climate change

Connecting climate science and policy in Scotland

Scottish Food Security Alliance Crops

UKERC

UK Energy Research Centre

Researching pathways to a low carbon future

The role of bioenergy in Britain

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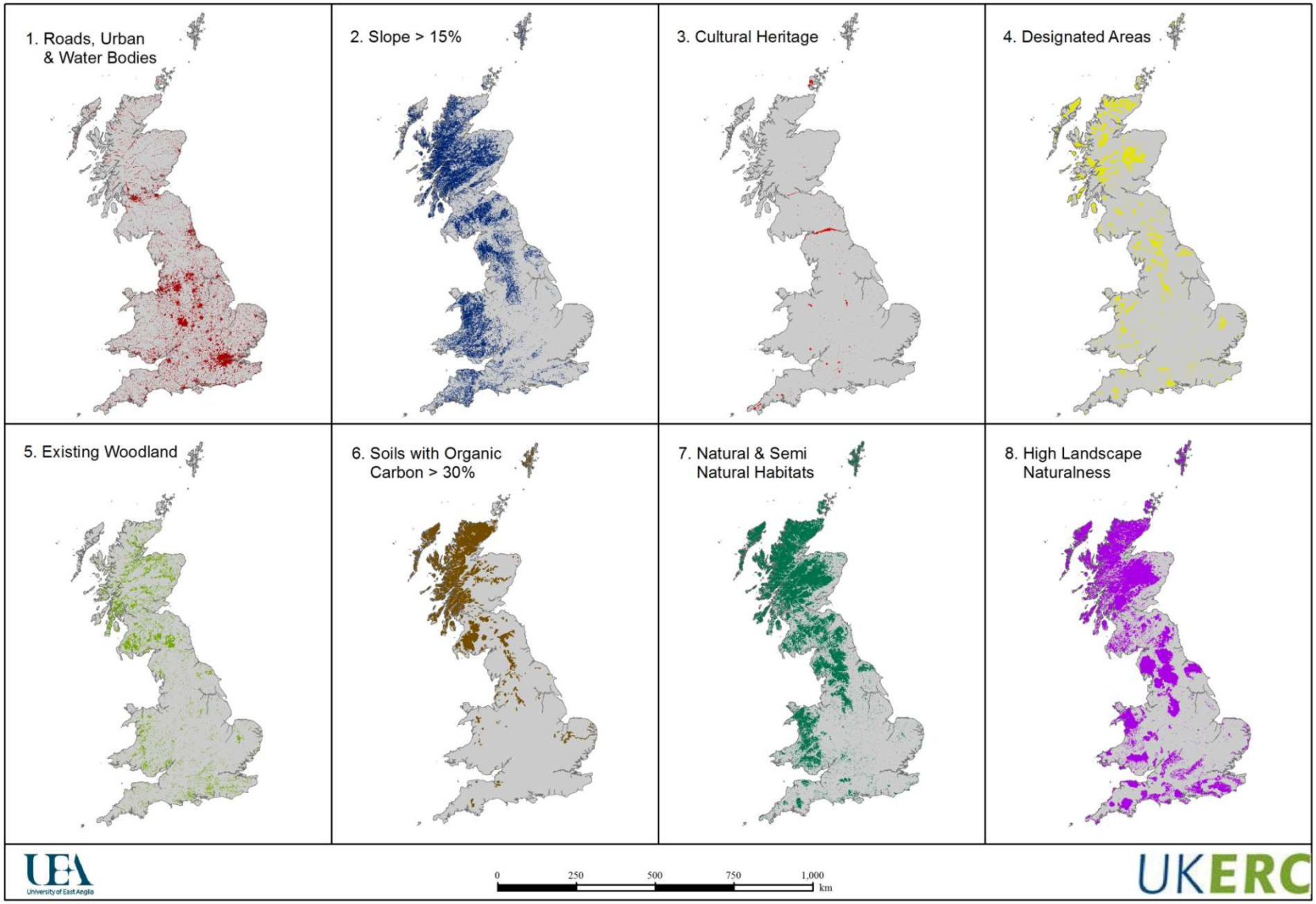
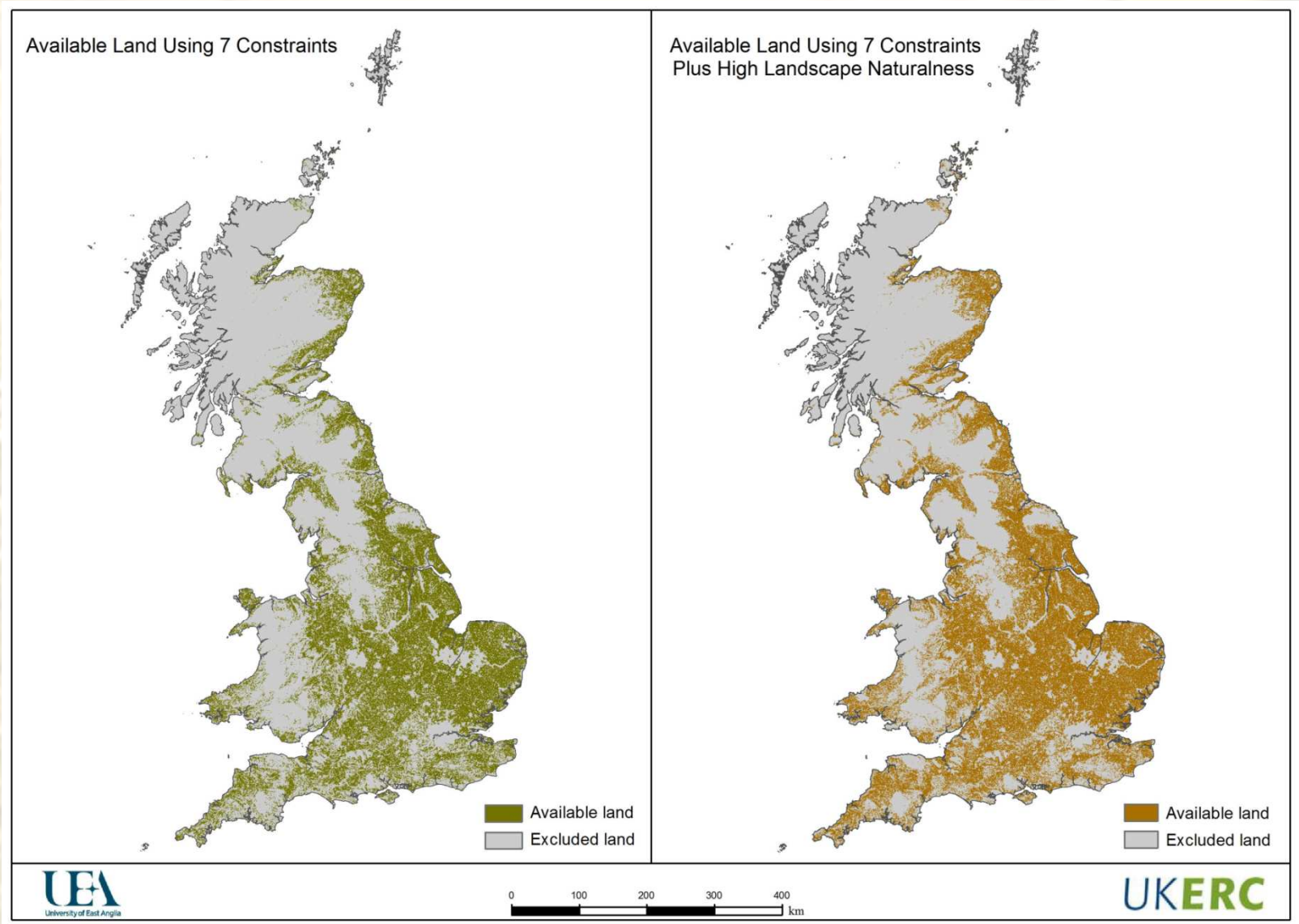
7 Loughborough University

UK Energy System in Transition: Technology, Infrastructure and Investment, Edinburgh, 1st April 2014

