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Supergen Bioenergy Hub 2018-2022:

Bioenergy Vectors Research Theme

Increasing the Role of Bioenergy in the UK's Wider Energy Mix and Bio-Economy

12th ECCRIA Conferences

5th September 2018, Cardiff University

Andrew Welfle

Tyndall Centre for Climate Change Research

University of Manchester

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Supergen Bioenergy Hub Project Structure

Supergen Bioenergy Hub

TG4: Systems

TG1: Resources

TG2: Pretreatment & Conversion

TG3: Vectors

Case studies

Impact within the Hub

- Improve co-operation
- Integrate partners
- Integrate science & engineering
- improve industrial understanding
- Training - SHARE

IMPACTS

Impact outside the Hub

- **Industry** (companies, professional bodies, trade associations, catapults, Energy Research Accelerator)
- **Policy** (government, statutory bodies, climate change committee, UKRI
- **Society** (public engagement, NGO's and media)

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Bioenergy Vectors Topic Leader

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So what is a Bioenergy Vector

Feedstocks — Energy Crops, Agricultural Residues, Woody Biomass Process Wastes & Residues etc.

↓ ↓ ↓

Conversion — Biological, Thermal, Chemical, Catalytic Conversion etc.

↓ ↓ ↓

Bioenergy Vectors — Animal Feed, Aviation Fuels, Biofuels, Biomethane, Bulk Chemicals, Electricity, Fertiliser, Fine Chemicals, Fuel Gas, Heat, Hydrogen, Liquid Fuels, Syngas etc.

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The Bioenergy Vectors Theme

Aims & Objectives:

- Identify preferred bioenergy pathways that will produce appropriate bioenergy vectors to meet the UK's demands.
- Analyse the role that different bioenergy vectors could have within the wider UK energy network.
- Determine how these fit within the UK's wider bioenergy, bio-refinery and carbon reduction strategy.
- Target to reduce emissions, reliance on fossil fuel & improve national & regional resilience through bioenergy.

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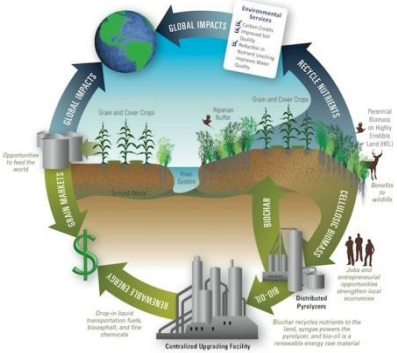
The Bioenergy Vectors Theme Work Tasks

Task 1 - Review

- Review of existing UK bioenergy systems & bioproduct pathways.
- Identify primary case studies
- Define the existing knowledge base on relevant conversion pathways, costs and TRL's for key vectors.



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The Bioenergy Vectors Theme Work Tasks

Task 2 - Specification

- Parameterize the quality specifications for bio-based alternatives.
- Compatibility with existing technologies & infrastructure.
- Longevity of vectors – viability

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The Bioenergy Vectors Theme Work Tasks

Task 3 – Case Studies

- Exploration of wider impacts.
- Attributional LCAs of selected pathways.
- Water, GHG & Energy balances.
- Spatial analysis – impact location.
- Temporal analysis – impact timeline

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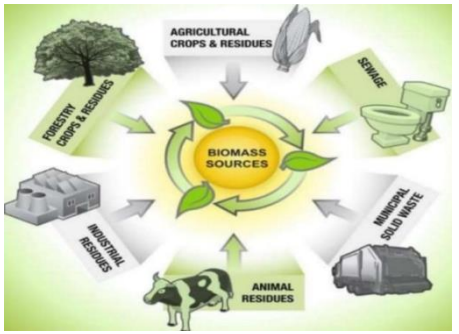
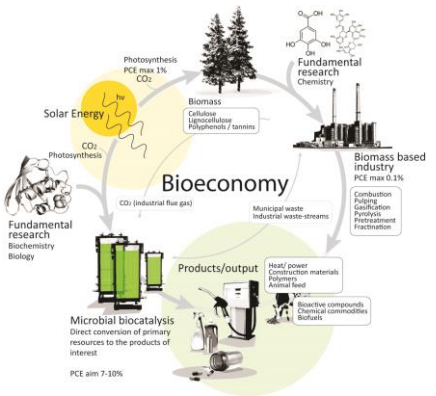
The Bioenergy Vectors Theme Work Tasks

Task 4 – Integration

- Explore role of bioenergy in the UK's energy mix & bio-economy.
- Build on the existing Transition Pathways work.
- Analyses of high value non-energy bio based vectors.





