Where to locate new energy infrastructure? A natural capital approach

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What is the UK's current climate strategy?

Climate Change Act 2008

Net Zero
The UK's contribution to stopping global warming

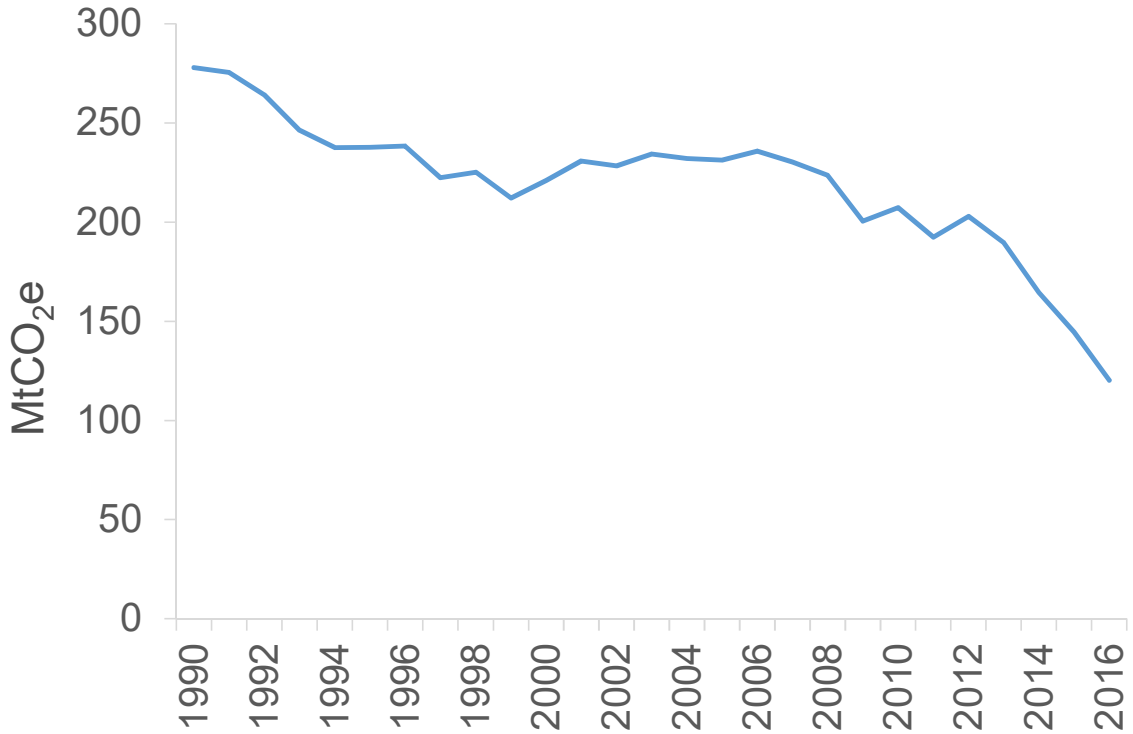
Committee on Climate Change
May 2019

GOV.UK

Press release

PM Theresa May: we will end UK contribution to climate change by 2050

How have the UK's energy emissions changed?



57% reduction in emissions from energy supply sector between 1990 and 2016

What is the UK's current electricity mix?

What's
NEXT

What will the UK's future energy system look like?

✓ Which energy technologies?

✓ How much energy is needed?

✗ Where will energy infrastructure be located?

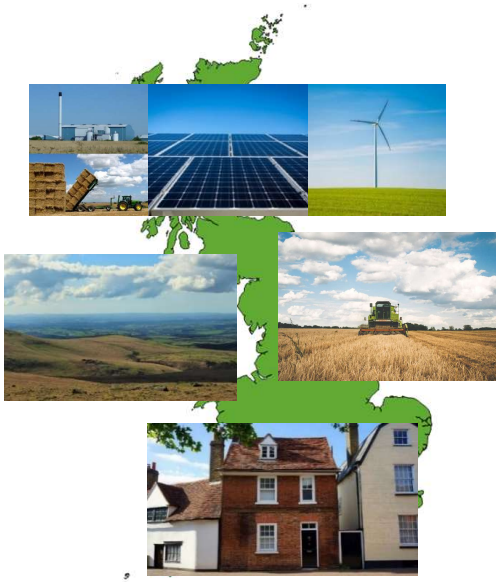
Why do we need to spatialize energy pathways?