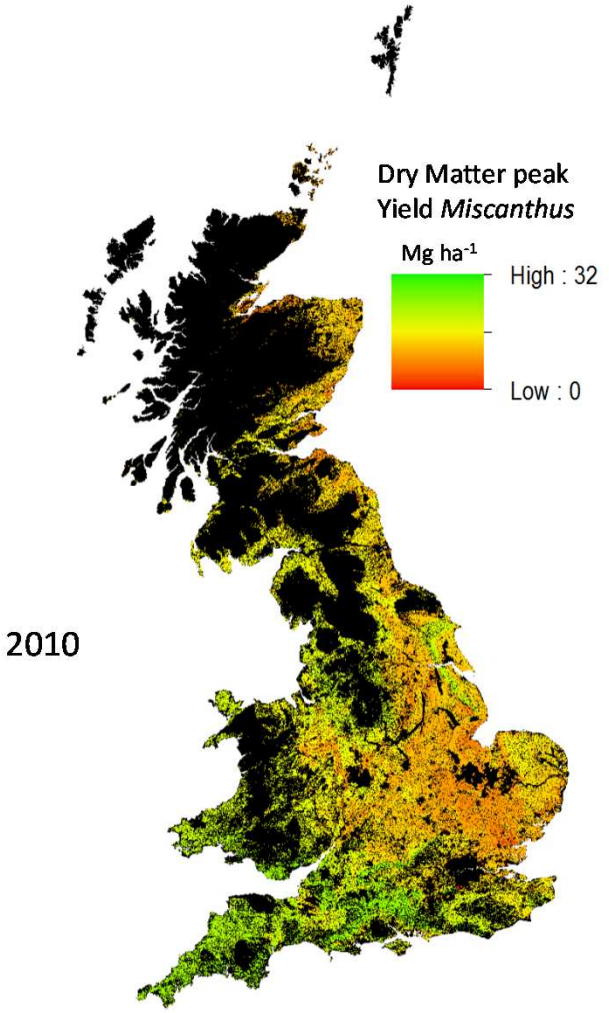
Areas unsuitable for energy crops

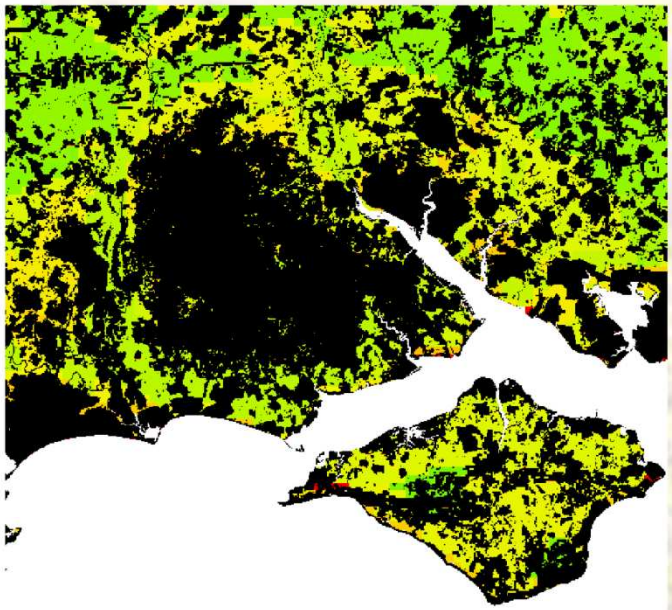


Areas unsuitable for energy crops



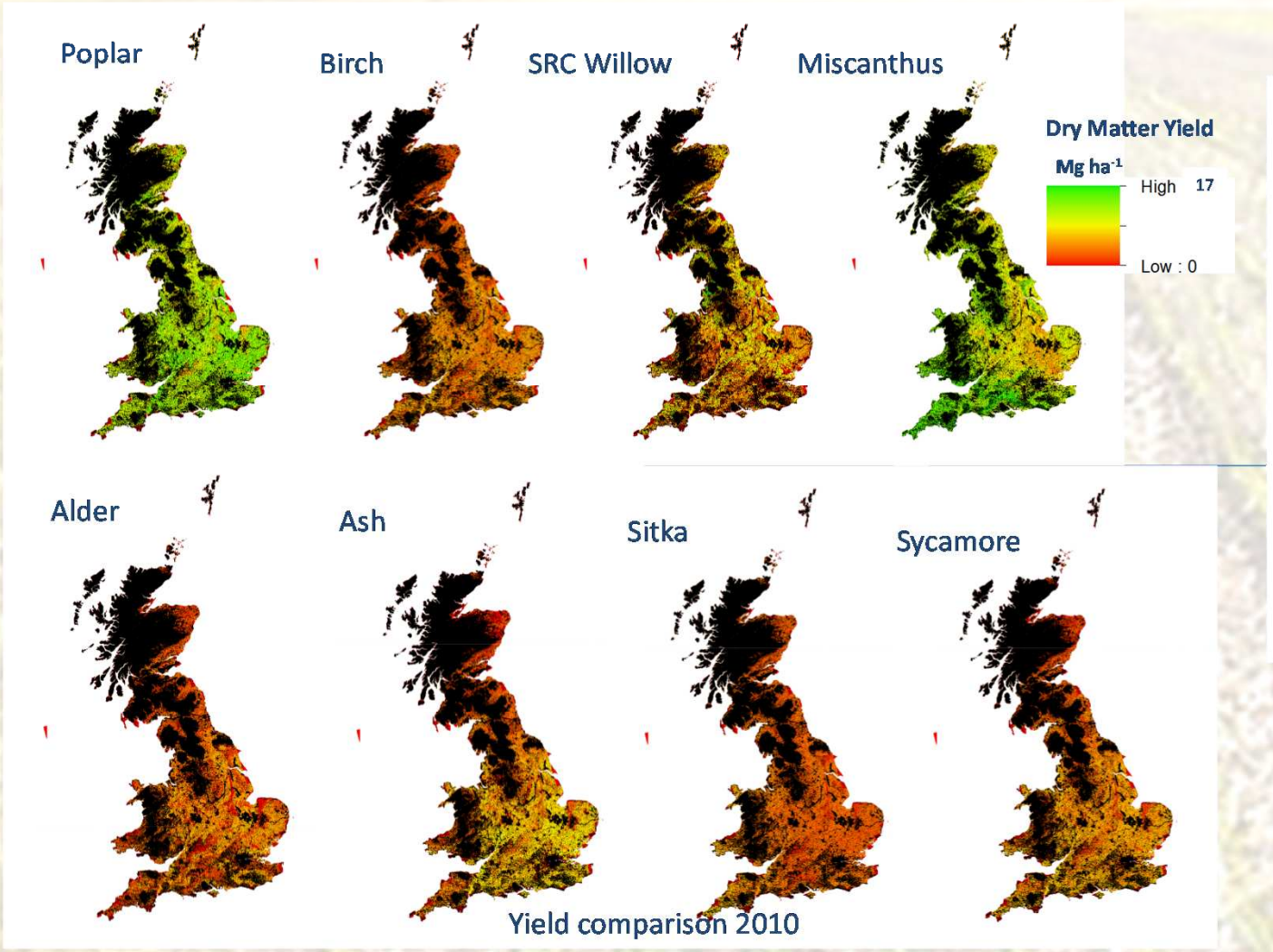
Areas unsuitable for energy crops



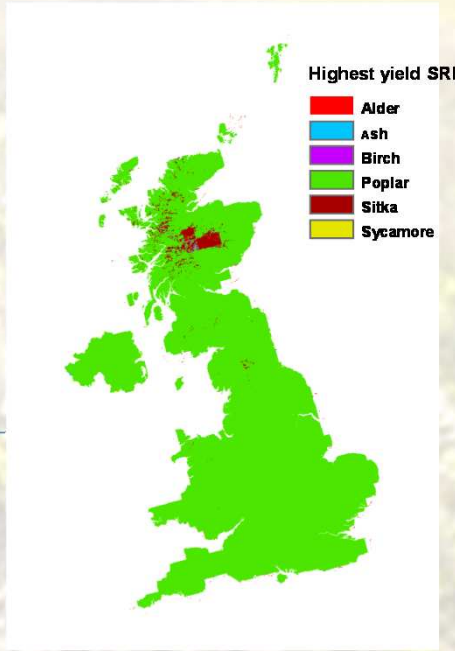


Miscanthus dry matter peak yields
with constraint 1-9 (black mask)
1 ha resolution

