SUPERGEN Bioenergy Hub

UK Bioenergy Perspectives: Research and Innovation

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Supergen Bioenergy Hub

University of Manchester, Tyndall Centre for Climate Change Research

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RCUK Energy Programme Priorities

Investment in high-quality, inter-disciplinary research to target the **energy 'trilemma'** of reducing carbon emissions, energy security and affordability

- **Systems Approach**
- **Understanding Future Energy Options**
- **Reducing Energy Consumption and Demand:**
- **Enabling Technologies:** .
- **Speculative Research:**
- **Accelerated Deployment of Technologies:**
- **Building Capacity and Diversity**
- **Build on our major international links:**

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Balancing Capability

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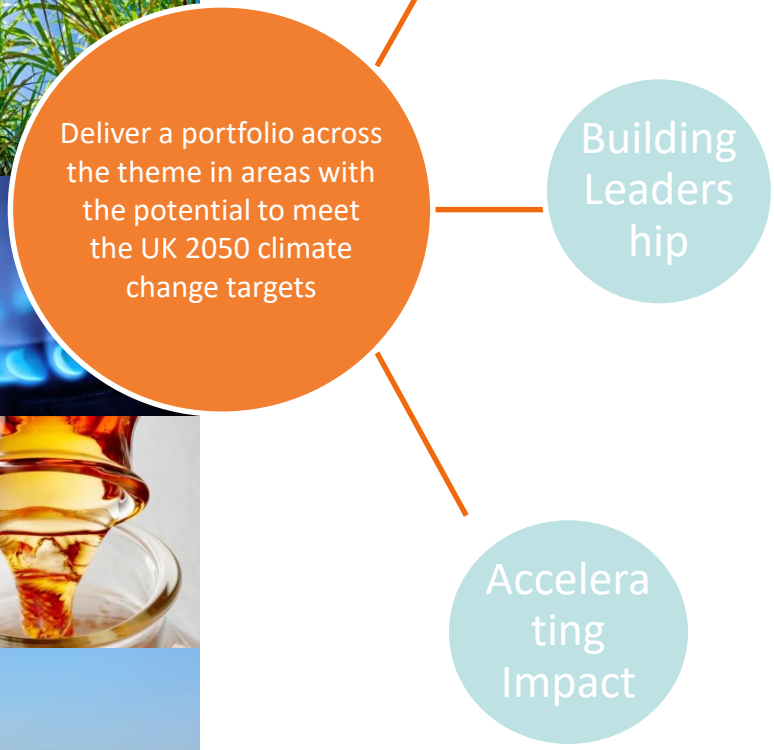

Research Area	Action
Bioenergy	Maintain
Carbon Capture and Storage (CCS)	Maintain
End Use Energy Demand (Energy Efficiency)	Maintain
Hydrogen and Alternative Vectors	Maintain
Marine, wave and tidal	Maintain
Nuclear Fission	Maintain
Solar Technology	Maintain
Storage	Grow
Whole Systems	Maintain
Fuel Cell Technology	Reduce
Wind Energy	Maintain
Fossil Fuel Power Generation	Maintain
Energy Networks	Maintain
Materials for Energy Applications	Grow
Catalysis	Maintain
Infrastructure and Urban Systems	Maintain

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To bring together industry, academia and other stakeholders to focus on the research and knowledge challenges associated with the chief objective of increasing the contribution of UK bioenergy to meet strategic environmental and energy security targets in a coherent, sustainable and cost-effective manner.

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Supergen Bioenergy Hub (2)

- 2012-2017: £4.5M (6 academic, 8 industry/policy) – became £12.8M (> 40 academic, > 40 non-academic)
- 2018-22: £5M research programme
- Technically integrated
- Engaging with stakeholders
- Flexible funding
- Researchers' network
- Collaborative funding opportunities

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Structure

CORE MANAGEMENT GROUP

- **WP1: Biomass & Waste**
- **WP2: Pre-processing technologies**
- **WP3: Conversion engineering**
- **WP4: Energy Vectors**
- **WP5: System Modelling**

Impact on the Hub

- Improve cooperation
- Integrate partners
- Integrate science & engineering
- Improve Training - SHARE

