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Bioenergy and Land-use change

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PRIFYSGOL ABERYSTWYTH UNIVERSITY

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THE UNIVERSITY of York

Ecosystem Land Use Modelling & Soil Carbon Flux Trial

Aim to reduce uncertainty in carbon savings from perennial bioenergy feedstocks in the UK

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GHG balance from cultivation

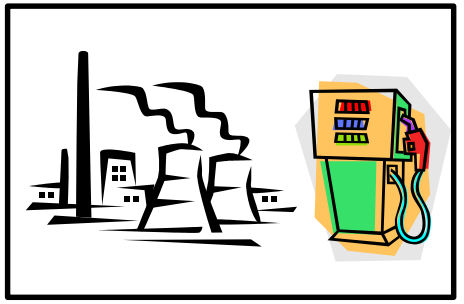
CO_2 CH_4 N_2O

Soil carbon stock change

Indirect N_2O

harvesting, drying, processing, transport

combustion

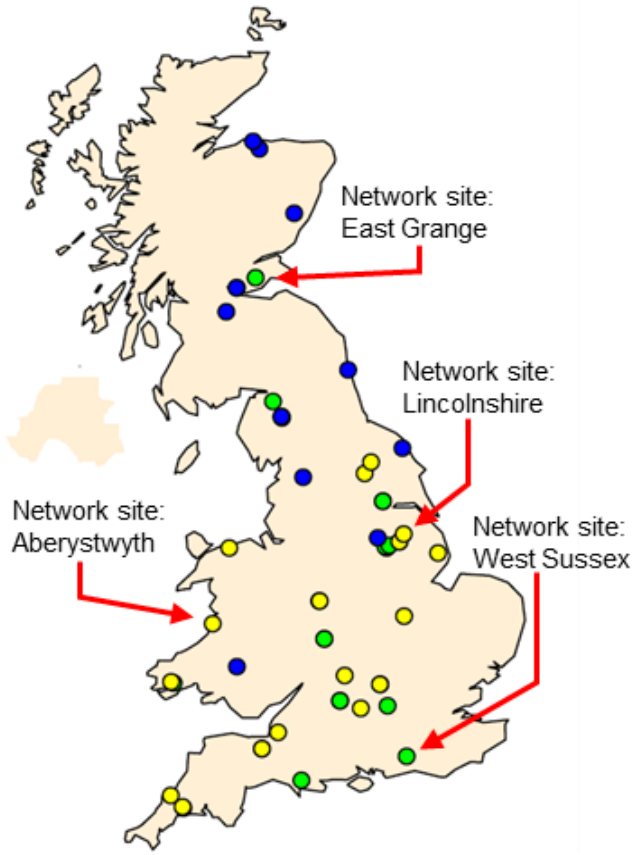


Co-products from biofuel production

Effects of land-use change and management: crop/ fertiliser/ prior land-use

Measuring and modelling direct land-use change to bioenergy crops

- Short rotation forestry
- Short rotation coppice willow
- *Miscanthus* (perennial grass)



- **Measured** the impact of direct land-use change to 2nd gen. bioenergy crops on soil carbon stocks and GHG emissions
- Developed the **ELUM model** to assess changes in soil carbon and GHG emissions resulting from land conversion to bioenergy in the UK through to 2050

18 Land use change scenarios for the UK		
Original land use	***Bioenergy land use***	
Arable Grassland Forestry	*Miscanthus* SRC willow Short rotation forestry	**2nd generation crops:** Measured and modelled
	Wheat Sugar-beet Oilseed rape	**1st generation crops:** Modelled

