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## Biomass as a long-duration store of energy

A scoping study for UKERC and the Supergen Bioenergy Hub

Keelan Colechin, PhD candidate

# ▶ Why I'm here

- ▶ Exploring whether biomass could play a role in delivering flexibility into the energy system
- ▶ Found there was potential for delivering dispatchable stores of energy over long durations
- ▶ However, there are key unknowns that need to be addressed

# Challenge

## ▶ Energy system challenge


- ▶ Increasing dependence on variable renewable energy sources
- ▶ Creates need for controllable and flexible long-duration stores of energy
- ▶ These are needed urgently to align with 2030 Clean Power Mission

# The challenge - background



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NESO (2023) identified that bioenergy 'provides a renewable low carbon power source' that can be used as dispatchable generation to 'help meet demand during times of low wind and solar output'.



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However, where CCS is installed they are suggesting that higher load factors would be desirable to 'maximise carbon removal from the atmosphere'.

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The CCC's Sixth and Seventh Carbon Budgets (2020, 2025) identified BECCS as the 'best long-term use of scarce bioenergy resources' in an energy generation context. However, the need for strategic flexibility is still acknowledged.

# Scope & methodology



Collected evidence from over 50 stakeholders through semi-structured interviews, focus groups and facilitated workshops



Interview data was collated, categorised and presented back to stakeholders as distinct narratives through an iterative process



All data was finally analysed to produce a set of pathways, highlighting key points of contention and important 'unknowns'

# Bioenergy Themes

We explored the potential role of bioenergy for addressing these different flexibility needs through three key themes:

**Plant, infrastructure and products** - current operation, future operation, best match to flexibility needs

What are the technical and commercial implications of more flexible operating regimes?

Considering electricity, heat and biogas as products

**Dynamics of BECCS** - timescales and feasibility of the transition

How does BECCS impact the ability of biomass to deliver flexibility to the energy system?

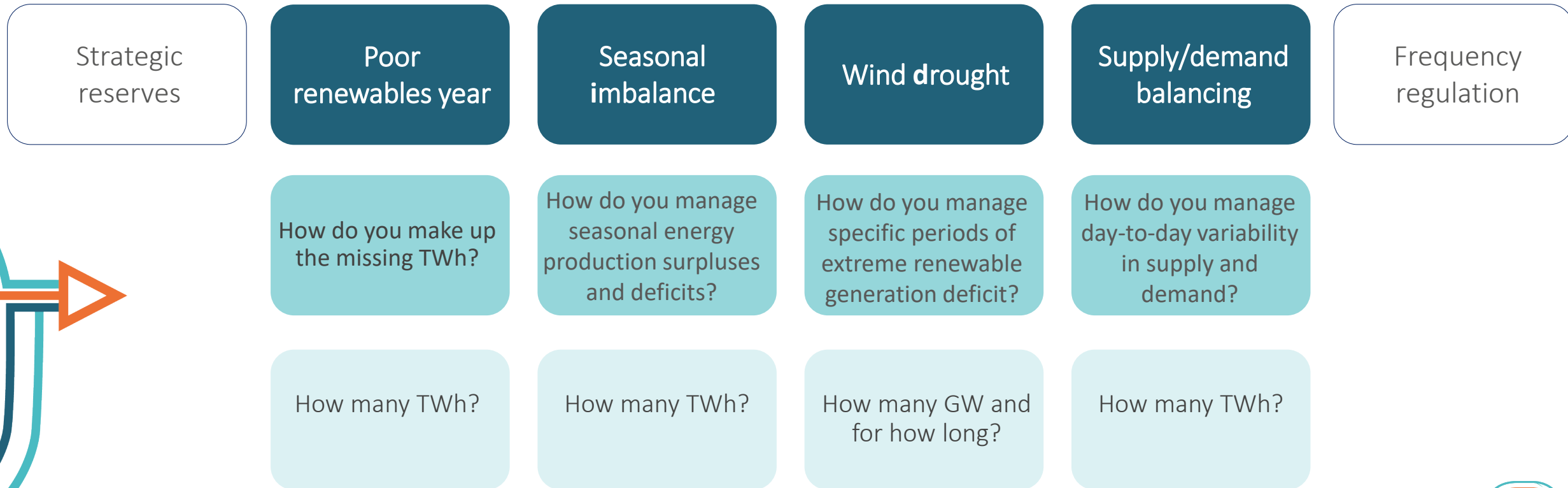
When will this come into effect?

