

The Pentland Centre for Sustainability in Business

Biennial Report
1 August 2018 – 31 July 2020



The Pentland Centre for Sustainability in Business continues to be funded with a grant from the Rubin Foundation Charitable Trust – a Foundation run by the owners of Pentland Group plc.



Our mission is to deliver world-class transdisciplinary research evidence and engagement to support and advance the mainstreaming of social and environmental sustainability into purposeful business strategy at board level

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There is likely to be an increasing demand for socially purposeful business strategies in a post-COVID world. Research and engagement by The Pentland Centre for Sustainability in Business informs the development of such evidence-based strategies.

Prof. Jeffrey Unerman, Interim Centre Director

Introduction – review of Pentland Centre’s activities and future direction

I am pleased to present this biennial review of the major activities of Lancaster University’s *Pentland Centre for Sustainability in Business* for the two years from 1 August 2018 to 31 July 2020, along with an indication of the Centre’s future direction. We are honoured to have appointed Professor Jeffrey Unerman as the Interim Director. He has led the implementation of the Pentland Centre’s distinctive new strategic direction during the recruitment of a new permanent Director.

Professor Angus Laing
October 2020

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The end of this period has been a time of transition for the Pentland Centre, but a transition with many continuities. It marked the end of the initial five-year term of funding from the Rubin Foundation Charitable Trust. We are delighted and grateful that they have agreed to renew their very generous funding at a higher level for a second five-year term, which has enabled us to expand our strategic ambitions.

We continue our focus on bringing robust research insights to bear in informing board-level development of business sustainability strategies. We want to build on our successes and expand our remit and influence, and so have broadened the former focus (on helping develop environmental strategies for large companies) to cover social sustainability and organisations of all sizes.

This gives us scope to act on the recognition that, in practice, social and environmental impacts are

often closely intertwined. Addressing both together can be more effective than seeking to tackle them separately, a vital strategic consideration as societies and businesses rebuild after the COVID pandemic.

The new latitude for the Pentland Centre also recognises that many sustainability innovations come from small and medium-sized enterprises. Having scope within our strategic ambitions to help these organisations embed robust scientific insights into the development of their purposeful social and environmental sustainability strategies will further enhance the Pentland Centre’s positive impact over the next five years.

The end of the first five-year term also marked a transition for some Pentland Centre members. We are delighted that Professor Jess Davies’ significant successes and contributions as a Pentland Centre member have been recognised by her appointment as Director of Lancaster University’s *Centre for Global Eco-innovation*. We all wish Jess and her team much success in their new roles. There are many synergies between the Pentland Centre and the Centre for Global Eco-innovation, and we look forward to realising these in the future.

The Pentland Centre’s Director for its first five years, Professor Gail Whiteman, moved to a new post at Exeter University in August 2020. Gail provided strong and distinctive leadership in driving the Pentland Centre’s strategic ambitions, as I know the incoming Director will do.

Professor Jeffrey Unerman
October 2020

The Pentland Centre has now become an integral part of Lancaster University and can look forward to many years of productive research and collaboration helping to solve some of the world's biggest problems.

Stephen Rubin, Pentland Group plc



Founder's Statement

Oak trees grow from little acorns, but they do so very slowly. It is with a measure of gratification, during this particularly extraordinary time for us all, that we can look back at the solid way in which the Pentland Centre has planted its roots and begun to flourish.

It is now some five years since its inception and during that time the Centre has grown to embrace fifteen academic staff, alongside six staff providing administrative and project management support to various projects and the Centre itself. It has had six visiting scholars, two teaching fellows and has supported seven PhD Lancaster University students. The Centre has eighty-four publications to its credit and has been awarded £5,506,501 in research grants. Additionally, it has been able to raise contributions from other philanthropic foundations, together with some small personal donations. Thank you all.

The Pentland Centre team has worked with the Dutch Research Institute for Transitions (DRIFT) and the Chinese Academy of Science on a project funded by the UK Research Council on the SIRIUS project (Sustainable, Innovative, Resilient and Interconnected Urban food Systems). The team has completed: a research project with REPIC on Waste Electrical and Electronic Equipment (WEEE) flows; a project, together with Lancaster's Centre for Global Eco-Innovation, funded by the UK Research Council's BBSRC, ESRC, NERC and the Scottish Government called the Rurban Revolution to consider how to transform UK food production, particularly by radically upscaling fruit and vegetable growing in our towns and cities; consultancy work for the new Taskforce for Climate-related Climate Disclosures (TCFD) and

many other smaller projects in the area of sustainability.

