Measuring and Managing Biofuel Carbon Intensity –

UK evidence and experience

Overall GHG impact of biofuels and bioenergy

JRC seminar, COP15, Copenhagen

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Outline

- The importance of biofuel sustainability
- UK GHG-savings from biofuels
  - Lessons from the UK experience
- Measuring indirect emissions
- Policy options for managing indirect emissions
- Next steps for policy makers

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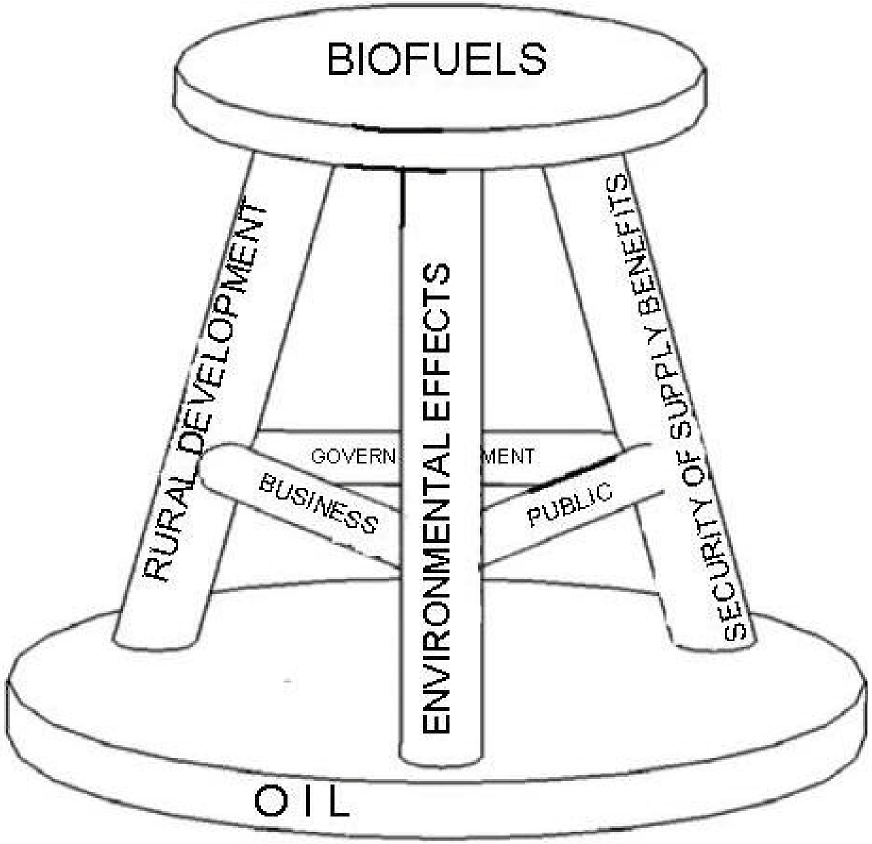
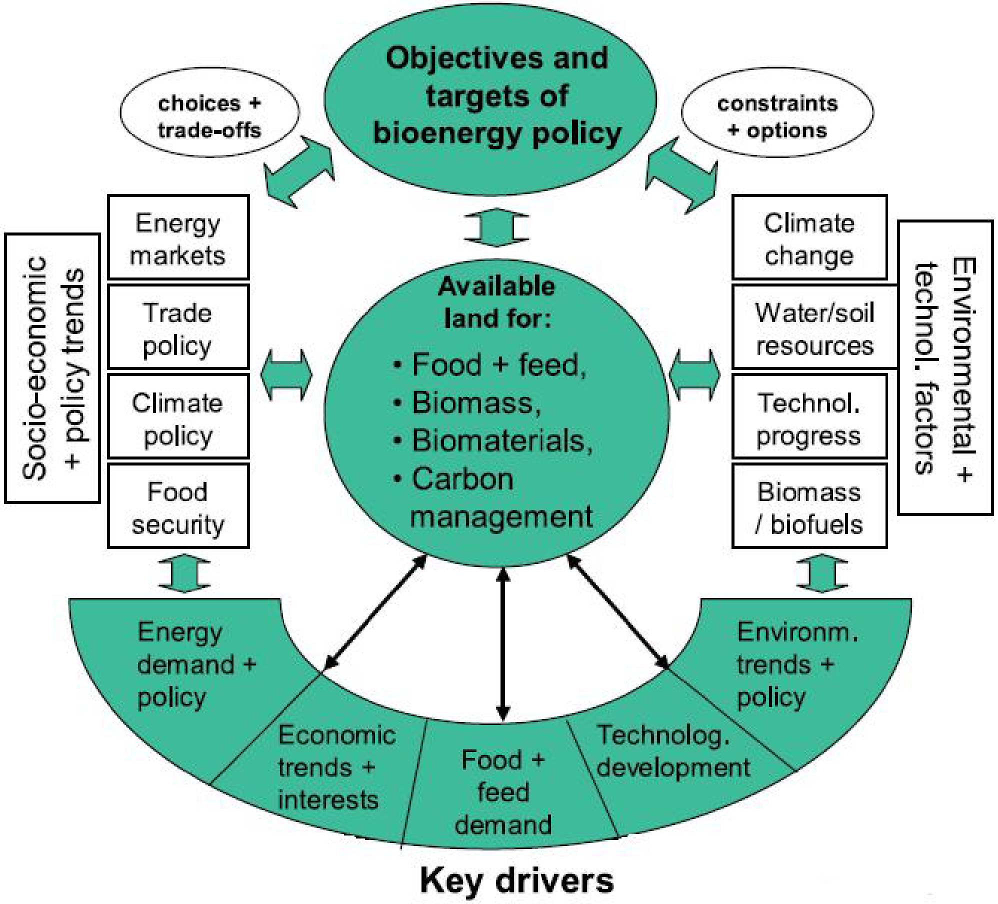
Complex interactions between food, bioenergy and environment create both opportunities and risks