IMPACT

Impact outside the Hub

- Government
- Industry
- Statutory bodies
- Rest of World
- Society
- Europe

Impact on complementary bodies

- CCC
- RCUK
- ESC
- Professional bodies
- ERA
- ETI
- InnovateUK
- REA




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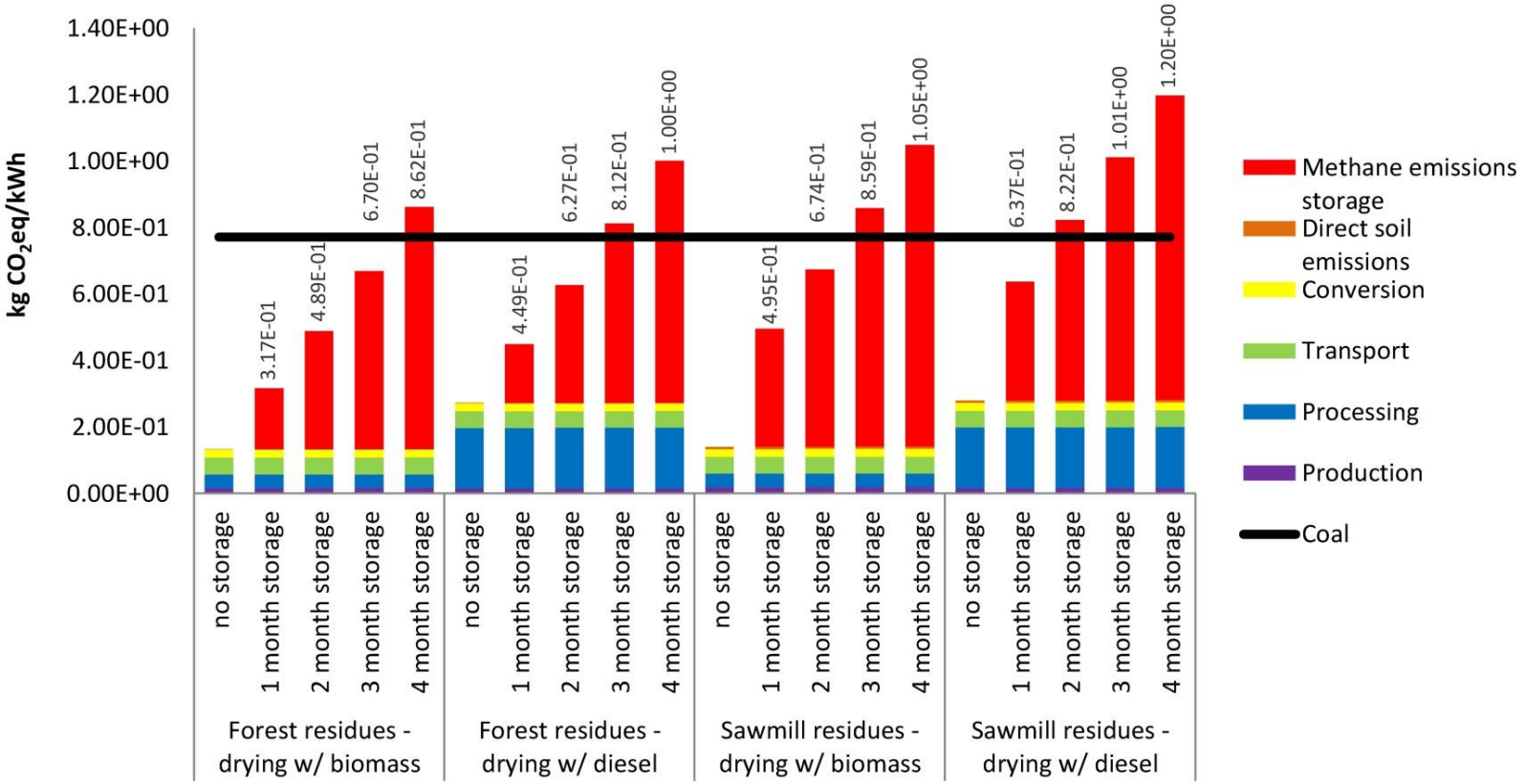
Variability due to assumptions



Röder et al., "How certain are greenhouse gas reductions from bioenergy?": Life cycle assessment and uncertainty analysis of a forest residue-to-electricity supply chain", Biomass and Bioenergy 2015



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ROTHAMSTED RESEARCH

Streamlining the supply chain

- Harvesting as whole rods avoided those losses in storage, but cost slightly more in financial, energy & GHG terms to produce a saleable product – chip (*based upon small data set*).
- Douglas Fir chips did not heat or produce any GHGs during storage, but did not dry either.
- Leachate from Douglas Fir heaps was more toxic than from willow (TOC, COD, pH).

Recommendation – harvesting as chip is OK but do not compact the heap

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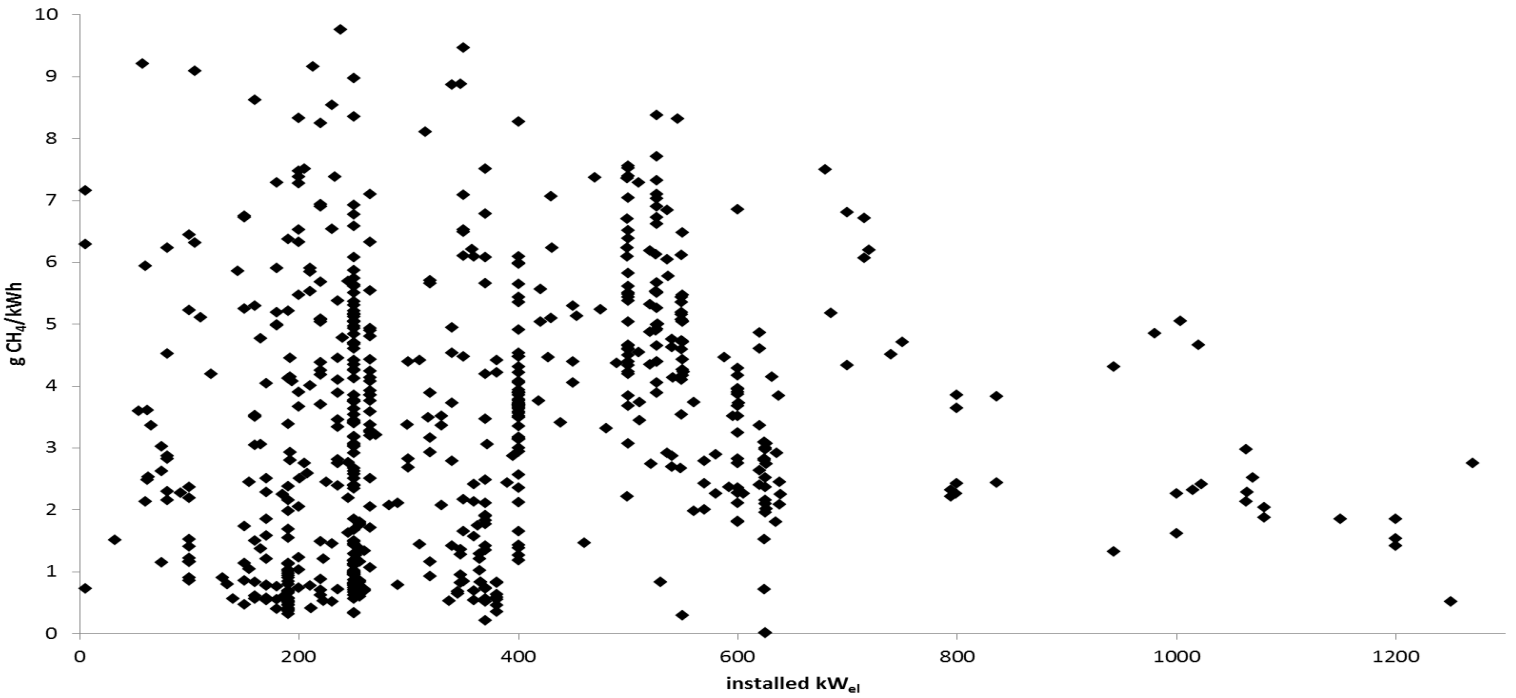
Variability from site to site (methane)