In short, the achievements are starting to be recognised and I would like to thank Professor Gail Whiteman for her leadership and the whole team for forging a path that the expanded Centre can now follow. I also want to express my appreciation to Professor Jeffrey Unerman for the invaluable contribution he has made to the ongoing development of the Centre prior to the arrival of the new Director. We wish Professor Jan Bebbington, the incoming Director, every possible good wish for the Centre's growth and success in the future.

I hope that the Pentland Centre has now become an integral part of Lancaster University and can look forward to many years of productive research and collaboration helping to solve some of the world's biggest problems.

*Stephen Rubin
Pentland Group plc*



Arctic Basecamp youth team 2020 L-R: Gail Whiteman, Kaime Silvestre, Brix Whiteman, Max Whiteman, Eva Jones, Wenying Zhu, Vanessa Nakate, Andy Rubin © Henry Iddon

Highlights 2018-20

The Pentland Centre successfully delivered and contributed to a number of major projects during the 2018-20 period under review. This section provides a summary of some of these projects.

Informing sustainability dialogues at the World Economic Forum

The Pentland Centre continued its established [Arctic Basecamp at Davos](#) event in both 2019 and 2020. This science communications event, focussed on the global impact of Arctic Change, involves scientists and climate activists camping at a prominent location in Davos, and interacting with delegates at the World Economic Forum (WEF) annual meeting.

Alongside a range of prominent scientists and members of the business community, the 2019 event brought youth climate activist Greta Thunberg to the camp, speaking to a range of WEF delegates and members of the public about the need to take urgent action on climate change. In 2020, building on that connection, Arctic Basecamp at Davos hosted a team of young climate activists from around the globe, participating in conversations with climate scientists, and supporting the #FridaysforFuture protest in Davos on the final day of the WEF meeting.

In 2020 Arctic Basecamp founder Gail Whiteman was invited to speak at the main WEF Congress Centre, presenting [What's at Stake: The Arctic](#) and participating in a panel discussion alongside Sanne Marin, Al Gore, and Scott Minerd (moderated by Elena Cherney). This mainstreaming of Arctic Basecamp at Davos's work over the preceding three years, plus the

opportunity to speak directly to congress delegates was particularly important.

Enhancing strategic understandings of the financial impacts from climate risks

Regulators and major corporations are becoming increasingly aware of the financial risks associated with climate change. Across the two years of this review, the Pentland Centre engaged in novel research, consultancy and policy advice to help corporations better understand the strategic nature and incidence of these risks.

There was a particular focus on helping corporations prepare for reporting in accordance with the game-changing recommendations of the 2017 *Taskforce on Climate-related Financial Disclosures* (TCFD). These focus on corporate dependencies on a stable climate rather than the more traditional reporting of corporate impacts on climate change.

A successful multidisciplinary Pentland Centre consultancy project helped Nestlé develop [their TCFD reporting](#), providing an understanding of the impact of possible climate futures on their business operations, suppliers and customers. Our work was cited by Nestlé colleagues in helping to convince the company to declare a zero-carbon ambition.

Pentland Centre members Paul Young and Jeffrey Unerman contributed to the *World Business Council for Sustainable Development's* Food, Agriculture and Forest TCFD Preparer Forum. This was targeted at helping large multinationals understand the impacts of climate change on their operations, in preparing for TCFD reporting.



Lingxuan Liu visits an e-waste processing facility in Huddersfield as part of research into the flows and fates of e-waste

Jeffrey Unerman also published an [agenda-setting paper in Accounting Auditing and Accountability Journal](#) on research opportunities in relation to TCFD reporting.

Relatedly, Patrick Bigger researched how climate change is changing the ways that financiers think about, and respond to, risk. Three joint papers have been published in the period of this review from this project. These build on research with bankers, regulators, stock exchanges, pension funds, municipalities and multilateral development banks about the burgeoning green bond market. The research found that green bonds are becoming a key source of climate finance globally. They are perceived as relatively safe, well understood funding mechanisms, but there are a host of unanticipated negative outcomes that accompany the reduction of climate action to questions of funding within existing political economic structures.

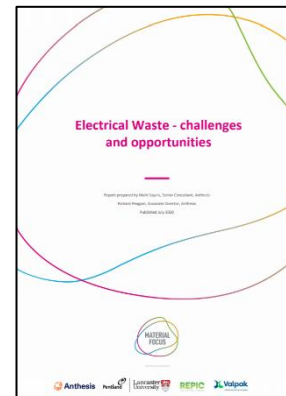
Flows and fates of e-waste

Understanding the flows and fates of discarded products is of paramount importance when trying to set waste policy targets, understanding where materials can be captured as a secondary resource, what impacts these have on local economies and where actions are needed to mitigate leakages.