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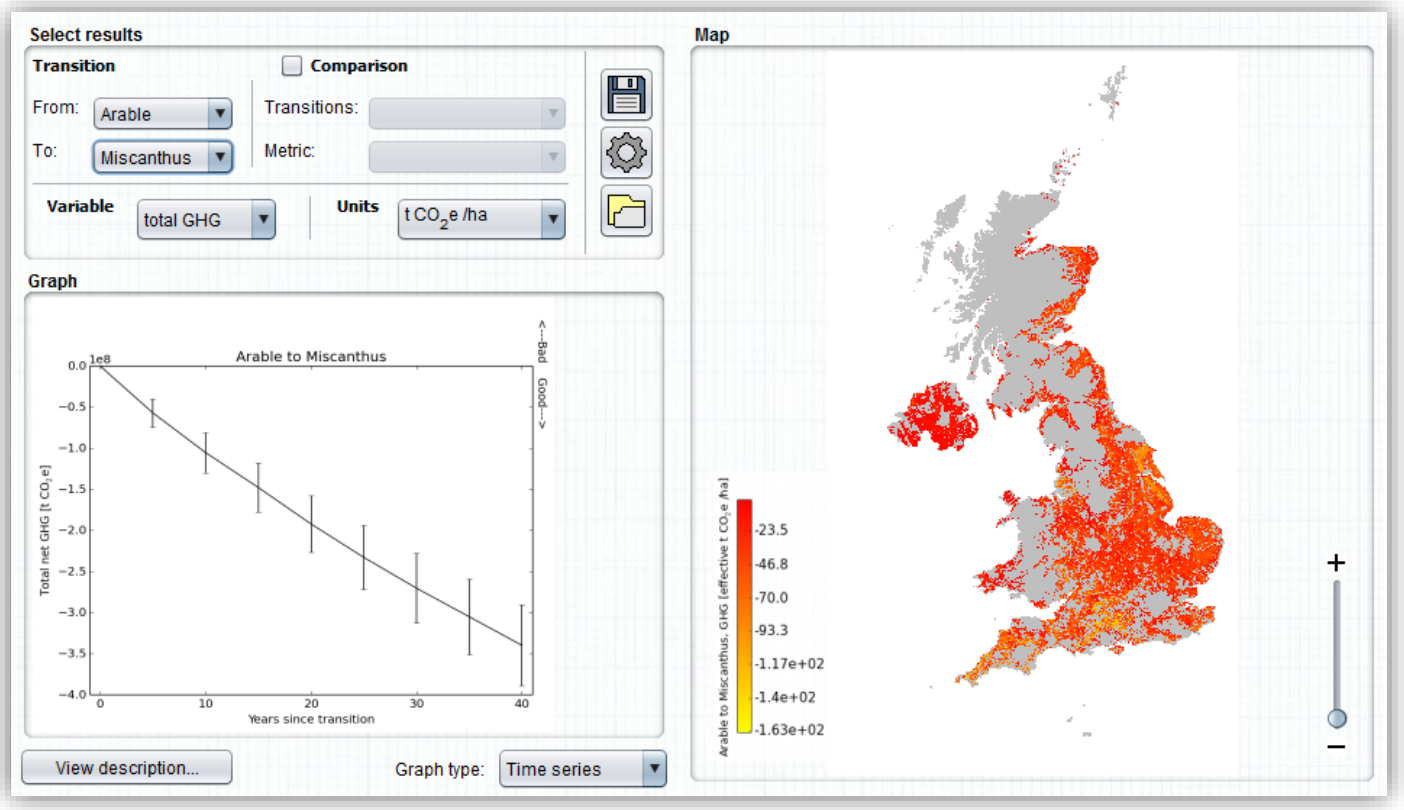
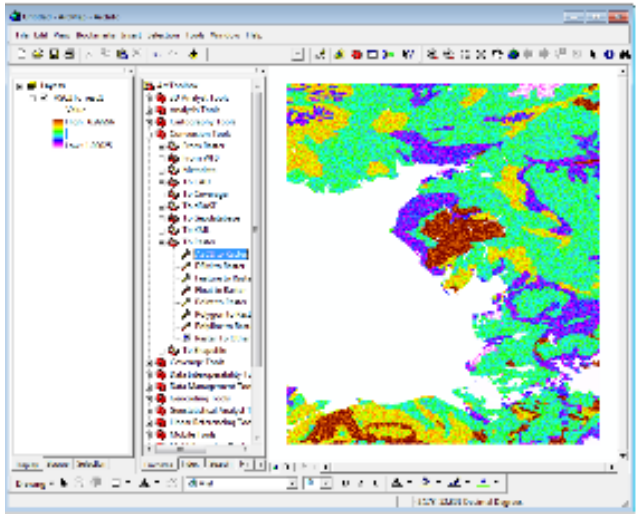
The Ecosystem Land Use Modelling Tool

A user-friendly spatial tool to explore the consequences of land use change to bioenergy, in terms of soil carbon and GHG emissions to 2050





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Available to download from the CEH website in 2017

