

Climate Change and Diffuse Pollution

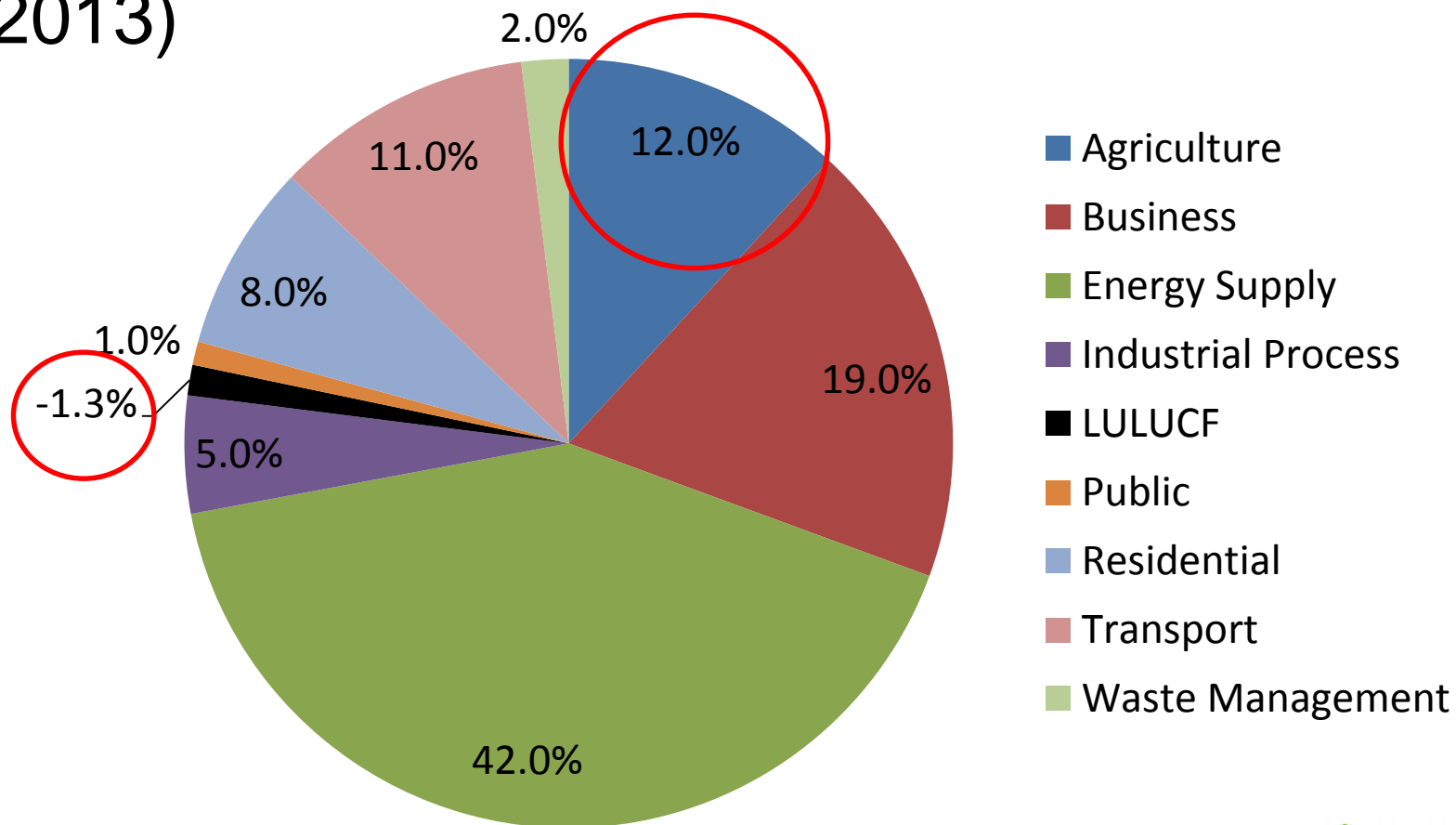
Dave Chadwick *et al.*
Bangor University

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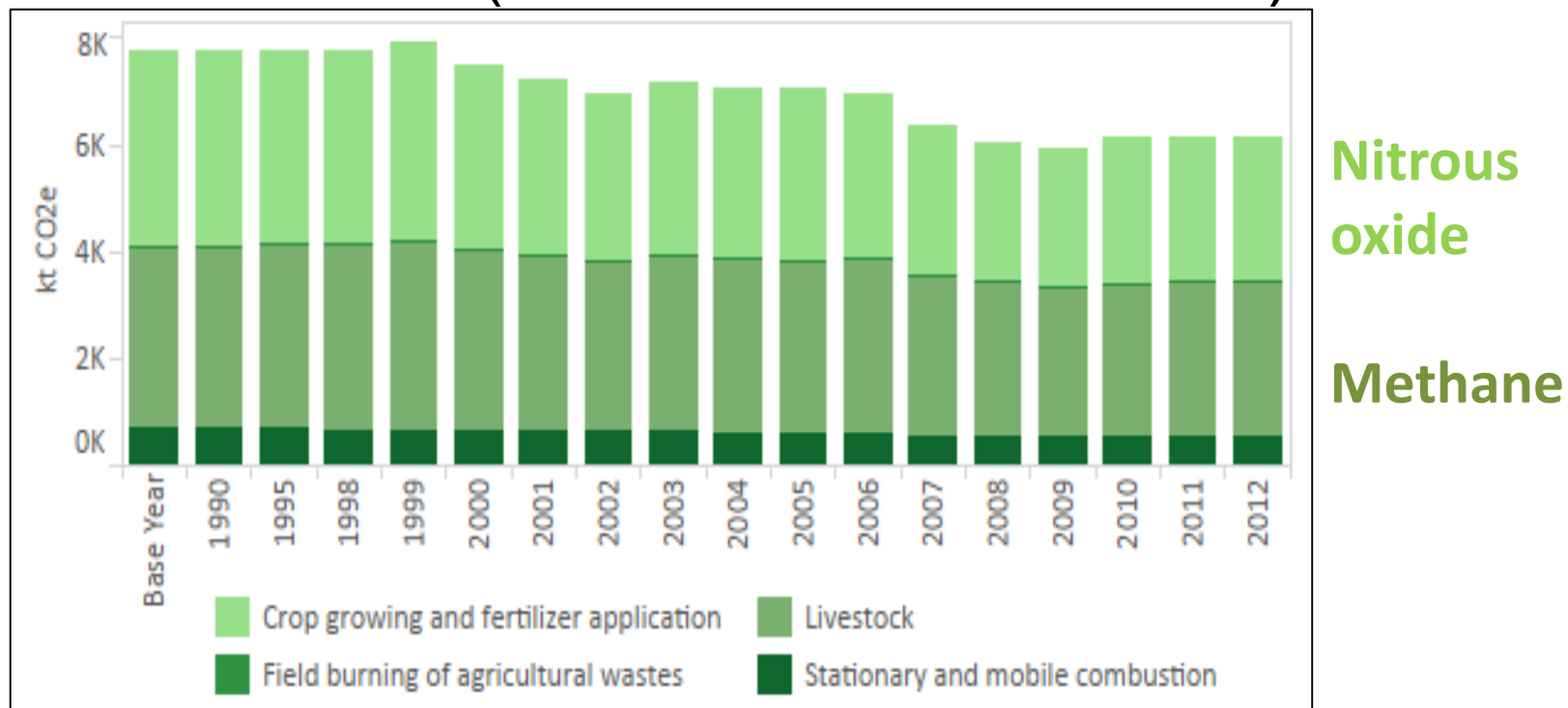
GHG emission sources and sinks in Wales