Pentland Centre members Alison Stowell, Dmitry Yumashev and Lingxuan Liu undertook research on e-waste, funded by REPIC Ltd, which was published in September 2018 in an industry white paper '[Setting robust and realistic targets for WEEE to support the transition to a Circular Economy](#)'. This documented the findings and put forward a proposal for a new way of modelling

electrical and electronic equipment product flows and fates through the economic system.

The paper has triggered a dialogue across the sector and started to mobilise support from market actors, government and not-for-profit actors. It also acted as a springboard to secure further consultancy funding, from UK Material Focus funds, to investigate unreported flows of e-waste and resulted in an industry white paper '[Electrical Waste – challenges and opportunities](#)'.



Participatory research on sustainable supply chain management

Taking an action research approach, Lingxuan Liu worked with global companies to understand the effectiveness of their supplier development programmes – in which buyer companies not only set green procurement requirements, but also invest resources in helping suppliers achieve sustainability goals. The research revealed that the effectiveness of supplier development is based on suppliers' knowledge base and their relationship with buyer companies, and the process can be initiated or facilitated by multiple 3rd party stakeholders. The [resulting publication](#) was the most-downloaded paper of 2018 in *Business Strategy and the Environment*.



Ben Neimark (fourth from left) working with vanilla smallholders in Madagascar

Building an international consortium of sustainable and resilient urban food systems

Lingxuan Liu is the project lead of [SIRIUS](#) – a JPI/UKRI/NSFC-funded international consortium that explores the sustainability, resilience, innovation and interconnection of the urban food system. From May 2019 to April 2022, the project involves a three-country, four-institute partnership, working with researchers and case cities in the UK, Netherland and China. The Lancaster team also includes Mustafa Ali, Jing Zhang and a visiting scholar/student every year.

The business case for investing in soil health

Soils are a vital asset that are key to producing food, absorbing some carbon emissions from human activities, enhancing biodiversity and regulating floods. However, in most parts of the world soils are under pressure from climate change, demands for agricultural and urban land, and unsustainable management practices.

Led by Jess Davies, with contributions from Dmitry Yumashev and Victoria Janes-Bassett, in collaboration with the Climate Smart Agriculture Team at the World Business Council for Sustainable Development (WBCSD), a research report set out the case for investing in soils. It brought together 20+ authors from five continents working in global corporations in agri-food, forestry, and banking sectors, with International Organisations like the United Nations Convention to Combat Desertification (UNCCD) and International NGOs. The report was launched at the UNCCD COP 13 in 2018 and is available [online](#).

Preliminary results were shared with UK Government Department for the Environment, Farming and Rural Affairs (DEFRA). The work is

expected to contribute to ongoing enquiries as part of the new Environmental Land Management scheme. This is set to replace the Common Agricultural Policy and prioritise a wide range of positive environmental outcomes for the UK's land, while maintaining essential services such as food production.

Linked to the project, Jess Davies was an invited speaker at a Westminster event 'The Economics of Soil: Private Asset or Public Good?' in 2019. This event was co-hosted by the Sustainable Soils Alliance and Rebecca Pow MP, with contributions from Liz Truss, Chief Secretary to the Treasury and Greg Clark, Secretary of State for Business, Energy & Industrial Strategy. The talk can be viewed on [youtube](#).

The Price of Vanilla: Collecting Public Experiences of the Vanilla Global Value Chain in Eden-Cornwall

Ben Neimark is leading a [Lancaster ESRC Impact Acceleration Account funded project](#) that aims to collect insights into public awareness of global commodity chains and food commodities. Specifically, it addresses the public's loss of connection between food, biodiversity and global commodity production. It seeks to educate the public on global links connecting the ingredients in some of their favourite foods, namely Malagasy vanilla used in ice cream and Ghanaian cocoa in chocolate. The project is designed around a unique botanical exhibit at the Eden Project in Cornwall. It will focus mainly on vanilla, with follow up demonstrations at the Learning Lab in Eden, centring on both vanilla and cacao production.



Fresh produce at Liverpool allotments - Rurban Revolution © Lael Walsh

Advancing the roles of accounting in achievement of the UN Sustainable Development Goals (SDGs)

A research project by Jeffrey Unerman provided academic insights to help enhance the roles that accounting can play in achievement of the UN SDGs. [A 2018 paper co-authored with Professor Jan Bebbington \(University of Birmingham\)](#) was awarded the Mary Parker Follet Award for the most outstanding paper that year in *Accounting, Auditing and Accountability Journal*.