All publications available on www.elum.ac.uk

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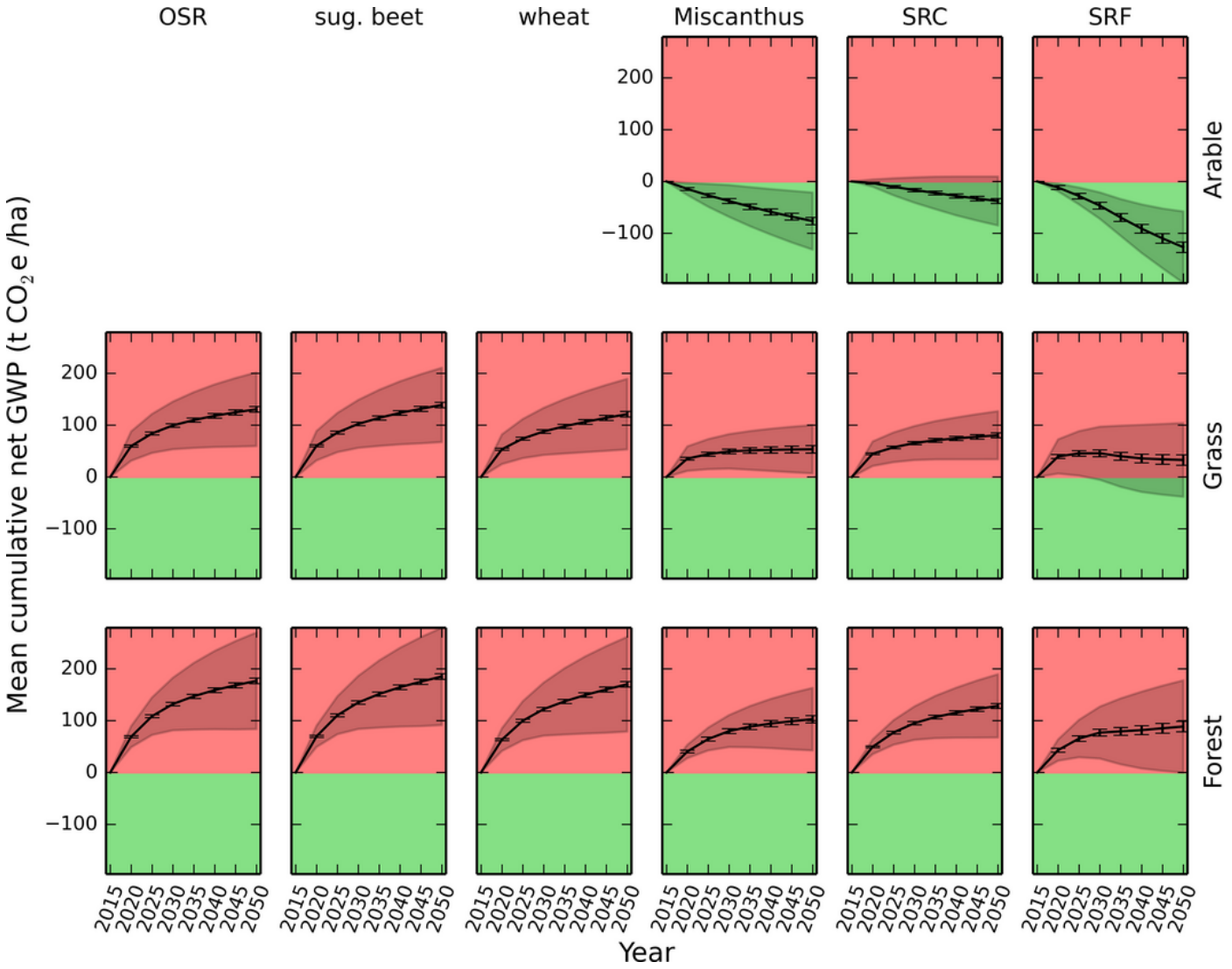
Direct land-use change to bioenergy: net GHG balance



Key findings

Changes in soil carbon stocks are most important in determining the carbon saving or losses

Emissions savings are greatest when 2nd gen. crops are grown on arable or temporary grassland (< 5 years old)

Emissions savings can be achieved when crops are planted on permanent grassland, but greater care is needed to select appropriate sites.