Adams, P., McManus, M. & Holgrem, M.A., 2016. European Biogas Conference, Gent, Belgium, 27-28 September 2016

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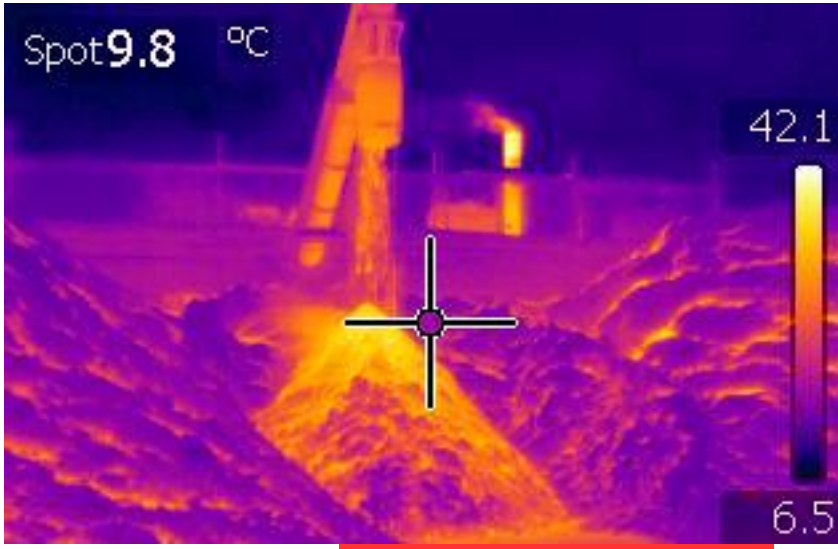
GHG Variability due to fugitive emissions (N2O)



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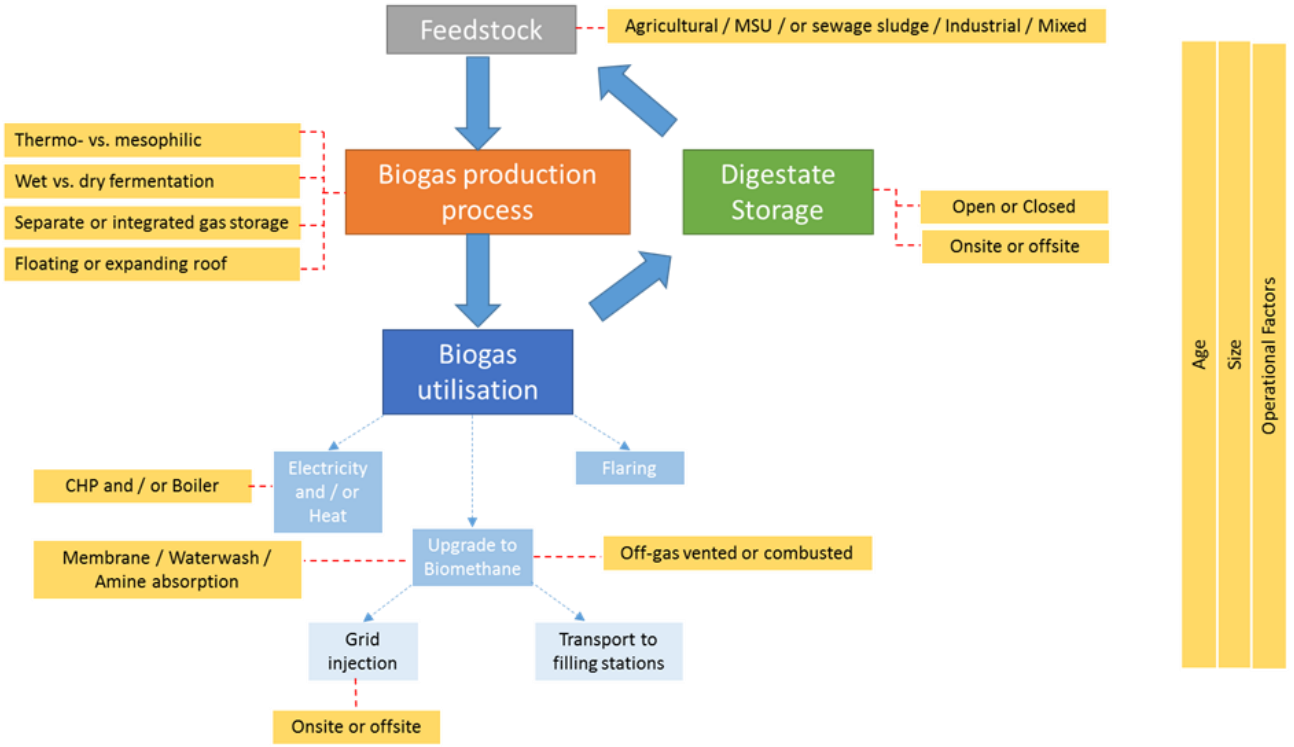
Breakthroughs: Methane Emissions from AD



Considerations in the categorisation of different AD facility

Results show substantial variability in methane emissions across sites, ranging from 0.01% to 1.52% for biogas production (average 0.63%), 0.35% to 5.30% from CHP engines, and 0.71% for biogas upgrading.

