Thermal energy research at Aston University

Patricia Thornley

We work with academia, industry, government and societal stakeholders to develop sustainable bioenergy systems that support the UK's transition to an affordable, resilient, low-carbon energy future.

Supergen Bioenergy Hub

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EBRI
European Bioenergy Research Institute

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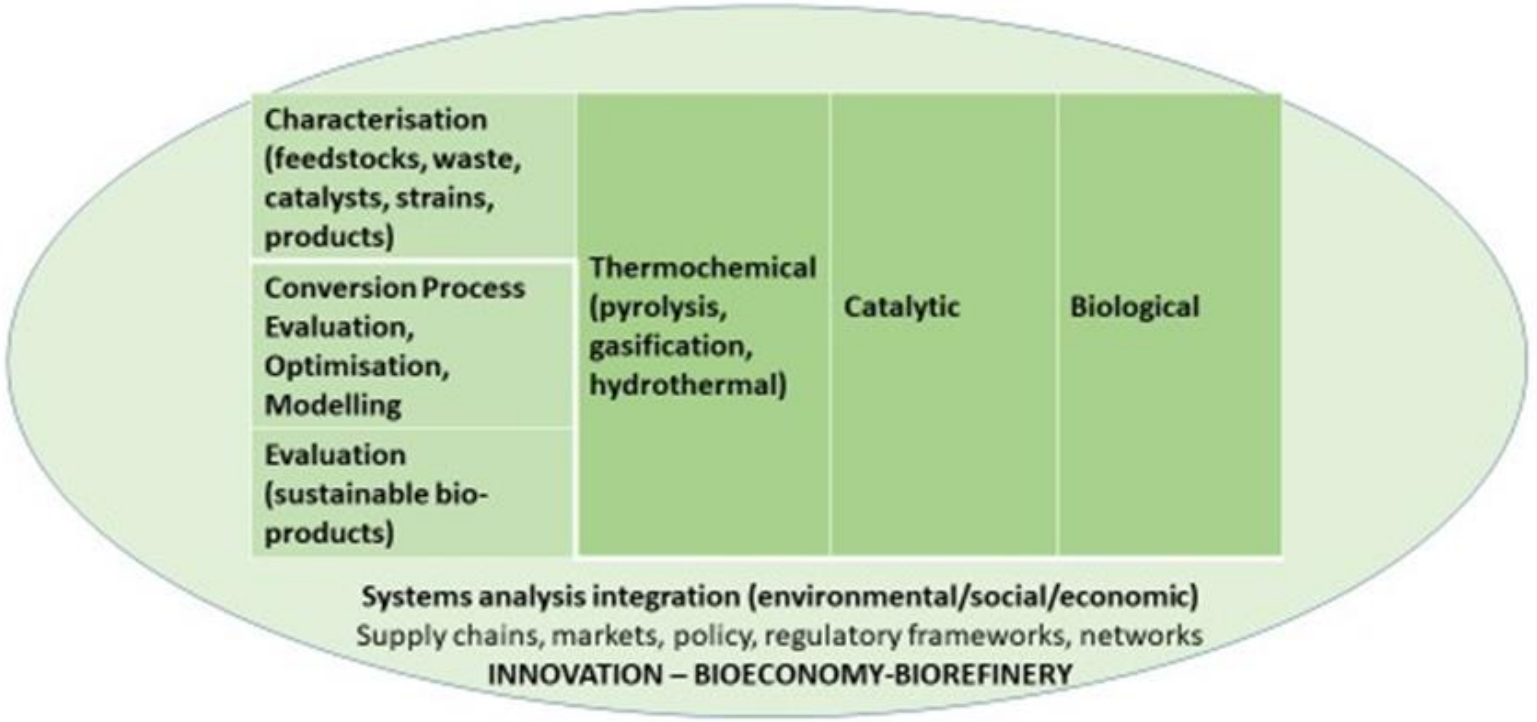
Energy and Bioproducts Research Institute (EBRI)