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GCB Bioenergy
Volume 9, Issue 3, pages 627-644, 23 APR 2016 DOI: 10.1111/gcbb.12360
http://onlinelibrary.wiley.com/doi/10.1111/gcbb.12360/full#gcbb12360-fig-0007

Key Findings

When planted sensitively, for example by avoiding soils rich in organic carbon and applying minimal fertiliser **2nd generation energy crops can deliver significant carbon savings**

Remaining uncertainties

- Start and end of life of perennial crops - impacts on nitrous oxide emissions and soil carbon stocks
- High variability in effects on soil carbon stocks of planting on permanent grasslands

On-going Research

MAGLUE: Measurement and analysis of bioenergy greenhouse gases

- Quantify *'temporal GHG hotspots'* over the life cycle of perennial energy crops
- Test management strategies to mitigate hotspot emissions
- International case studies e.g. GHG balance of sugarcane and U.S. wood pellets

MAGLUE

SUPERGEN Bioenergy Hub

EPSRC
Engineering and Physical Sciences Research Council

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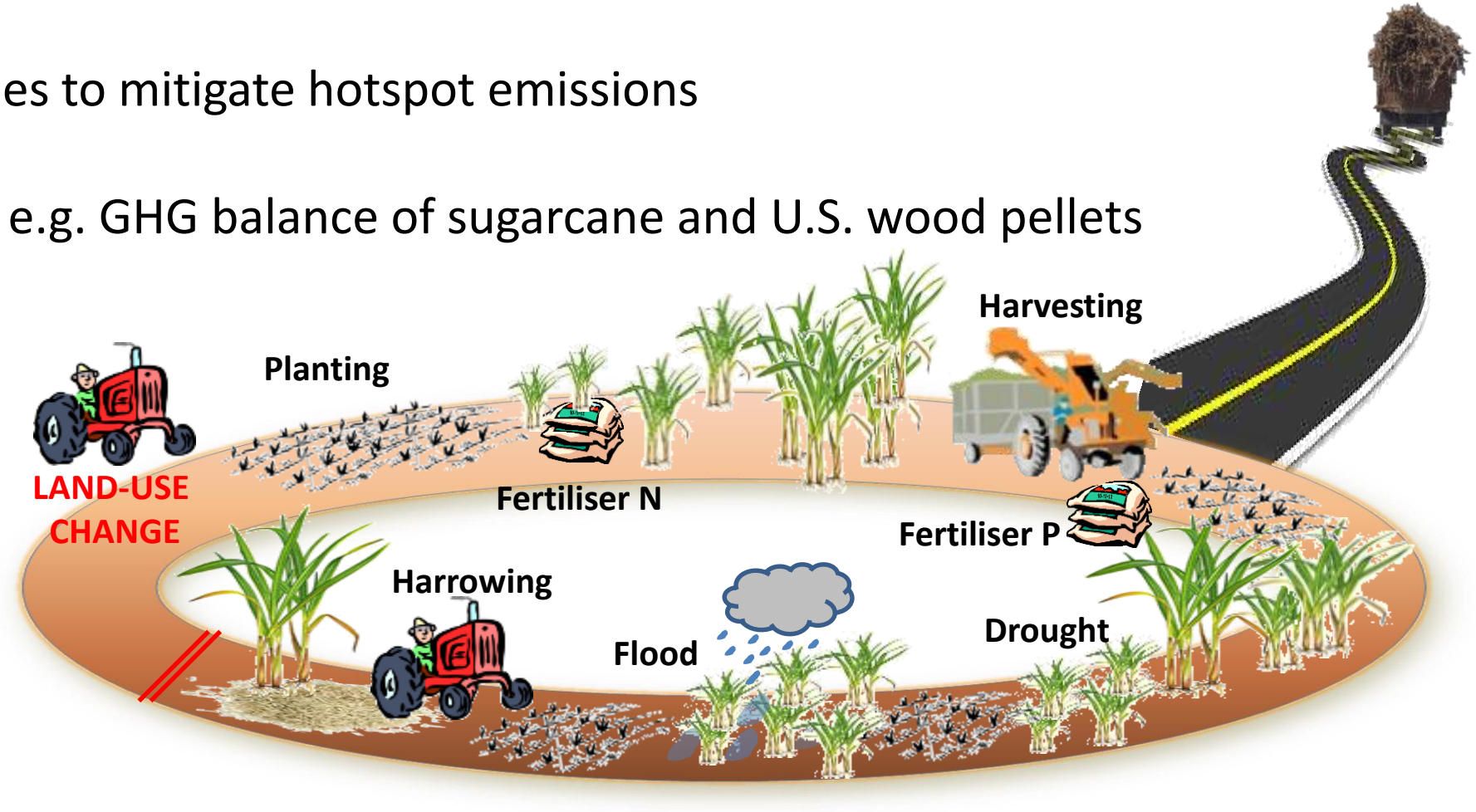

Research-policy-industry engagement

UK Researchers

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Prifysgol Aberystwyth University
University of Southampton
Forest Research
University of Aberdeen
The University of York
University of East Anglia
Imperial College London
The University of Edinburgh
Warwick
The University of Warwick
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International