World Business Council for Sustainable Development (WBCSD) bootcamp module

Alison Stowell has continued to organise unique sustainability teaching activities. These have enabled a further 30 students to participate in the WBCSD module and attend WBCSD annual meetings. From inception to date, students on this Bootcamp module have written more than 100 blogs that have been viewed almost 5000 times worldwide reaching 83 countries, and have established an alumni network which continues to grow.

Starting a Rurban Revolution

Jess Davies has led the [Rurban Revolution](#) project. Funded by the UKRI Global Food Security Programme, this is a two-year interdisciplinary project focused on the transformative potential of urban greening and food growing. The project brings together expertise in ecosystems, psychology, plant sciences and supply chains from Lancaster University, Cranfield University and University of Liverpool. Over the two years, it seeks to build an interdisciplinary evidence base on how urban green spaces and growing potentially influences:

- Healthy and sustainable diets
- Food production
- Ecosystem service delivery

The project engages with a diverse range of community groups, sustainability networks, SMEs, large corporations and local and national policy makers.

Global impacts of Arctic warming

Carbon released into the atmosphere by the increasing loss of Arctic permafrost, combined with higher solar absorption by the Earth's surface due to the melting of sea ice and land snow, will accelerate climate change – and have a multi-trillion dollar impact on the world economy.

[Dmitry Yumashev's study](#) on global impacts of Arctic warming employed state of the art models to explore the decline of Arctic land permafrost, snow and sea ice as the climate warms. It estimated the resulting impacts on the global climate and economy under a range of scenarios consistent with the Paris Agreement.

The study was published in [Nature Communications](#) and generated extensive global media coverage and publicity. It was also mentioned by Lancaster and Fleetwood MP Cat Smith at a UK Parliamentary hearing on climate change in the House of Commons, which contributed to the adoption of the flagship “net zero in 2050” policy for reducing the UK's carbon emissions.



Appendix 1: Research Themes in the period 2018-2020

I. Supply Chain Sustainability

Considers the realities of global supply chains, and attempts to identify key success factors and the roots of ongoing systemic problems.

II. Waste and the Circular Economy

Considers the social and business perspectives of waste, particularly the role the circular economy can play in transforming industrial operations by keeping products and materials in circulation for as long as possible, eliminating waste, and using greener energy for production.

III. Food, water, energy & business

Considers how companies drive negative environmental impacts around food, water, energy and climate change, as well as driving potential solutions.

IV. Sustainability accounting and Finance

Sustainability accounting plays a crucial role in embedding understandings of interconnected and complex sustainability impacts and dependencies in organisational strategic decision-making. From a finance perspective, private investment is increasingly considered indispensable for everything from climate change adaptation to scaling up renewable energy, and our work helps understand how and where those investments are taking place.

V. Global ecosystem risk

Examines the complex ecological and systemic foundations of sustainability and identifying global risk.

VI. Science-based targets for action

Supports ongoing development and implementation of Action2020, an ambitious collaboration between the WBCSD and a globally prominent network of scientists, which aims to develop targets for how businesses and markets can improve sustainability efforts.

VII. Sustainable soils and land use

Considers the management of land and our soil, and how it is vital to the sustainability of societies, economies and our environment.

VIII. Sustainable cities

Cities are complex systems containing both social and ecological processes. They need to be resilient to shocks, and have the ability to bounce back and thrive even in the face of rapid social and ecological change.



Appendix 2: Teaching and Outreach 2018-20

I. Undergraduate & Postgraduate Teaching

World Business Council for Sustainable Development Student (WBCSD) Bootcamp

This unique undergraduate module has been designed in partnership with the WBCSD and is focused on sustainability and employability. In a competitive process, students apply to visit the two annual meetings held by WBCSD every year. Following a week of intensive teaching and preparation, they work at the events, and get to meet a huge range of C-suite business leaders. In 2019 a further twenty students visited WBCSD events in Singapore and Montreux, whilst in 2020 ten students participated in a virtual WBCSD liaison delegate meeting, due to the COVID-19 pandemic.

These trips are life-changing for students, and impact upon their future career choices. We ask all students to contribute blogs that cover their experiences at the WBCSD meetings and the impact the experience has on them:

<https://lumsatthewbcd.wordpress.com/>

The course is convened by Alison Stowell, with contributions from Gail Whiteman, Jess Davies and other Pentland Centre members.

