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How to achieve high oilseed rape yields with low greenhouse gas emissions

Christina Baxter

24/04/2025

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UK Net Zero Target

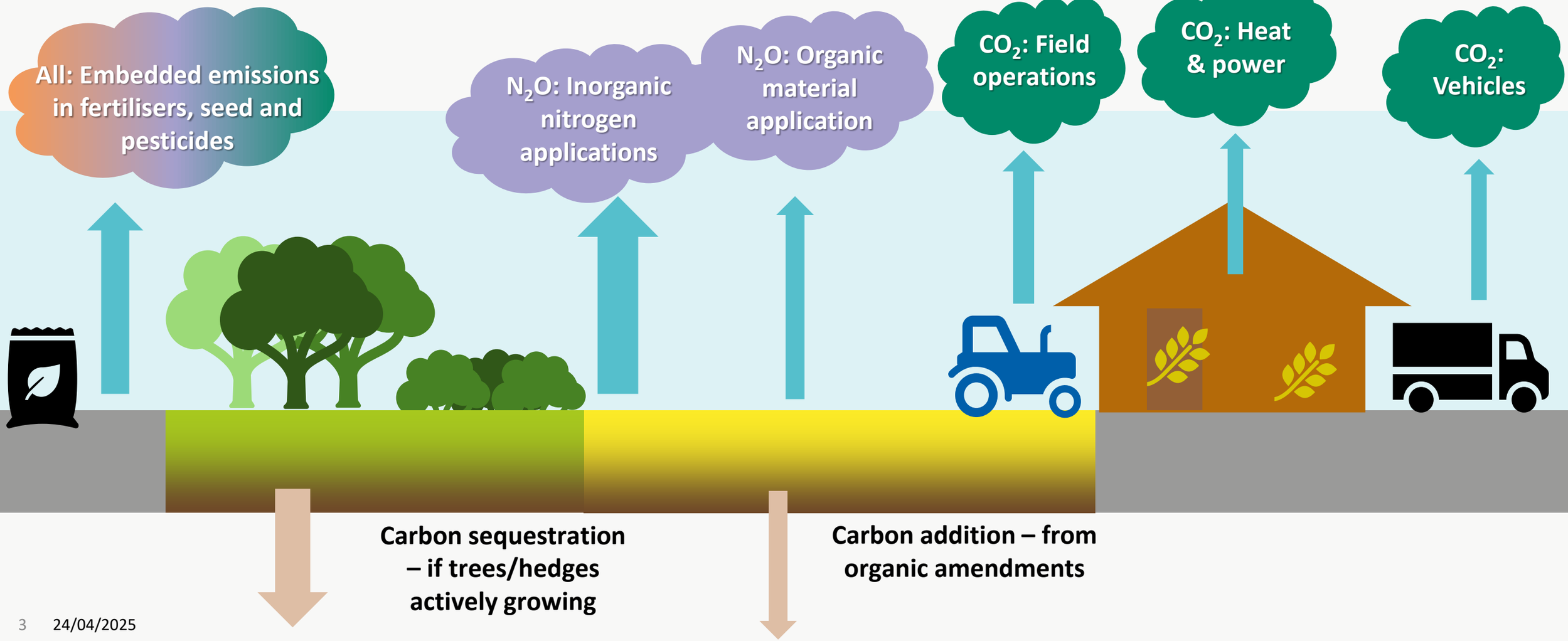
- In June 2019 – UK Government committed to Net Zero by **2050**
  - Emissions balanced by carbon capture
  - Covers all sectors
  - Requires strengthening of policy
- NFU set aspiration for English and Welsh Agriculture to achieve Net Zero by **2040**
  - To achieve this aspiration requires ‘radical changes’