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Transformative energy research for a secure lower-carbon future

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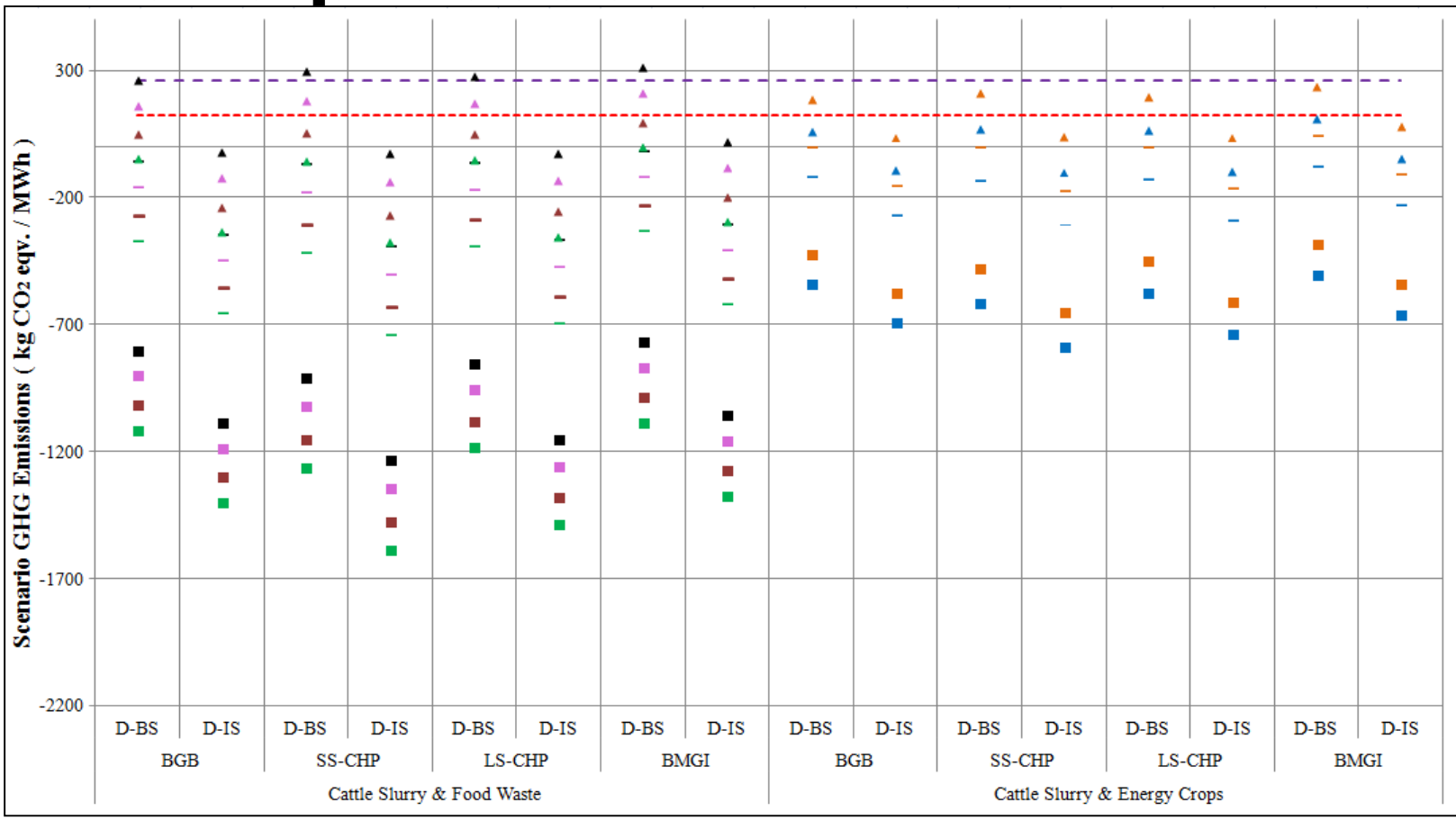
Policy relevance: GHG Variability due to process variations



Welfle A., Gilbert P., Thornley P., The potential for generating low carbon heat from biomass resources: life cycle assessment of bioenergy and counterfactual scenarios, forthcoming