GHG emissions from different sectors in Wales (2013)



Trends in GHG emissions in Wales

1990-2012 (1996 IPCC Guidelines)

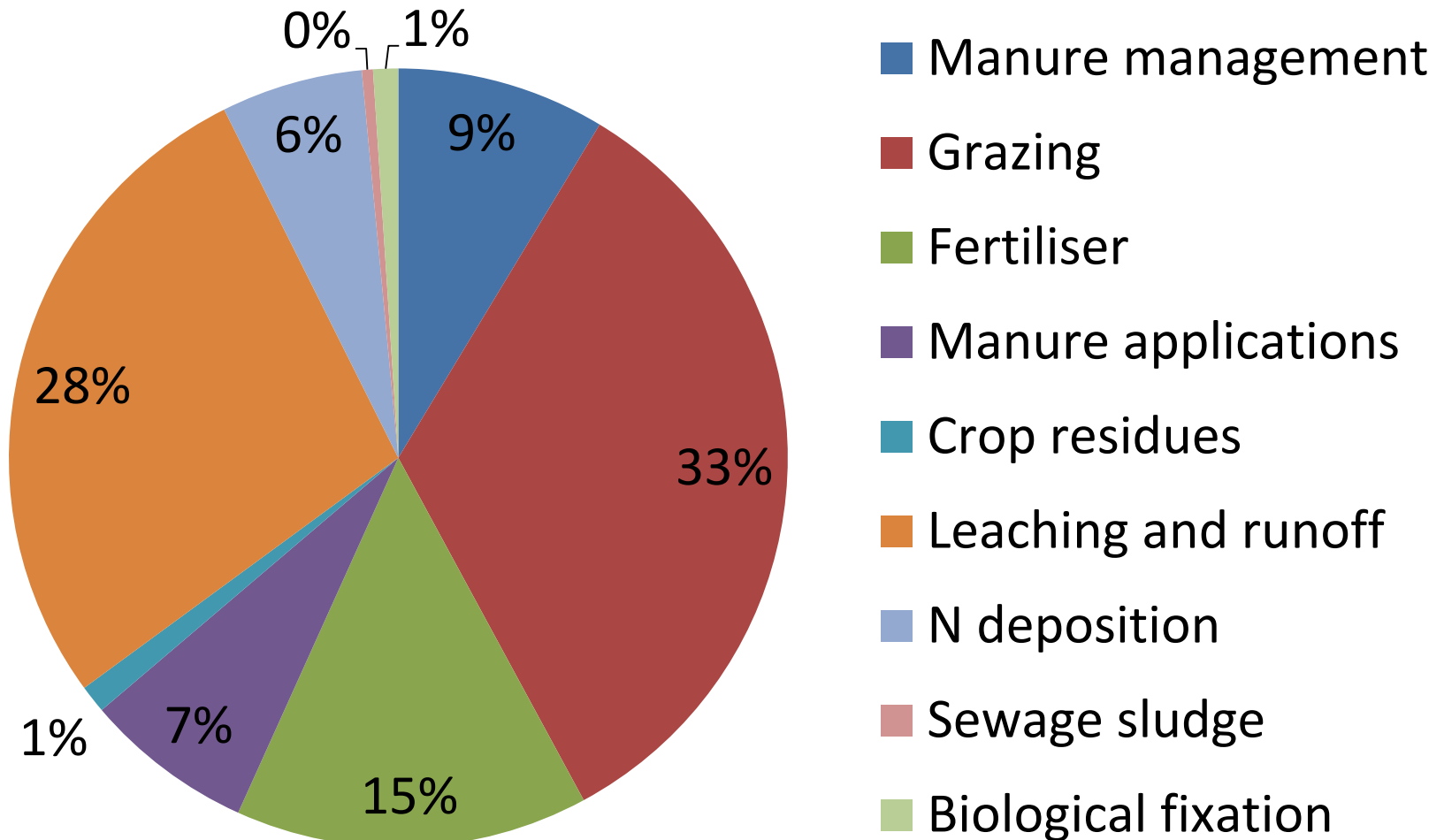


Trend due to changes in fertiliser use and ruminant livestock numbers.

Cardo-AEA Technology (2014)

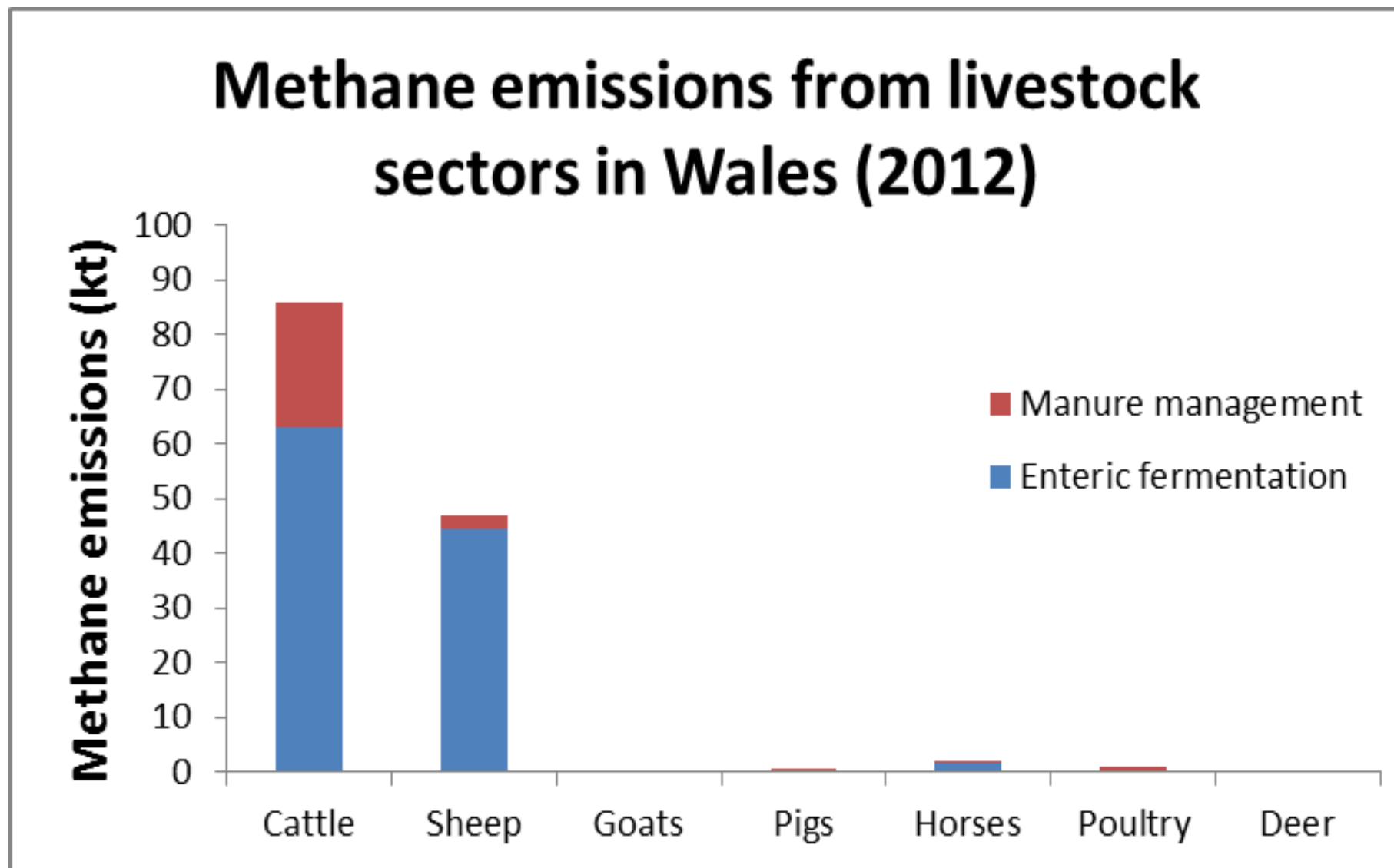
N₂O sources in Wales Agriculture (2012)