Greenhouse Gases in crop production

CO_2 Carbon dioxide

N_2O Nitrous oxide

CH_4 Methane



Industry network - YEN Zero

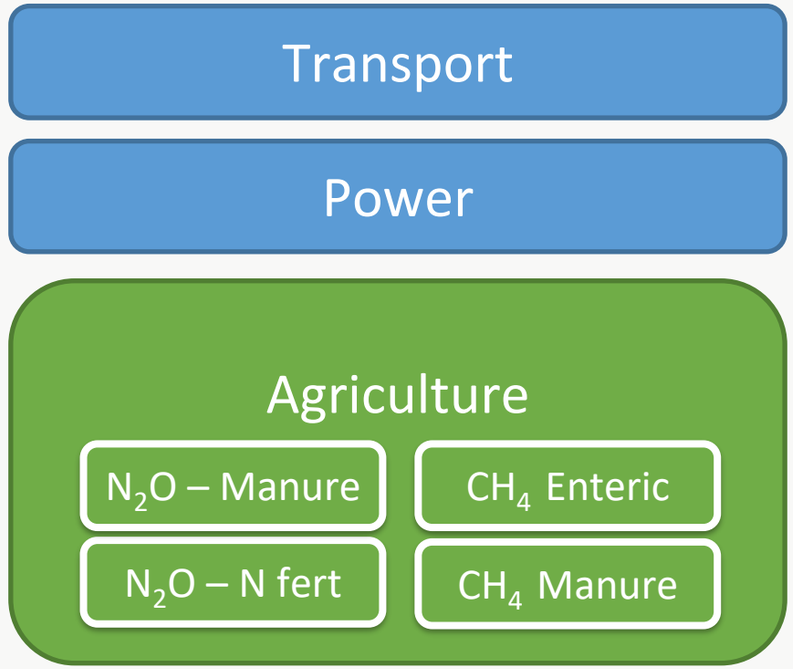
To create a net zero community to develop solutions for reducing the GHG emissions associated with farming and increasing farm productivity.

- Running since 2021:
  - 100 growers and 755 crops entered
  - Measuring and benchmarking GHG emissions of individual crops and whole rotations
  - Identifying solutions which can reduce emissions while sustaining or increasing productivity
  - Facilitate discussion workshops to share knowledge and solutions

Greenhouse Gas assessment methodology

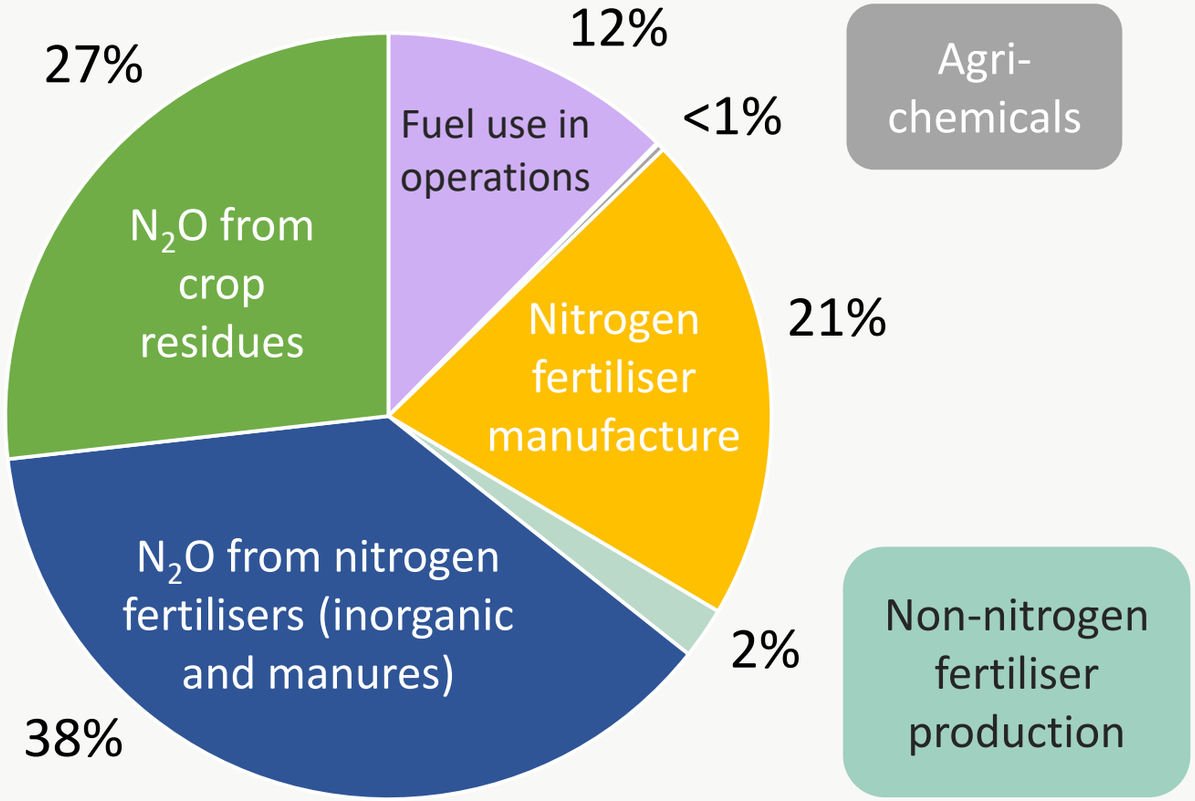
1. National level – GHG Inventory
   i. Calculated on an industry level
   ii. No embedded emissions
2. Product level – Field or crop
   i. Includes all inputs and outputs
   ii. Considers any sequestration