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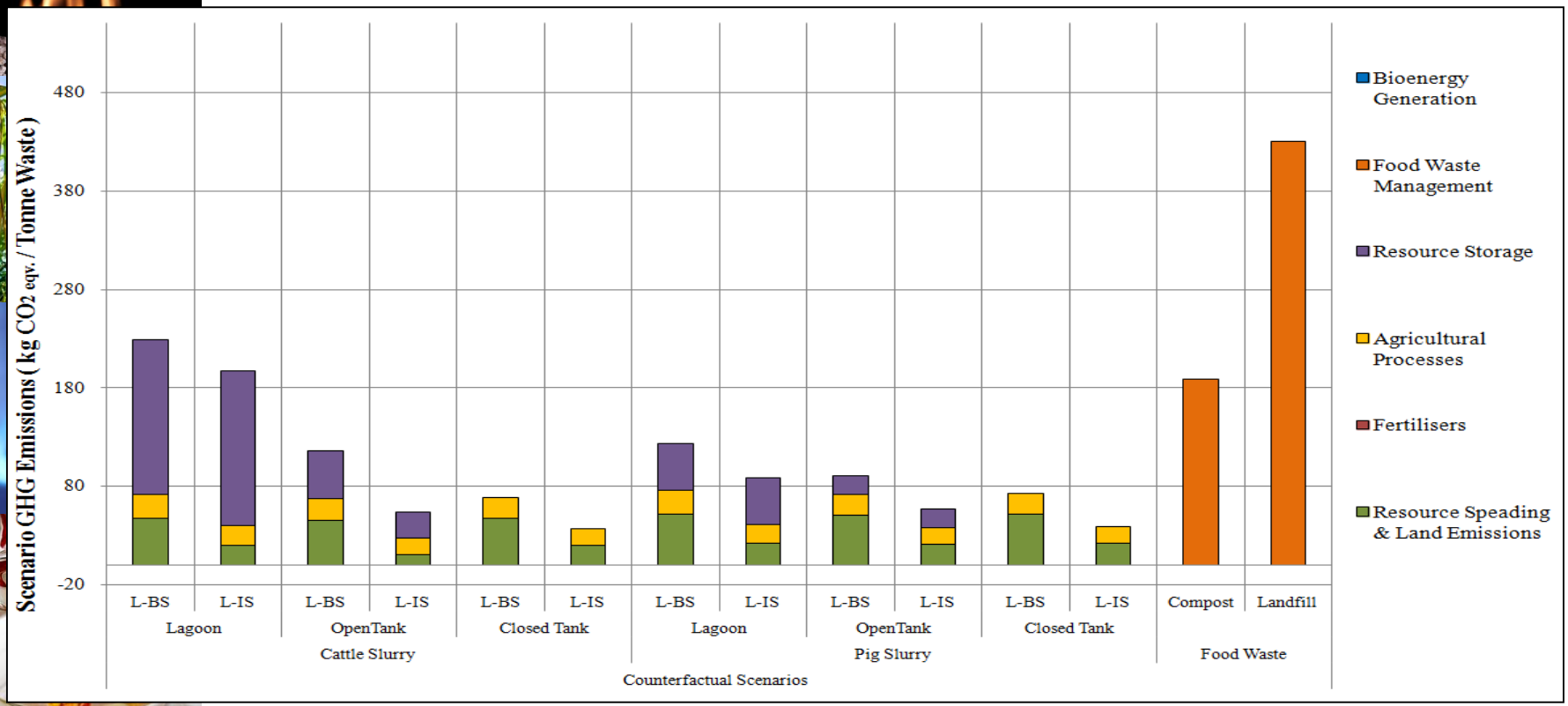
GHG Variability due to counterfactuals



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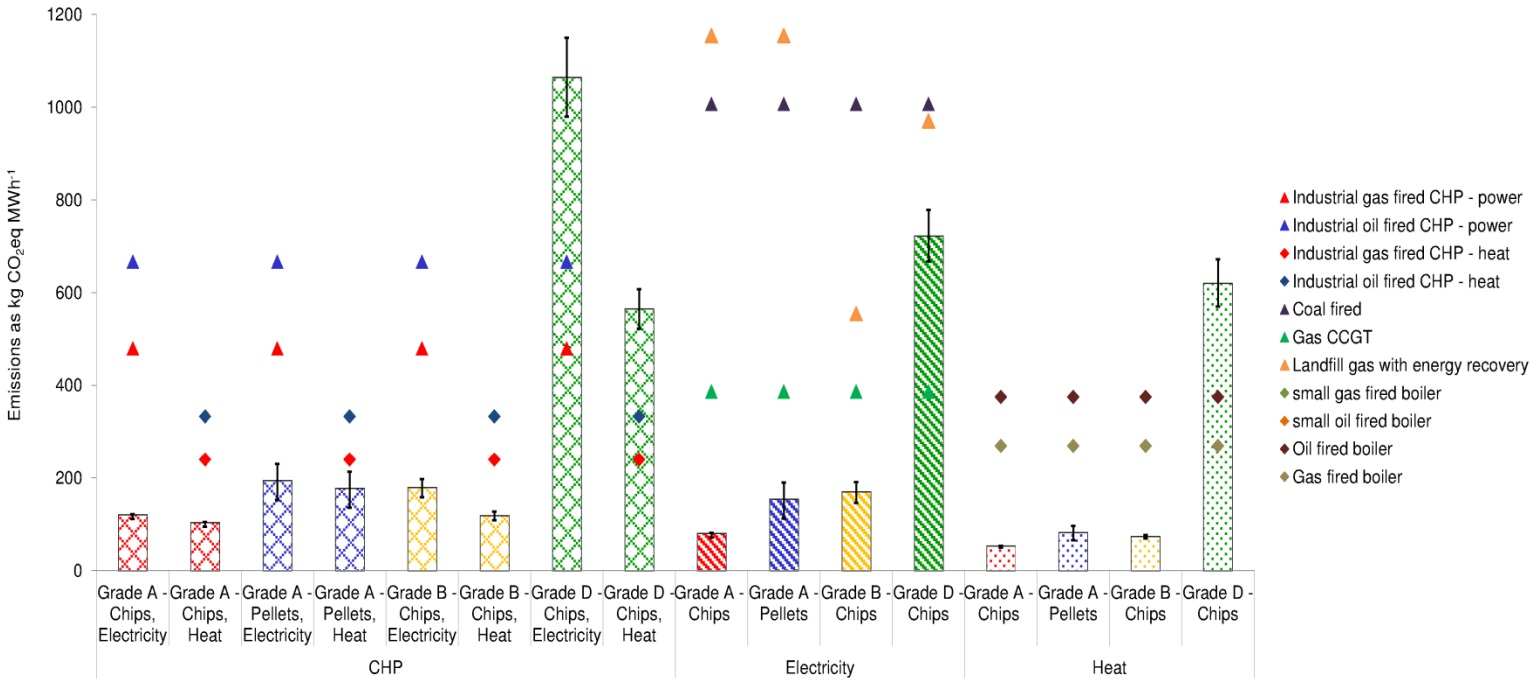
Greenhouse Gas Balances