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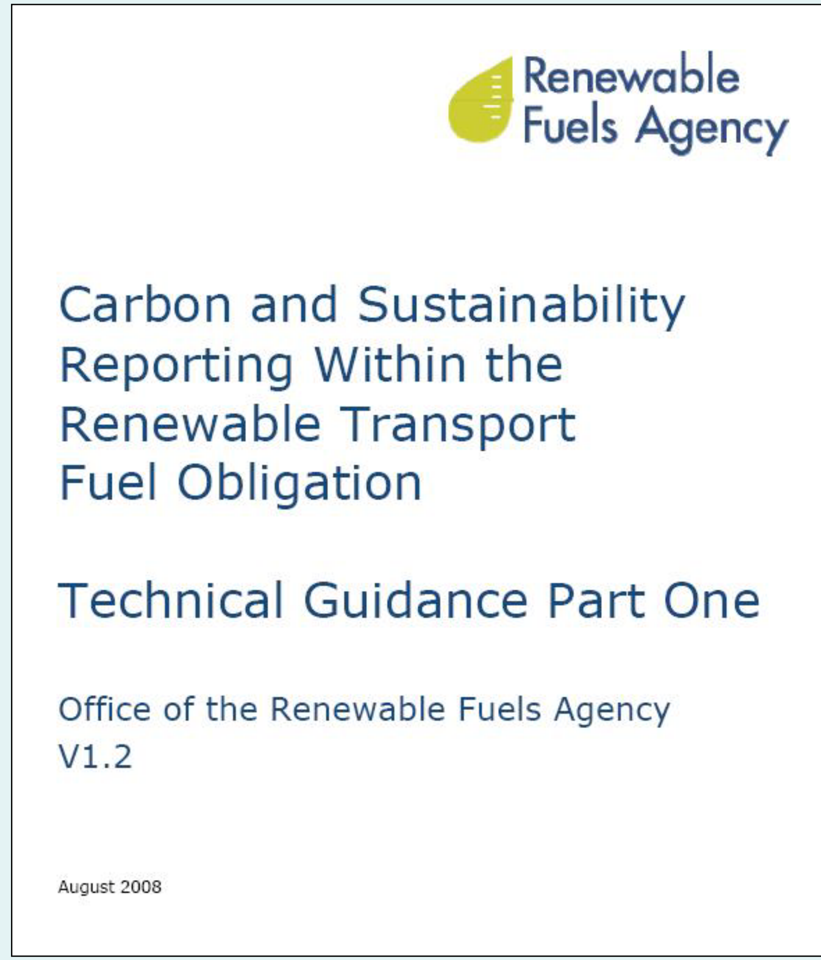
IEA Bioenergy

The UK operates the world's only (current) national biofuel carbon and sustainability assurance scheme

- Requirement of the UK Renewable Transport Fuels Obligation
- Requests data on biofuel batch sustainability and carbon intensity
- Encourages supply of more sustainable biofuels
  - Company performance published and compared against targets
- Increases awareness & understanding
- Practical but robust
- Non-discriminatory
- Developed through a multi-stakeholder process
  - Consultancy support from Ecofys / E4tech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Carbon and Sustainability Reporting Within the Renewable Transport Fuel Obligation

Technical Guidance Part One

Office of the Renewable Fuels Agency
V1.2

August 2008

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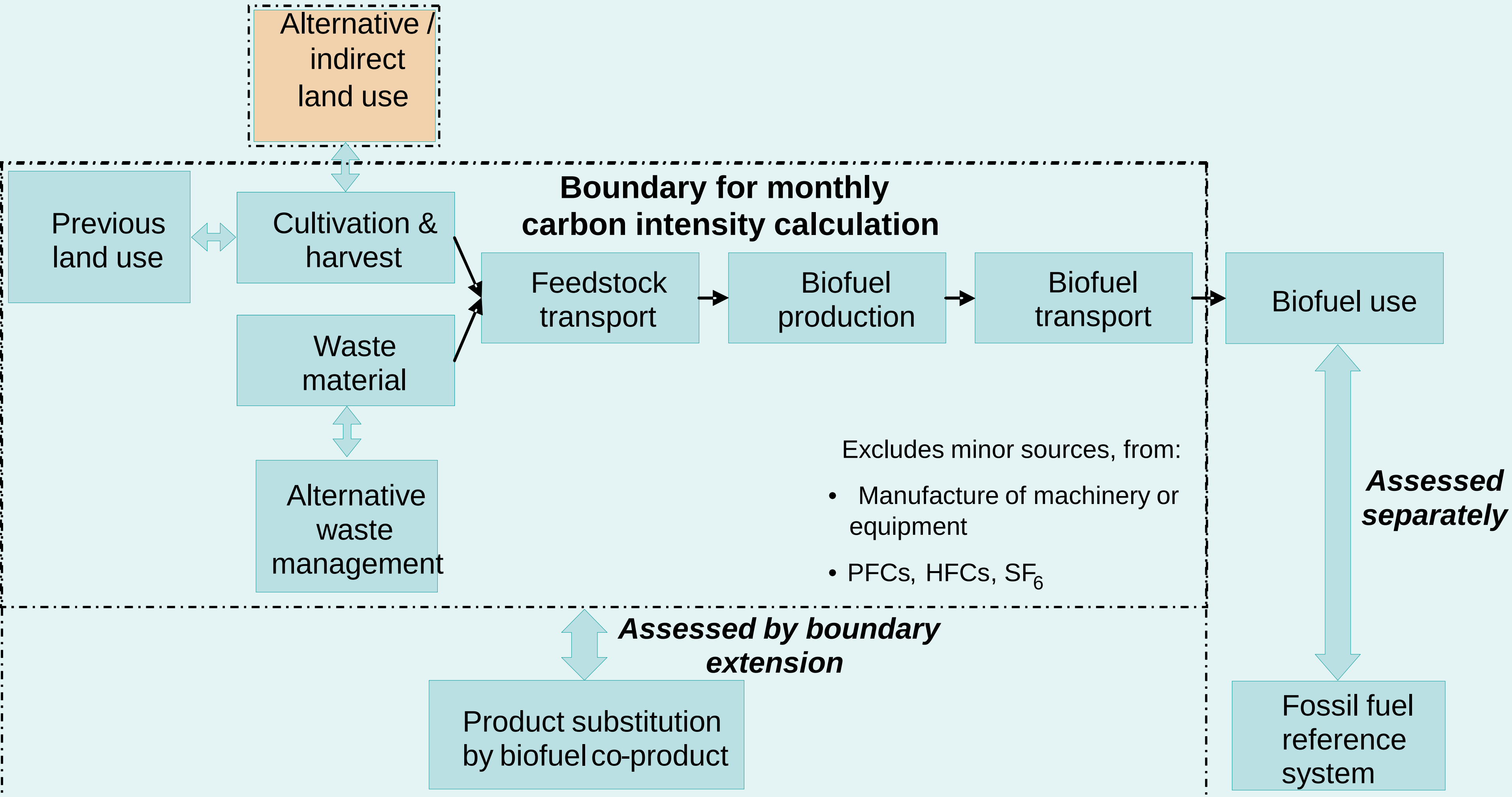
Carbon Intensity calculation considers direct land use change and co-products but not indirect or alternative land uses