Capabilities

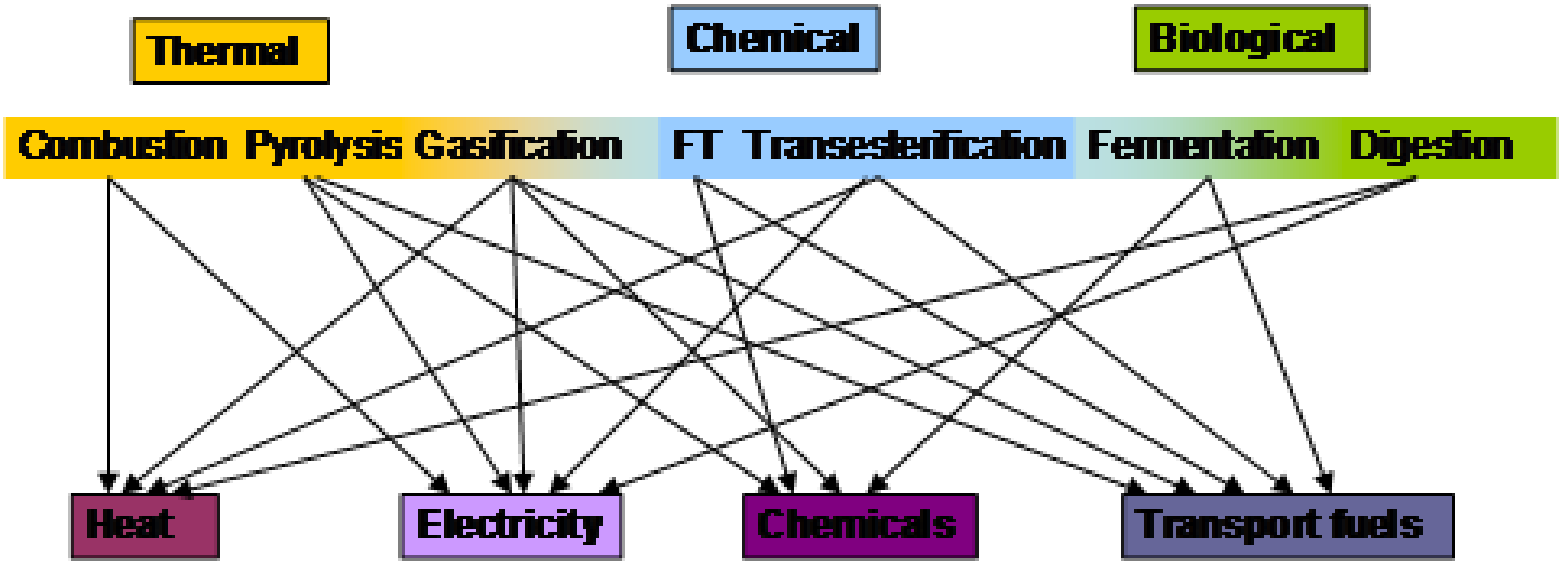
Pyrolysis and gasification
Torrefaction
Biochar production and analysis
Bio-refining and Anaerobic digestion
Algae for waste remediation, bio-products and energy
Hydrogen and fuel cells
Catalysis for synthesis of fuels and chemicals
Lifecycle analysis, carbon accounting
Techno-economics
Transport and logistics
Smart energy systems, vehicle to grid, CHP
Bioenergy and bio-product market opportunities

Potential for UK Bioenergy

- Up to 45% of UK bioenergy demand[1]
- 10% electricity (baseload)
- 50% heat (industrial, district, gas)
- 20% liquid fuels (aviation, shipping, heavy duty/mobile plant)

1. Welfle A., Gilbert P., Thornley P., Securing a bioenergy future without imports, Energy Policy, vol 68, 2014

Bioenergy range of pathways and products



Committee on Climate Change

BIOMASS AND BIOENERGY 81 (2015) 35–43

Available online at www.sciencedirect.com

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Research Paper

Maximizing the greenhouse gas reductions from biomass: The role of life cycle assessment