Total: 8.73 kt N₂O (1996 IPCC Guidelines)

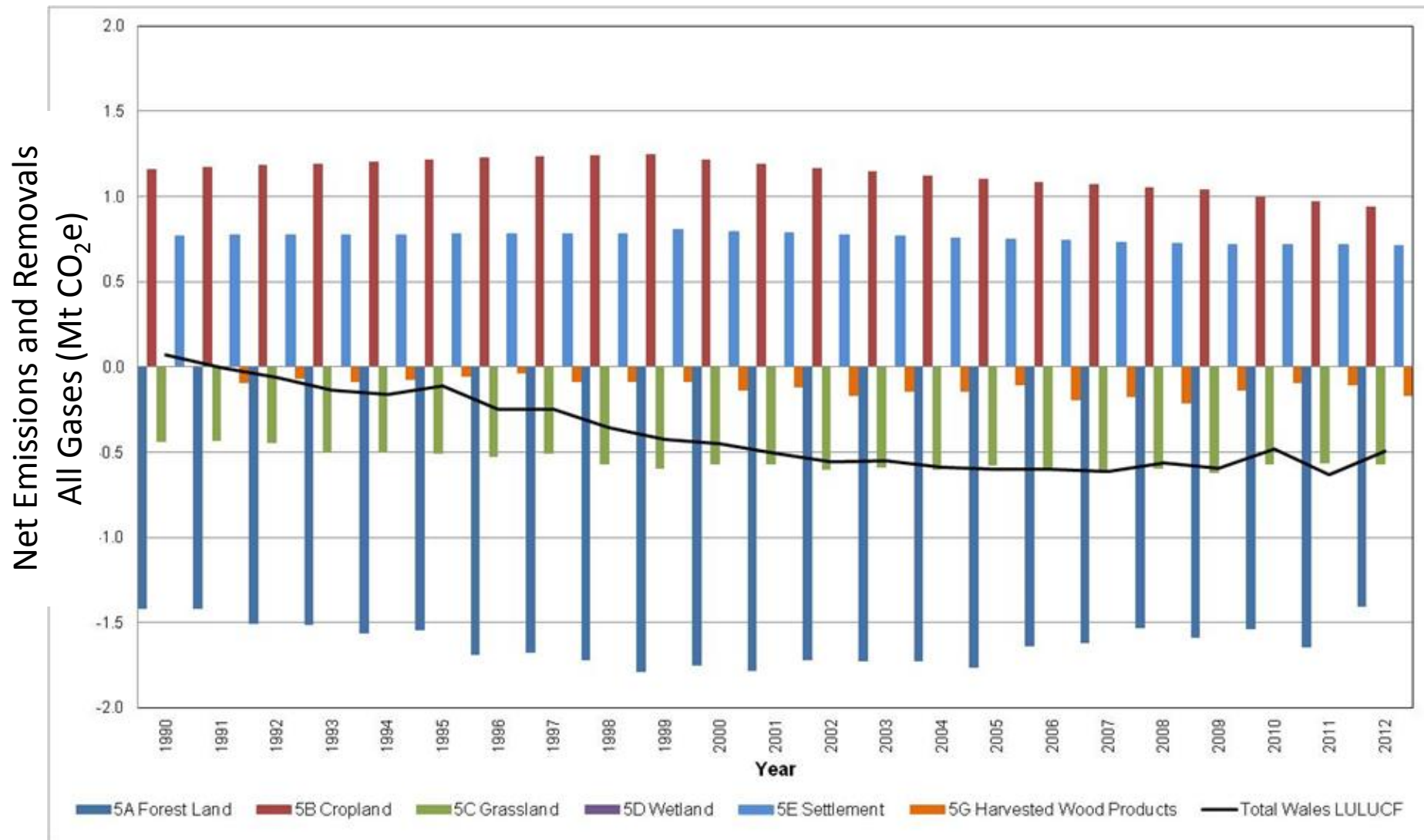


Sources of methane emissions in Wales

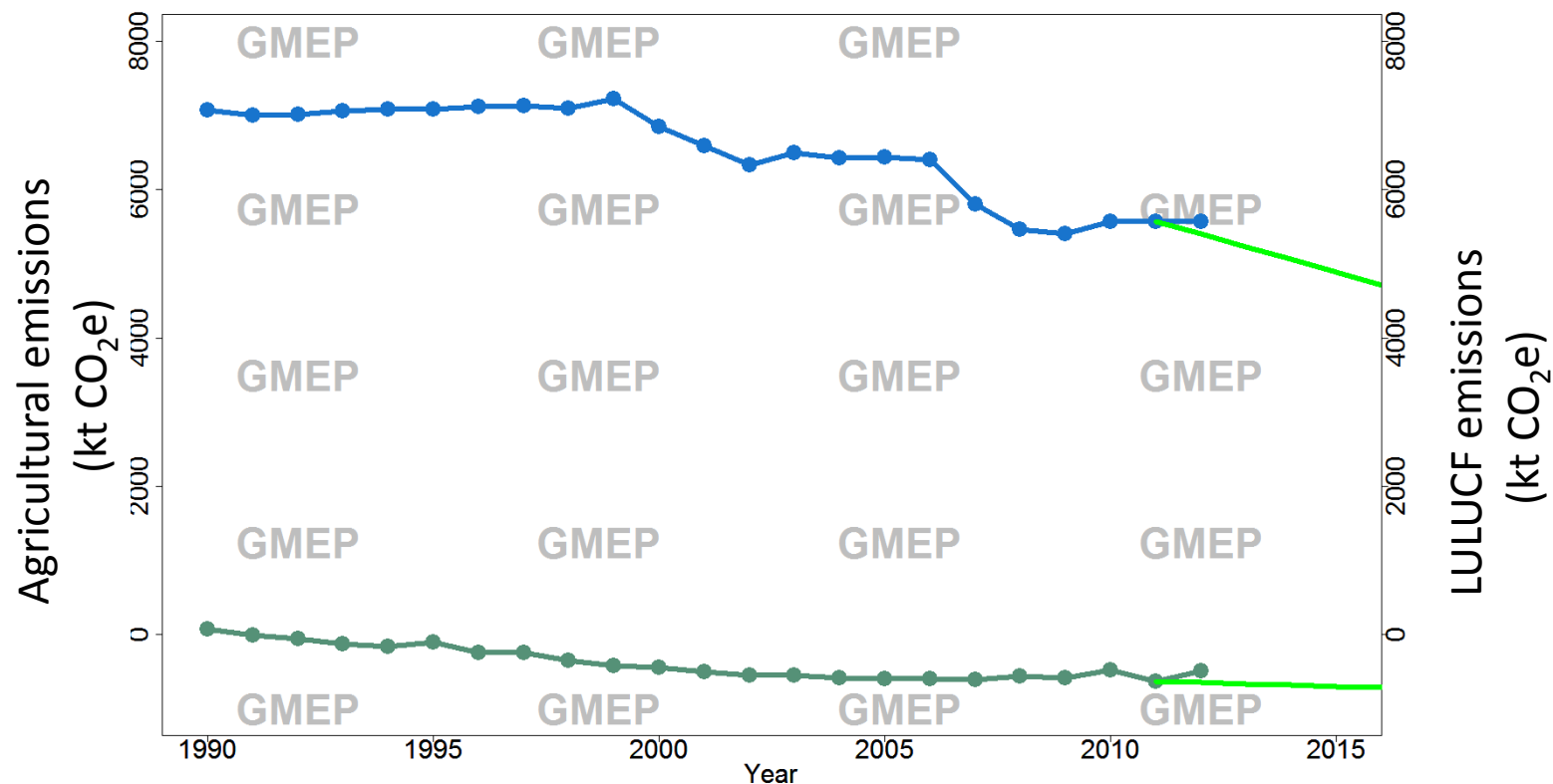
Methane sources 2012 (1996 IPCC Guidelines)



Land-based C sinks in Wales - 2012



Forestry does not compensate for agricultural GHG emissions in Wales

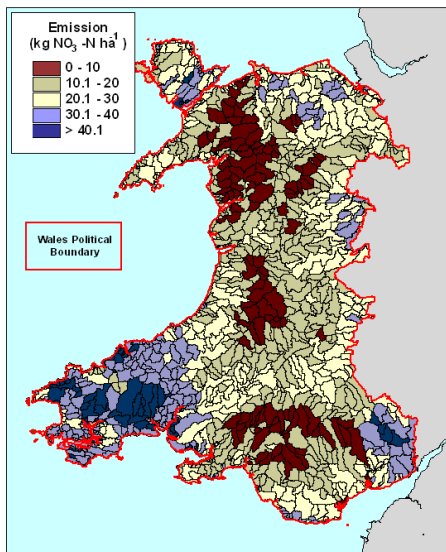


Set against a target 3% reduction (from baseline 2006-2010)

Diffuse water pollution in Wales