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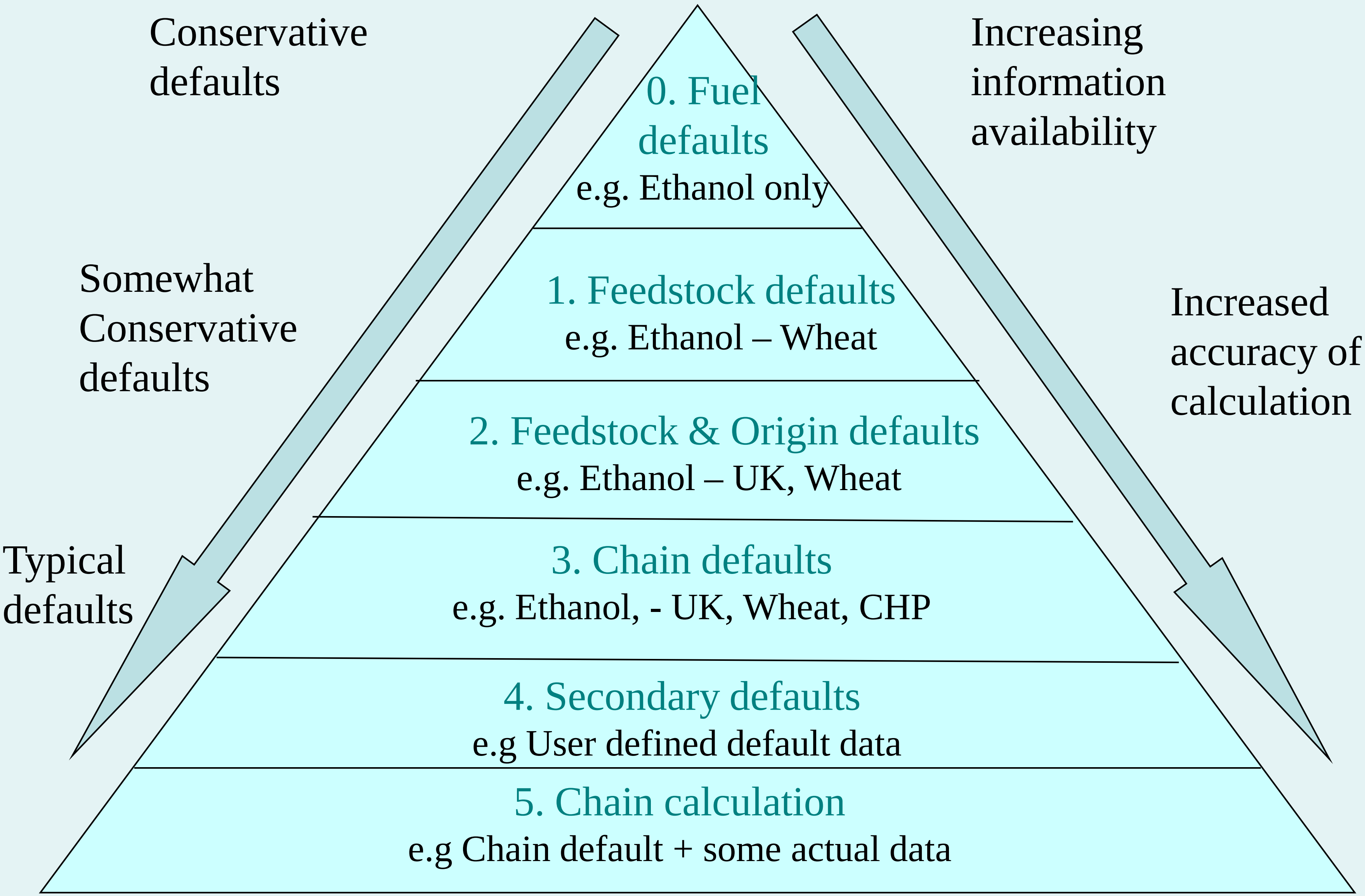
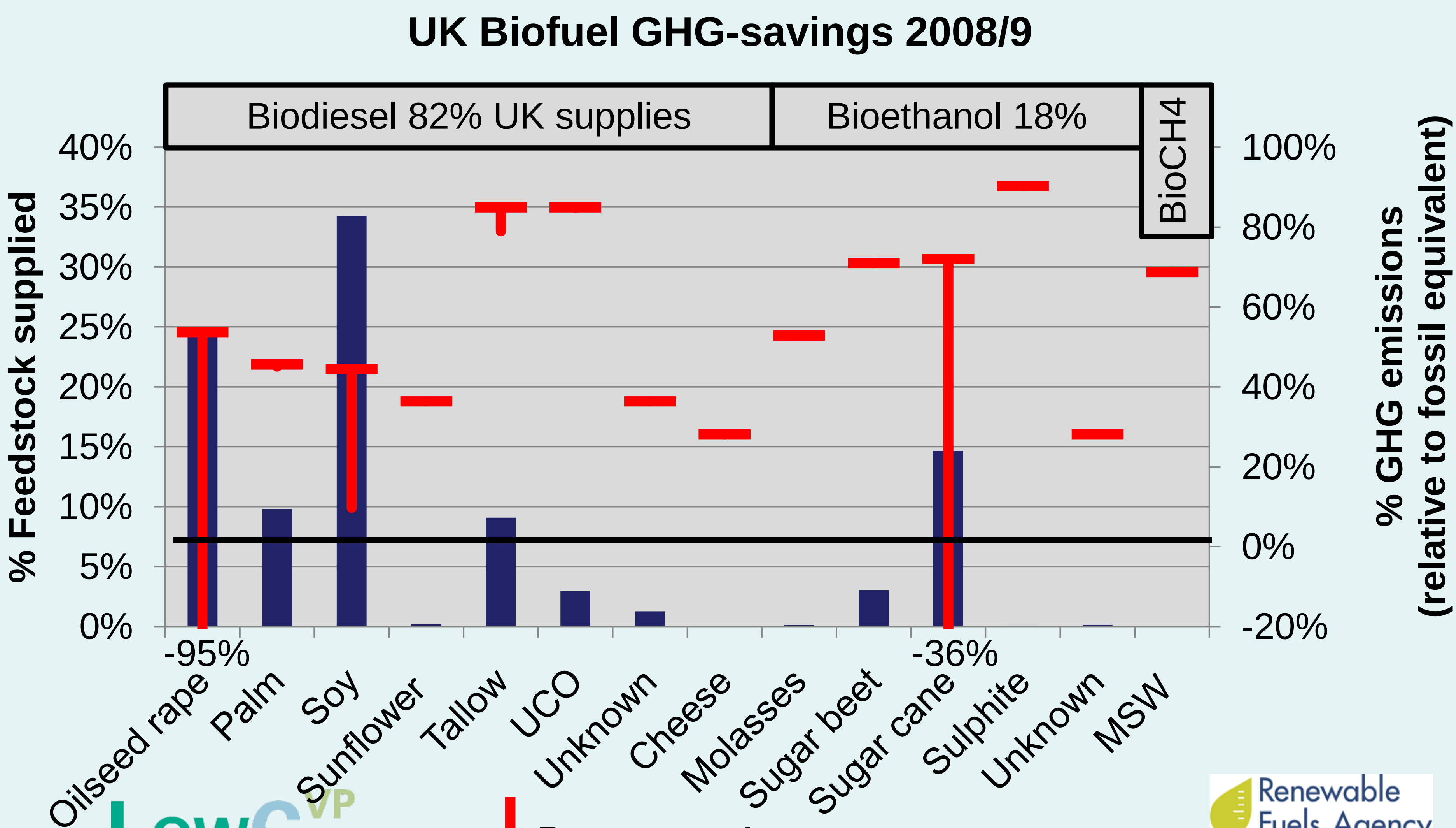
Flexible carbon intensity calculation allows tiered default values and real data