Patricia Thornley [a,*], *Paul Gilbert* [a], *Simon Shackley* [b], *Jim Hammond* [b]

[a] *Tyndall Centre for Climate Change Research, School of Mechanical, Aerospace and Civil Engineering, University of Manchester, M13 9PL, UK*

[b] *UK Biochar Research Centre and School of Geosciences, University of Edinburgh, Crew Building, The King's Buildings, Edinburgh, EH9 3JN, UK*

ARTICLE INFO

Article history:
Received 27 August 2014
Received in revised form
3 May 2015
Accepted 4 May 2015
Available online

Keywords:
Biomass
Electricity
Chemicals

ABSTRACT

Biomass can deliver significant greenhouse gas reductions in electricity, heat and transport fuel supply. However, our biomass resource is limited and should be used to deliver the most strategic and significant impacts. The relative greenhouse gas reduction merits of different bioenergy systems (for electricity, heat, chemical and biochar production) were examined on a common, scientific basis using consistent life cycle assessment methodology, scope of system and assumptions. The results show that bioenergy delivers substantial and cost-effective greenhouse gas reductions. Large scale electricity systems deliver the largest absolute reductions in greenhouse gases per unit of energy generated, while medium scale wood chip district heating boilers result in the highest level of greenhouse gas reductions per unit of harvested biomass. However, ammonia and biochar systems deliver the most cost effective carbon reductions, while biochar systems poten-