- Product crop GHG emissions can be reported:
  1. Per unit area (kg CO_2eq/ha)
  2. Per unit output (kg CO_2eq/tonne) – <u>GHG intensity</u>



https://farmpep.net/YENZero

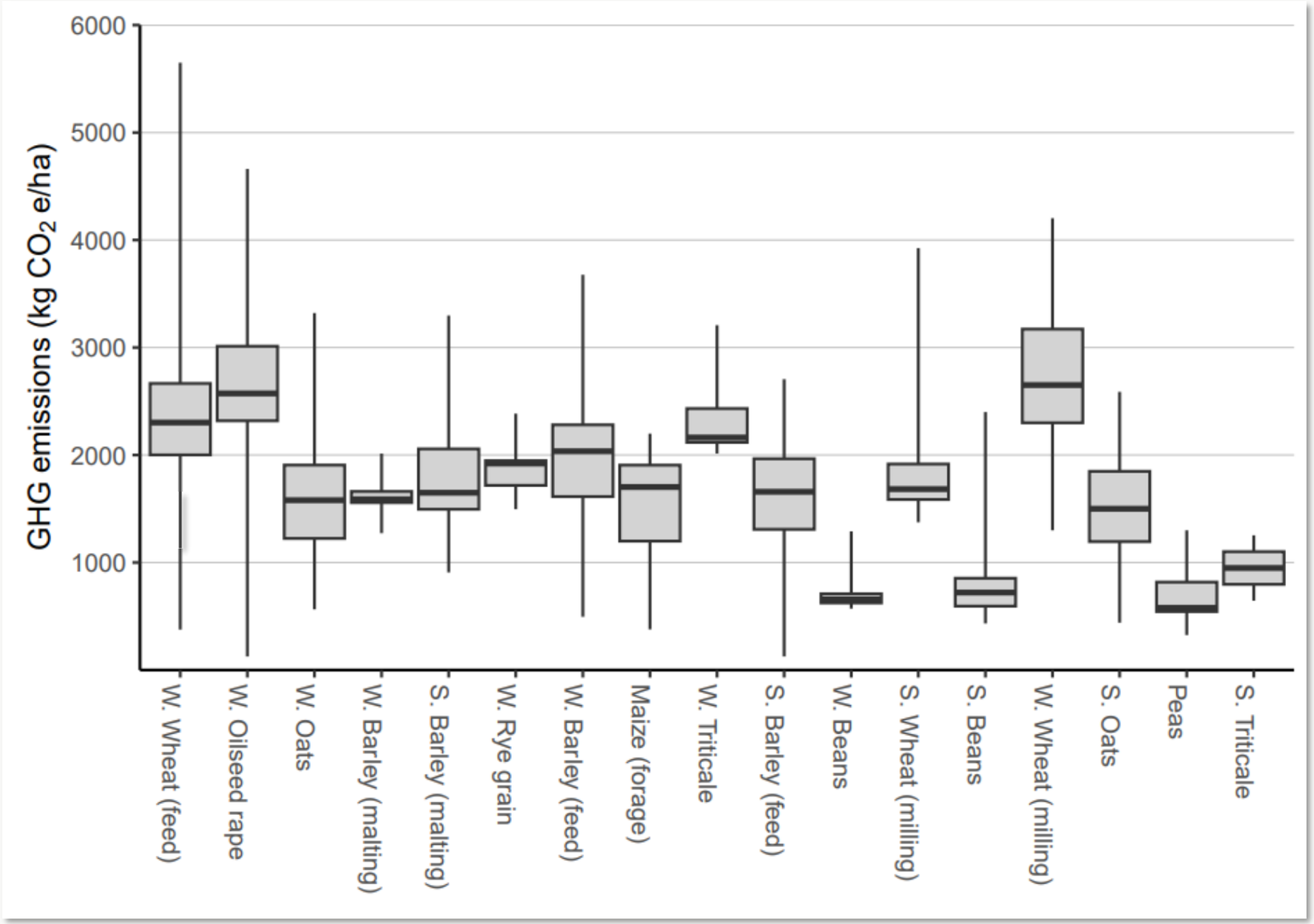
Emission hotspots – oilseed rape



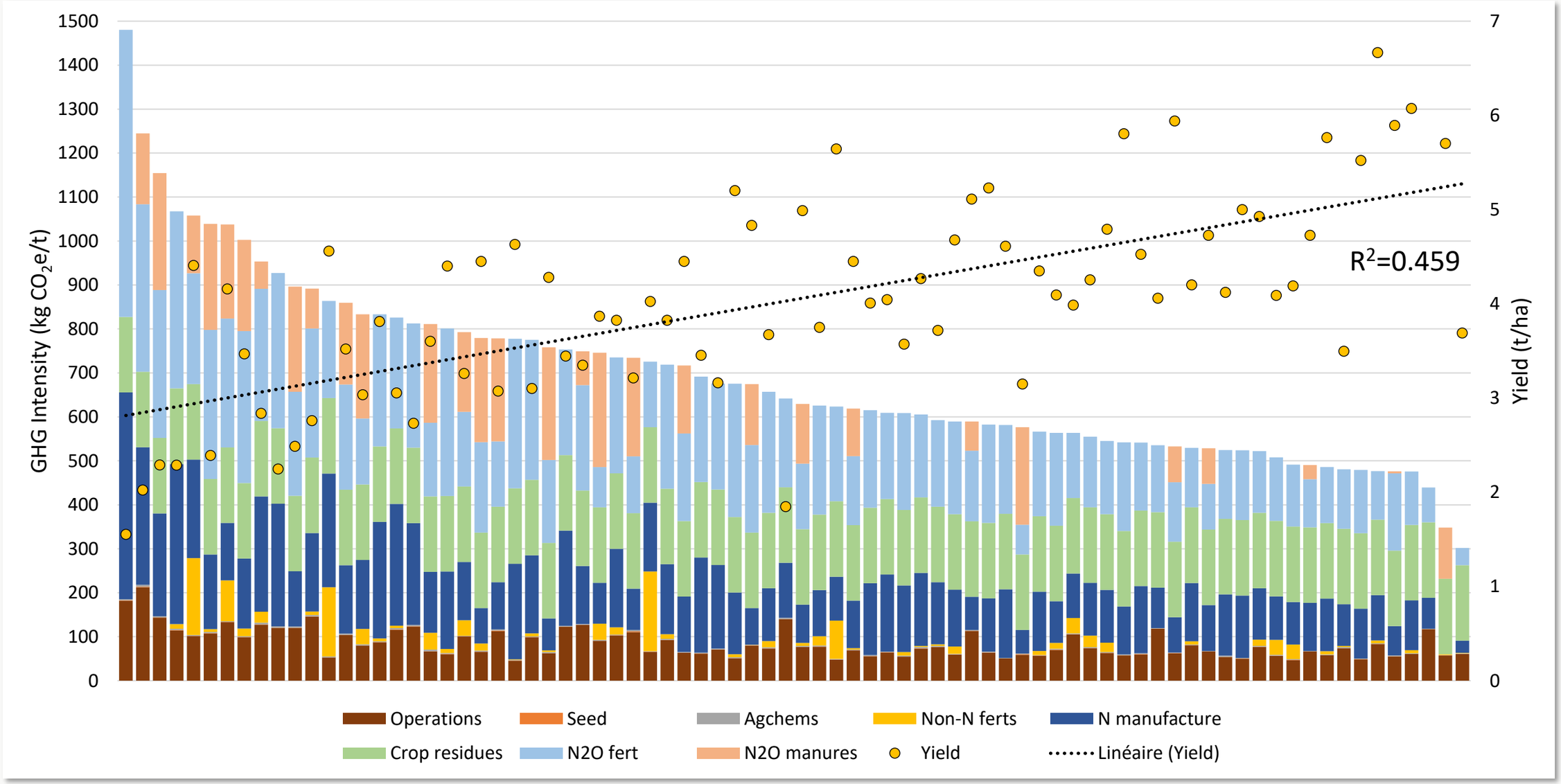
Carbon stock change: This can be positive or negative