Roeder et al, "Climate change impacts and related emission uncertainties", International Bioenergy Conference, Manchester 2017

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Transformative energy research for a secure lower-carbon future






UKCCS RESEARCH CENTRE Supergen Bioenergy

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Bio-CAP-UK Project

Project aim:

To address specific issues to deployment, remove some of the significant technical barriers to development and progress current understanding of its potential in the UK energy system, so that realistic projections of deployment, costs and achievable GHG reductions can be incorporated in policy development

WP1: *fundamental studies and biomass characterisation*

WP2: *pilot-scale plant campaign at UKCCSRC PACT*

WP3: *power plant simulations for air-/oxy-biomass combustion*

WP4: *bio-CCS value chains in the UK*






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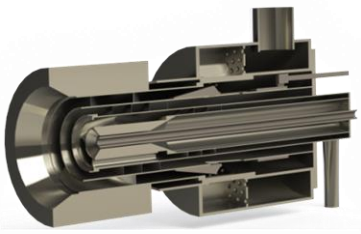
Bio-CAP-UK Project

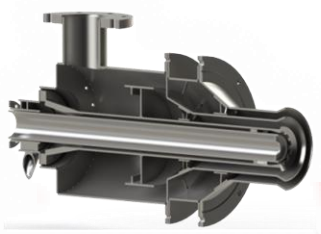
Comments:

- *results generated are novel for this industry*
- *produced good data and outputs for underpinning the science*
- *assessed critical, industrially-relevant issues: plant performance, metal aerosol composition and particle size*
- *overall, a successful programme that has opened up new research avenues*
- *if everyone wants BECCS, what will we have to burn? is the same option always the best?*

coal firing baselines

biomass firing tests

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University of Sheffield : Karen Finney and Mohamed Pourkashanian






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Networks in Industrial Biotechnology and Bioenergy

IBCarb NETWORK

Metals IN BIOLOGY

PHYCONET

NPRONET

AD NETWORK Harnessing Anaerobic Digestion

biocatnet

C1net gas fermentation

P2P

FoodWasteNet

CBMNet

BioProNET

LBNet Lignocellulosic Biorefinery Network

High Value Chemicals from Plants

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BBSRC

- Three preliminary broad themes for future phase II networks in industrial biotechnology and bioenergy of: **manufacturing**, **bioremediation** and **bioenergy** but no consensus on number of networks or scientific themes to be covered
- FAPESP – BBSRC Joint Call in Advanced Biofuels
- Global Challenge Research Fund
- Industrial Biotechnology and Bioenergy in the Developing World - call April 2018

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Global Challenges Research Fund

The UK's place in the world

Global Challenges Research Fund

- Focus areas:
  - Equitable access to sustainable development
  - Sustainable economies and societies
  - Human rights, good governance and social justice

Global research: e.g. ALMA

UK Research and Innovation

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Innovate UK

Four innovation sector programmes

- **Emerging and enabling technologies** Round 3 – Open, closes 8th November 2017
- **Manufacturing and Materials Round 4** – expected to open in December 2017
- **Infrastructure Systems Round 4** – expected to open in January 2018
- **Health and Life Sciences Round 4** – expected to open in February 2018

https://www.gov.uk/government/collections/innovation-grants-for-business-apply-for-funding

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Innovate UK

Energy Catalyst Round 6 – expected to open this year

Scope must solve the energy trilemma of affordability, security of supply and emissions reduction.

Open to any energy related technology including;

- Renewable energy (heat, cooling and power)
- Nuclear fission
- Hydrogen and fuel cells
- Energy networks and systems integration
- Demand side technologies
- Enabling technologies (storage)

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BEIS

Industrial Energy Efficiency Accelerator - £9.2m

Open to all UK manufacturing sectors, the IEEA is a technology neutral competition which will fund demonstration projects that prove energy efficiency and carbon reduction in the industrial/manufacturing processes.

Projects could include but are not limited to;

- Alternative materials which make the industrial process more energy efficient
- Reuse the heat required for the industrial process more efficiently (heat recovery)
- Design better process equipment to improve energy efficiency
- Use alternative fuels to generate the heat, cooling and power needed for the industrial process (biomass, biogas etc)

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Dept for Transport

Future Fuels for Flight and Freight Competition - £20m

The competition aims to increase domestic production of advanced fuels capable of tackling emissions from hard-to-decarbonise sectors - Aviation and Freight. The £20m programme will fund demonstration of low carbon fuel production in these sectors.

The competition is a two phase process;

- Stage 1, Project development (2017 - 2018)
- Stage 2, Demonstration (2018 - 2021)

The deadline for Stage 1 applications has been extended to the 8th December 2017.