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Important to Understand the UK's Bioenergy & Bio-Product Demands

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UK Bioenergy & Bio-Product Demands

UK Bioenergy Sector		2015	2020	2030	2040	2050
		Near-Term		Mid-Term	Long-Term	
Bio-Heat Sector	Demand Trends	Gradual increase in demand reflecting both increased traditional and specialist roles for bio-heat.		Gradual decline in demand reflecting the targeted focus on emerging alternative low carbon heat technologies. Bio-heat continuing within specialist roles such as by industry.		
	Key Resource Demands	▪ **Wood based resources**	▪ **Wood based resources (pellets & chips)** ▪ **Feedstocks for advanced bioenergy technologies**			
Bio-Power Sector	Demand Trends	Sharp increase in demand driven by increased & further conversion of conventional power plants to allow co-firing with biomass.		Gradual decline in demand as co-firing plants are expected to gradually close. Continuing demand for bio-power systems contributing to balance peak energy demands.		
	Key Resource Demands	▪ **Solid biomass resources (wood, animal based, plant based, wastes)**				
Bio-Fuel Sector	Demand Trends	Sharp increase in demand for biofuels for the transport sector.		High uncertainty for the long-term biofuel sector, due to potential emergence of alternative low carbon technologies.		
	Key Resource Demands	▪ **Energy Crops**	▪ **Energy Crops** ▪ **Lignocellulosic resources.**			

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The Opportunities & Challenges of the Variability of Bioenergy

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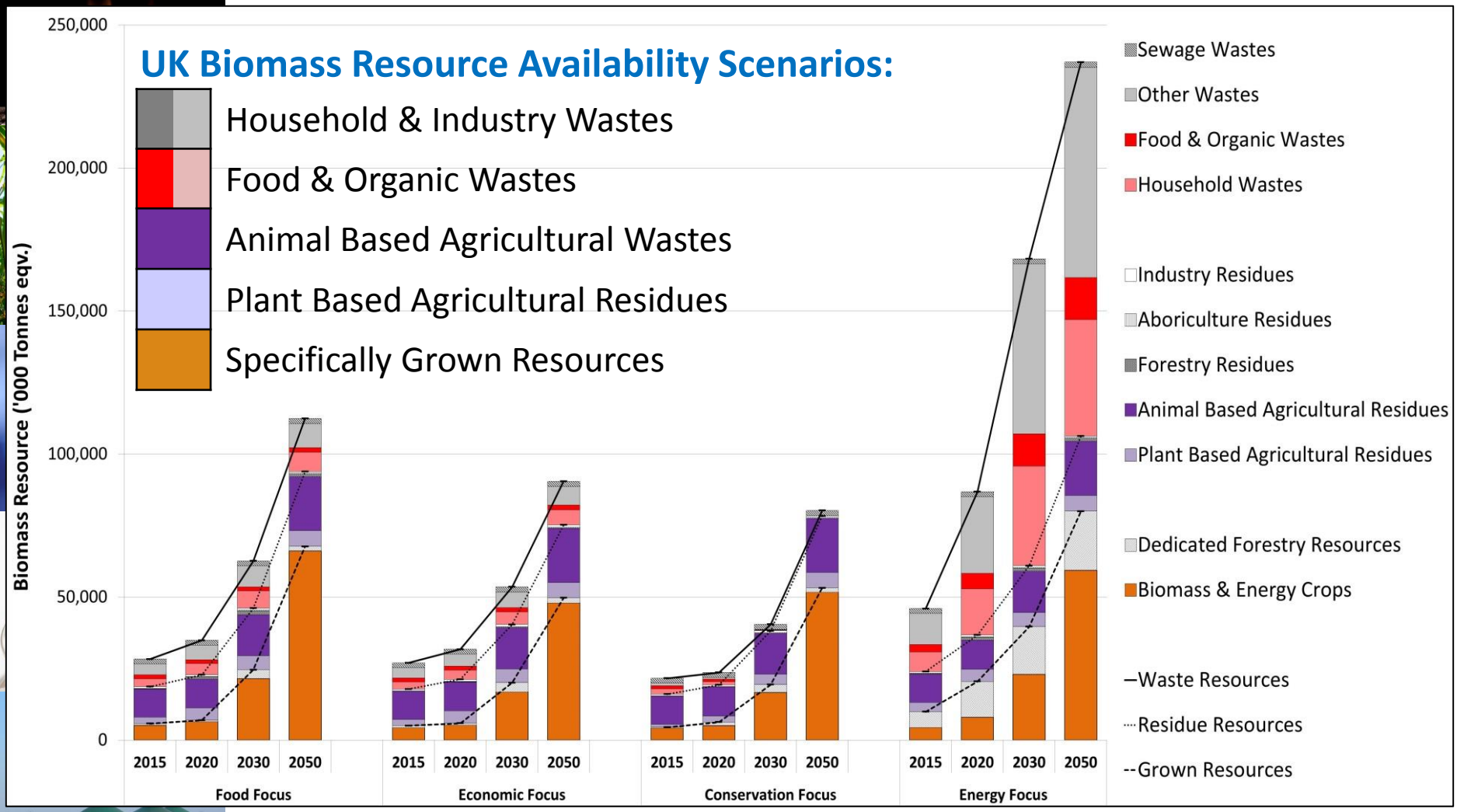
Variability of UK Biomass Resources