In addition to this course Alison Stowell organised and hosted visits from a series of guest speakers from WBCSD to speak with undergraduate Marketing students (Johanna Tahtinen WBCSD Redefining Value Associate), OWT students (Prof Rodney Irwin WBCSD SMT, Managing Director for Education and Redefining Vale) and our Human

Resource Management and Human Resources and Consulting postgraduate students (Jean-David Raffanel WBCSD HR Manager)

Along with Pentland Centre Student Champions, Alison Stowell also organised Pentland Centre involvement in the LUMS Marketing Me Careers Challenge.

Pentland Centre Champions

Between 2018-20 the work of the Pentland Centre has been supported by five student and/or alumnus champions.

- 2018-19: Maria Zani and Sharlene Gandhi
- 2019-20: Sharlene Gandhi, Lottie Gregory, Freya Oxtan-Grant and Lisbeth Gärtner.

Our Champions have co-ordinated social media activity, [organised discussions and film showings](#), contributed blogs and articles to our website, and worked with the LUMS Marketing team on the annual [Marketing Me](#) event.

Their contributions have been invaluable, and we are cheering them on as they take their next steps in study and work.

II. Executive Education

Alison Stowell is a faculty member and academic advisory for the WBCSD Leadership Program, and Lancaster University continues to provide a pathway to an accredited postgraduate qualification for participants.



Pentland Centre Team members, L-R: Alison Stowell, Victoria Janes Bassett, Ben Neimark, Desna Mackenzie, Angela Towers, Paul Young, Lingxuan Liu, Roisin O’Riordan, Gail Whiteman, Marta Ferri, Ivar Struijker Boudier, Dmitry Yumashev, Jess Davies

Appendix 3: People (1 Aug 2018 – 31 Jul 2020)

The Team

Professor Gail Whiteman (to Jul 20)	Centre Director & Rubin Chair in Sustainability
Dr Paul Young (to Jul 20)	Associate Director & Senior Lecturer, LEC
Dr Benjamin Neimark (to Jul 20)	Associate Director of Engagement & Senior Lecturer, LEC
Professor Jeffrey Unerman	Associate Director, Faculty Engagement, LUMS
Dr Alison Stowell	Associate Director, Corporate Relations & Lecturer, LUMS
Professor Jessica Davies (to Jun 2020)	50 th Anniversary Lecturer in Sustainability
Dr Lingxuan Liu	50 th Anniversary Lecturer in Sustainability
Dr Patrick Bigger	Lecturer in Human Geography, LEC
Dr Di Wang (from Apr 2019)	Lecturer in Accounting, LUMS
Dr Victoria Janes Bassett (to Jun 2020)	Senior Research Associate Soil Value Project
Dr Dmitry Yumashev (to Jun 2020)	Senior Research Associate
Dr Lael Walsh (Apr 2019-Mar 2020)	Research Associate Rurban Revolution Project
Dr Mustafa Ali (from Sep 2019)	Research Associate, SIRIUS Project
Dr Stacia Stetkiewicz (Nov 2019-Jun 2020)	Senior Research Associate, Cropbooster Project
Dr Jonathan Menary (Nov 2019-Jun 2020)	Senior Research Associate, Cropbooster Project
Angela Towers (to Jun 2019)	Marketing, Communications and Design Assistant
Helen Clay (from Nov 2019)	Marketing, Communications and Design Assistant
Desna Mackenzie	Centre Co-ordinator
Sharlene Gandhi	Pentland Centre Alumnus Champion (2018-20)
Maria Zani	Pentland Centre Student Champion (2018-19)
Lisbeth Gärtner	Pentland Centre Student Champion (2019-20)
Lottie Gregory	Pentland Centre Student Champion (2019-20)
Freya Oxtan-Grant	Pentland Centre Student Champion (2019-20)
Professor Minna Halme (to Jun 2019)	Visiting Professor, Aalto University Business School
Dr Nadine Andrews	Visiting Researcher
Dr Junfeng Wang (Sep 2018-Sep 2019)	Visiting Researcher
Elisabeth Rogers (Dec 2018-Dec 2019)	Visiting Researcher
Jimena Alvarez	PhD Candidate, LUMS
Katre Leino	PhD Candidate, LUMS
Roisin O’Riordan (to Jun 2020)	PhD Candidate, LEC
Marta Ferri	PhD Candidate, LUMS

Advisory Board Members

Stephen Rubin	Chairman of the Pentland Group plc.
Tom Trezise	Chairman, Patient Privacy Rights
Peter White	Vice-President and Chief Operating Officer, WBCSD

Honorary Teaching Fellows

Professor Rodney Irwin	Leuphana University & Managing Director, WBCSD
Andrea Brown	Impact Management Director, Quadia



Appendix 4: Publications

Agyemang, G.; O'Dwyer, B.; Owusu, C.A.; **Unerman, J.** (2019) / *NGOs in Ghana: accountabilities, performance and motivations*, P Weetman & I Tsalavoutas (eds), Routledge Companion to Accounting in Emerging Economies. Routledge, Abingdon.