Renewables have a larger spatial footprint

0.2 m^2/MWh

500 m^2/MWh

Land is a scarce resource



Costs and environmental impacts differ spatially

Terrain

Value of land

Proximity to grid

CO^2

Emissions

Visual impact

Biodiversity

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How do we make the best decisions for society?

Construction costs etc.

Opportunity costs

Electricity

Market values

Social value

Non-market values

Visual amenity

Flooding

Carbon storage

CO^2

HM Government

A Green Future: Our 25 Year Plan to Improve the Environment

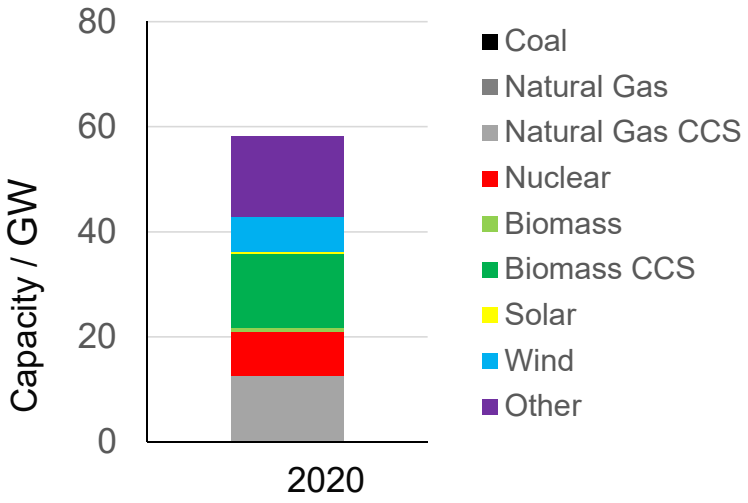
Research focus

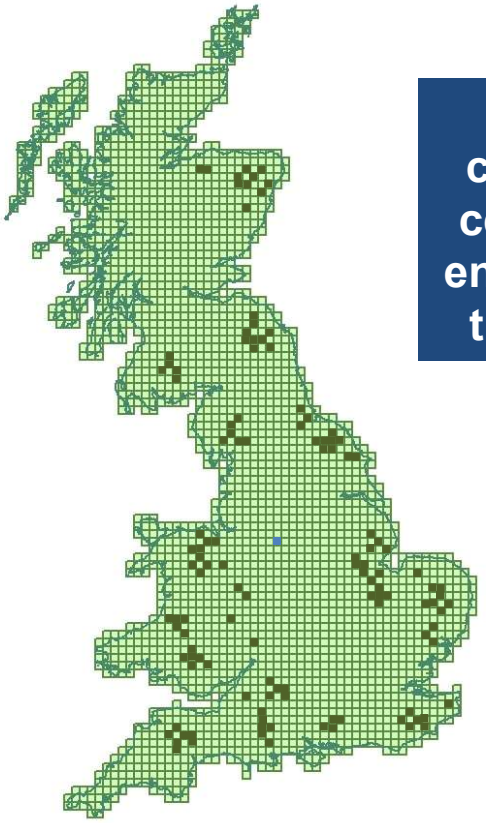
- Develop a **spatial cost minimisation model** to identify the socially optimal locations for new energy infrastructure in the UK
  - ➢ …determine the cost of **excluding land to protect food production and the natural environment**
  - ➢ …explore how **ecosystem service models** can be incorporated into energy modelling

Model development

How can we spatialise energy pathways?

Energy scenario





Which combination of cells deliver the energy system at the least cost?