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Energy Biosciences Institute
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University of Illinois at Urbana-Champaign
USDA
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AHDB
Cereals & Oilseeds
terravesta
Energy, naturally.
bp
IGGESUND
HOLMEN GROUP
drax
The Bioeconomy Consultants
NNFCC
E4tech
Strategy | Energy | Sustainability
CFA
Cool Farm Alliance
RICARDO-AEA
North Energy

Knowledge Exchange Fellow

Policy

Department for Business, Energy & Industrial Strategy
Committee on Climate Change
Department for Environment Food & Rural Affairs
European Commission
Department for Transport
UNCCD

Cross-council

SUPERGEN Bioenergy Hub
NERC
Science of the Environment
Research Councils UK
Energy
For a Low Carbon Future
EPSRC
Engineering and Physical Sciences Research Council
Innovate UK
BBSRC Sustainable Bioenergy Centre

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International Bioenergy and Land-use workshop

Compare outcomes from UK and global research on bioenergy and land use and identify areas of consensus and uncertainty

Researchers: Brazil, USA, Belgium and UK
Policymakers: BEIS, EU JRC and UNCCD
Industry: Shell, BP, AHDB, ETI

Ecosystem Land-use Modelling (ETI)	UK	Miscanthus, SRC willow, Short rotation forestry
POPFULL (ERC)	Belgium	SRC poplar and willow
Energy Biosciences Institute, Illinois	USA	Miscanthus, switchgrass
Soil carbon & Land-use change	Brazil	Sugarcane

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BBSRC bioscience for the future

EPSRC Engineering and Physical Sciences Research Council

NERC SCIENCE OF THE ENVIRONMENT

Workshop conclusions

- Perennial bioenergy crops can deliver significant GHG savings and additional environmental benefits e.g. water quality, flood mitigation
- Knowledge on initial soil carbon stocks could improve GHG savings achieved through targeted deployment of perennial bioenergy crops
- There are environmental risks associated with increasing land-use change but a strong evidence base is now available to support the development of a sustainable bioenergy industry

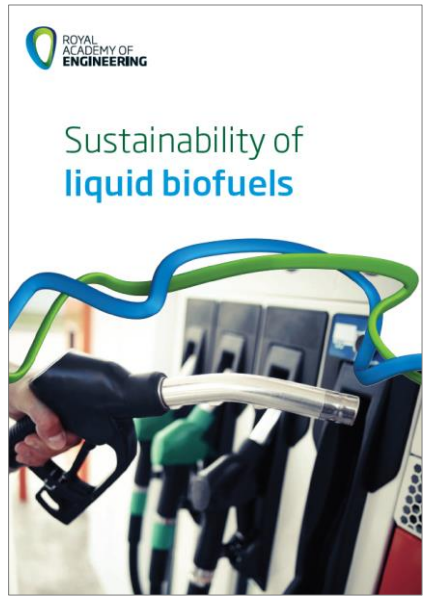
Whitaker et al., 2017. Consensus, uncertainties and challenges for perennial bioenergy crops and land use. GCB Bioenergy.

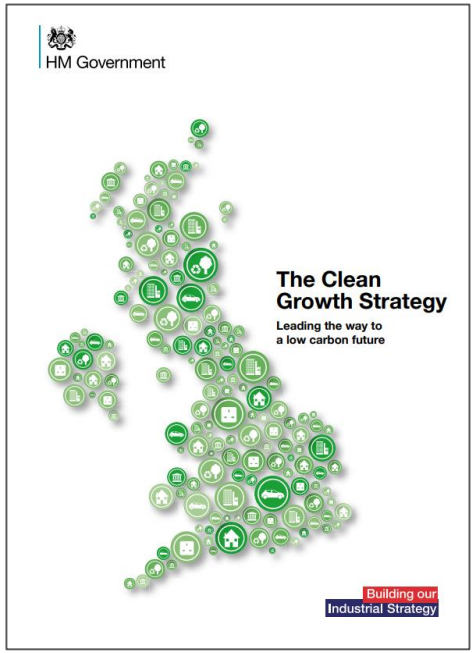
Use of ELUM data

Cool Farm Tool – online greenhouse gas, water and biodiversity calculator for farming

Improving the representation of soil carbon for the Forest Land category of National Greenhouse Gas inventories (BEIS)

Quantifying the impact of future land use scenarios to 2050 and beyond





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