Ali, M.; **Liu, L.**; Geng, Y.; Khokhar, S. (2020) / *Energy based sustainability evaluation of a hydroelectric dam proposal in South Asia*, Journal of Cleaner Production; Vol. 264.

Alvarez, J.; **Yumashev, D.**; **Whiteman, G.** (2019) / *A framework for assessing the economic impacts of Arctic change*, AMBIO: A Journal of the Human Environment.

Andrews, N. (2019) / *An integrative methodology for investigating lived experience and the psychosocial factors influencing environmental cognition and behaviour*, Climate Psychology: On Indifference to Disaster, ed. Paul Hoggett. Palgrave Macmillan, pp. 61-84

Andrews, N.; Hoggett, P. (2019) / *Facing up to ecological crisis: a psychosocial perspective from climate psychology. Facing up to climate reality: honesty, disaster and hope*, ed. / John Foster, Green House / London Publishing Partnership.

Asif, K.; Chaudhry, M.N.; Ashraf, U.; Ali, I.; **Ali, M.** (2019) / *GIS-Based Multi-Criteria Evaluation of Landfill Site Selection in Lahore, Pakistan*, Polish Journal of Environmental Studies; Vol. 29. pp. 1511–1521.

Bais, A.F. et al, incl. **Young, P.J.** (2019) / *Ozone–climate interactions and effects on solar ultraviolet radiation*, Photochemical and Photobiological Sciences.

Barnes, P.W. et al, incl. **Young, P.J.** (2019) / *Ozone depletion, ultraviolet radiation, climate change and prospects for a sustainable future*, Nature Sustainability, Vol. 2, No. 7. pp. 569-579.

Bassett, R.; **Young, P.**; Blair, G.; Samreen, F.; Simm, W. (2020) / *A Large Ensemble Approach to Quantifying Internal Model Variability Within the WRF Numerical Model*, Journal of Geophysical Research. Vol. 125, No. 7

Batista, P.V.G. et al. incl. **Davies, J.** (2019) / *Using pedological knowledge to improve sediment source apportionment in tropical environments*, Journal of Soils and Sediments, Vol. 19, No. 9. pp. 3274–3289.

Batista, P.V.G.; **Davies, J.**; Silva, M.L.N.; Quinton, J.N. (2019) / *On the evaluation of soil erosion models : Are we doing enough?*, Earth-Science Reviews, Vol. 197.

Belcher, O.; **Bigger, P.**; **Neimark, B.**; Kennelly, C. (2019) / *Hidden carbon costs of the “everywhere war”: Logistics, geopolitical ecology, and the carbon boot-print of the US military*, Transactions of the Institute of British Geographers.

Belcher, O.; **Neimark, B.**; **Bigger, P.** (2020) / *The U.S. military is not sustainable*, Science. Vol. 367, No. 6481. pp. 989-990.

Bigger, P.; Millington, N. (2019) / *Getting soaked? Climate Crisis, Adaptation Finance, and Racialized Austerity*, Environment and Planning E: Nature and Space.

Bigger, P.; Webber, S. (2020) / *Green Structural Adjustment in the World Bank's Resilient City*, Annals of the American Association of Geographers.

Blair, G. et al, incl. **Young, P.J.** (2019) / *Data Science of the Natural Environment : A Research Roadmap*, Frontiers in Environmental Science. Vol. 7.

Cao, G.; Yang, L.; **Liu, L.**; Ma, Z.; **Wang, J.**; Bi, J. (2018) / *Environmental incidents in China: Lessons from 2006 to 2015*, Science of the Total Environment, Vol. 633. pp. 1165-1172.



Christophers, B.; **Bigger, P.**; Johnson, L. (2020) / *Stretching scales? Risk and sociality in climate finance*, Environment and Planning A. Vol. 52, No. 1. pp. 88-110.