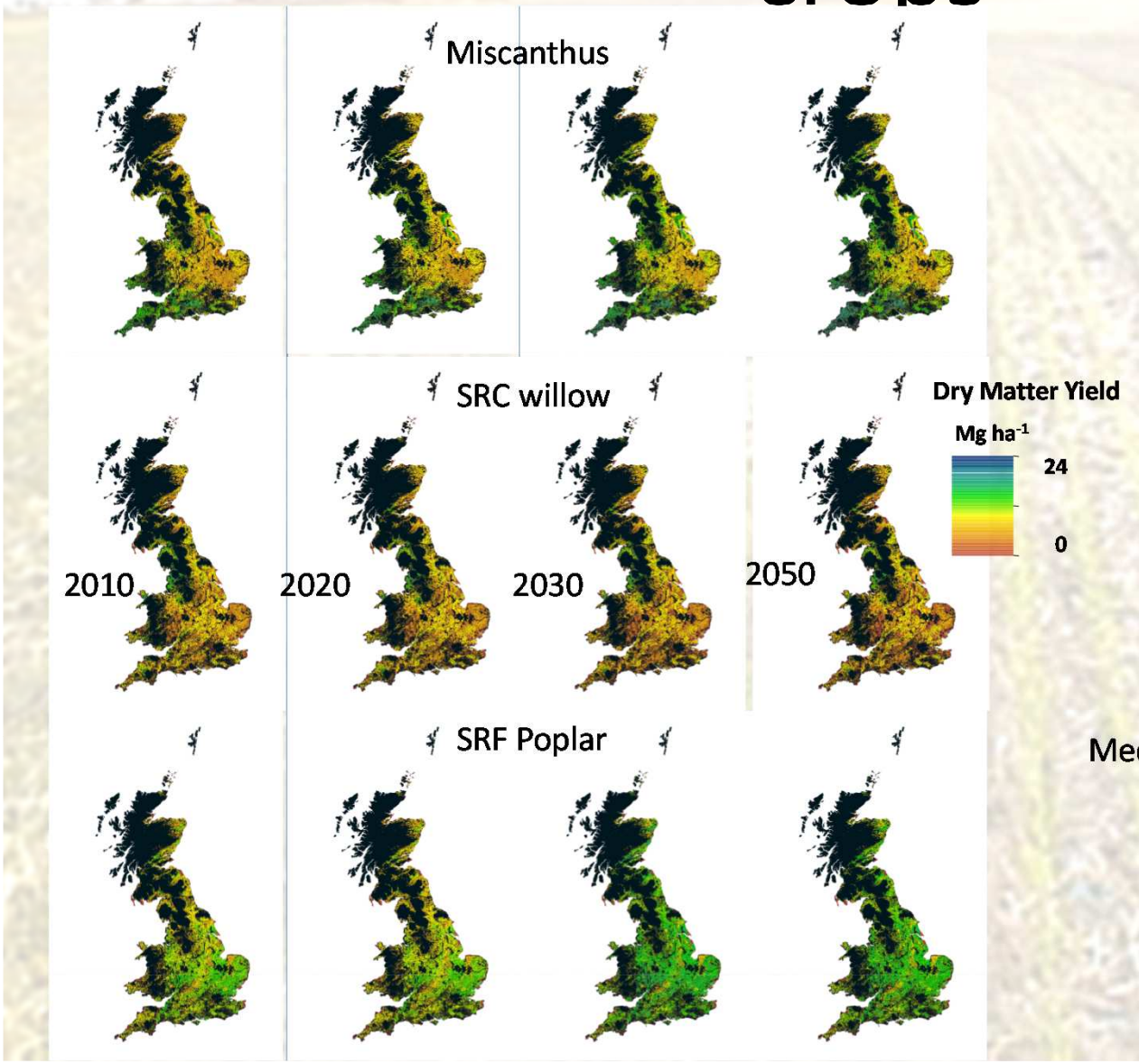
Biomass supply from energy crops



Current conditions

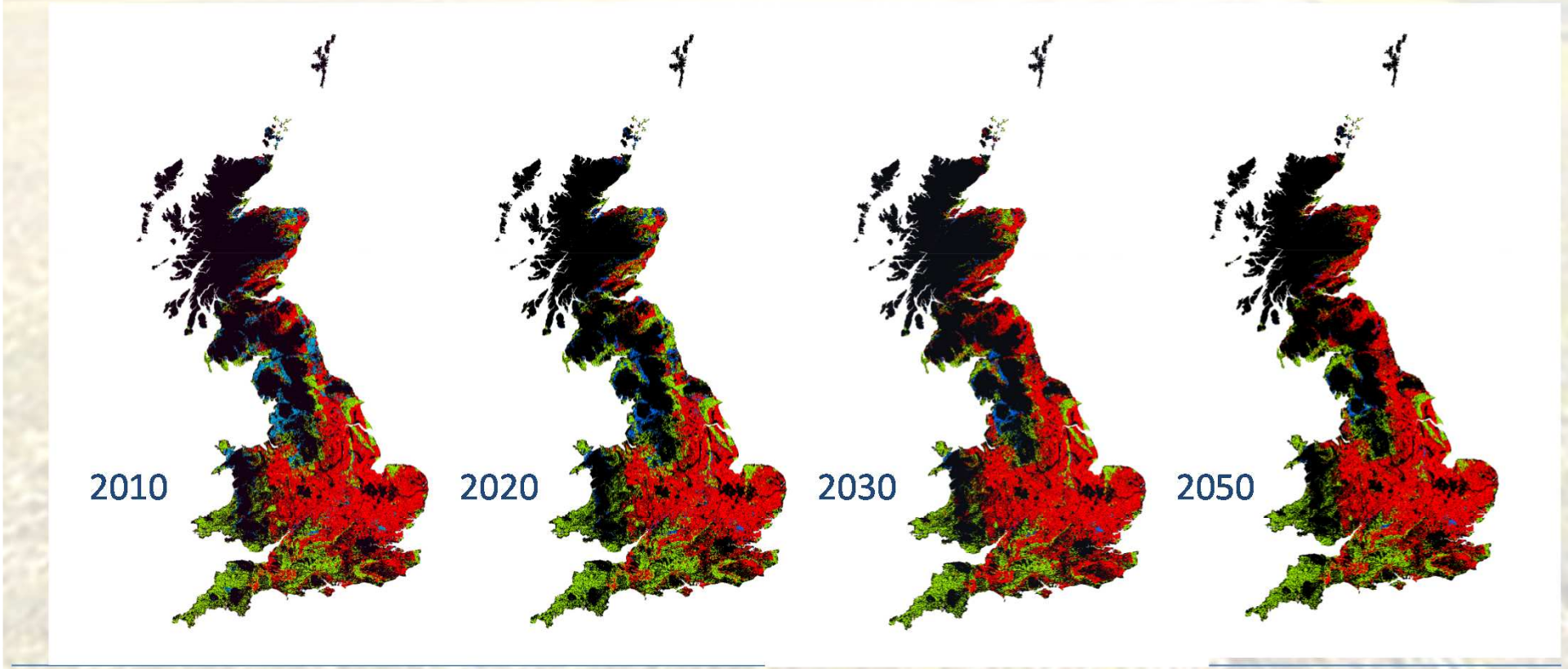


Biomass supply from energy crops



Future conditions

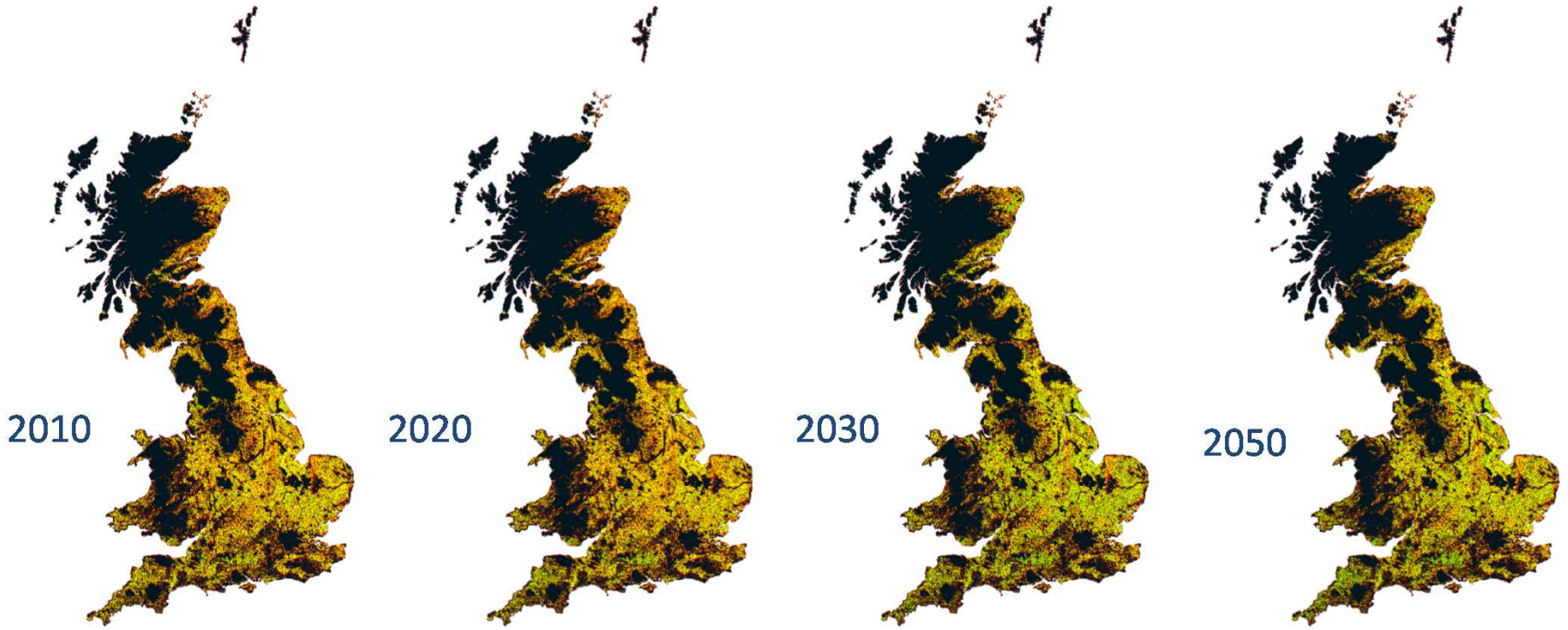
Medium Scenario



Highest yield

- Exclusion
- SRF
- Miscanthus
- SRC

Which crop (Misc/SRC willow/SRF poplar) gives the best yield?



