

Institution: Aston University		
Unit of Assessment: UoA12 Engineering		
Title of case study: Bioenergy Policy		
Period when the underpinning research was undertaken: 2000-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Professor Patricia Thornley	Professor	2018 – to date
Dr Mirjam Roeder	Senior Research Fellow	2018 – to date
Dr Katie Chong	Lecturer	2014 – to date
Professor Tony Bridgwater	Professor	1996 – to date
Dr John Brammer	Lecturer	2002-2013
	Senior lecturer	2016-2016
Period when the claimed impact occurred: 2018-2020		
Is this case study continued from a case study submitted in 2014? No		
<p>1. Summary of the impact</p> <p>Bioenergy has significant global potential for reducing carbon emissions – but remains controversial. While 40% of the Climate Assembly UK “agreed” or “strongly agreed” that bioenergy should contribute to how the UK reaches net zero, 36% were unsure; thinking only certain types of bioenergy should be used, coupled with robust frameworks to ensure real carbon reductions. To apply bioenergy effectively, policymakers need access to robust and relevant evidence. Aston research enables this by providing data on the efficiency, costs and carbon reduction potential of bioenergy technologies. This is synthesised and delivered to policymakers via the Aston-led Supergen Bioenergy Hub (SGBH) contributing to a sustainable low-carbon energy future.</p>		
<p>2. Underpinning research</p> <p>The climate emergency requires an urgent, evidence-based response. In 2019, the UK committed to net zero greenhouse gas emissions by 2050 – and bioenergy can play a key role in achieving this ambitious goal. Bioenergy provided 31% of total UK renewable electricity in 2019 (up 6.8% on the previous year) and sustainable bioenergy could contribute 45% of the UK’s primary energy demand without imports.</p> <p>Aston University’s Energy and Bioproducts Research Institute (EBRI) plays a key role in enabling this greener energy future. EBRI is an internationally-renowned centre of excellence for converting biomass into sustainable energy and products, using thermochemical, biological and catalytic processes. Its research is bolstered by specialist insights provided by partners and collaborators in the Aston-based Supergen Bioenergy Hub, which is directed by Thornley and works 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. (Grant 1)</p> <p>EBRI generates significant fundamental data through its lab-based activities. Critically, it then converts this into performance data that represents the entire bioenergy system via its integrative expertise in process modelling, techno-economic analysis, and life-cycle, environmental, economic and social sustainability assessment. EBRI’s engagement and</p>		

experience with industry allows it to adapt theoretical model projections and predict the performance of energy systems deployed in the real world. Crucially, through the Supergen Bioenergy Hub – and via engagement with colleagues and partners on supply chains, business models, policy, regulation and system performance – EBRI ensures that its research is relevant to and informs the policymaking community, benefitting communities globally.

Specifically, the Aston research which underpins the claimed impacts focuses on the following key areas:

- **Gasification:** Work on the conversion of biomass into a usable gas allows EBRI to assess the potential for biomass to deliver carbon reductions via the production of heat, power, fuels and energy-intensive chemicals such as ammonia. **(R1,R2)**
- **Pyrolysis:** Work on the conversion of biomass into liquids enables the assessment of biomass liquids as a substitute for domestic and industrial heating oil. **(R1,R2)**
- **Catalysis:** Work on catalytic upgrading allows Aston to develop sustainable aviation fuels from biomass **(R1,R2)**
- **Techno-economics:** Work on techno-economics allows us to compare different biorefinery configurations, evaluating which designs result in economically viable business models as processes scale up in the real world **(R3,R4, R2)**
- **Life-cycle assessment:** EBRI's detailed study of the dynamic partition and evolution of carbon pools during biomass growth, processing, conversion and use allows us to evaluate which land-uses, management regimes, conversion technologies and end-uses deliver the most significant carbon savings and how those trade-off against other sustainability impacts. **(R5)**

EBRI brings these research streams – along with those of its Supergen partners – together for policymakers in a scalable, practical and sustainable way **(R4,R5,R6)**. Insights from our research outputs are synthesised into dedicated reports for, and/or commissioned by, policy makers **(R3, R6)**.