Welfle, A., Gilbert, P. & Thornley, P., 2014. Securing a Bioenergy Future without Imports. Energy Policy, 68, pp.1–14. Available at: http://www.sciencedirect.com/science/article/pii/S0301421513012093 [Accessed November 26, 2014].

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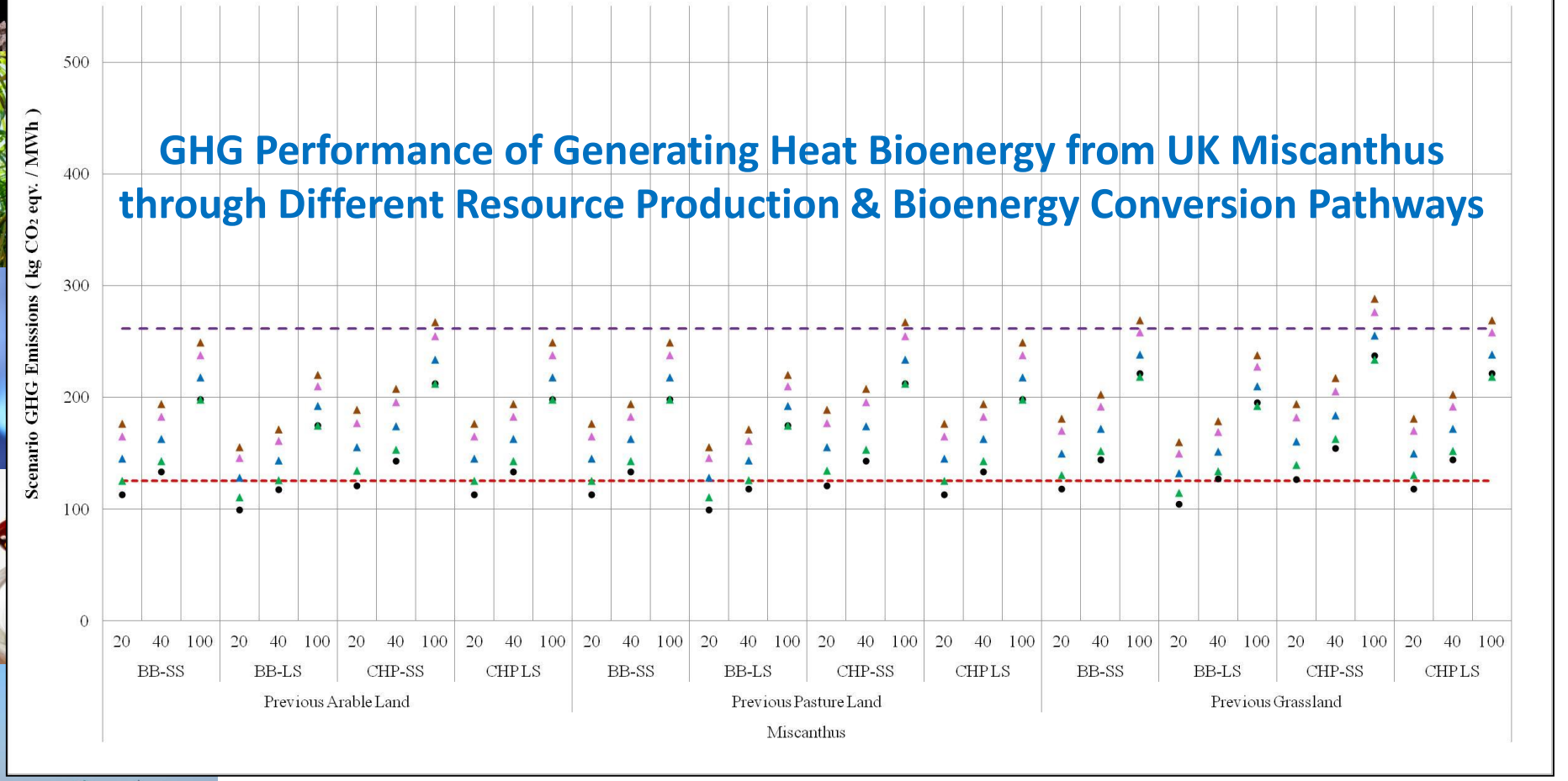
Variability of Bioenergy GHG Emissions



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Developing the Supergen Case Study Scenarios for Analysis

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The Supergen Bioenergy Case Studies

Range of Potential Case Study Components

RESOURCES

- UK agricultural product e.g. energy crop or residue
- Lignocellulose (woody biomass or waste)
- Organic wastes e.g. waste wood & MSW
- Difficult wastes
- Dry brown biomass & waste & wet biomass & waste
- Woody material e.g. forest residues and coppice
- Process residues from bio-processing

PRETREATMENT & CONVERSION

- Biocatalysis
- Catalytic conversion
- Chemical conversion
- Digestion
- Fermentation
- Fractionation to simple sugars
- Hydrolysis & separation,
- Hydrothermal processing
- Omnivorous catalytic technology
- Pyrolysis
- Saccharification
- Gasification to syngas
- Separation
- Synthesis of alcohols
- Synthesis of hydrocarbons
- Thermal conversion of residues
- Upgrading

VECTORS

- Animal feed
- Aviation fuels
- Biofuels
- Biomethane
- Bulk chemicals
- Electricity
- Ethanol
- Fertilizer
- Fine Chemicals
- Fuel gas
- Heat
- Hydrogen
- Liquid fuels
- Syngas