Dry Matter Yield

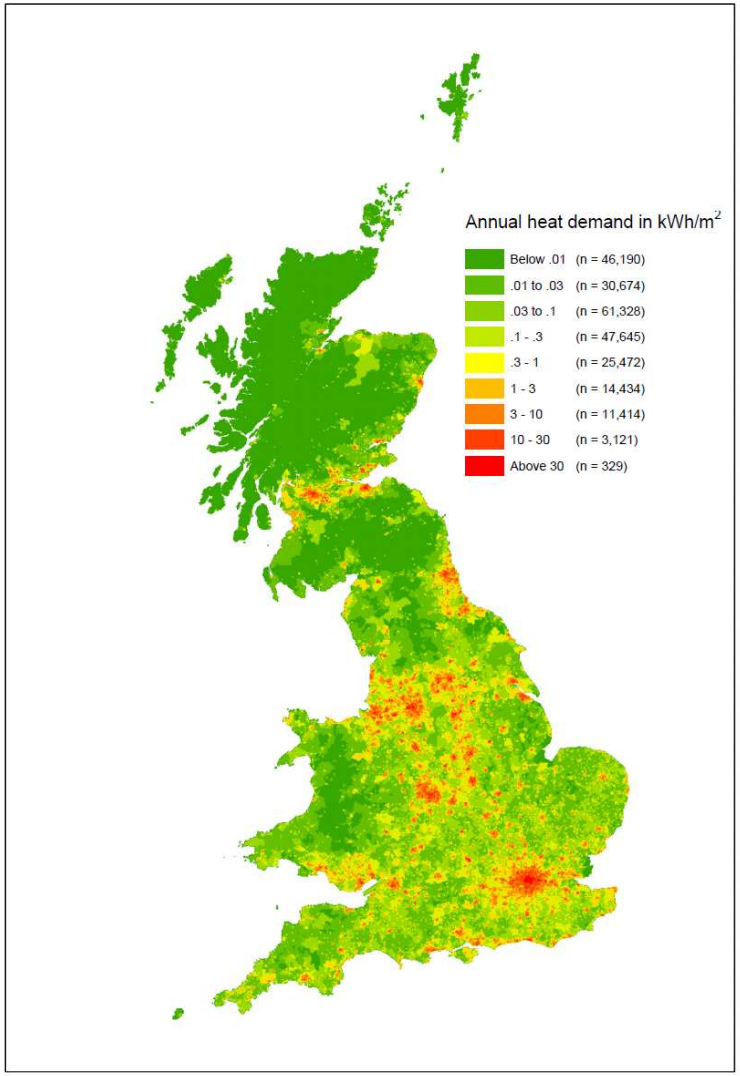
Mg ha^{-1}

High : 24

Low : 0

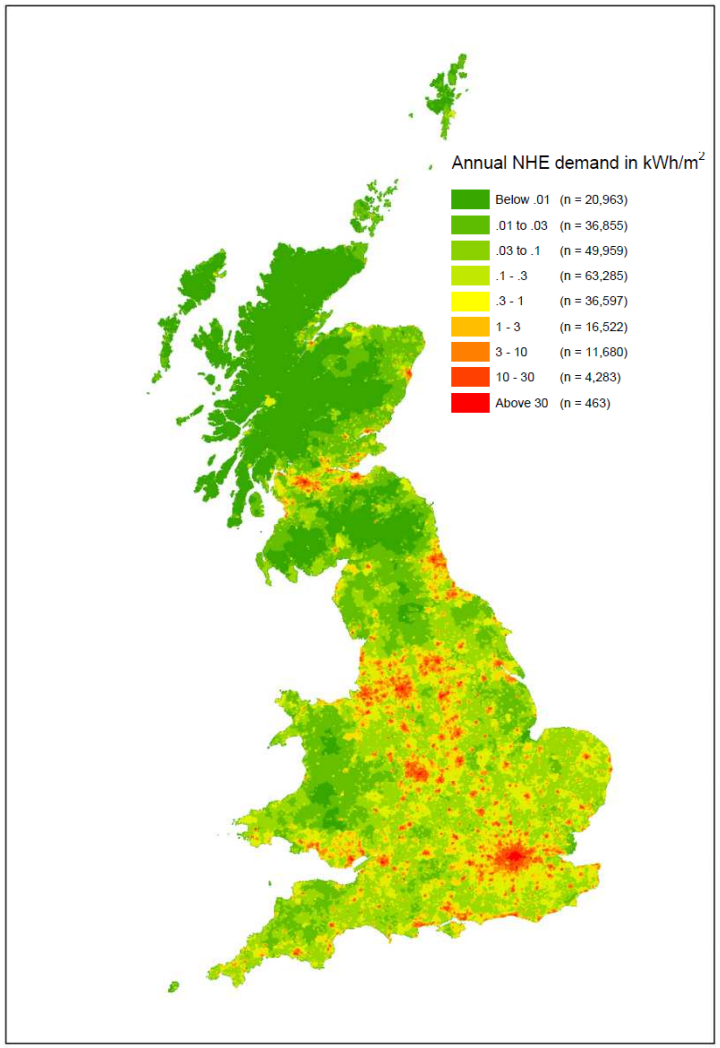
Total biomass yield best of Misc/SRC willow/SRF poplar