3. References to the research

R1. Thornley, P., Upham, P., Huang, Y., Rezvani, S., **Brammer, J.**, Rogers, J., Integrated assessment of bioelectricity technology options, Energy Policy, vol. 37 (3), 890-903 March 2009, <https://doi.org/10.1016/j.enpol.2008.10.032>

R2. Thornley, P., Chong, K., & Bridgwater, T. (2014). European biorefineries: implications for land, trade and employment. Environmental Science and Policy, 37, 255–265. <https://doi.org/10.1016/j.envsci.2013.09.004>

R3. Cross, S., Welfle, A. J., **Thornley, P.**, Syri, S. & *Mikaelsson, M.*, 8 Dec 2020, In: Biomass and Bioenergy. 144, 105887, Bioenergy development in the UK & Nordic countries: A comparison of effectiveness of support policies for sustainable development of the bioenergy sector, <https://doi.org/10.1016/j.biombioe.2020.105887>

R4. Welfle, A., **Thornley, P.** & **Röder, M.**, 1 May 2020, In: Biomass and Bioenergy. 136, 105542, A review of the role of bioenergy modelling in renewable energy research & policy development, <https://doi.org/10.1016/j.biombioe.2020.105542>

R5. Cucuzzella, C., Welfle, A., **Röder, M.** (2020). Harmonising GHG and sustainability criteria for low carbon transport fuels, bioenergy, and other bio-based sectors. Supergen Bioenergy Hub Report No. 04/2020. Available from: <https://www.supergen-bioenergy.net/wp-content/uploads/2020/11/Harmonising-sustainability-standards-report.pdf>

R6. Thornley et al., What next for bioenergy, Chairs Summary Report on Behalf of the Advisory Board Convened for the Committee on Climate Change's Bioenergy Review Report, 2019, <https://www.theccc.org.uk/publication/what-next-for-bioenergy/>

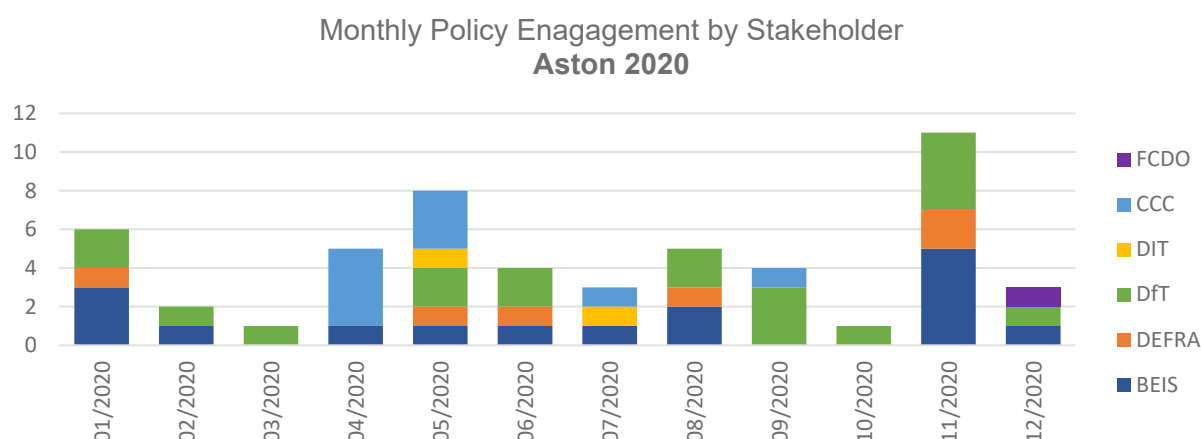
Grant 1 Supergen Bioenergy Hub 2018, Thornley (PI), EPSRC EP/S000771/1, £1,760,025, 11/18-10/22

4. Details of the impact

The Aston-led SGBH – is a partnership between universities (e.g. Imperial College London, University of Manchester), industry (e.g. Drax Power, Kew Technologies), and policy stakeholders (Department of Business, Energy and Industrial Strategy (BEIS), Department for Transport (DfT)). It is the national flagship programme for UK bioenergy research.

Aston leads on public engagement and consequently **Thornley** addressed Climate Assembly UK on bioenergy's role in the UK 2050 climate targets in 2020. **Thornley** and **Röder** wrote widely-read articles for The Conversation on bioenergy [S1] and **Thornley** has discussed the issue on BBC World Business Report (<http://bbc.in/2UphSbu>; starts at 00:30) and BBC Farming Today (clip link [here](#)) [S2]. Aston staff constituted four of the eleven contributors to the [Supergen bioenergy comic](#): (3,000 copies distributed globally at the request of research and education agencies worldwide) a successful engagement and research dissemination tool for younger audiences [S3].

However, Aston research impact goes beyond public understanding. Researchers maintain regular contact with UK government to understand their policy needs and provide scientific information so that policies are based on the latest evidence. Research is developed by Aston and SGBH partners, but Aston collates, synthesizes and communicates the outputs, transforming them into “policy-maker friendly” material addressing UK government's key bioenergy questions. The figure below demonstrates typically four interactions with seven relevant government departments every month in 2020.



The direct beneficiaries of the research are the UK government departments charged with transforming climate and renewable energy targets into workable policies.

Aston has carried out extensive work on process modelling, life-cycle assessment and techno-economic assessment of bioenergy systems, providing a wealth of published data on typical performance, environmental and economic impacts, and costs.