UK biofuel GHG-savings averaged 47% - with wide variations between and within feedstocks



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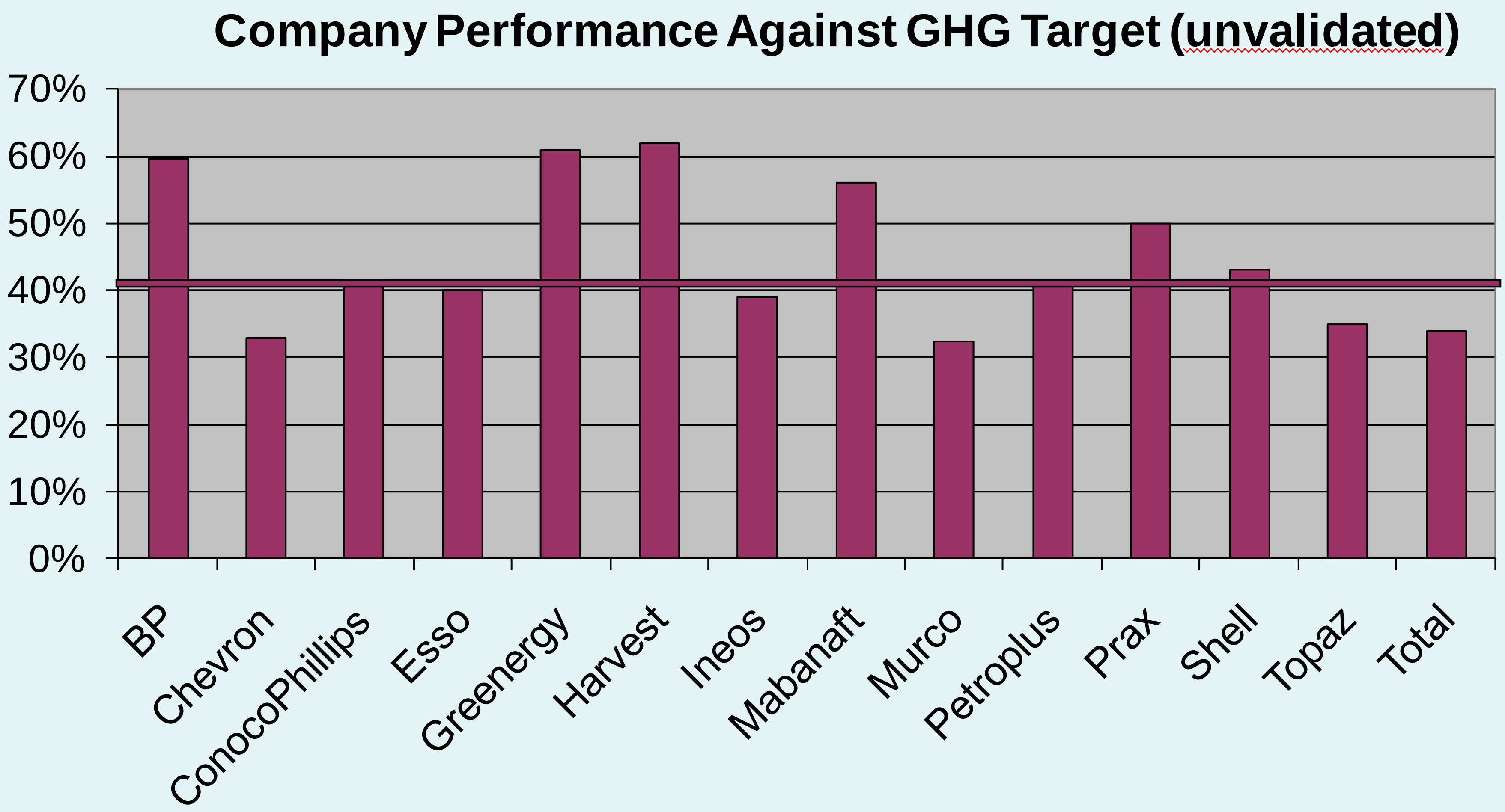
There is a wide range of company performance compared to the Government target



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Few companies are consistently achieving targets

Targets met 2008-9 (out of 3)	***Fossil fuel company***	**Targets met Oct 09**
3	*ConocoPhillips Ltd*	3
	Mabanaft UK Ltd	3
	Greenergy Fuels Ltd	2↓
	Prax Petroleum Ltd	
	BP Oil UK Ltd	2
	Harvest Energy Ltd	2
	Ineos Refining Ltd	2
	Petroplus Refining Teesside Ltd	1↓
2	*Shell UK Ltd*	2
	Chevron Ltd	0↓
	Esso Petroleum Company Ltd	0↓
	Murco Petroleum Ltd	0↓
	Topaz Energy Ltd	
1	*Total UK Ltd*	0↓

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Key lessons from the UK experience

- Reporting delivers some GHG-benefits – but incentives are needed
- Verification of chains of custody is possible and cost-effective
- Flexibility and simplicity is essential
- Feedstock markets are global
  - Limited agri-environmental assurance

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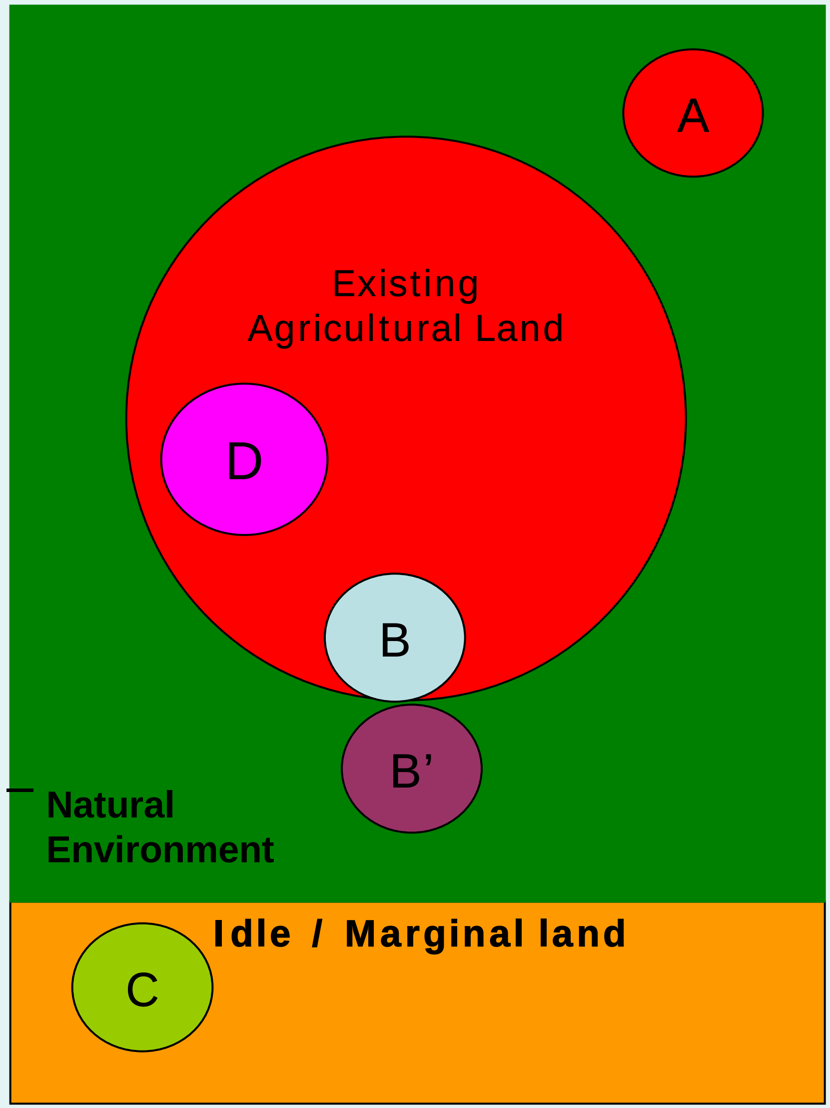
Indirect effects on land use and food prices have emerged as a key concern and future legislative driver