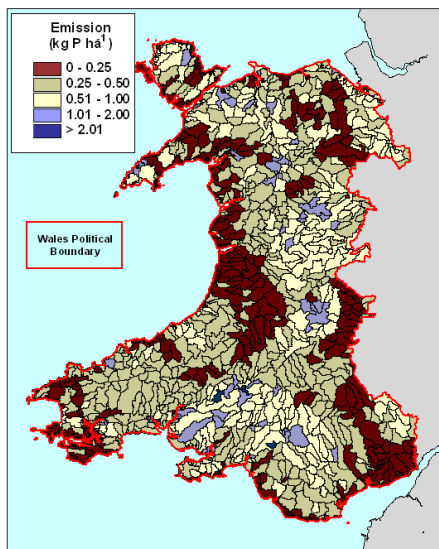
Nitrate

Present Day Modelled Nitrate Emission
from all Agricultural Land Including Commons



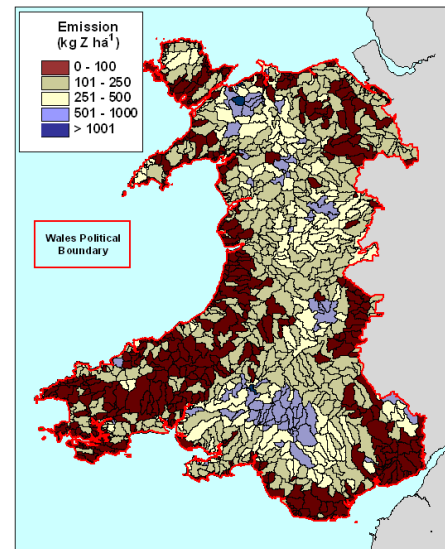
Phosphate

Present Day Modelled Phosphorus Emission
from all Agricultural Land Including Commons



Sediment

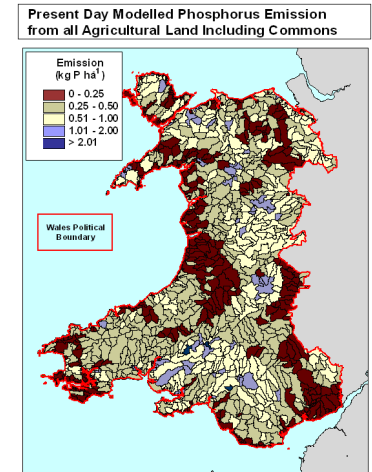
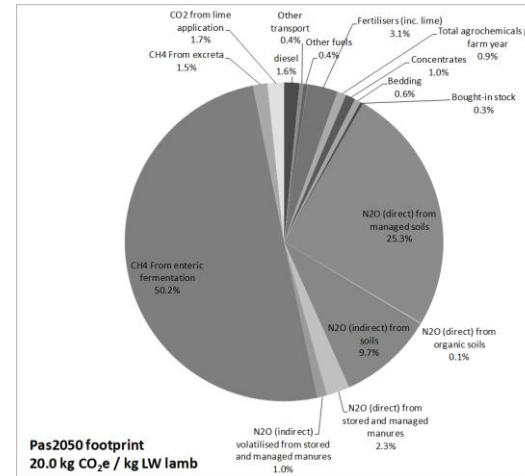
Present Day Modelled Sediment Emission
from all Agricultural Land Including Commons