Average YEN Zero data

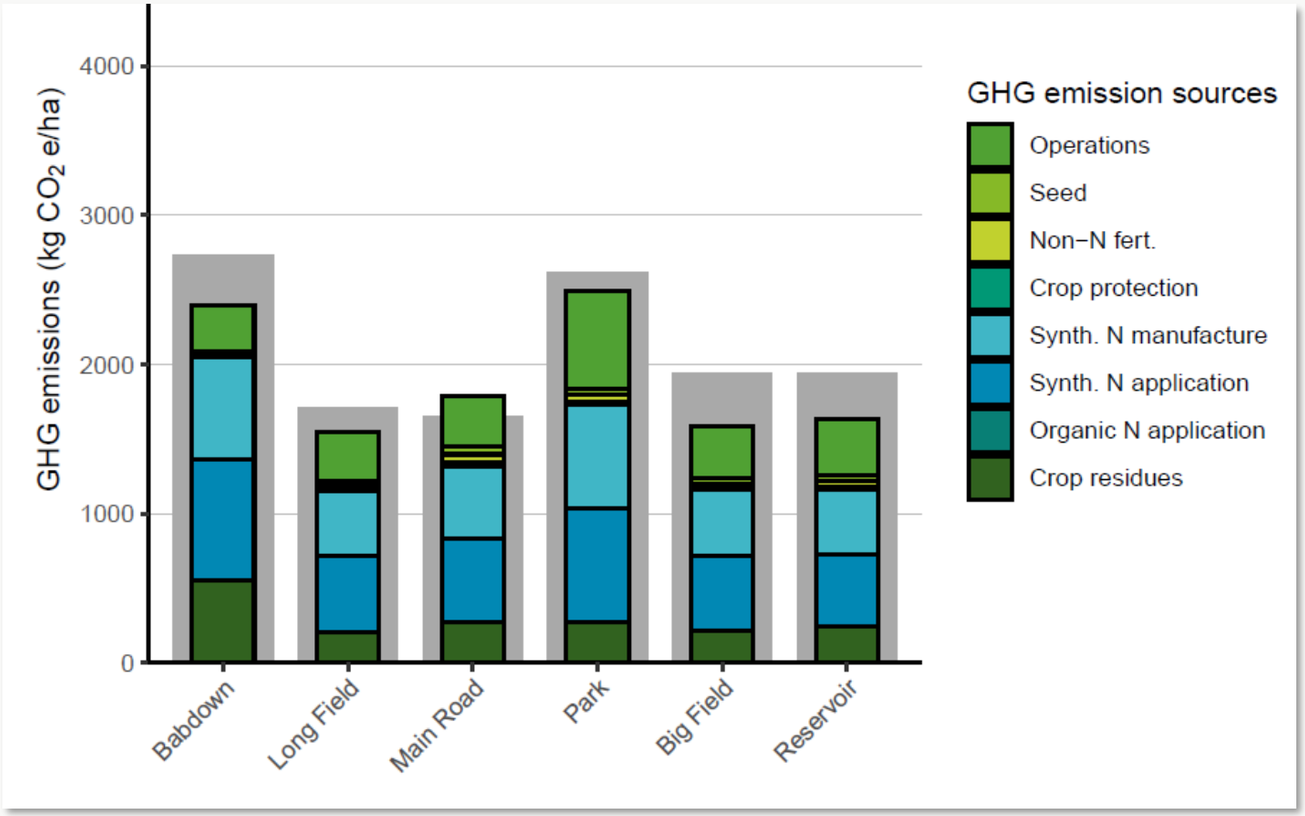
YEN Zero crop GHG emissions dataset

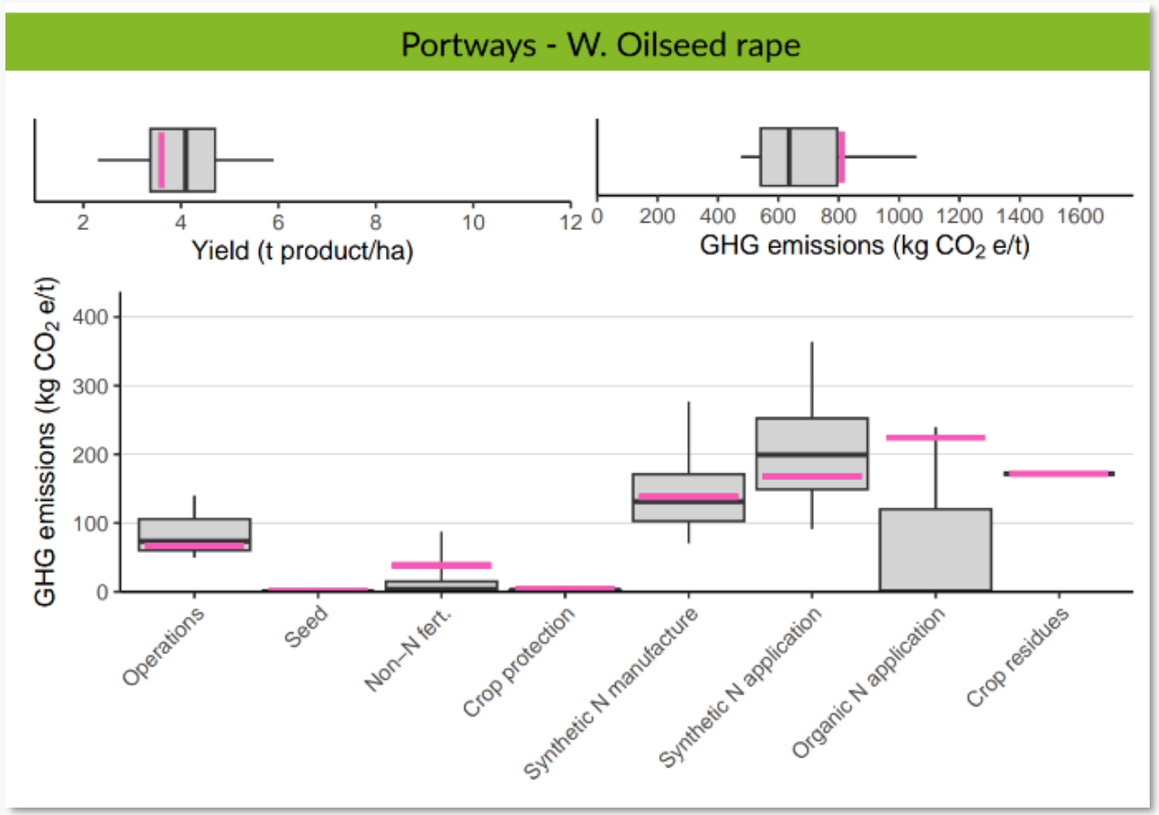


Range in oilseed crop GHG emissions



Benchmarking GHG emissions





Partition analysis of crop agronomic practice

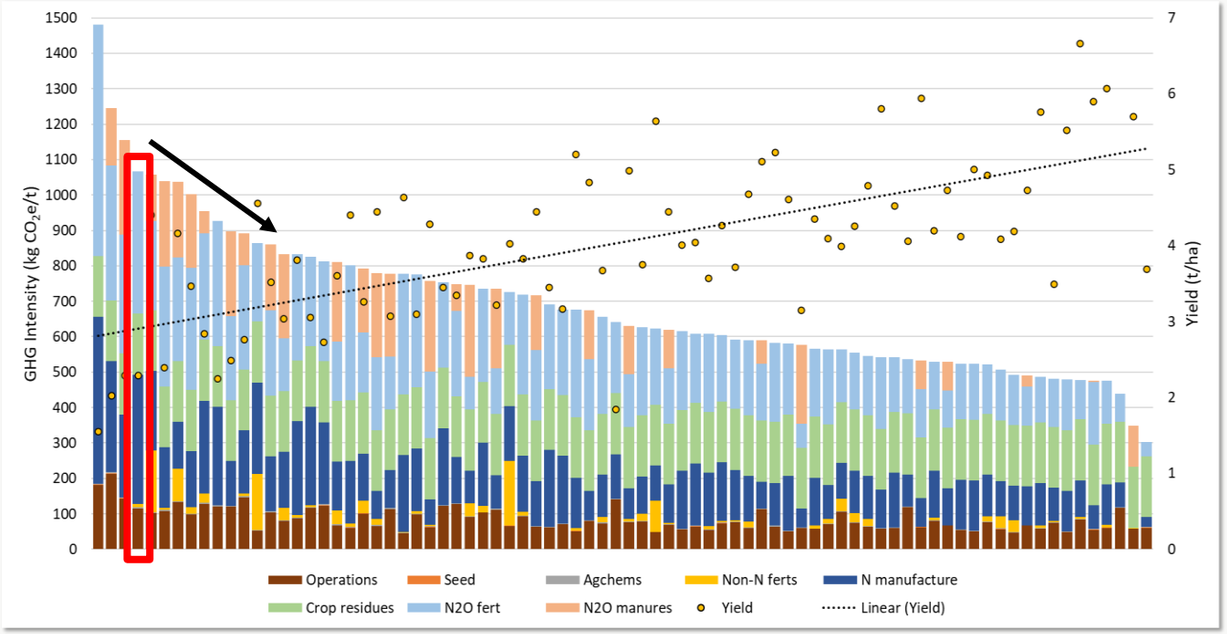
Factor	Units	Lower third for GHG/t	Upper third for GHG/t	p < 0.05
Emission intensity	kg CO_2e/t	504	926	*
Yield @ 15% mc	t/ha	5.0	3.3	*
Total manufactured N applied	kg N/ha	162	201	*
% crops using inhibitors	%	11	8	NS
% crops with manure applied	%	22	62	*
GHGs from P, K or lime	kg CO_2e/ha	36	101	NS
GHGs from residue decomposition	kg CO_2e/ha	850	557	*
GHGs from grain drying	kg CO_2e/ha	48	14	NS
GHGs from cultivation	kg CO_2e/ha	64	68	NS
% crop direct drilled	%	59	38	NS

Mitigating crop GHG emissions

YEN Zero oilseed rape crop entry yielding 2.3 t/ha

Management factor	Current scenario	Mitigated scenario	Emissions reduction	
			(kg CO_2e/ha)	Proportion (%)
Cultivation	Deep non-inversion	Strip tillage	60	3
Nitrogen application	198 kg N/ha; urea	175 kg N/ha; urea	46 + 126	8
Inhibitor use	None	Urease inhibitors	54	3