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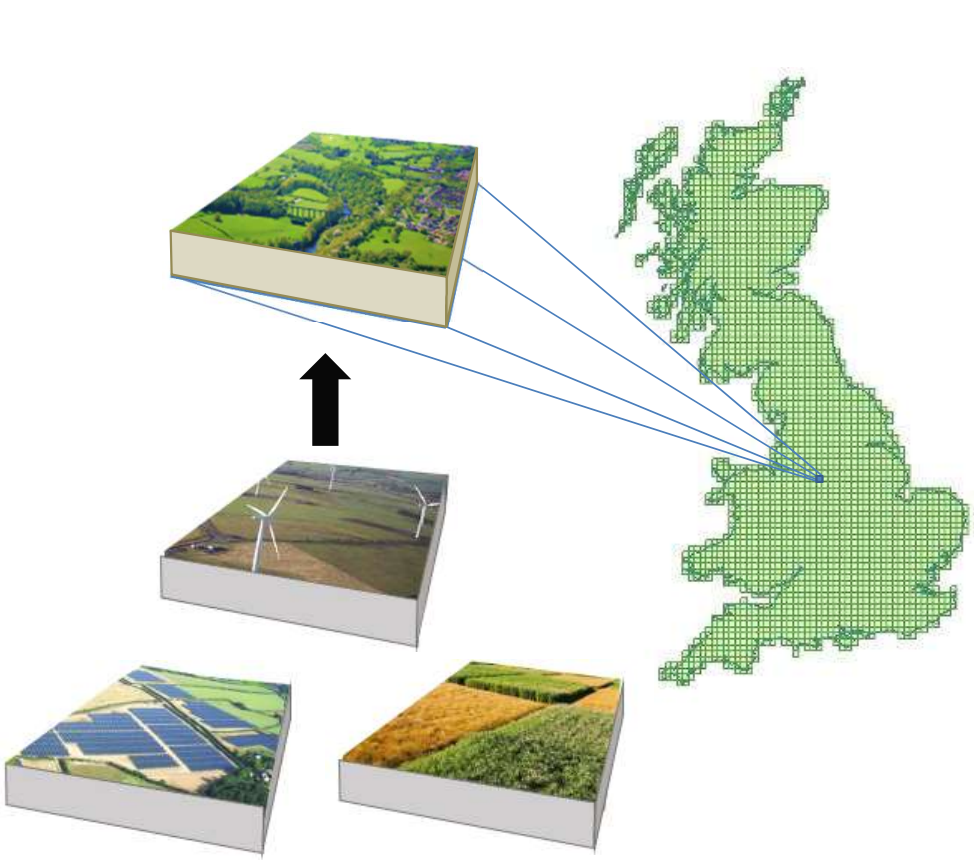
How can we spatialise energy pathways?



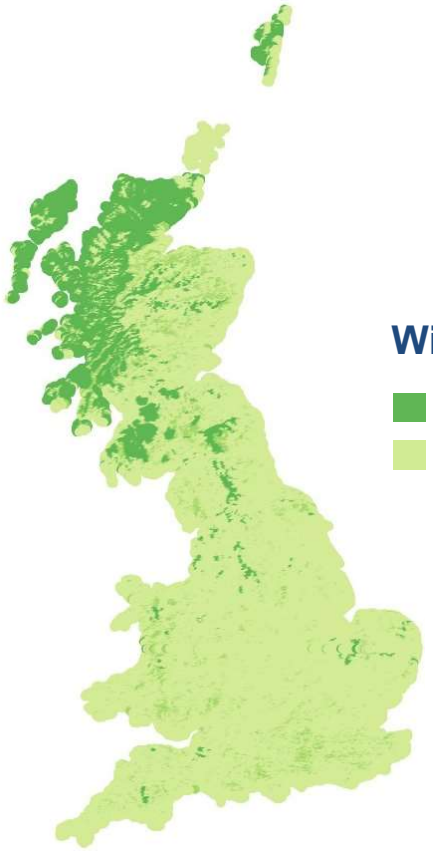
Market values

Non-market values

How do we include the value of nature?