A — Direct Land use change

B — Indirect Land use change

C — Non-agricultural land - No land use change

D — Productivity improvement – No land use change



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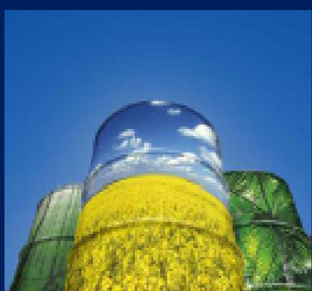
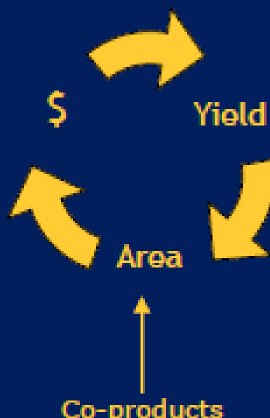
Quantifying indirect emissions from increasing biofuel supply is highly uncertain

Biofuel Mandates

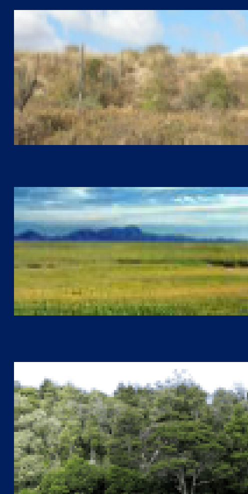


1. Market response?



I. Food prices and consumption

2. Types of LUC?



II. Biodiversity impacts

3. Carbon stocks?

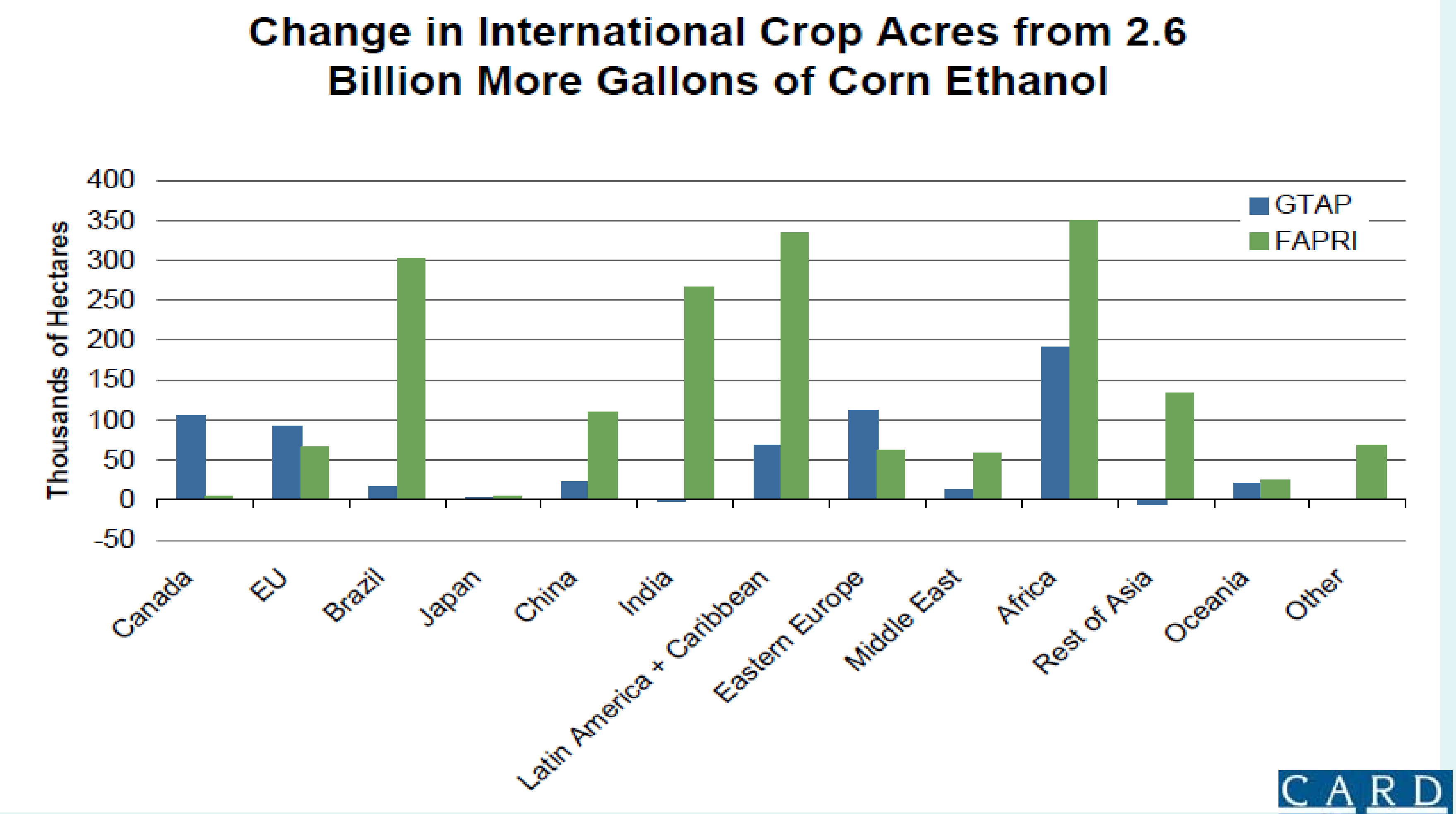
C-stocks

4. Time / allocation?

g CO_2/MJ

III. GHG impacts

Models estimating the scale and location of land use change produce inconsistent results



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CARD

Studies quantifying iLUC have produced widely differing results – but all show ILUC is significant