www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/

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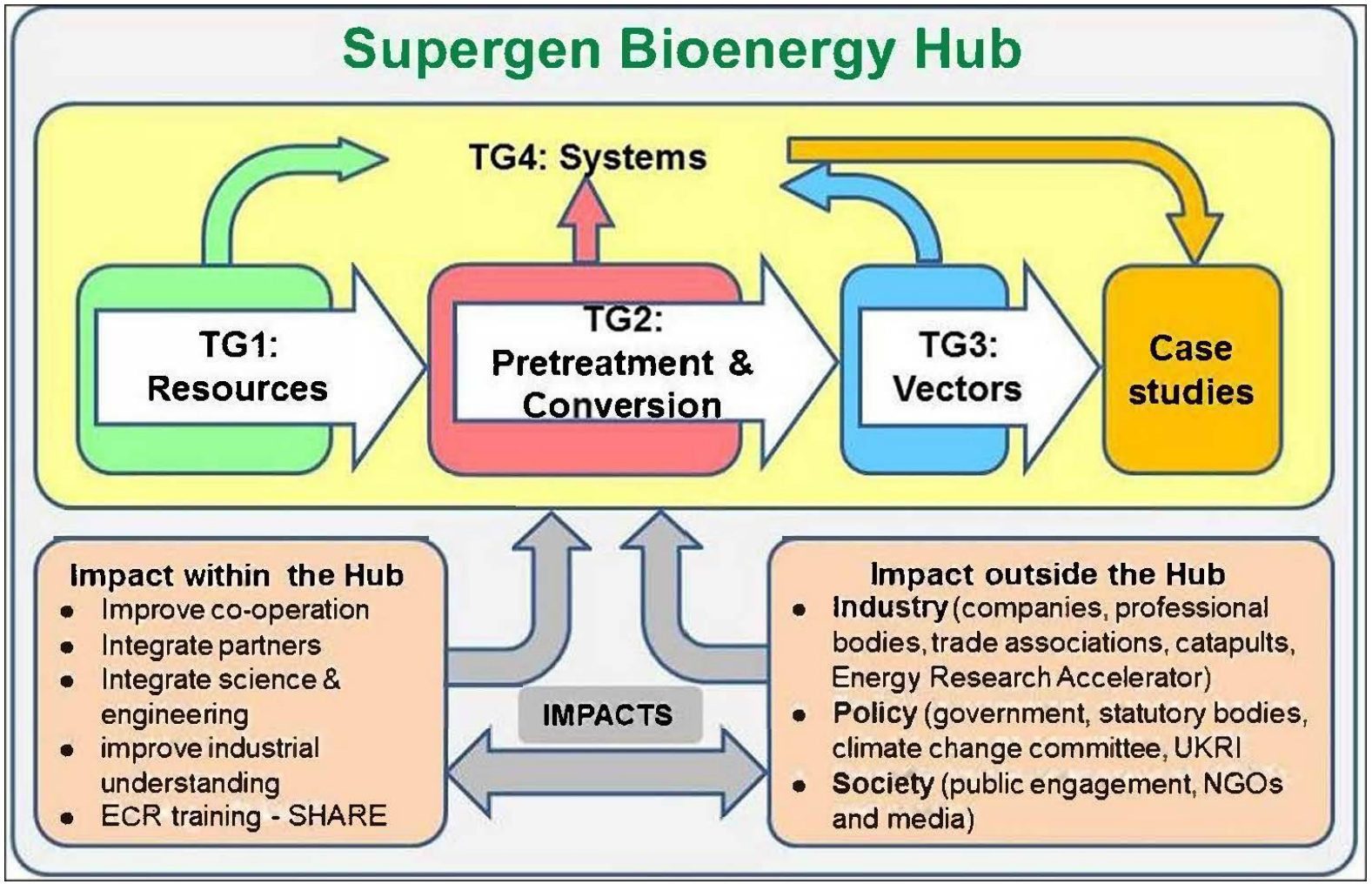
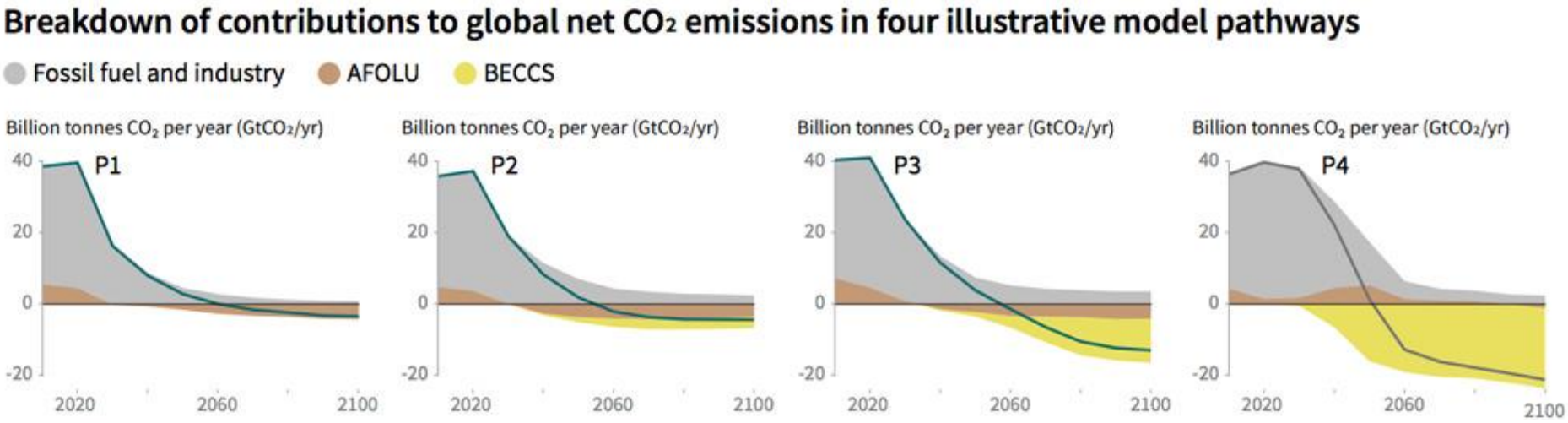
Hub structure

