	+
4. Multispecies swards	++	++	++	++	++	++	+	+
5. Improved fertiliser applications	+	++	++	+	++	+	++	++
6. Peatland restoration	++	~	~	++	+	+	+	~
7. Grazing land management	+	++	++	+	++	++	+	+
8. Organic fertiliser applications	++	++	+	+	+	+	+	~

Note: ++, Significant improvement; +, Minor improvement; ~, Neutral.

(McGuire et al., 2022)

Carbon Stocks - New Precision Measuring Technologies

When repeated every five years, measures “real” change, essential for Tier 3



- **Aerial LiDAR Survey at 15 points per square metre, for topography & above ground biomass**
- **Precision Soil Sampling, for Soil Organic Carbon & Bulk Density at 0-15cm, 15-30cm, 30-60cm, 60cm +**

UK Agri-food Policy: Life After the CAP

BRIEFING PAPER

Number CBP 8702, 10 November 2020

The Agriculture Bill 2019-21



Environmental Land Management: policy discussion



Sustainable Farming Incentive



Countryside Stewardship



Landscape Recovery

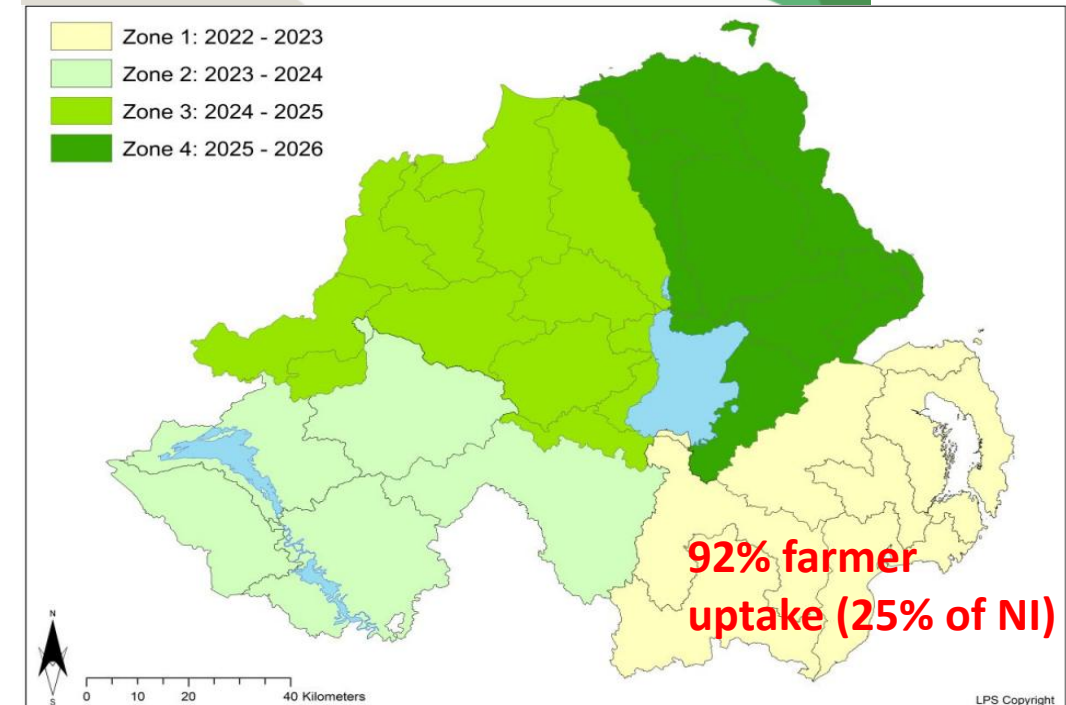
Northern Ireland Agricultural Policy



- Ruminant Genetics
- Carbon Benchmarking
- Beef Sustainability Package
- Farming with Nature

The Northern Ireland Soil Nutrient Health Scheme (SNHS)

- £37million national soil health / carbon scheme – public funds.
- One of the most comprehensive regional soil nutrient sampling programmes
- Approximately 700,000 fields:
 - Detailed information on the nutrient status of their soils;
 - Runoff risk maps for nutrient loss to waterbodies for each field sampled;
 - Estimates of carbon stored in their soils and as above ground biomass for each farm;
 - Training on the interpretation of reports and generation of farm nutrient plans



UK Agri-food: Key Policy Questions

UKQ1: What role can the agri-food play in delivering a net zero trajectory?

- Is the baseline for certain farm systems common to all?
- What are the implications for land use change?
- What role can the wider post farm gate supply chain play in achieving the goal?

UKQ2: What are the barriers that we need to overcome to deliver such trajectories?

- Do we understand the logistical, infrastructural, behavioural, and technical barriers?
- What is the role of the private sector?
- Are there fundamental constraints?

UKQ4: How effective are technology driven or nature driven pathways to net zero in the agri-food domain?