Modelling study inputs and outputs for quantification of ILUC from corn ethanol

		RFS	**LCFS**	**Searchinger**	**IIASA**
Cropland expansion	ha/toe	0.29	0.17	0.38	0.17
LUC emissions	tCO2eq/ha	288	235	351	219
Time allocation	Years	30	30	30	30
LUC emissions	gCO2eq/MJ	56	32	103	30

Fossil Fuel comparator 86-96 gCO2eq/MJ

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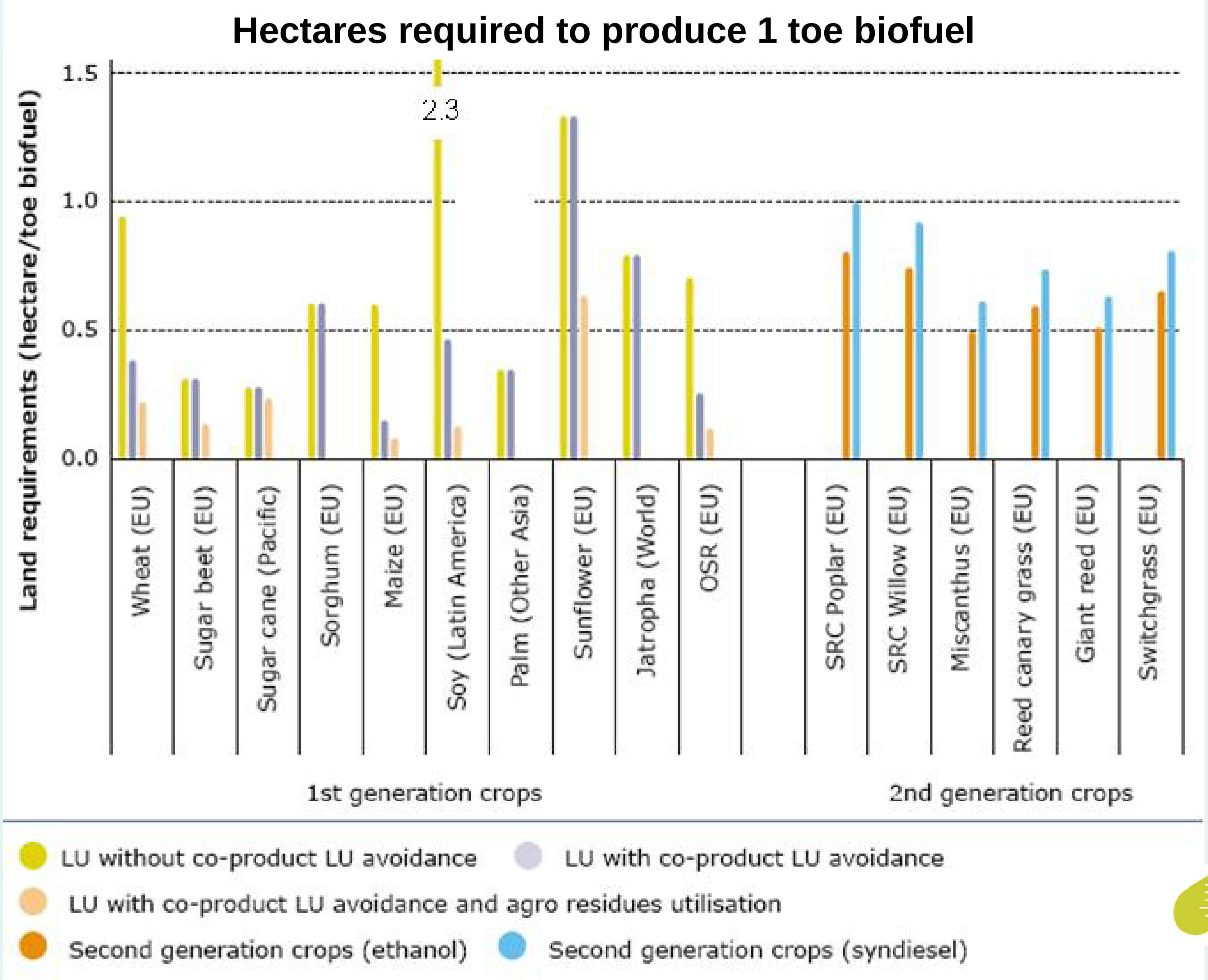
ECOFYS

Co-products significantly reduce land demands - most current models fail to quantify this effect



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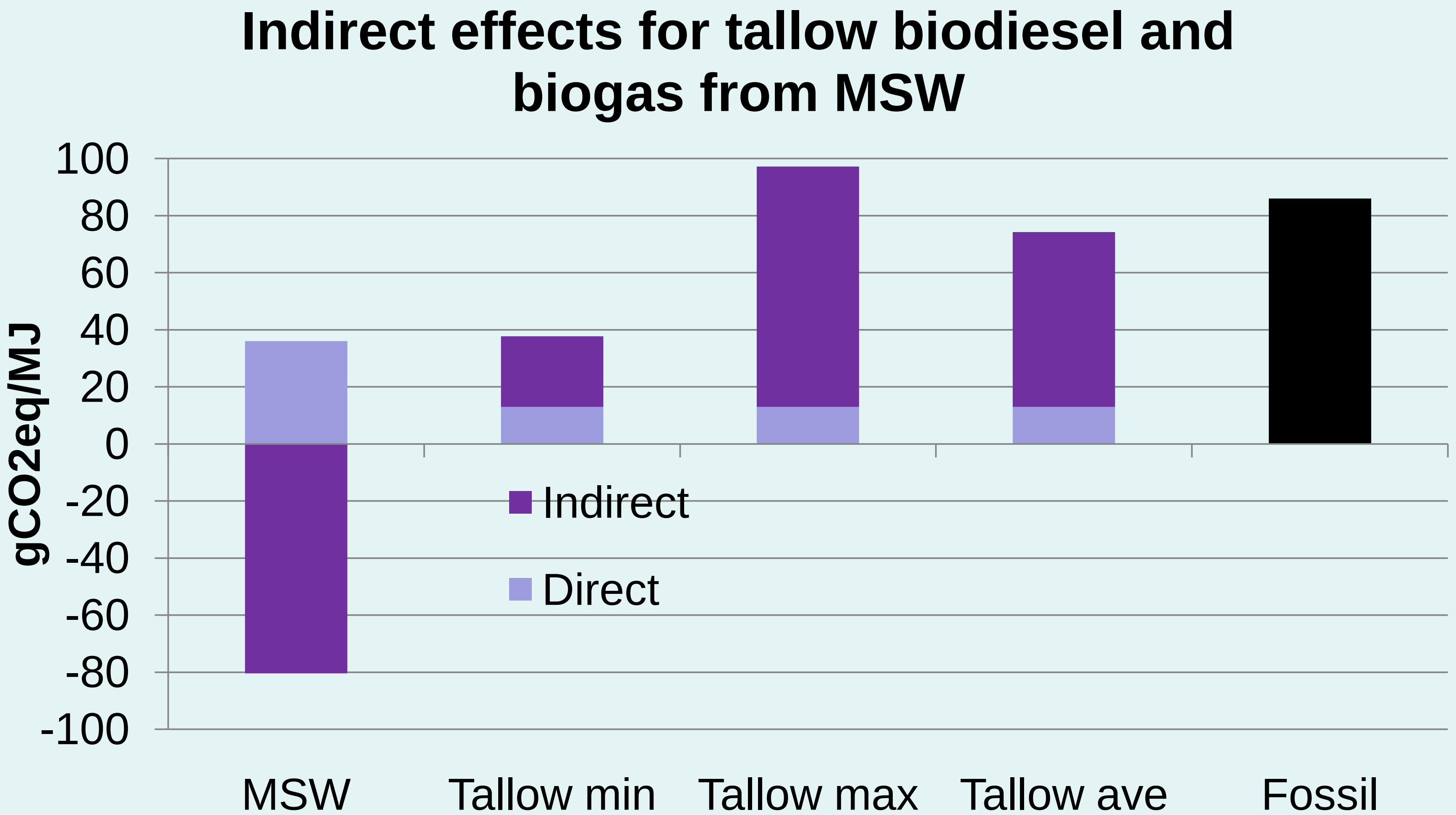
Inelastic supply of wastes and residues can creates both positive and negative iLUC