For more information contact F4C@ricardo.com

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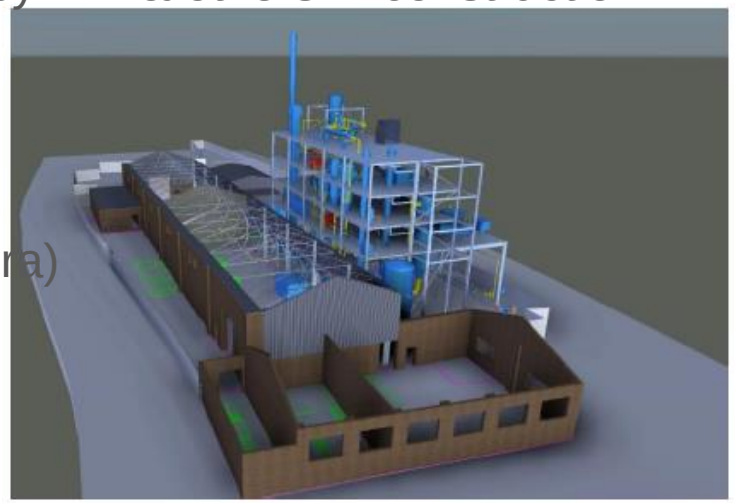
Gasification developments

- ETI
  - 1.5 MWe power station incorporating
    - “ultra-clean” tar free syngas fuelling a gas engine
  - North West Birmingham
  - Construction in hand
  - Syngas test facility (e.g. to test FT)
- GoGreenGas
  - 3MWth bioSNG plant funded by DfT & others in construction
  - Swindon
- Others include:
  - EnergyWorks Hull
  - Birmingham Biopower (Nexterra)
- All projects are waste fuelled



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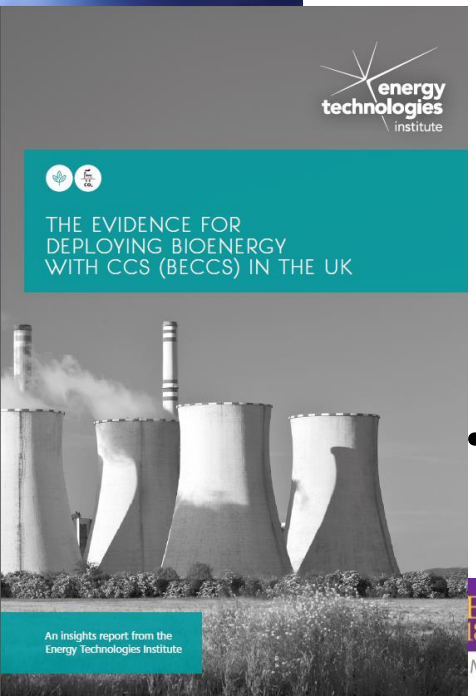

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De-risking BECCS deployment

- Critical for the UK to meet its 2050 emissions target cost effectively. Advances have been made in:
  - Costs, efficiencies and challenges of biomass combustion with carbon capture
  - Evidencing that BECCS can deliver genuine negative emissions
  - Understanding availability and sustainability of feedstocks
  - Identifying and assessing high capacity, low cost, low risk stores for CO
- UK has vast storage opportunities offshore, experience in bioenergy deployments and strength in bioenergy and CCS research and development

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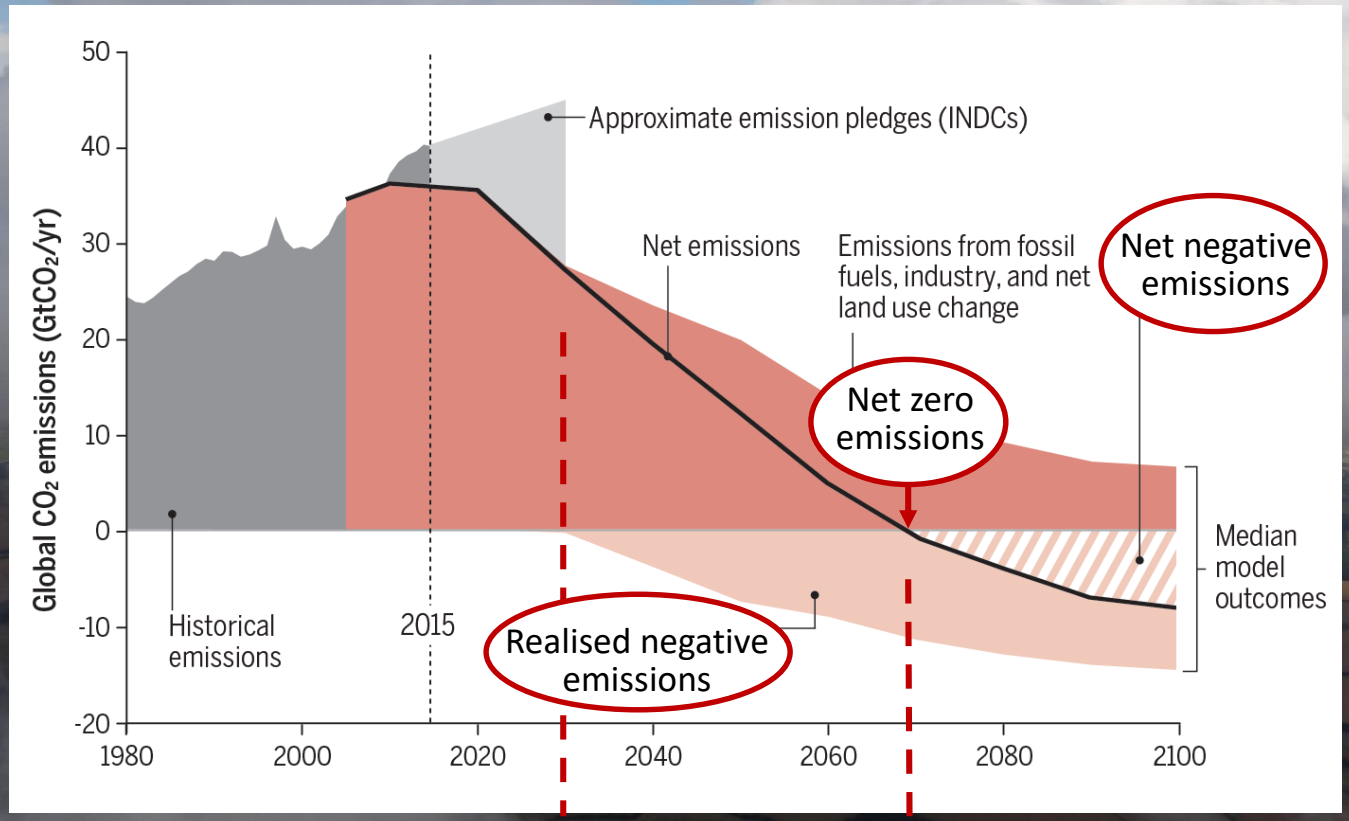
Greenhouse Gas Removal (GGR) research