BEIS Head of Bioenergy and Land-Use Science notes Thornley has:

“provided ... evidence that has enabled BEIS analysts to model pathways for future bioenergy technologies such as gasification, which has enabled HMG to commit to net zero by identifying technologies that deliver negative emissions” “improving confidence that delivering net zero is technically feasible if not straightforward.” [S4]

The [text removed for publication] notes that Aston has:

“provided academic research evidence (via several meetings, seminars and exchanges of documents) to evidence and substantiate identified areas where there was potential for enhanced carbon savings “ and “enabled the department to, identify and fill gaps in our knowledge and establish the basis for policy development and deployment that will contribute to achieving ‘Net Zero’ by 2050.” [S5]

Aston has helped inform government-commissioned research and studies by working with government departments to synthesise existing knowledge and identify future prospects and gaps/innovation needs that are impeding progress. It is a collaborative process whereby these beneficiaries help to drive the research agenda. Our research provides policymakers with initial performance data sets.

A 2019 SGBH policy briefing on UK biomass resource and potential initiated by Aston led to an invitation to present our research to a Cross-Government Working Group on Bioenergy. After subsequent collaborative discussions, government departments identified to us several areas of information deficit, including the total availability of biomass resource and the ability to adequately forecast it. To address this, policymakers commissioned Supergen to produce a report [S7], co-authored by Aston staff. The report was presented to and discussed with the commissioning departments and provided them with evidence of bioenergy's potential and the associated knowledge gaps. [Text removed for publication] confirm this:

“provided vital corroboration of the knowledge gap pertaining at that point in time, which helped staff to develop the scope of a new piece of work now being pursued by government as part of the Biomass Strategy announced in the 2020 Energy White Paper.” [S5]

and BEIS note our work:

“enabled them to progress with internal cases for a fully-resourced review of the existing Bioenergy Strategy – and this major policy initiative will now be carried out by a team in BEIS. Aston is liaising with the policy leads to provide input data, steering guidance and specialist advice.” [S4]

Our completed assessments of cost, deployment and carbon reduction potential enable government officials to appropriately scope the scale of government targets, establish the relevant mechanisms and calculation methodologies. Through this evidence-based approach, the public also benefit from improved global climate protection and carbon reduction.

In 2019, Thornley also chaired the advisory board for the Committee on Climate Change's Biomass Report (see above) that's recommendations on global bioeconomy strategy, land-use strategy, aviation and bioproducts are now being picked up in the forthcoming Biomass Strategy. [S6]

Bioenergy is an SME dominated landscape and trade associations are vital to mobilize commercial interests in the sector. Aston staff (**Thornley, Röder, Chong**) contributed to the Renewable Energy Association's biomass strategy steering group helping to set the direction and aims of the report [S8]. The REA chief executive notes:

“Supergen's involvement proved invaluable during the development of the REA's Bioenergy Strategy, strengthening the credibility and influence of the report” and that “In November 2020, in part due to the REA's Bioenergy Strategy, Government committed to producing a new Biomass Strategy for the UK.” [S9]

Our research impacts extend overseas through the funding and development of technologies that help deliver sustainable development goals in low- and middle-income countries, including the Philippines [S10] and South Africa with Aston is leading the research component of the current DfID project on bioenergy in Sub-Saharan Africa and high-level international engagement with the Foreign and Commonwealth Office in key countries. [Text removed for publication] notes they have used:

“UK bioenergy research (from Thornley, Röder, Chong etc.) to connect with the wider international research landscape” and as a “basis to develop international collaborations and understanding in this area” noting a “workshop (chaired by Thornley)” in Washington D.C. in 2019 “supported discussion and alignment of emerging policy frameworks to support low carbon aviation fuels.” Overall the [text removed for publication] notes our work has “enhanced the Departmental evidence base around state of the art technologies and challenges, supporting us in clearly defining and pursuing work

programmes that have accelerated our progress towards deployment of sustainable biofuels in the UK.” [S5]

5. Sources to corroborate the impact

- S1** Conversation articles by Thornley, 12/2019, and Röder, 10/2019
- S2** Links to BBC radio programmes
- S3** Bioenergy comic
- S4** Letter from Head of Bioenergy and Land Use Science, Department for Business, Energy & Industrial Strategy, 02/2021
- S5** Letter from [text removed for publication], 2020
- S6** Committee on Climate Change Biomass Report, November 2018
- S7** Supergen Bioenergy Hub UK Biomass Availability Modelling Scoping Report, 2020
- S8** REA Bioenergy strategy 2020 (<https://www.bioenergy-strategy.com/publications>)
- S9** Chief Executive, REA, 02/2021
- S10** First-of-its-kind rice straw to biogas facility launched in the Philippines, Bioenergy International, 07/2019