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ILUC factor assessment principles

- Take account of:
  - Increasing global agricultural demand for food, feed, fibre and fuel
  - Global biofuel demand
  - Anticipated yield improvements
  - Changes in inputs for use of marginal land
  - Avoided land use through co-products and price induced yield improvements
  - And quantify uncertainties
  - Practices / feedstocks that avoid ILUC
  - Indirect effects from non-crop feedstock
- Ensure modelling is transparent and peer reviewed
- Update regularly

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iLUC can be mitigated through both global and local approaches

Global

- Prevent unwanted "direct" LUC, globally and for all sectors
- Reduce pressure on land from the agricultural sector:
  - increasing yields
  - Build supply chain efficiencies
  - Reduce consumption

Local

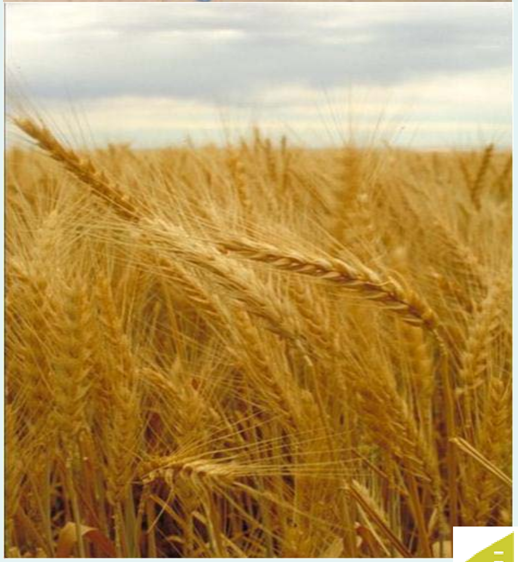
- Expand production at the project level in ways that minimise the risk of unwanted indirect impacts
  - Use "unused" land
  - Increase productivity of existing bioenergy systems
  - Increasing productivity of non-bioenergy systems (integration)
- Use non-energy crop biofuels: (e.g. from residues or algae)

Diverse case-studies demonstrate opportunities for mitigating iLUC

Palm oil production on imperata grasslands

Liberia smallholder yield increases

Co-production of cattle and sugar cane or soy



EU wheat production

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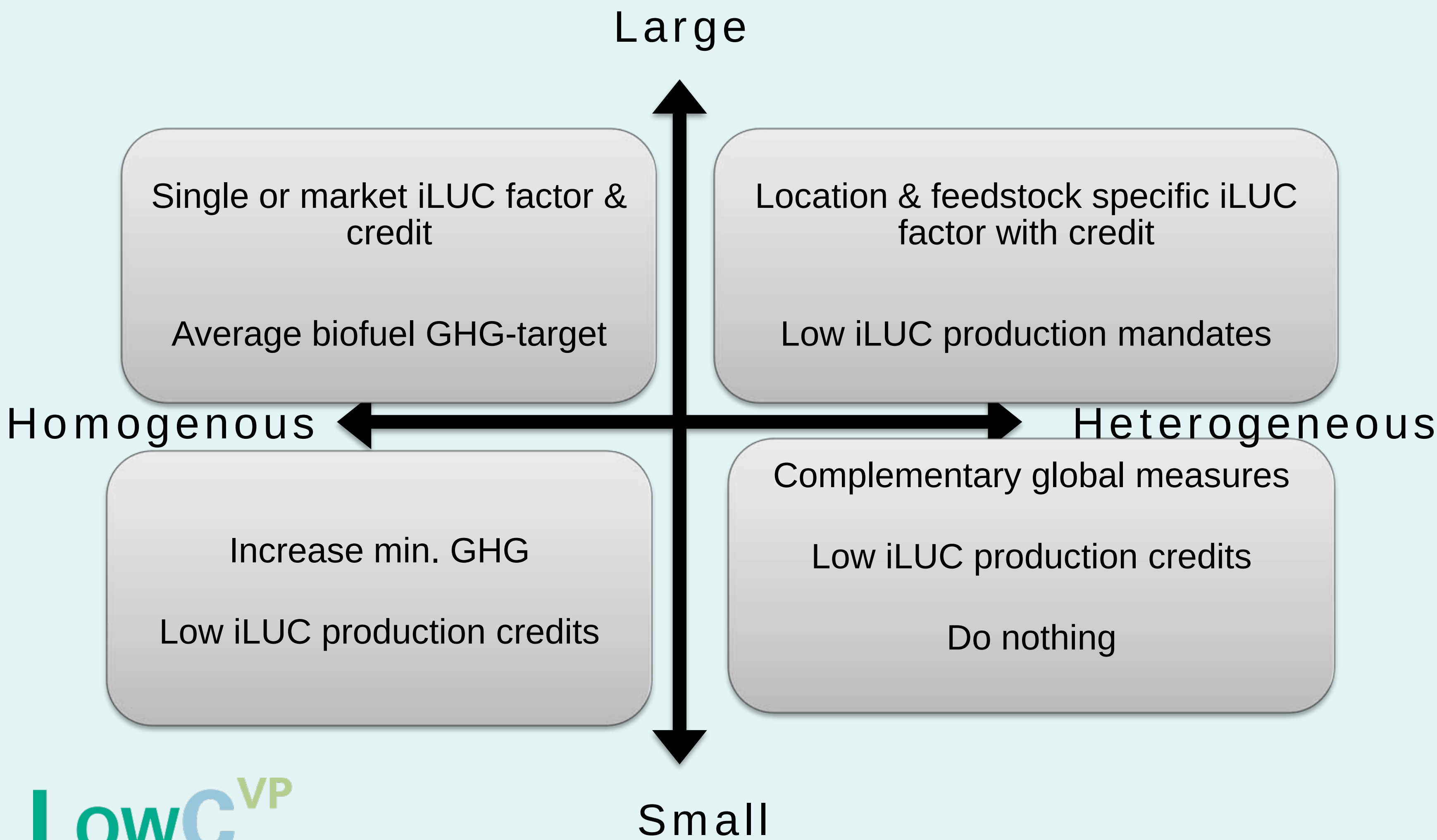
The appropriate policy response depends upon the scale of the ILUC effect and its homogeneity