**Feedstock supply chains** - UK and international

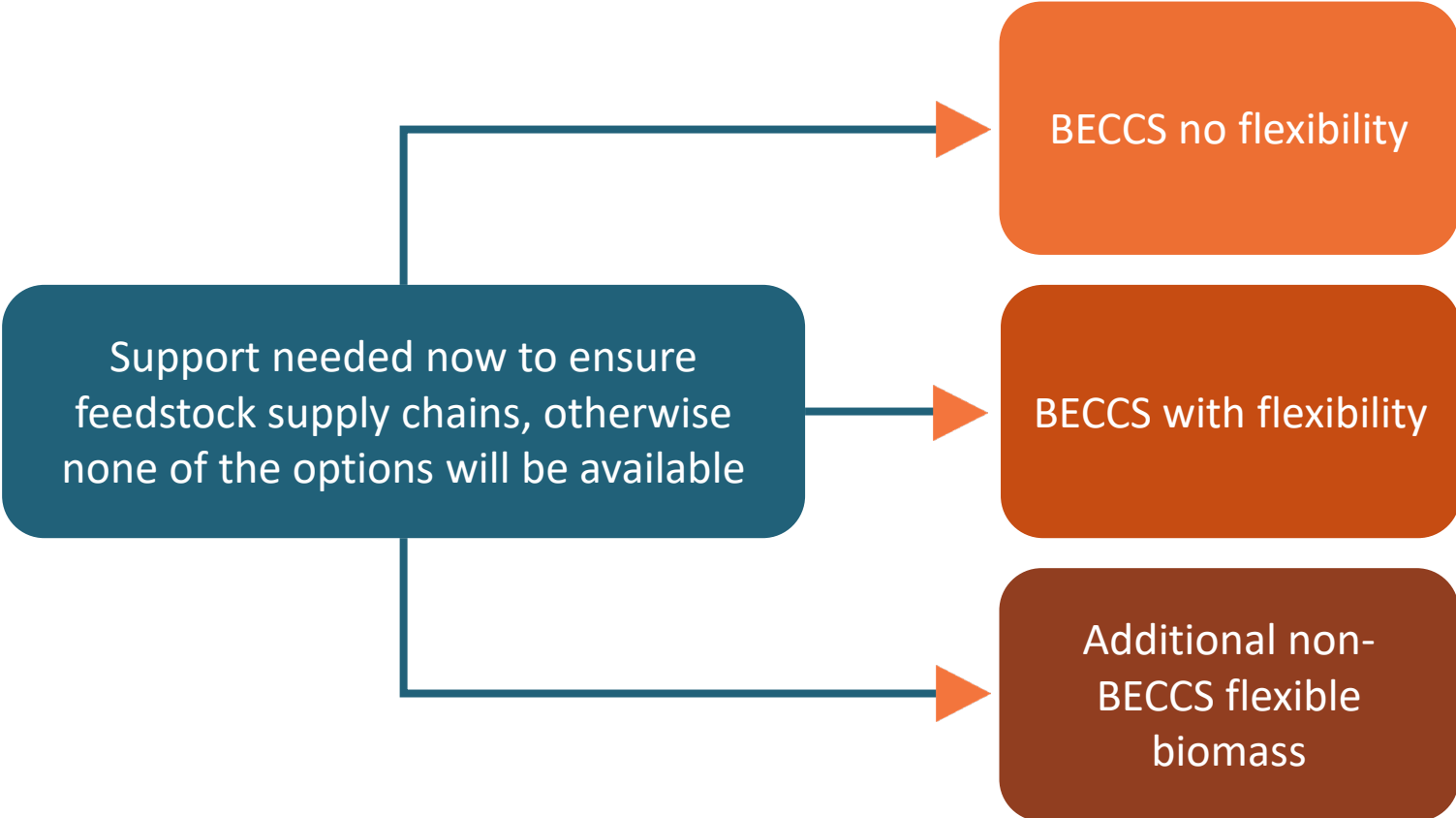
What are the impacts of flexible biomass operations on sustainable feedstock supply chains?