- What role can soils and on farm biomass play in achieving net zero? What are the implications for LUC and food security?
- The role of GGRs' through SOC and aboveground biomass?
- Can technology (*land sparing*) and nature-driven pathways (*land sharing*) be effectively combined at the farm scale or are they mutually exclusive?

Agri-food & Net Zero: Science-Policy-Society

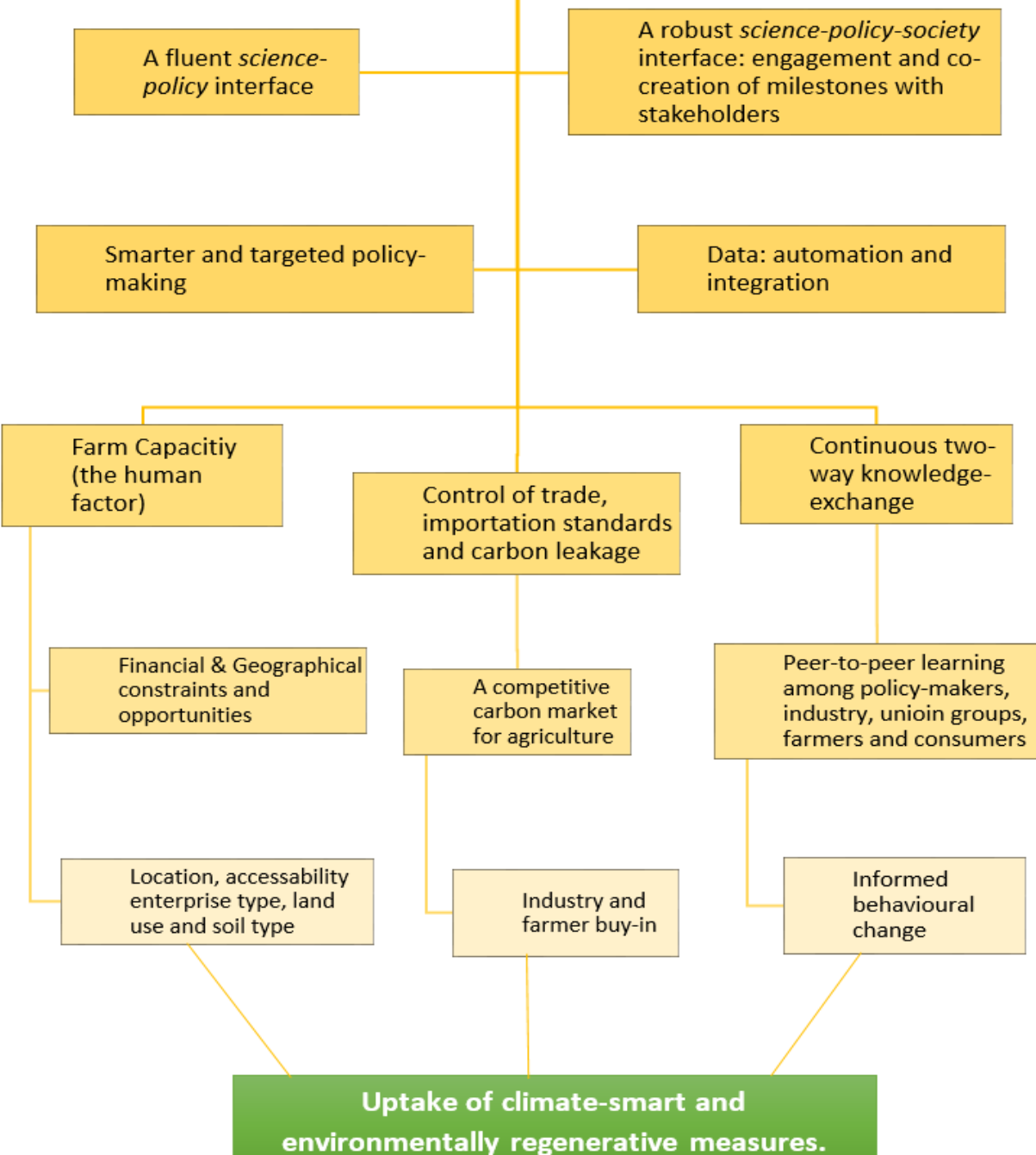
- Policy must be informed by:
 - scientific modelling;
 - new tech *and*;
 - socio-economic capacities of industry.
- Top-down & bottom-up approach.
- Co-create a plausible pathway:
 - more targeted (regional) approach;
 - environmentally regenerative;
 - feasible for farmers;
 - stimulates industry buy-in



Agri-food & Net Zero: Plausible Pathway



Conditions to a Plausible Pathway



(McGuire et al., 2023)

Concluding Remarks

- Do not wait for perfection – measuring the baseline (**net**) is vital;
- Most significant barrier: limited *plausible* road map(s);
- Public - private partnership... not two separate vehicles!
- Feasible mitigations for farmers;
- This sector's ability to apply science into practice is challenging;
- KE at scale;
- A net zero strategy will only become plausible when it creates such parameters for industry.



Thank You

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