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Conclusions

- Biofuel offer huge potential benefits – but most current policies and production are not sustainable
- Biofuels will only deliver GHG-benefits if increased production avoids causing land use change
- A robust chain of custody can be established to quantify carbon intensity
- Incentives are needed to reward sustainably produced, low carbon intensity biofuels
- iLUC quantification is highly uncertain but effects are real and material
  - Appropriate assessment principles can be defined but no studies to date adequately meet these
  - Positive and negative indirect effects also occur for wastes and residues
- Opportunities to mitigate iLUC at the global, regional and local level offer considerable potential and need greater attention
- The appropriate policy response depends upon the extent to iLUC effects are homogeous between locations and feedstocks
  - An iLUC factor with credits for low iLUC practices offers **one** solution – if the science can be improved
- Capturing emissions and compensating countries for avoiding LUC is essential

Any Questions?

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Accelerating a sustainable shift to low carbon vehicles and fuels in the UK

Stimulating opportunities for UK businesses

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Data is compiled on feedstock origin, sustainability and carbon intensity

General Information				Sustainability Information				Carbon Information	
Fuel type	Quantity of fuel (litres)	Biofuel Feedstock	Feedstock Origin	Standard	Env Level	Social Level	Land use on 30 Nov 2005	Carbon intensity incl LUC g CO_2e / MJ	Accuracy level
Bioethanol	250,000	Wheat	UK	LEAF	QS	-	Cropland	61	2
Bioethanol	100,000	Wheat	France	GlobalGAP	-	-	Grassland	122	2
Bioethanol	250,000	Sugar beet	UK	ACCS	QS	-	Cropland	35	5
Bioethanol	1,000,000	Sugar cane	Brazil	Meta-Standard	RTFO	RTFO	Cropland	24	2
Bioethanol	500,000	Unknown	Unknown	Unknown	-	-	Unknown	61	0
Biodiesel	1,000,000	Oilseed rape	UK	ACCS	RTFO	RTFO	Cropland	55	2
Biodiesel	250,000	Oilseed rape	Unknown	Unknown	-	-	Unknown	55	2
Biodiesel	500,000	Palm oil	Malaysia	RSPO	QS	QS	Cropland	45	2
Biodiesel	500,000	Soy	Argentina	Basel	QS	QS	Grassland	177	2
Biodiesel	250,000	UCO	UK	By-product	QS	QS	By-product	13	2
Biomethane	150,000	Dry manure	UK	By-product	QS	QS	By-product	36	2

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It's easy really ……!

Additional biofuel demand	Area expansion	Types of LUC	Carbon stocks	Time allocation
MJ/y (D)	ha/MJ (A)	type (L)	CO2eq/ha (per type) (C)	y (T)

- Choice of feedstock
- Treatment of co-products
- Agricultural intensification <-> demand
- Food consumption <-> food price

Types of LUC caused by cropland expansion

Carbon stocks of land used for cropland expansion

Time allocation of GHG emissions from LUC

$$\text{GHG impact} = \frac{A \times L \times C}{D \times T}$$

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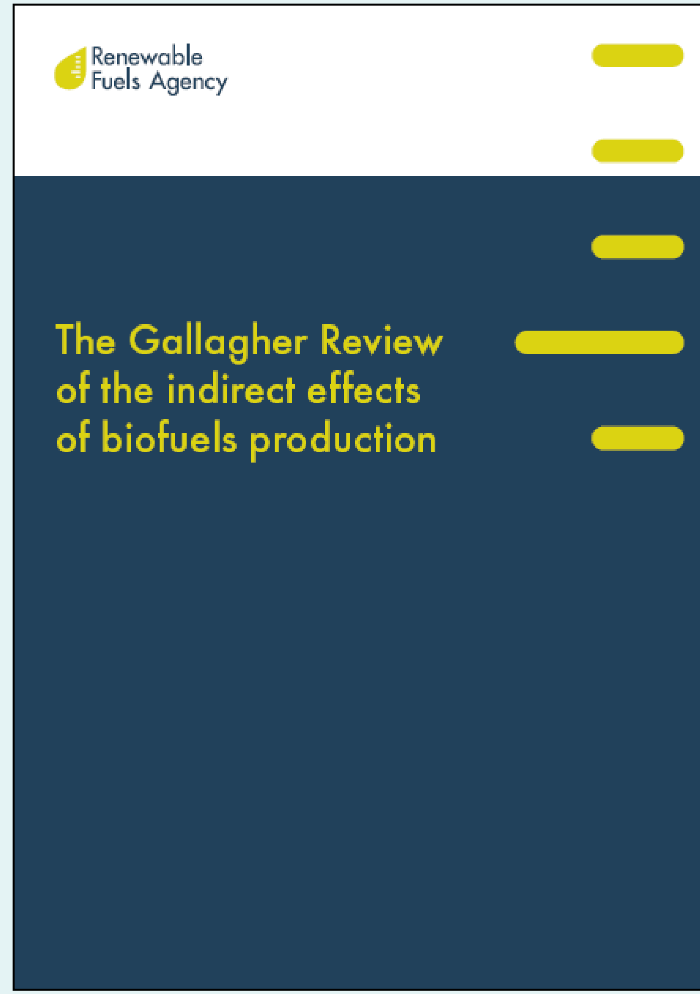
The Gallagher Review concluded indirect effects are real and significant

- There is a future for a sustainable biofuels industry – but, feedstock production *must* avoid agricultural land that would otherwise be used for food production
- Current policies will reduce biodiversity and may even cause greenhouse gas emissions
- The introduction of biofuels should be significantly slowed until adequate controls to address displacement effects are implemented and are demonstrated to be effective
- A slowdown and shift in biofuel feedstock production will reduce the impact of biofuels on food commodity prices that have a detrimental effect upon the poorest people



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Direct land use change arising from biofuel feedstock cultivation usually causes net GHG-emissions

Table 2.1: Illustrative GHG savings and payback times for biofuel feedstock causing land change[13]

Fuel chain	Assumed country of origin	GHG saving excluding the impacts of land-use change	Carbon payback (years)	
		%	Grassland	Forest
Palm to biodiesel	Malaysia	46%	0 – 11	18 – 38
Soya to biodiesel	USA	33%	14 – 96	179 – 481
Sugarcane to bioethanol	Brazil	71%	3 – 10	15 – 39
Wheat to bioethanol	UK	28%	20 – 34	80 – 140

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