Director: Patricia Thornley



CCC Report: The importance of bioenergy

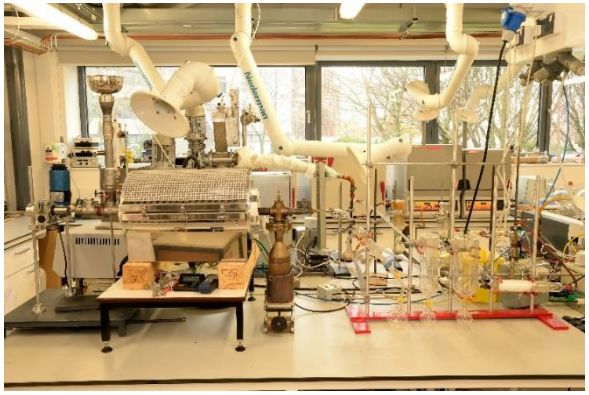
Bioenergy is particularly valuable in achieving future GHG/climate targets because of its ability to sequester carbon dioxide from atmosphere.



Industrial Laboratory 02 (ground floor)

Thermal Processing Laboratory

- Fast pyrolysis reactor (300 g/h) (incl. secondary catalytic bed reactor)
- Fast pyrolysis reactor (1 kg/h)
- Fast pyrolysis reactor (7 kg/h) fully automated (software controlled) with the gas circulation system
- Auger reactor (pyrolysis/torrefaction; can be used as a fixed-bed reactor) (up to 300 g/h)
- CFB gasifier
- EBRI pyroformer (prototype/lab scale) (20 kg/h)
- ASTM ash and moisture analysis (ovens)
- All reactors with on-line gas analysis (micro-GC units)



Catalysis Laboratory (1st floor)

This laboratory was redesign in 2014 – so called EBRI Phase 2 (additional fume hoods and independent air handling / extraction system)

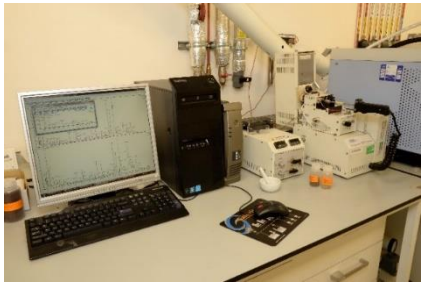
- Large (5 l) universal reactor system (2x)
- 6x 100 ml high-pressure (140 bar) rector vessels with overhead stirrests and temperature controllers
- 6x Radleys ‘carousel’ reactor systems (universal synthesis / wet chemistry)
- GC-MS system for analysis of organic components
- 4x GC-FID units with autosamplers (dedicated applications – analysis different type of chemicals/groups of components)
- 2x HPLC unit
- Leton calcination ovens
- Bench top centrifuge

Syngas Laboratory (1st floor)

This laboratory is dedicated to specific high-pressure processes (HTL, FT, flow reactors) and includes some equipment for characterisation of biomass and biomass-derived fuels

- Continuous Fischer–Tropsch reactor with on-line GC-FID/TCD analyser
- 2x autoclaves for HTL studies (25 ml capacity) (ERA)
- Continuous flow reactors for the catalytic DeNOx studies
- Photocatalytic reactor (2 chambers)
- GC-MS system for analysis of organic components
- TGA (pyrolysis and combustion)
- Analytical pyrolysis system with GC-MS (Py-GC-MS)
- Full set for characterisation of fuels (calorimetric bomb, TAN, KF sytsem for water content analysis in fuels, viscometer, density meter for viscous samples, corrosion bath, oven for fuel ageing studies, pH/conductivity-meter)





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University of Southampton

NFU

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CATAPULT Energy Systems

Aston University

Cranfield University

Progressive energy

GHD

Loughborough University

REA
Renewable Energy Association

The University Of Sheffield.

Department for Transport

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Research collaborations

- Biomass resources – NFU, BEIS
- LPG pathways – SHV
- Gasification – Progressive Energy, Cadent, Kew Technologies,
- Low carbon fuel processes – DfT
- Heating oil characterization– In Perpetuum
- Fuel cell testing & control- Adelan
- Airborne emissions – Defra
- Policy impacts – LCVP
- User demands – Energy Systems Catapult

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www.supergen-bioenergy.net

p.thornley@aston.ac.uk