% Pollutant Source	Nitrate	Phosphorus	Sediment
Bank Erosion	1.8	5.1	27.6
Urban and Road Runoff	2.3	6.4	7.1
Wood and Forest	3.5	1.1	2.4
Sewage Effluent	5.9	41.1	0.7
Septic Tanks	1.0	4.2	0.0
Agricultural Land	85.3	42.0	61.7

Approaches

Modelling
farm-scale
catchment-scale
national-scale



Surveys, interviews focus groups



Measurements



Potential Glastir impact on GHG emissions and carbon sequestration

Five Glastir measures

- i) No inputs – grazed permanent pasture
- ii) Grazing management of open country
- iii) Woodland margin extension
- iv) Create new streamside corridors
- v) Retain winter stubble

Modelled farms – Dairy, Lowland beef/sheep, Upland beef/sheep, Mixed

Compared baseline vs Glastir measure

Potential Glastir impact on GHG emissions and C sequestration – farm scale

Results - % change from baseline

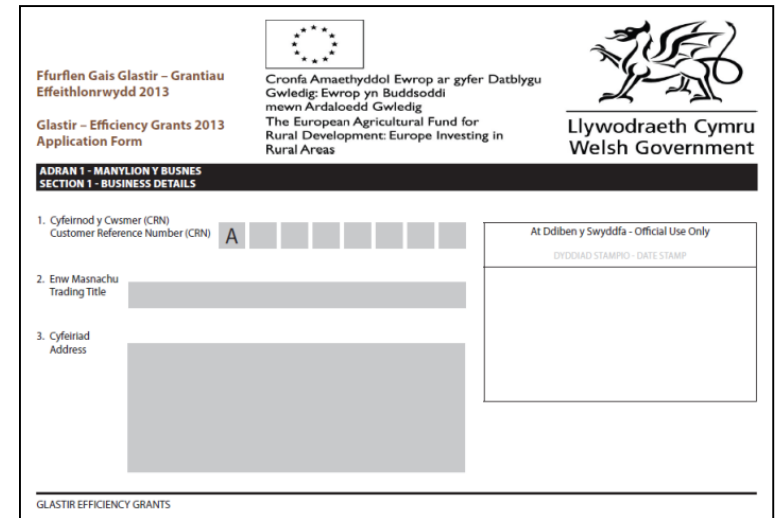
	GHG emissions	C sequestration
No inputs	-7	6
Open Country	-5	0
Woodland margin	-1.5	<0.1
Riparian Margin	-0.11	0.5

- Emission reductions linked to reductions in fertiliser N use and livestock numbers
- C sequestration linked to land use change

Glastir Efficiency Grants (2011-2013)

WG providing opportunity for grants to support

- Manure nutrient efficiency
- Energy use efficiency
- Water use efficiency

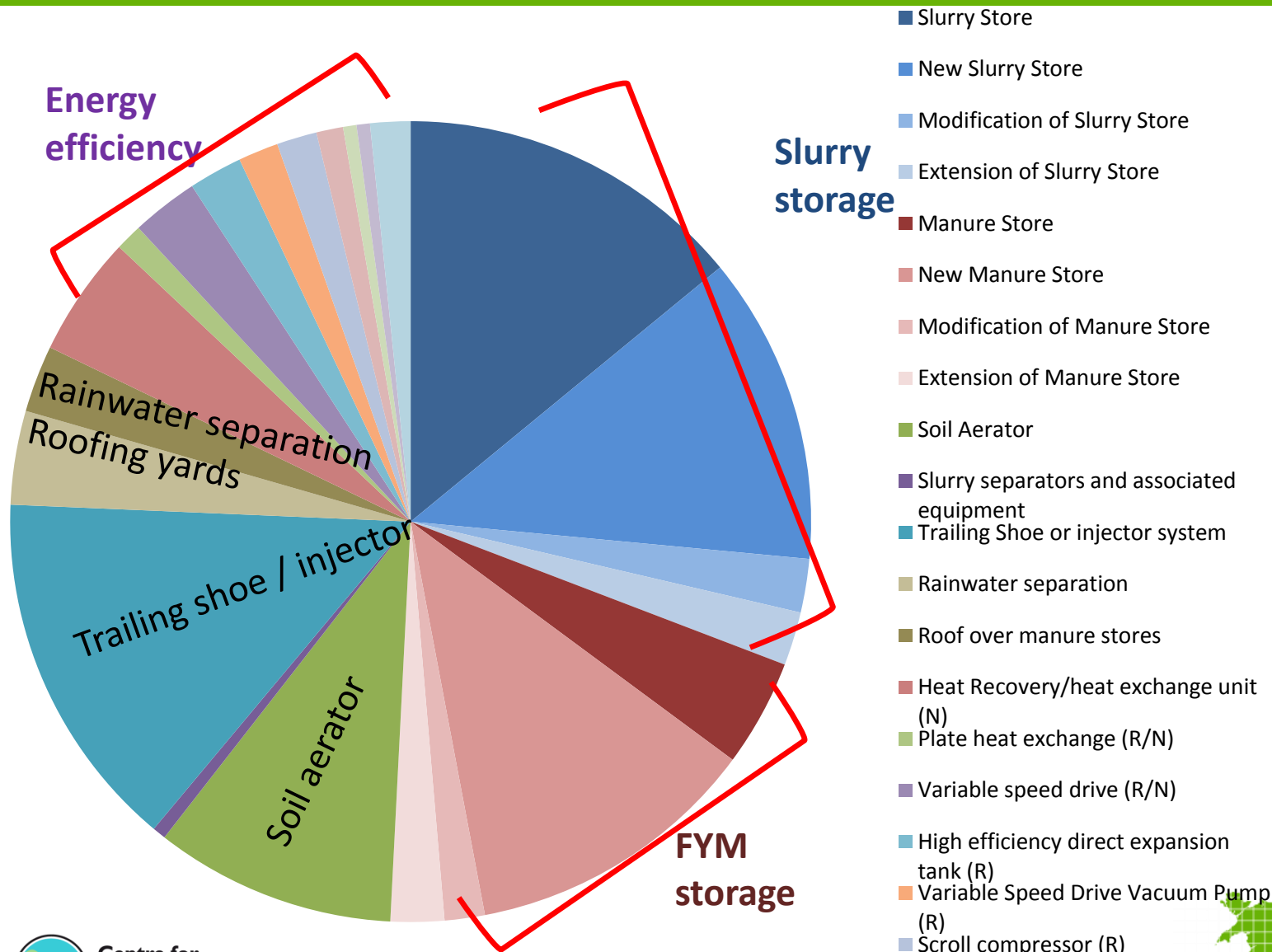


The image shows a screenshot of the 'Glastir - Efficiency Grants 2013 Application Form'. At the top, it features the European Union flag and the Welsh Government logo. The text includes 'Ffurflen Gais Glastir - Grantiau Effeithlonrwydd 2013' and 'Glastir - Efficiency Grants 2013 Application Form'. Below this, it states 'ADRAM 1 - MANYLION Y BUSNES SECTION 1 - BUSINESS DETAILS'. The form contains three main sections: 1. Cyfeirnod y Cwsmer (CRN) Customer Reference Number (CRN) with a grid of boxes, 2. Enw Masnachu Trading Title with a text box, and 3. Cyfeiriad Address with a large text box. On the right, there is a section for 'At Ddiben y Swyddfa - Official Use Only' with a 'DYDDIAD STAMPO - DATE STAMP' box. The bottom of the form is labeled 'GLASTIR EFFICIENCY GRANTS'.