Heat energy demand

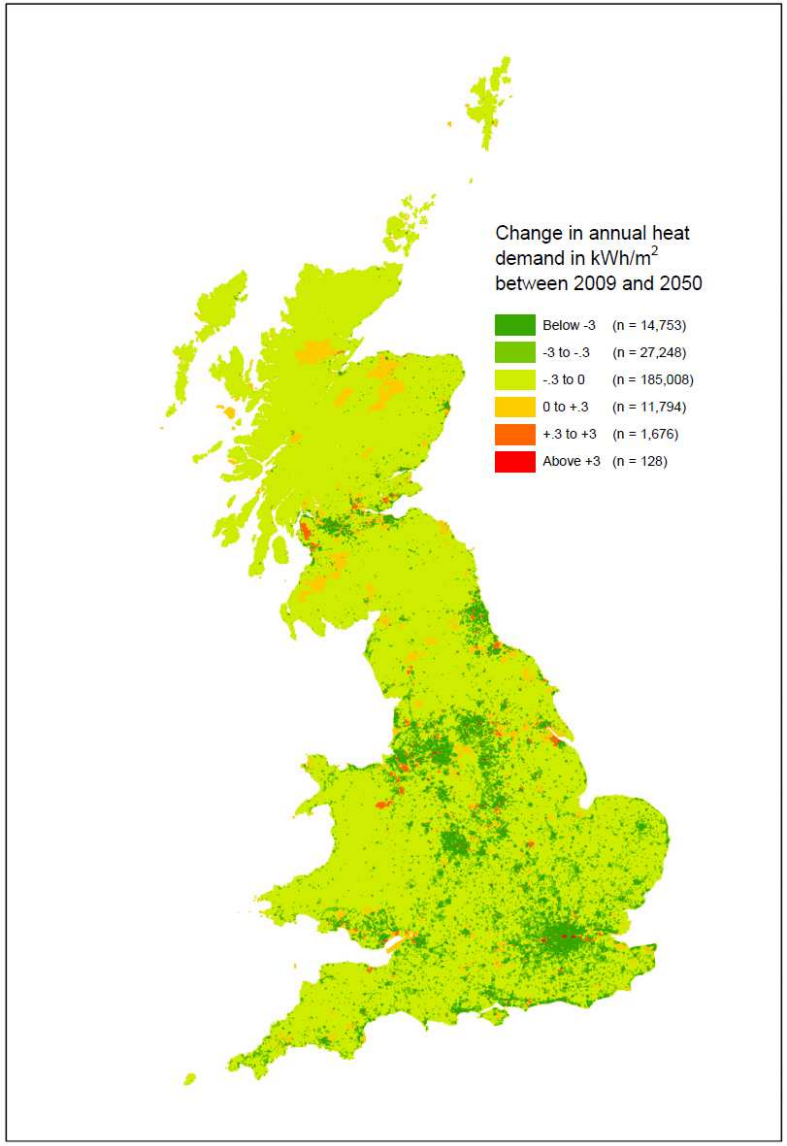


10% of UK land area accounts for approx.
90% of the heat demand from homes

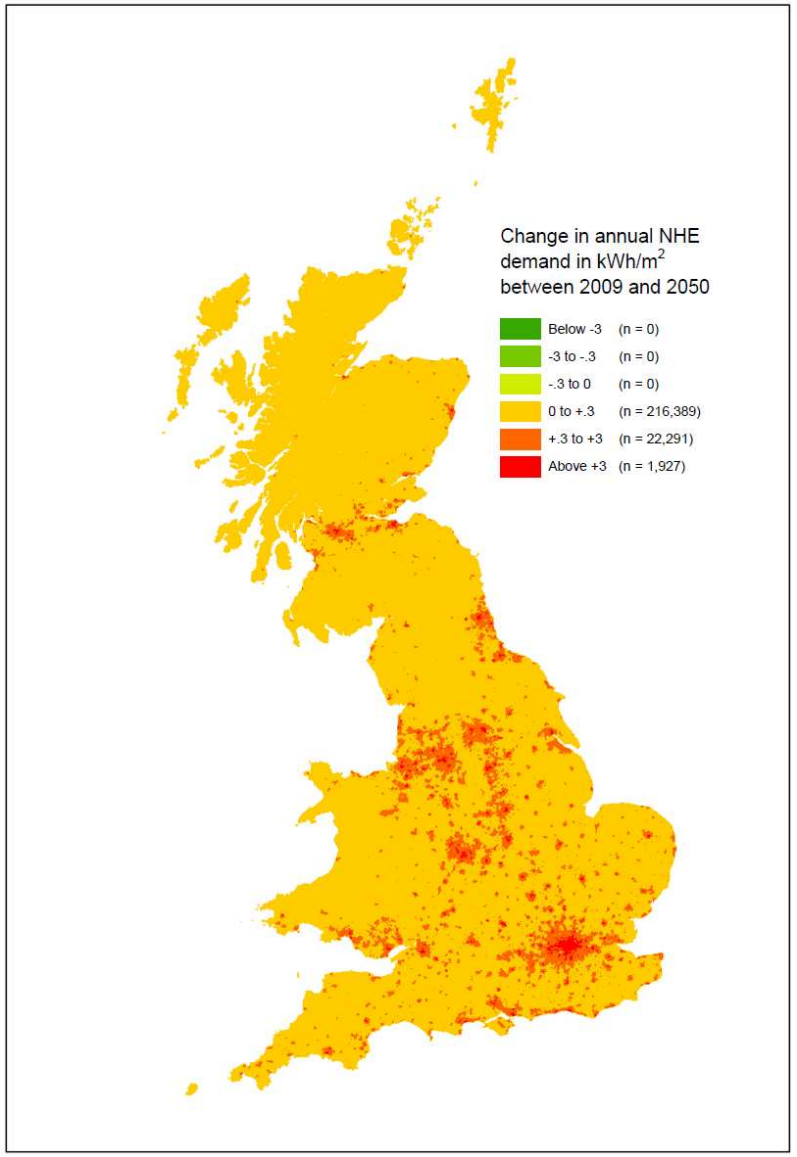
Non-heat energy demand



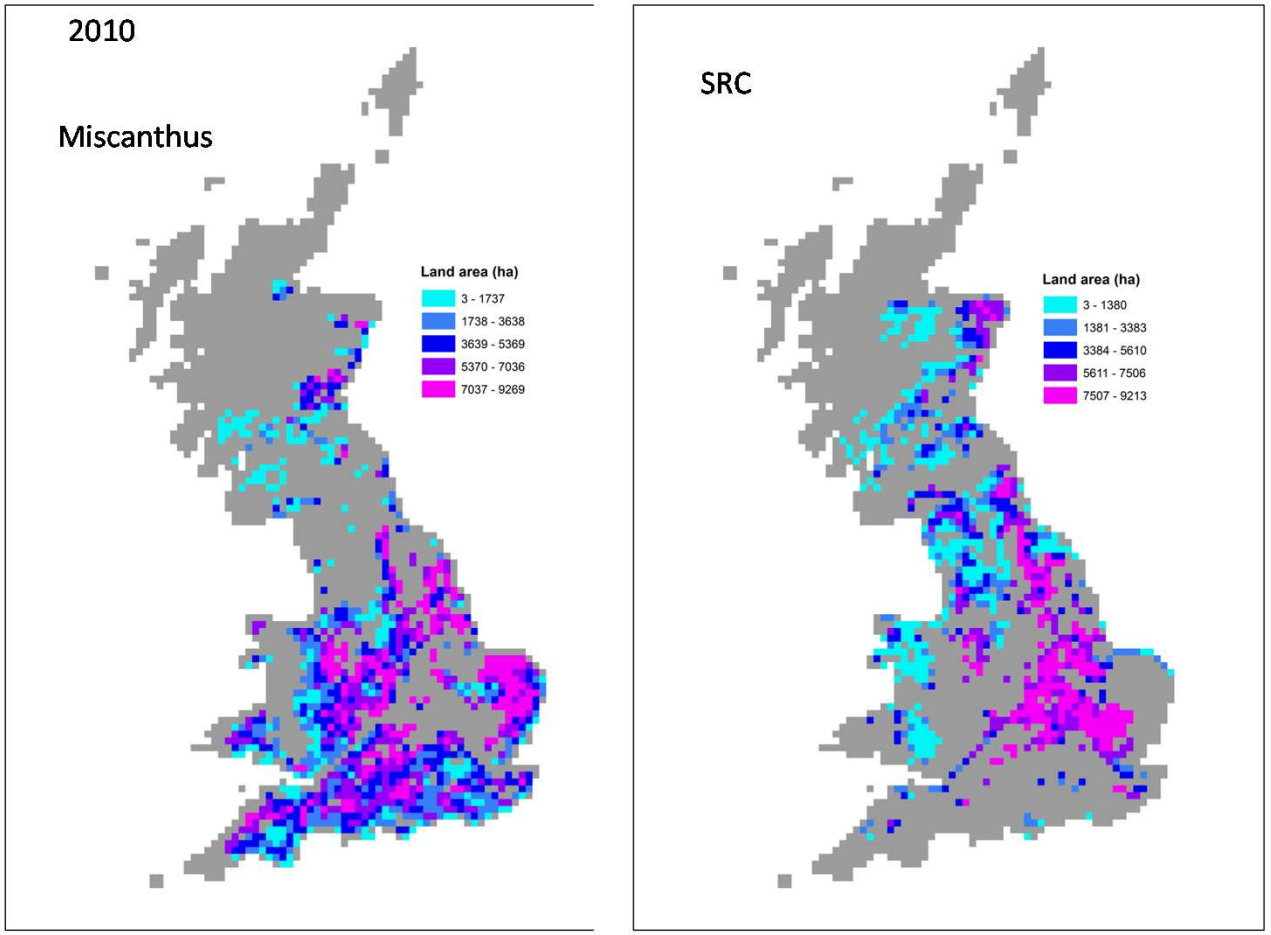
Change in heat energy demand – 2009-2050