Corvellec, H.; Bohm, S.; **Stowell, A.**; Valenzuela, F. (2020) / *Introduction to the Special Issue on the Contested realities of the Circular Economy*, Culture and Organization. Vol. 26, No. 2. pp. 97-102.

Davies, J.; Bos, G. (Editor); Bossio, D.; Vidal, A.; Vermeulen, S. (2018) / *The Business Case for Investing in Soil Health*. World Business Council for Sustainable Development.

Dempsey, J.; **Bigger, P.** (2019) / *Intimate Mediations of For - Profit Conservation Finance: Waste, Improvement, and Accumulation*, Antipode. Vol. 51, No. 2. pp. 517-538

Evans, D.; Quinton, J.; Tye, A.; Rodes, A.; **Davies, J.**; Mudd, S.; Quine, T. (2019) / *Arable soil formation and erosion: a hillslope-based cosmogenic nuclide study in the United Kingdom*, SOIL, Vol. 5, No. 2. pp. 253-263.

Fronzek, S. et al, incl **Janes-Bassett, V.** (2019) / *Determining sectoral and regional sensitivity to climate and socio-economic change in Europe using impact response surfaces*, Regional Environmental Change. Vol. 19, No. 3. pp. 679–693.

Guttman, D. et al, incl. **Liu, L.** (2018) / *Environmental governance in China: Interactions between the state and “nonstate actors”*, Journal of Environmental Management, Vol. 220. pp. 126-135.

Hendry, L.C.; Stevenson, M.; MacBryde, J; Ball, P.; Sayed, M.; **Liu, L.** (2019) / *Local food supply chain resilience to constitutional change : The Brexit effect*, International Journal of Operations and Production Management, Vol. 39, No. 3. pp. 429-453.

He, S.; Zhao, L.; Ding, S.; Liang, S.; Dong, L.; **Wang, J.**; Feng, Y.; **Liu, L.** (2019) / *Mapping economic drivers of China's NOx emissions due to energy consumption*, Journal of Cleaner Production. Vol. 241

Janes-Bassett, V.; **Davies, J.** (2018) / *Soil natural capital valuation in agri-food businesses*. Valuing Nature Programme, 12 p. (Natural Capital Synthesis Reports).

Janes-Bassett, V.; **Davies, J.** (2020) / *Simulating long-term carbon nitrogen and phosphorus biogeochemical cycling in agricultural environments*, Science of the Total Environment

Langematz, U.M. et al, incl. **Young, P.J.** (2019) / *Polar stratospheric ozone: Past, present and future*. Chapter 4 in Scientific Assessment of Ozone Depletion: 2018, Global Ozone Research and Monitoring Project – Report No. 58, World Meteorological Organization, Geneva, Switzerland.

Liu, L.; Zhang, M.; Ye, W. (2019) / *The adoption of sustainable practices: A supplier's perspective*, Journal of Environmental Management, Vol. 232. pp. 692-701.

Neimark, B.; Childs, J.R.; Nightingale, A.; Cavanagh, C.; Sullivan, S.; Benjaminsen, T.; Batterbury, S.; Koot, S.; Harcourt, W. (2019) / *Speaking Power to ‘Post-Truth’: Critical Political Ecology and the New Authoritarianism*, Annals of the Association of American Geographers, Vol. 109, No. 2. pp. 613-623.

Neimark, B.; Osterhoudt, S.; Alter, H.C.; Gradinar, A.I. (2019) / *A New Sustainability Model for Measuring Changes in Power and Access in Global Commodity Chains*, Palgrave Communications, Vol. 5.

Neimark, B. (2019) / *Address the roots of environmental crime*, Science, Vol. 364, No. 6436. pp. 139.



Papayiannis, A.; Johnson, P.; **Yumashev, D.**; Duck, P. (2019) / *Revenue management of airport car parks in continuous time*, IMA Journal of Management Mathematics. Vol. 30, No. 1. pp. 1-35.

Sayers, M. et al, incl. **Stowell, A.F., Yumashev, D.** (2020) / *Electrical Waste – challenges and opportunities*. An Industry White paper, 16 July 2020, Material Focus, UK. 158 p.

Silva, C.V. J. et al, incl. **Young, P.J.** (2018) / *Drought-induced Amazonian wildfires instigate a decadal-scale disruption of forest carbon dynamics*, Philosophical Transactions B: Biological Sciences, Vol. 373, No. 1760.

Stowell, A.F.; Brigham, M.P. (2019) / *E-Waste Trading Zones and the Economy of Greening: Imbricating Computer Sourcing in the Pre- and Post-WEEE Directive Era*, Society and Business Review. Vol. 14, No. 2. pp. 155-173.