# Flexibility

Energy systems flexibility can mean many things, we broke down our definition in terms of needs at different timescales:



# Key pathways

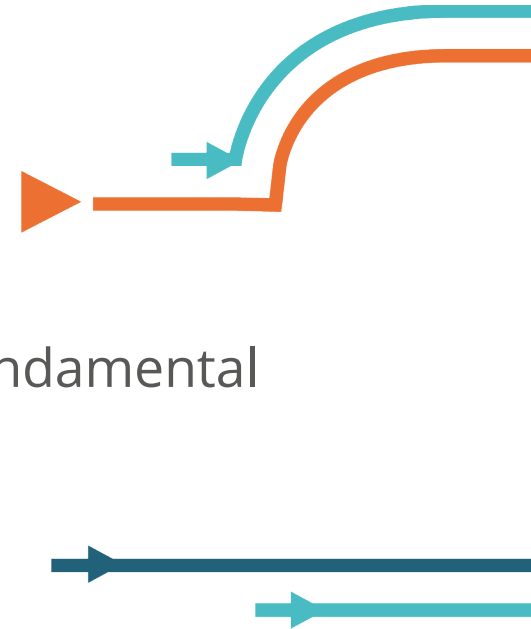


# Results: Headlines

- ▶ Sustainable biomass can and does act as a long-duration store of energy
- ▶ In the UK, there are unrealised opportunities to make greater use of this fundamental characteristic of biomass
- ▶ This value can be delivered alongside other key uses for biomass, such as BECCS
- ▶ Realising this value will require a different politics of biomass
- ▶ This study was limited to collating stakeholder views. A detailed solution couldn't be created, but a clear set of questions and next steps on the way to a solution.

# Results: Headlines

- ▶ Sustainable biomass can and does act as a long-duration store of energy
- ▶ In the UK, there are unrealised opportunities to make greater use of this fundamental characteristic of biomass
  - ▶ What's the scale of this potential?
  - ▶ What value could it deliver to the system?
  - ▶ How does this work economically/commercially?
- ▶ This value can be delivered alongside other key uses for biomass, such as BECCS
  - ▶ What's the balance?
  - ▶ How will this change over time?



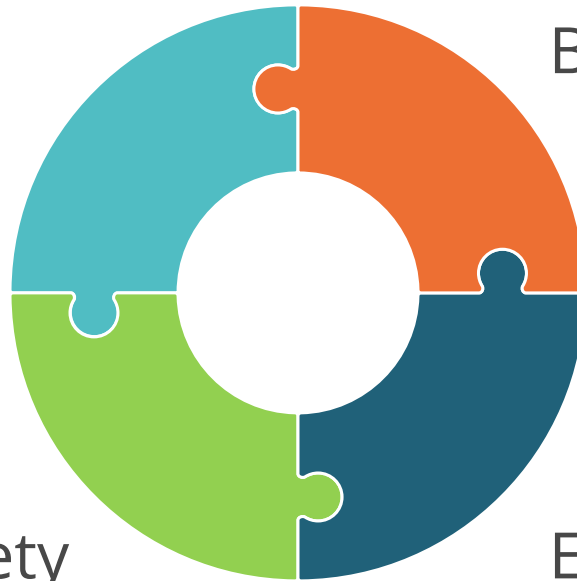
# Results: Headlines Continued

- ▶ Realising this value will require a different politics of biomass
  - ▶ Why has the negative public discourse developed?
  - ▶ How to address this?
- ▶ This study was limited to collating stakeholder views. A detailed solution couldn't be created, but a clear set of questions and next steps on the way to a solution.



# What's next

System value:  
flexibility and BECCS



Bioenergy Feedstocks

Wider society

Economics



# Summary / recap

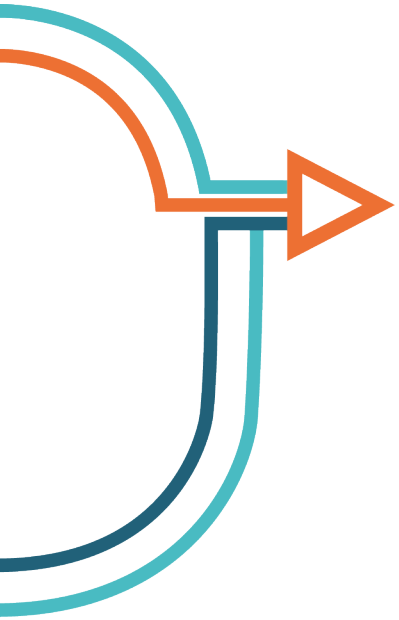


- ▶ Sustainable biomass can and does provide a long-duration store of energy.
- ▶ There are opportunities to make better use of this fundamental characteristic.
- ▶ We have identified some key next steps to making this a reality.
- ▶ Questions?



# Project Partners





Download  
the full report

**Webinar**

26 November 2025

13.00-14.00



# Key Messages (1/2)



- ▶ **Bioenergy infrastructure and supply chains** currently store energy at scale over relatively long periods. This characteristic could be used to **facilitate greater flexibility** in the operation of **heat, gas and electricity** systems and markets.
- ▶ The **capital and operational costs** of bioenergy are **well understood** and are already delivering **commercially**. This knowledge could deliver a complementary, lower-cost solution to the **long-duration energy storage challenge**.
- ▶ The **flexibility potential** of biomass operations is **diverse** and geographically as well as temporally distributed. This may be as valuable to the system as creation of negative emissions from BECCS.
- ▶ The potential for delivering **BECCS** is being investigated **at a range of scales** and with diverse feedstocks. There are configurations of plant and feedstock that could **combine** delivery of **BECCS** with seasonal energy **storage and flexibility**.