Change in non-heat energy demand – 2009-2050

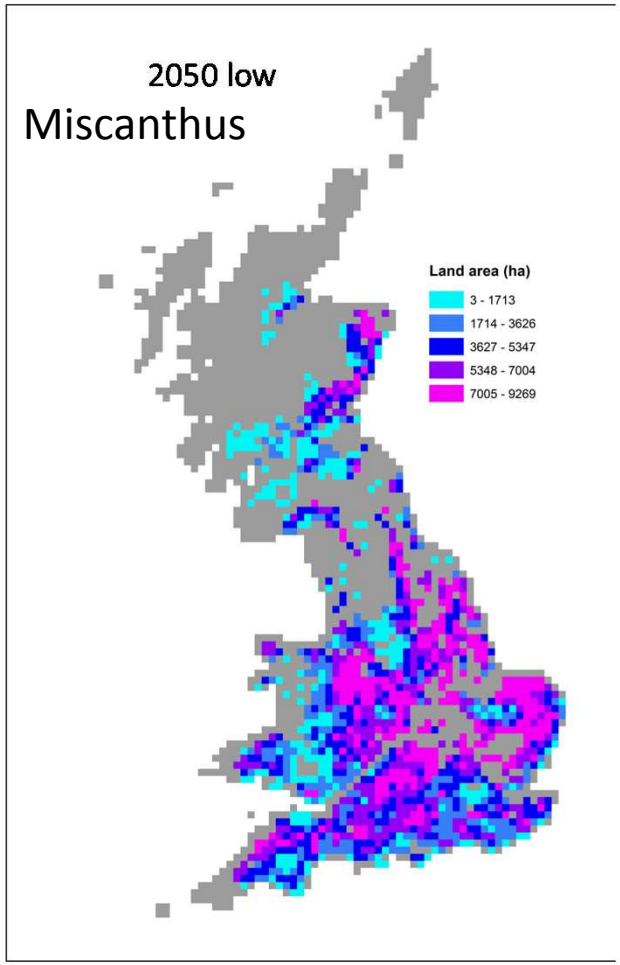


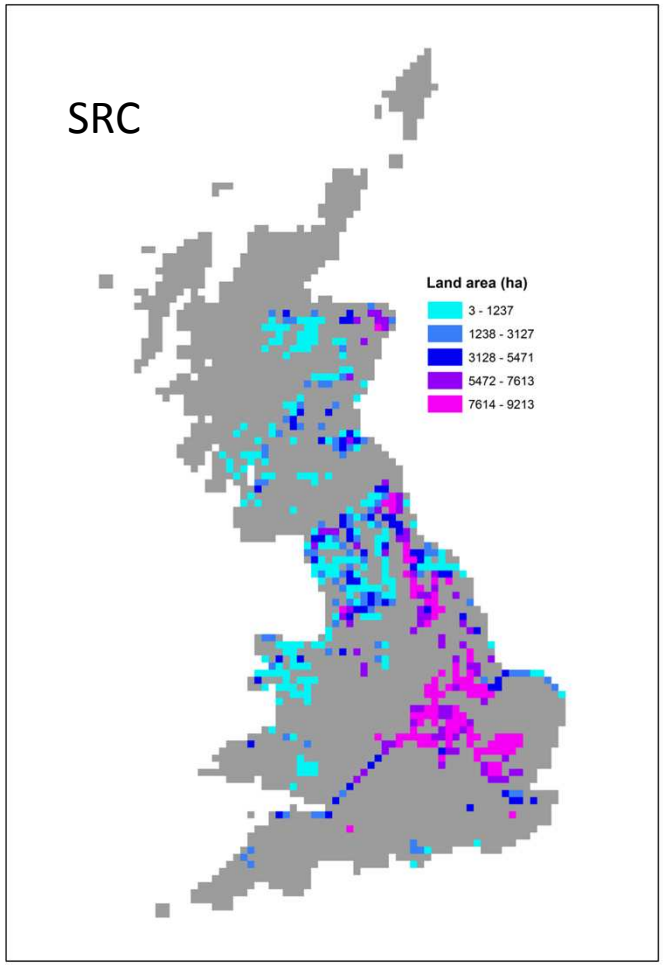
Where is bioenergy economically viable to meet demand?



Using an optimisation model to match supply and demand – where is it economic (from an energy price perspective) to meet demand with bioenergy?

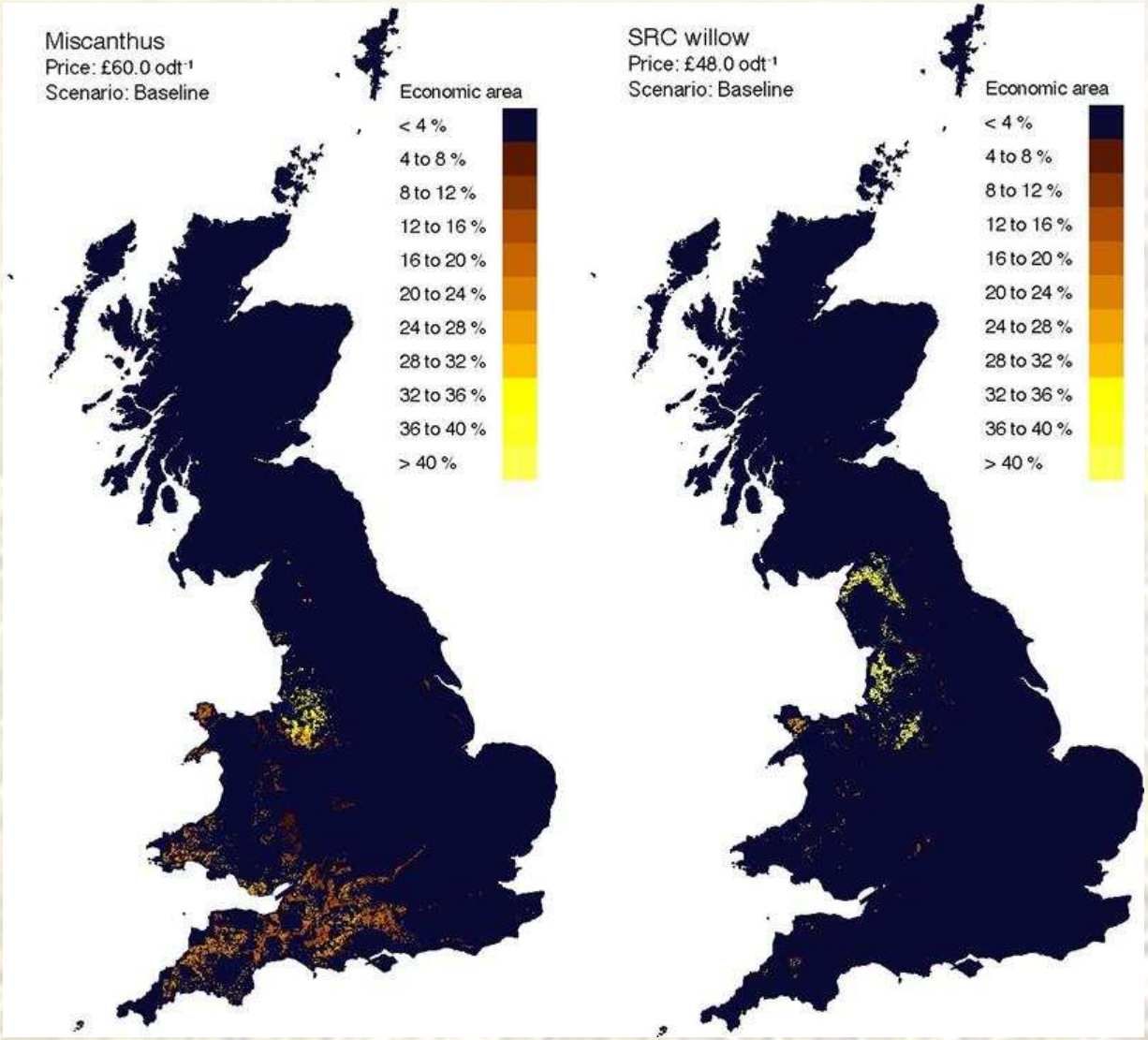
Where is bioenergy economically viable to meet demand?





Projections out to 2050 – no consideration of farm scale economics

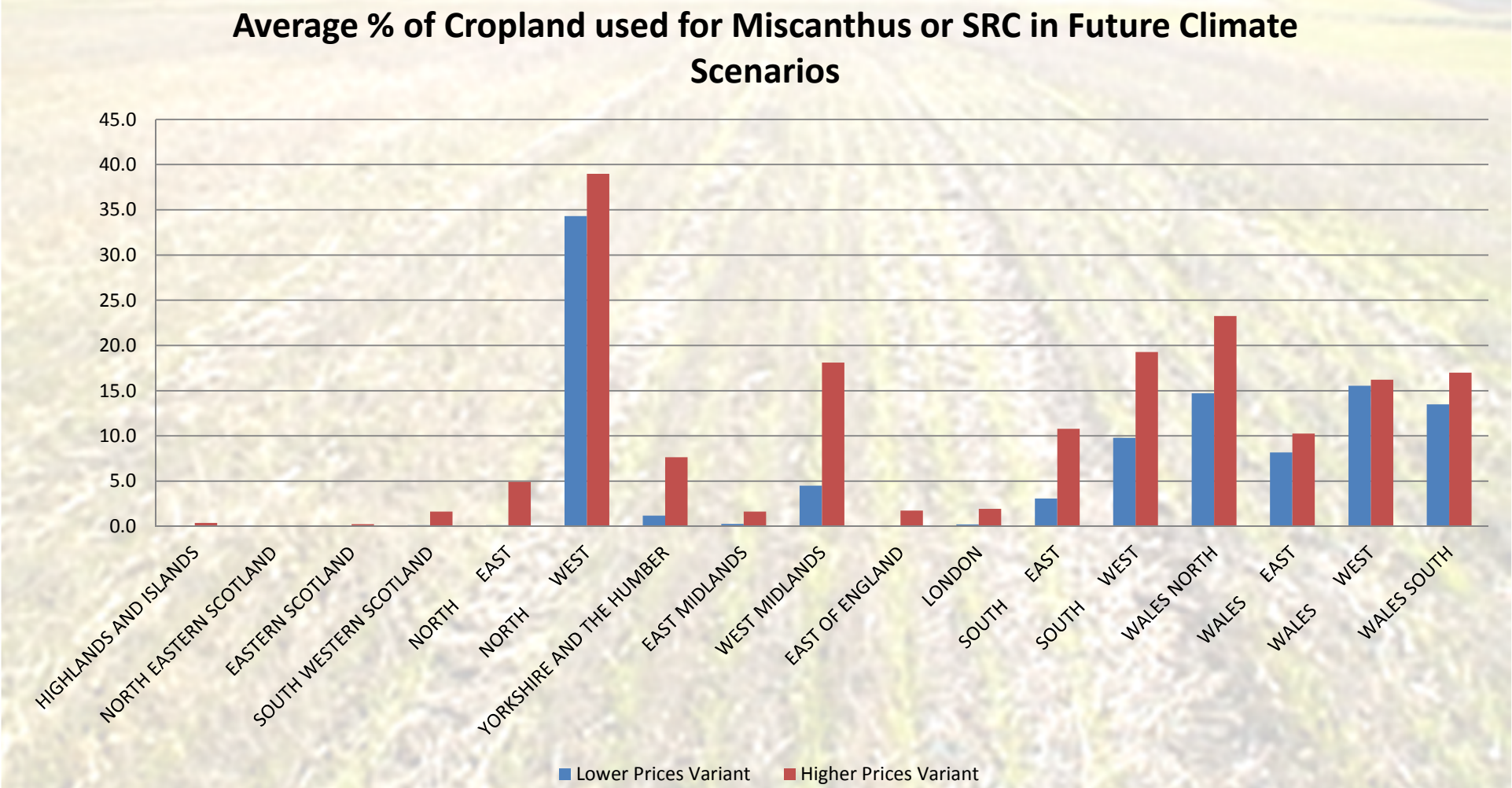
Where is it viable to grow energy crops?