Aims

- To assess the wider benefits of the GEGs
- Carbon footprinting at farm-level
- Economic impact at local / regional / national level

Glastir Efficiency Grants – grant numbers



Glastir Efficiency Grants - summary

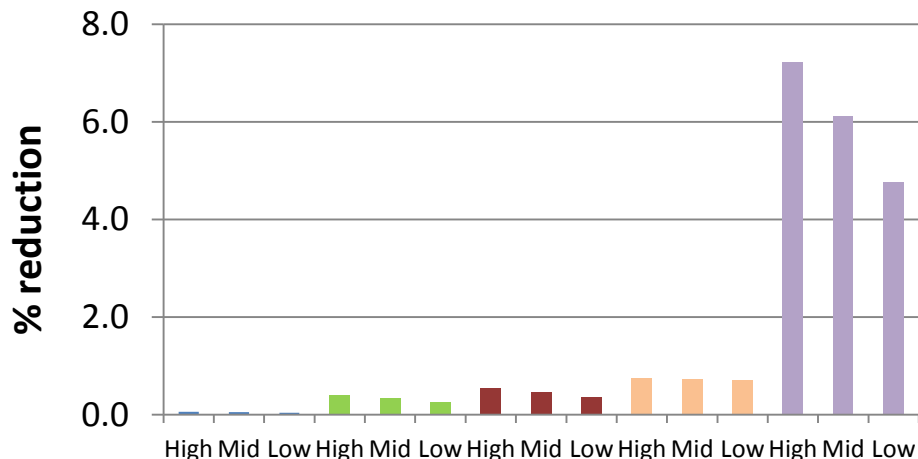
- Average farm CF was 10.2 t CO₂/ha/yr (2.4 t to 19.0 t CO₂e/ha/yr)
- Dairy farms (14.0 t CO₂e/ha/yr) was almost double that of LFA cattle and sheep farms
- Lamb for slaughter varied from 7.1 kg to 29.0 kg CO₂e/kg LW
- Typical footprint (CO₂e): CH₄ 47%, N₂O 24% and 'embedded' 28%
- C sequestration ranged from 0.5 to 1.6 t CO₂/ha/yr

% contribution to whole farm sequestration	Grassland soil	Woodland	Isolated trees	Hedges
	80 (+47 - +100)	13 (-5 - +34)	5 (+0.5 - +21)	7 (+0.4 - +26)

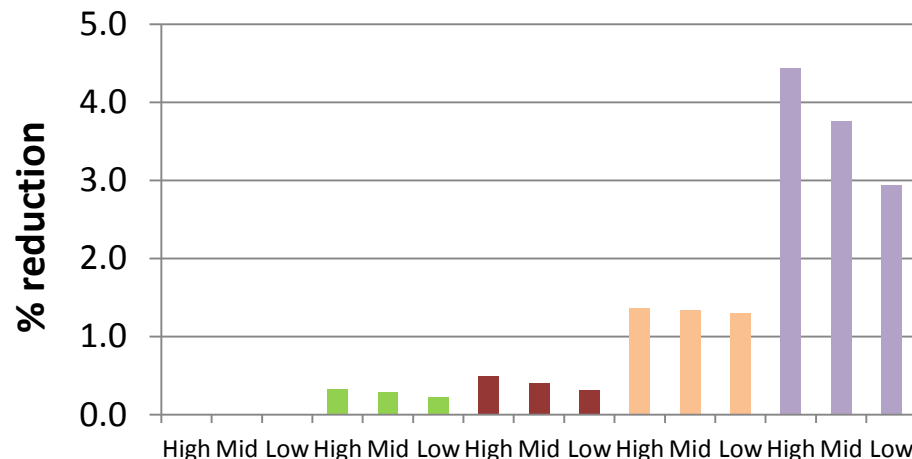
- Repeat C footprinting surveys of the 20 farms in 2016

National scale impacts on GHG emissions

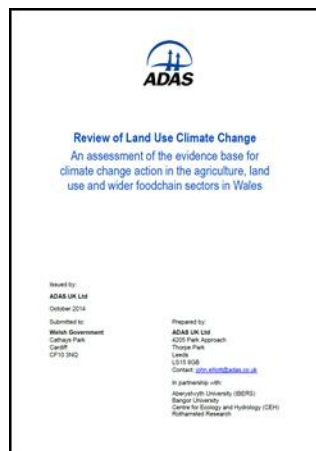
Nitrous oxide



Methane



- Winter stubbles
- Streamside corridors
- Woodland margins
- Open country
- Zero N



Review of Land Use Climate Change (2015) also concluded a 5-10% reduction in GHG emission possible

C sequestration – woodland creation

Discussion groups: farmers and local authority representatives

Summary of barriers:

Application process should be simplified.

- operation prescriptions are a barrier

Scheme needs to be more flexible

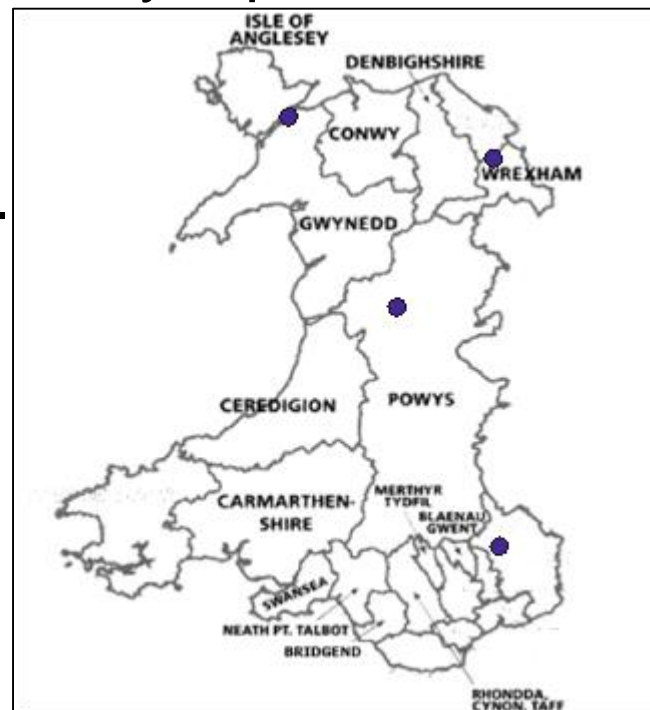
- to account for external influences

Auditing process is complex

- penalties need to be clearer, auditing process less threatening

Payment rates are obscure

- confusion about what is covered, rates for contractual labour



GHG measurements – grassland (eddy covariance methodology)