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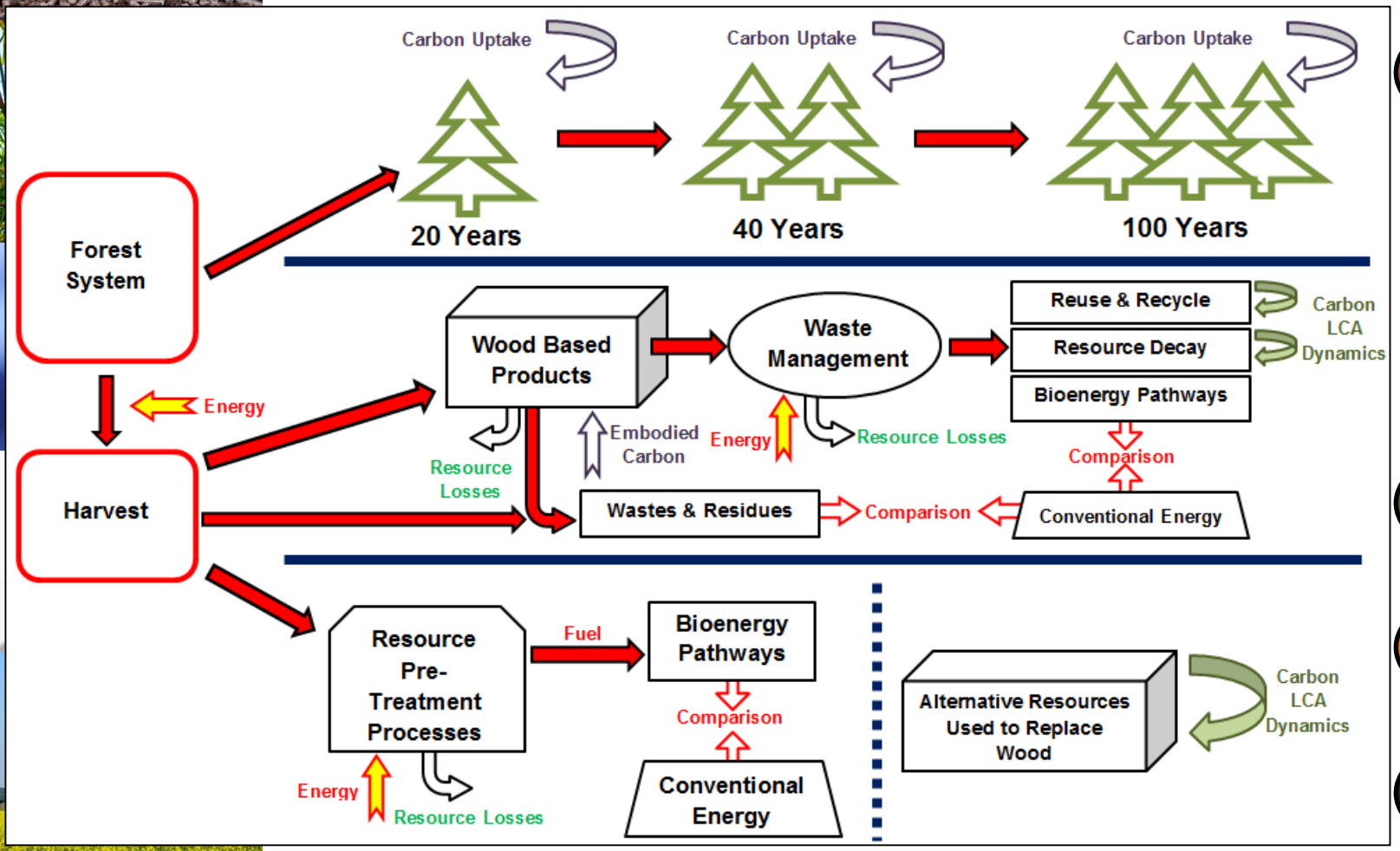
Case Study Example:

Generating Heat from Forestry Biomass



- Process Energy Demands
- GHG Performance
- Water Footprint
- Particulate Emissions
- Use of Process Bi-Products
- Temporal Emissions
- Techno-Economic Performance

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In Summary the Vectors Theme will:

*The **Vectors** and **Systems** will work closely together to evaluate the **future role of UK bioenergy** and its **impact**; with a particular focus on development of the **bio-based economy**, supporting the UK's **industrial strategy** with **integration** of bioenergy, bio-products and impacts.*

Our Approach

- Process Modelling & Life Cycle Assessment (LCA) of Key Case Studies
- Close integration with the Systems Research Theme that will focus on the wider sustainability impacts of UK bioenergy development.

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Any Questions?

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