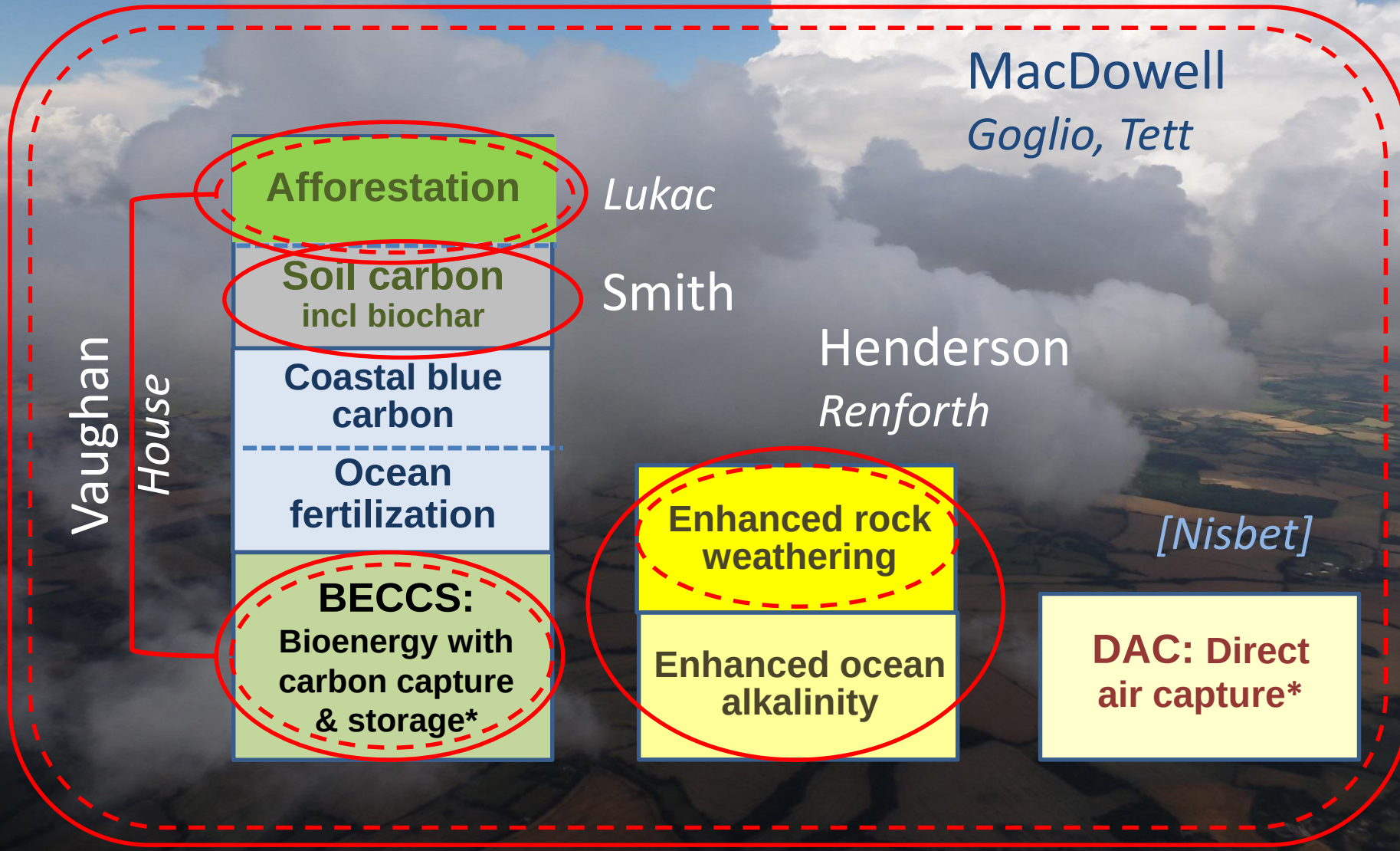
It seems (near-)impossible to meet climate change commitments without negative emissions/GGR



IPCC AR5 scenarios that keep warming below 2°C: Anderson & Peters (2016)

GGR needs to be at Gt scale by ~2030 and achieve net zero emissions by ~2070

GGR programme: coverage of techniques by consortia and *topic-specific projects*



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Any questions?

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- www.supergen-bioenergy.net

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