At a *Miscanthus* price of £60 odt^{-1} and an SRC price of £48 odt^{-1}, energy crops could supply around 50 Pj yr^{-1} (=1.6 Gw yr^{-1}) in GB.

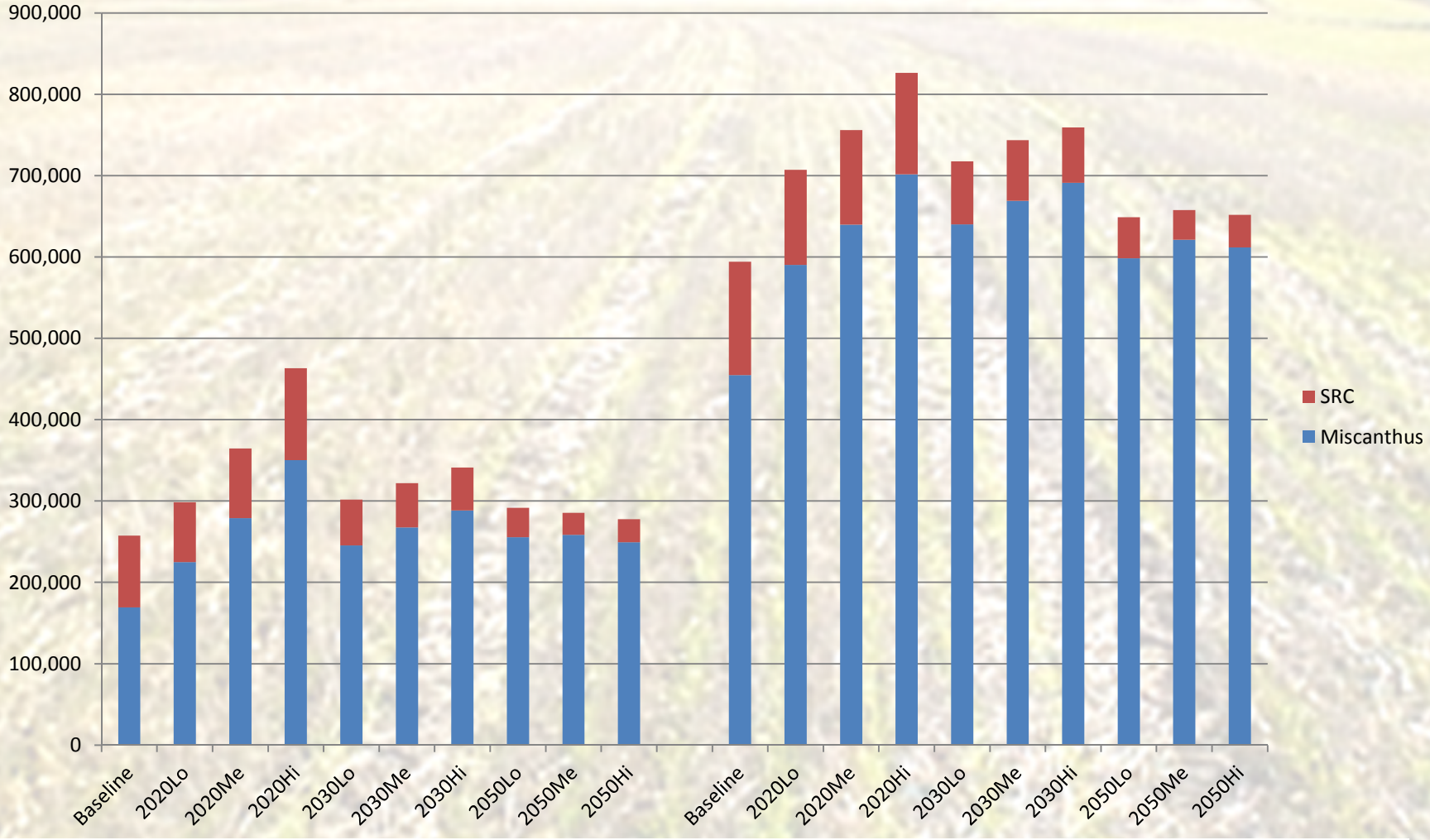
Relatively small increases in price, the area (and thereby the potential energy supplied by biomass) increases dramatically.

Environmental impacts of energy crops



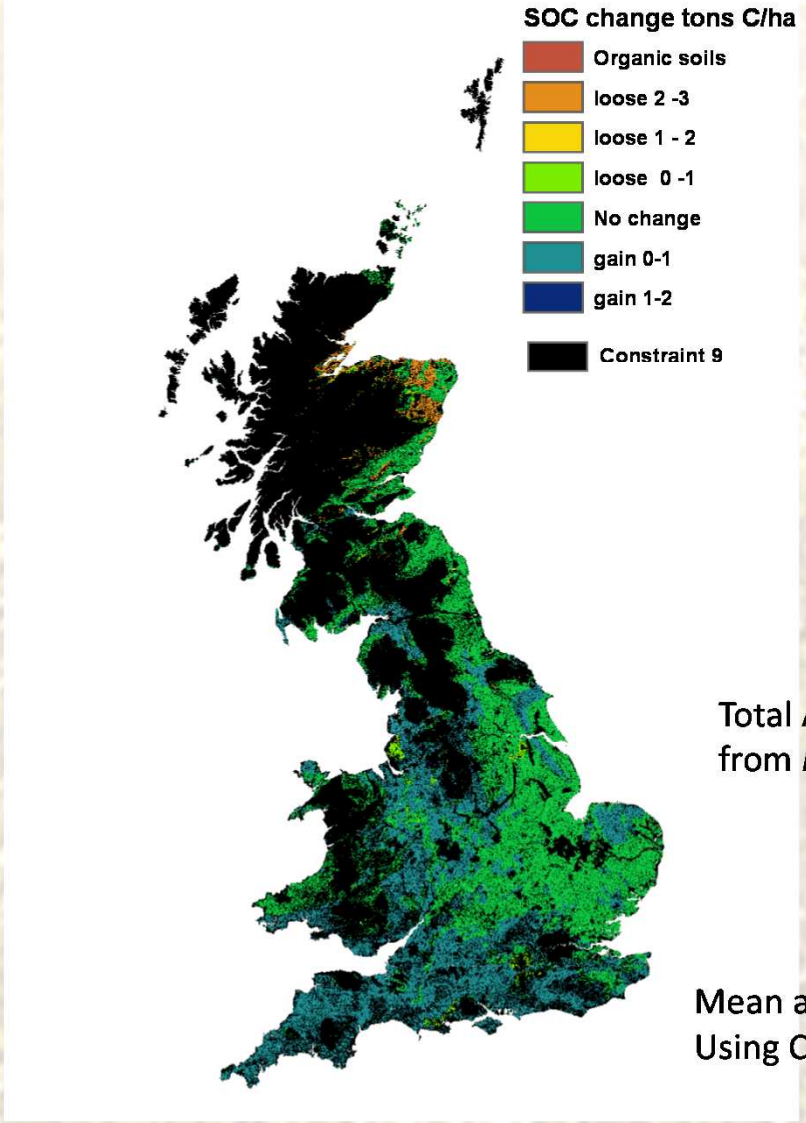
Considerable regional variation in energy crop planting compared to the national average rate

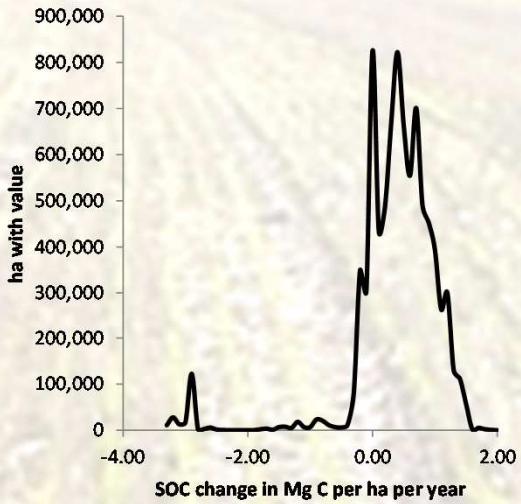
Environmental impacts of energy crops



Over time and with increased climate change the proportion of Miscanthus planting is likely to increase and SRC decline.