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Appendix 5: Research Grants & Sponsorship 2018-20

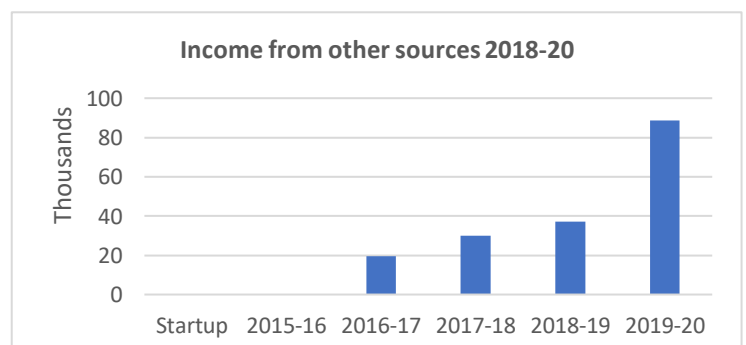
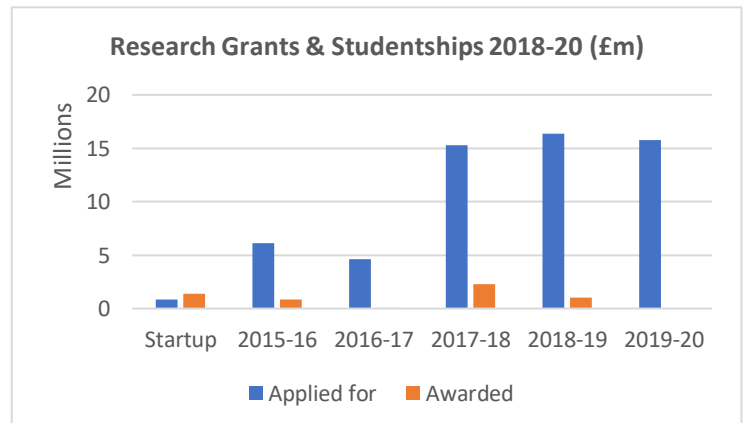
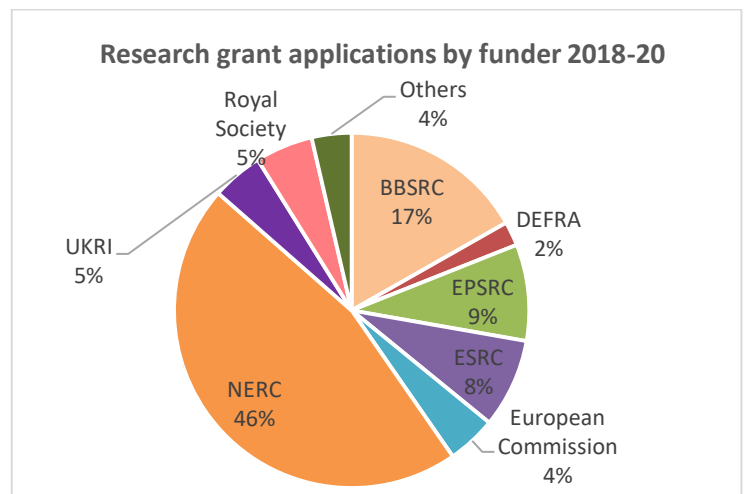
During 2018-20 Pentland Centre members submitted high-value funding applications to a number of UK Research Councils, including:

- Natural Environment Research Council (NERC)
- Biotechnology and Biological Sciences Research Council (BBSRC)
- Engineering and Physical Sciences Research Council (EPSRC)
- Economic and Social Research Council (ESRC)

Smaller applications have also been made to other bodies including the Department for Food and Rural Affairs (DEFRA), the European Commission (EC), UKRI and the Royal Society.

The volume of grant applications continued to increase in 2018-19, dipping slightly in 2019-20, with a slightly lower success rate than previously. This reflects the increasingly competitive environment for research grants, plus the impact of the COVID-19 pandemic. The largest grants awarded in this period were £384K funding to Jess Davies, a portion of a wider EU CROPBOOSTER project, and just below £300K to Lingxuan Liu to participate in the SIRIUS project.

In addition to our research grant funding we saw a rise in funding from other external sources, including project funding of £80K from the Fort Foundation, plus a further approx. £25K from individual and corporate donors, specifically to support the costs of the Arctic Basecamp at Davos. Work has begun to secure small amounts of income for the Centre via consultancy arrangements from members, and this will be developed in future years.





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