Non-market values

CO^2



Wind: Carbon rbon

High costs

Low costs

Application of model
Preliminary findings

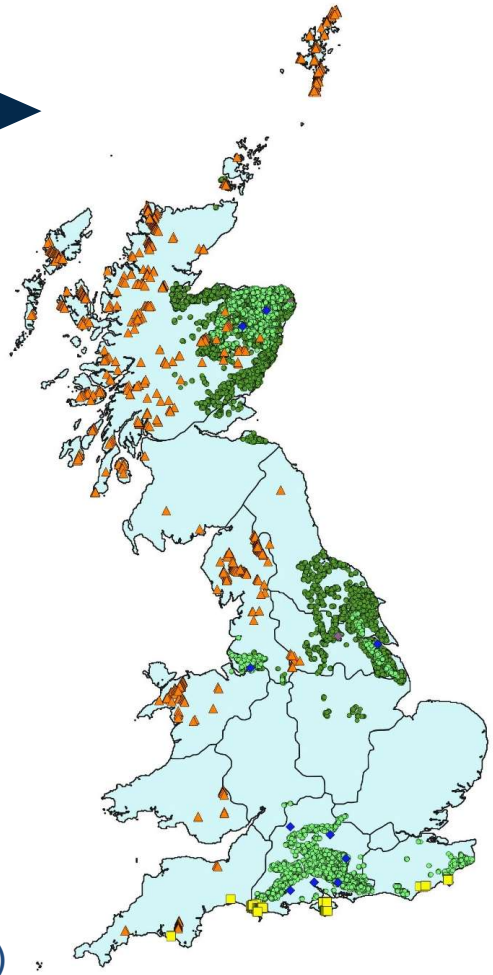
How much energy infrastructure is needed?

Example from Watson et al., 2018

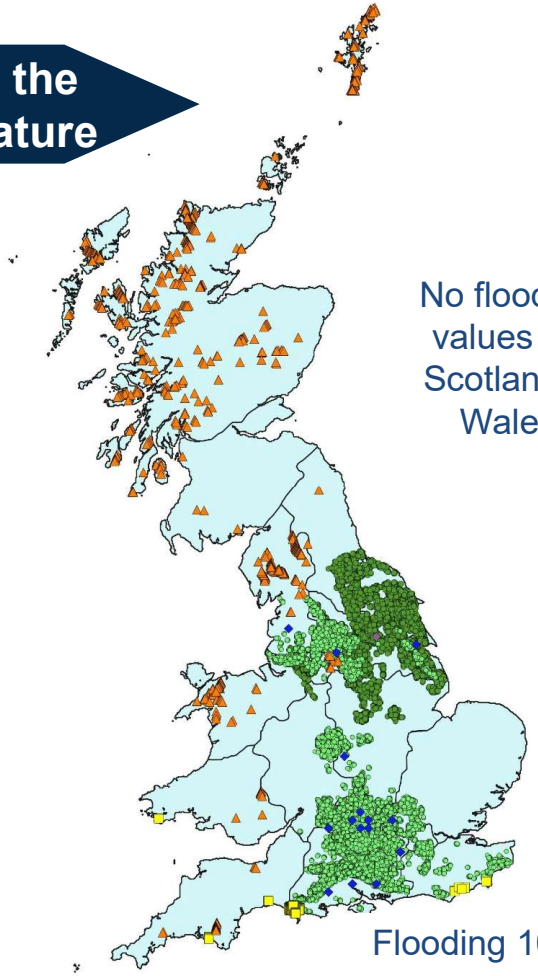
Technology	2015-2050
Bioenergy (40 MW)	29
BECCS (500 MW)	2
Solar Farms (5 MW)	856
Wind farms (10 MW)	810

Where are the ‘best’ locations for new energy infrastructure?

Excluding the value of nature



Including the value of nature



No flooding values for Scotland & Wales

Flooding 100% value

- Solar
- Wind
- Bioenergy power station
- Bioenergy crop
- BECCS power station
- Bioenergy crop (BECCS)

Thank you for listening!

Key messages:

1. Spatial optimization allows us to improve our understanding of the feasibility of different energy futures.

2. Including the value of the environment in energy modelling could help improve decision-making.

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NERC SCIENCE OF THE ENVIRONMENT

UKERC UK Energy Research Centre

ADVENT ADdressing Valuation of Energy and Nature Together

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