Environmental impacts of energy crops





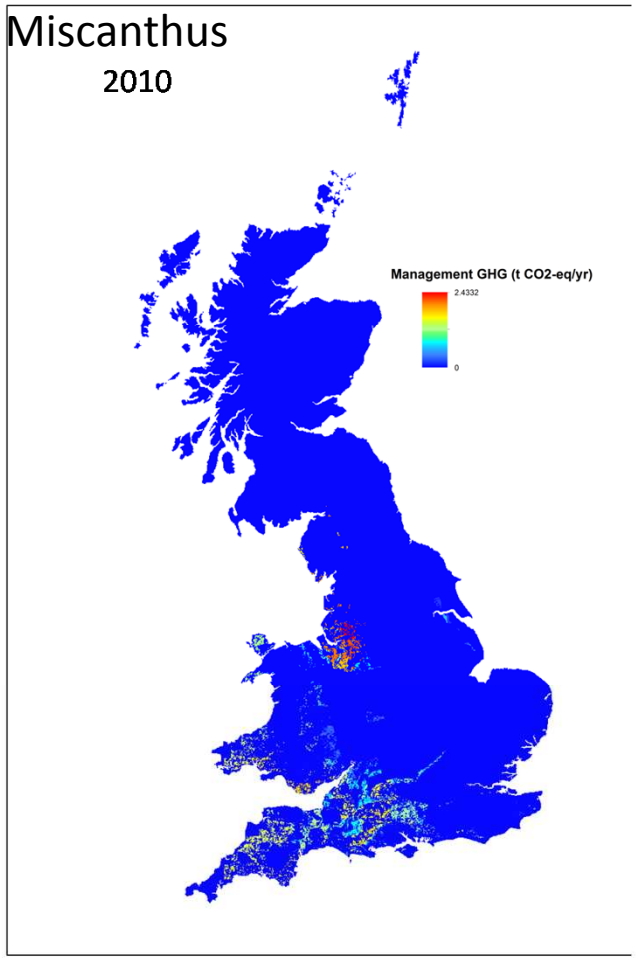
Soil carbon change from planted area

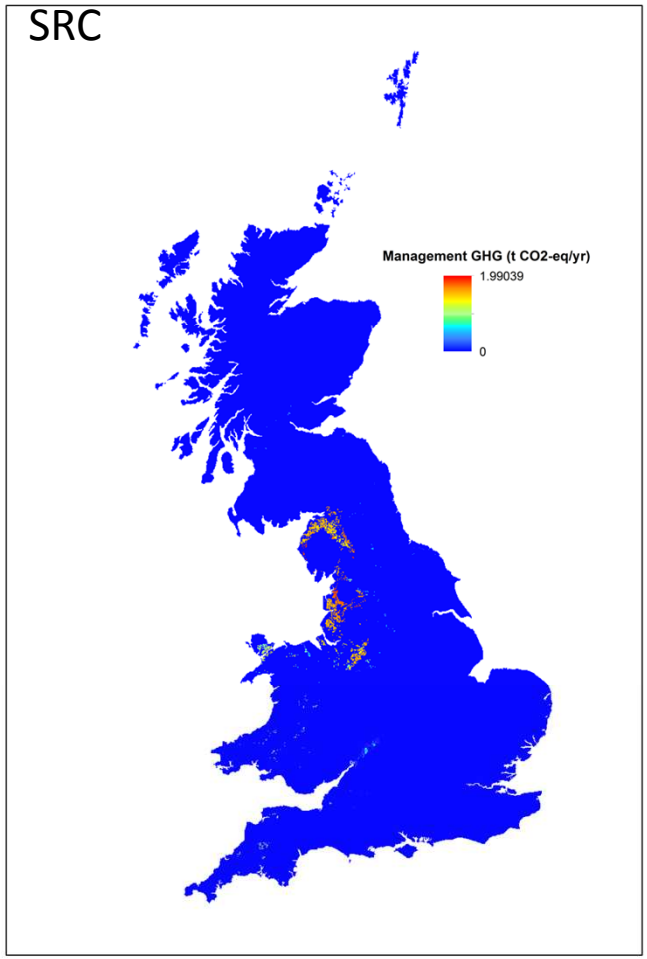
Total Annual SOC change all UK non C9 from *Miscanthus* plantations

3.3 Tg C per year

Mean annual SOC change for first 15 years
Using Cohort Model (Bossata and Ågren)

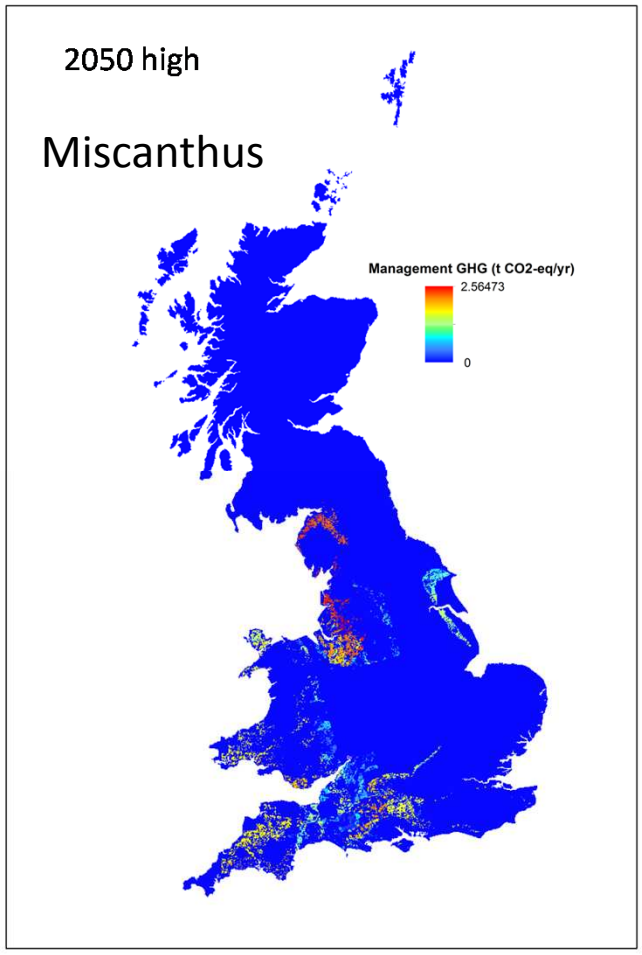
Environmental impacts of energy crops

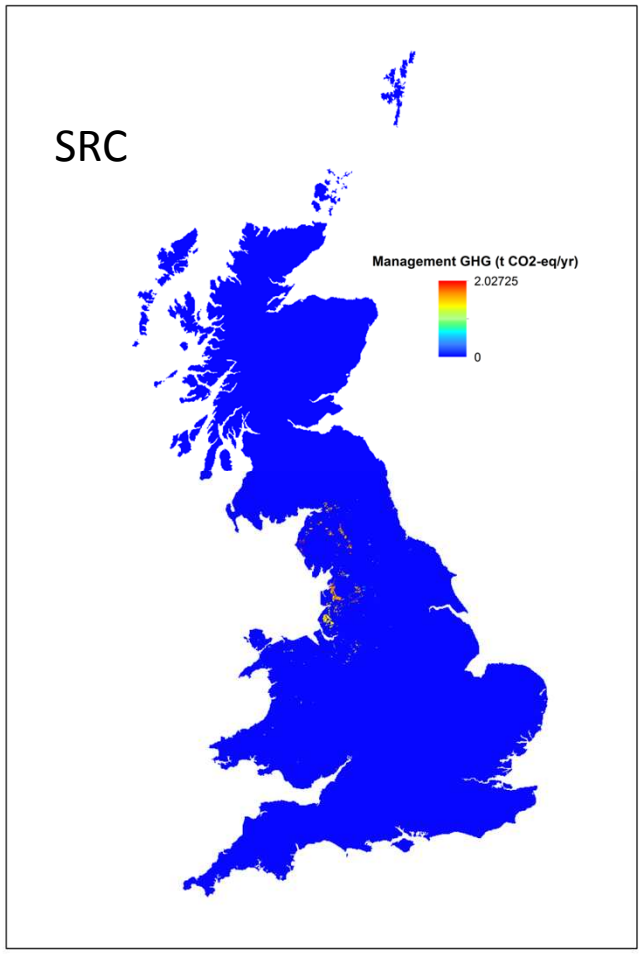




Greenhouse gas emissions from planted area

Environmental impacts of energy crops





Projections out to 2050

Conclusions

- Energy crops can help to meet energy demands, but feasibility depends of price paid for feedstock
- The location of the nearest power plant is critical - more distributed power generation infrastructure is needed
- Distribution will vary between regions and through time
- Environmental impacts vary – soil carbon may increase or decrease, and GHG emissions from crop management varies among crops.
- Special issue of *Global Change Biology Bioenergy* published in February 2014.