Total C footprint reduction of 14%
2,118 to 1,856 kg CO_2/ha

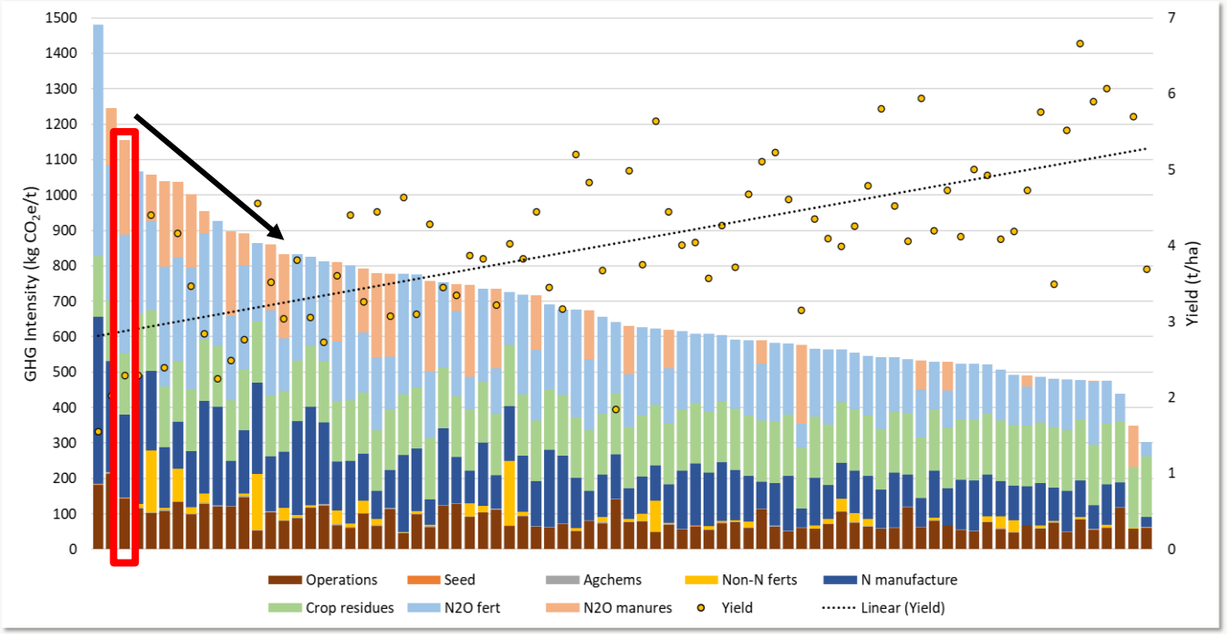


Mitigating crop GHG emissions

YEN Zero oilseed rape crop entry yielding 2.3 t/ha

Management factor	Current scenario	Mitigated scenario	Emissions reduction	
			(kg CO_2e/ha)	Proportion (%)
Biosolid application	Broadcast spread	Trailing shoe	52	2
Nitrogen application	151 kg N/ha; AN	111 kg N/ha; AN	139 + 229	14
Inhibitor use	None	Nitrification inhibitors	184	8

Total C footprint reduction of 24%
2,644 to 2,021 kg CO_2/ha



Oilseed rape GHG emissions: take home messages

- Wide range of crop GHG emissions per ha and per tonne across fields and farms
- High yields are not associated with greater GHG intensities
  - LUC implications should be considered when setting goals to reduce emissions
- Nitrogen fertiliser (inorganic and organic) is a major driver of GHG emissions
- Solutions to reduce oilseed emissions while maintaining yield:
  - More effective use of organic materials to reduce synthetic inputs
  - Urease and nitrification inhibitors
  - Choosing fertilisers with low manufacture footprints
  - Reduce nutrient losses to the environment e.g., cover crops
  - Reduce rotational footprint with low nitrogen input crops

Acknowledgements

- ADAS YEN Zero team:
  - Dr Pete Berry, Toby Rapson, Toby Townsend, Laurie Abel, Dhaval Patel
- YEN Zero Industry Sponsors
- YEN Zero Growers

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