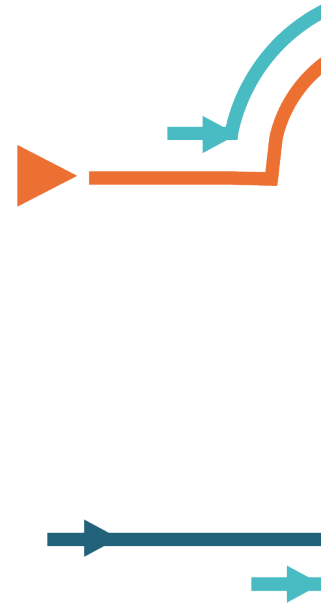
# Key Messages (2/2)



- ▶ Current supply and use of biomass in the UK is shaped by **government policy**, incentives and regulation, which focuses on negative emissions and does not currently promote flexible operation on smaller capacity sites.
- ▶ **Incentivising flexibility without increases in plant capacity could have a detrimental effect on hard-won feedstock supply chains – in many cases this is material that would otherwise go to landfill.**
- ▶ There is significant **pressure** being placed on government in the UK to **reduce the use** of biomass on the basis of concerns about emissions and sustainability of supply chains.
- ▶ There are a number of **uncertainties** about the timing of **BECCS** becoming a 'commercially available' option to all bioenergy producers.
- ▶ Longer-term the role for biomass will change – timing and shape of this role in long-term needs better characterisation, as does the transition

# System value: flexibility and BECCS

- ▶ **Energy system modelling** – whole energy systems modelling to assess the value that could be delivered to the system by biomass energy storage, comparing this to the system-wide costs of other long -duration energy storage options and the system value of BECCS.
- ▶ **BECCS** – address key uncertainties around the timing and feasibility of retrofitting BECCS to existing bioenergy plants, including the viability of small-scale BECCS, distributed CO<sub>2</sub> transport, and the commercial potential of flexible BECCS operations.
- ▶ **Appropriate technologies** – more detailed UK-specific analysis to assess opportunities, system impacts, and commercial changes required for investment in energy storage and flexibility from bioenergy across a range of plant types and scales of operation.
- ▶ **New flexible plants** – research to assess the opportunities for new flexible bioenergy plants that support energy storage, flexibility and other value streams,



# Bioenergy feedstocks



- ▶ **Feedstock modelling** – to help clarify a strategic role for bioenergy in delivering long-duration energy storage, taking account of the potential for sustainable imports and the influence of BECCS on feedstock pricing.
- ▶ **Feedstock supply-chains** – explore the investment and policy reform needed to unlock the long-duration energy storage potential of existing feedstock supply-chains through actor engagement, commercial incentives and wider market opportunities.
- ▶ **Feedstock production** - stakeholders want to better understand how sustainable bioenergy feedstock production - via marginal land and crop rotation - could support long-duration energy storage from bioenergy while reducing reliance on imports.
- ▶ **Fuel flexibility** – investigate impacts on energy system security, supply chain flexibility, and resource efficiency of expanding feedstock diversity on specific bioenergy plants, to assess the scale of benefit that can be achieved without compromising plant reliability.

## Economics



- ▶ **Market mechanisms** – examine capacity market reform and other mechanisms for incentivising operational flexibility from bioenergy and BECCS plants, evaluating commercial value streams and system-wide costs relative to other flexibility solutions.
- ▶ **Circular economy** – research to assess the impact on feedstock quality, supply and pricing of efforts to enhance the UK's circular economy, which is likely to reduce biogenic waste stream availability where these feedstocks have not been commoditised.



## Wider Society

- ▶ **Place** – investigate the role of local markets, agronomy, energy planning and other political factors in the success of distributed bioenergy production and explore how these could support flexibility, particularly for heat delivery.
- ▶ **Social acceptance** – investigate claims that some biomass technologies and/or scales of operation are more accepted by society. Do smaller scale plants, or technologies that don't involve certain feedstocks face less objections?
- ▶ **Unintended policy consequences** – assess who would benefit from the value flows created by incentivising bioenergy production flexibility, and address timescales and transitional arrangements to ensure effective system adaptation and maximise impact.