Henfaes (testing)

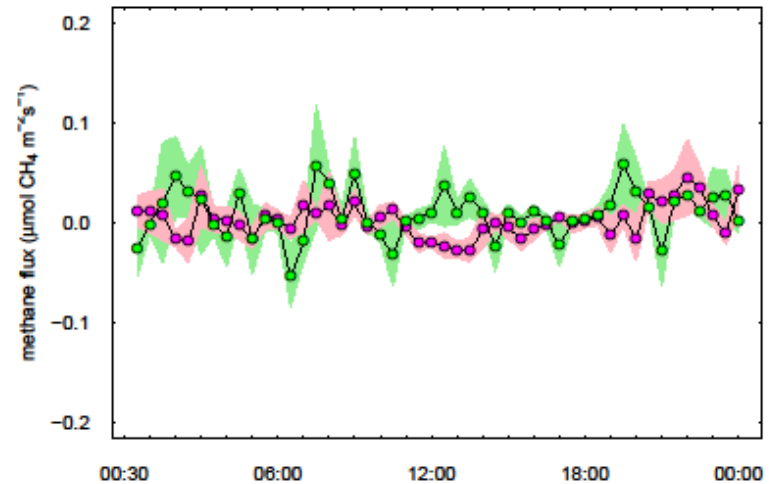
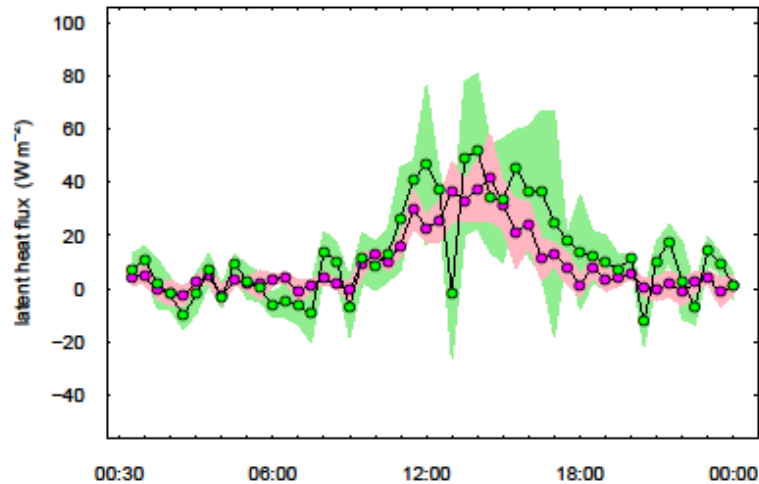
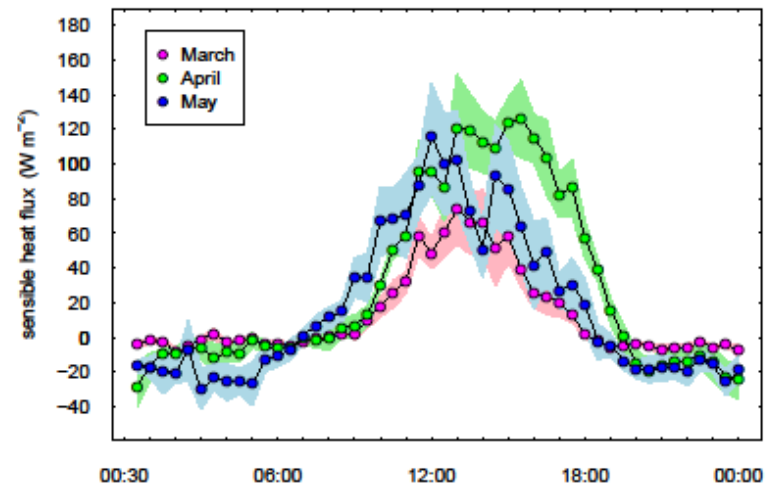
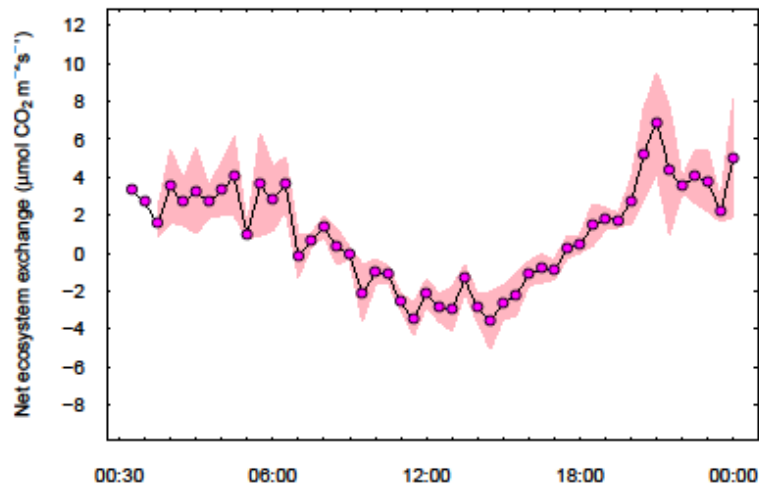
Cors Fochno, Borth



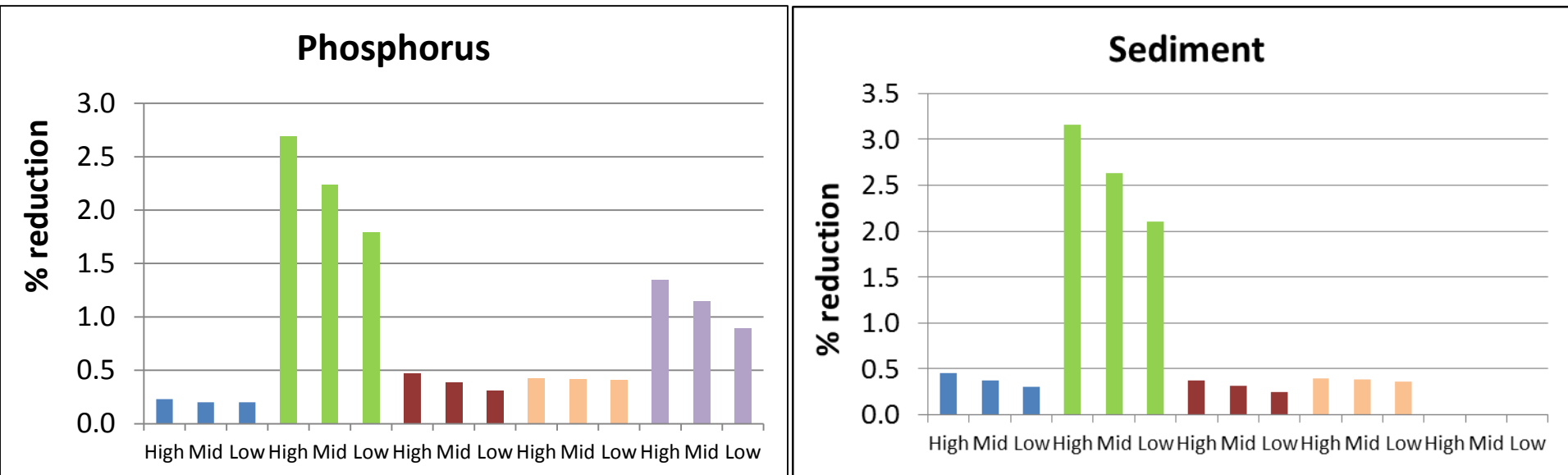
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Measurements - results

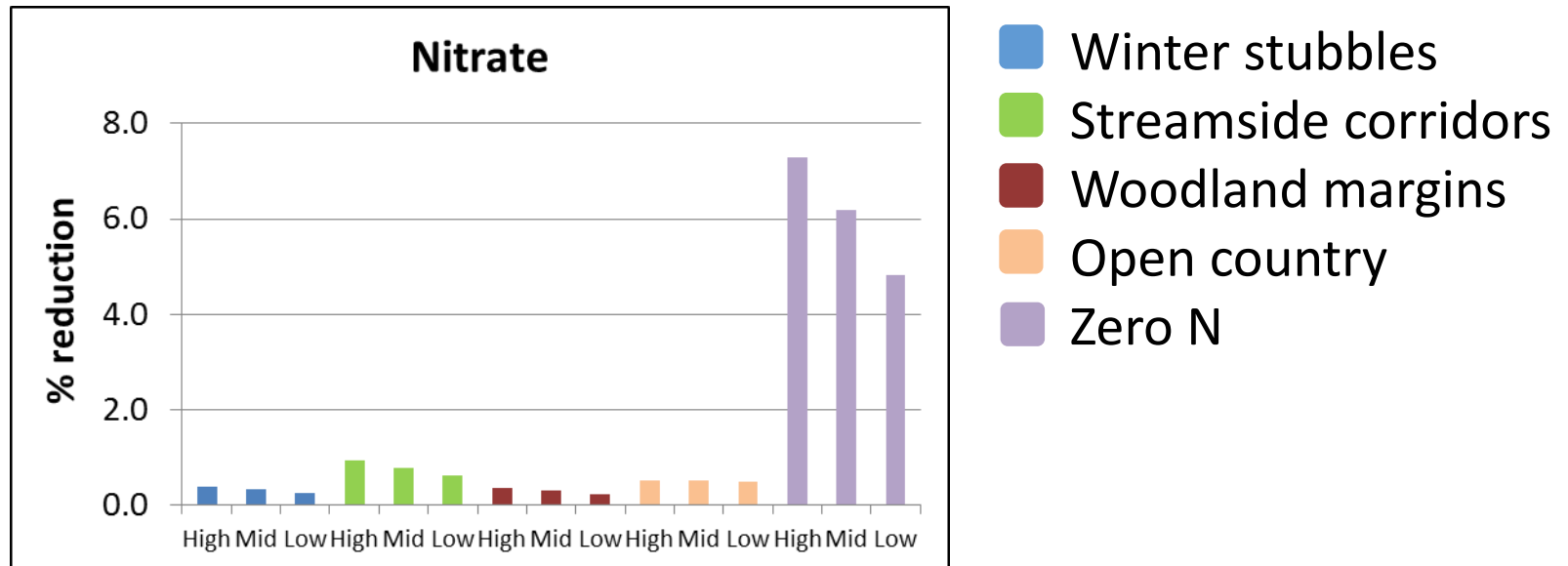


National scale impacts on diffuse water pollution



- Winter stubbles
- Streamside corridors
- Woodland margins
- Open country
- Zero N

National scale impacts on diffuse water pollution



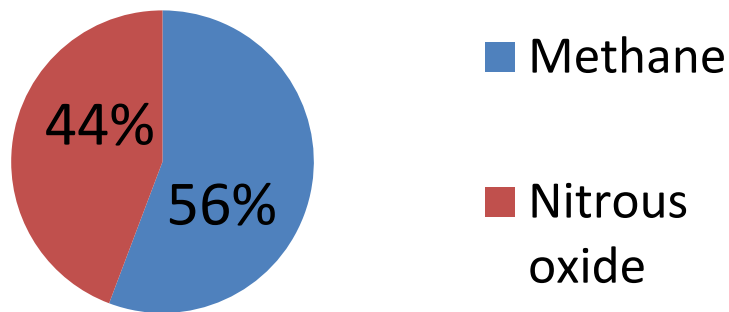
- Glastir measures offer opportunities to reduce DWPA from *source – mobilisation - delivery*

Plans

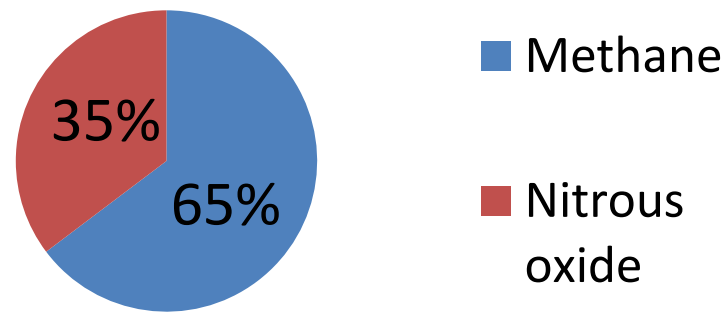
- Re-survey 'modelled' farms and assess impacts of Glastir Efficiency Grants on GHG emissions and C sequestration
- Continued N₂O, CH₄ and CO₂ measurements to validate models
- Wales Farm Practice Survey to assess real changes on the ground resulting from farm payments to inform model scenarios

Recent changes in GHG inventory – implications for Glastir impacts

2012 (1996 GL)



2012 (2006GL)



UK *GHGPlatform* projects – developed new emission factors

- N_2O EFs for deposited N, manure N, fertiliser N (arable land) have reduced significantly
- Methane will become even more dominant
- Total GHG emission will reduce

Thanks

- GEGs Farmers
- Farmers and Local Authority reps – Woodlands Discussion Groups
- Collaborators: Mohamed Abdalla, Steve Anthony, Chris Evans, Anna Jones, Janet Moxley, Pete Smith, Rachel Taylor