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Welcome to the Advanced Resource Efficiency Centre's 2020 Newsletter (Part I). The Newsletter contains updates and examples of some of our new projects, recent publications and activities.

AREC'S MISSION

To create a world leading supply chain resource efficiency and sustainability infrastructure addressing critical resource existentiality and challenges using a combination of method, tool, model, technology, process and system.

AREC'S VISION

To reengineer future supply chains by integrating supply chain resource efficiency and sustainability into strategic decision making in government, industry and education for improved competitiveness internationally.

OVERVIEW

AREC is a national scale facility within the flagship Energy Institute. We continue to work across disciplines and with partners in the UK and internationally, addressing the global challenges related to resources efficiency and sustainability, and creating future supply chains. With this core mission, we focus on several key activities in year 2020 including COVID-19 impact, digital disruptive technology, future transport and mobility, energy technology, sustainability, climate change, new materials and manufacturing, net zero and circular economy. This includes providing policies and strategies assessments and recommendations to decision makers.



Professor Lenny Koh, Director of Advanced Resource Efficiency Centre (AREC)

'One Nation' Strategy to Achieve Net Zero Emission by 2050

In June 2019 the UK launched a major new policy which will require the UK to achieve net zero emissions by 2050. The launch of the policy and passing of these laws sees the UK as the leading major economy to end its contribution to global warming by 2050.

Energy and Clean Growth Minister Chris Skidmore said:

"The UK kick-started the Industrial Revolution, which was responsible for economic growth across the globe but also for increasing emissions."

"Today we're leading the world yet again in becoming the first major economy to pass new laws to reduce emissions to net zero by 2050 while remaining committed to growing the economy - putting clean growth at the heart of our modern Industrial Strategy."

"We're pioneering the way for other countries to follow in our footsteps driving prosperity by seizing the economic opportunities of becoming a greener economy."

Key to achieving the net zero target by 2050 will be the investment into research and development, utilising our scientific expertise to investigate new technologies, materials and resources and establish solutions on how we can offset our emissions produced, against our emissions taken from the atmosphere to reach an overall balance.

The Prime Minister has already committed to doubling the research and development budget over the next 5 years, which is a significant increase over previous years. The aim for the UK is to become a global science superpower and it is recognised that research and development will help with this transformation.

Previous years have seen a disproportionate divide of funding, with the South and East of England benefitting more compared with other regions of the UK.

However this disproportionate divide has been recognised and where we choose to invest the money is now also seen as of great significance, the Prime Minister declared that this is a *'One Nation' government, committed to 'levelling up', so that every corner of the UK can benefit from its determination to share our future prosperity. For science and innovation, we too need a 'One Nation' strategy for R&D.*



Sources:

[GERD/BERD figures: ONS, Gross domestic expenditure on research and development, by region, UK](#)

<https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law>

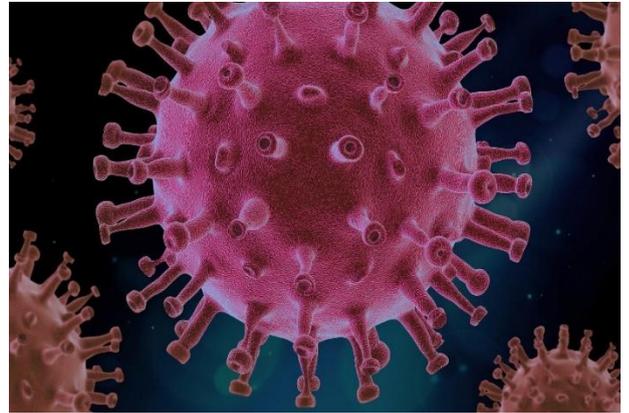
<https://www.gov.uk/government/speeches/levelling-up-research-and-innovation-right-across-the-united-kingdom>

New supply chains emerging from COVID-19

Written by Professor Lenny Koh

The year 2020 marked the start of a challenge to humankind. The world witnessed the first discovery of a new virus – the Coronavirus / COVID-19. The first epicentre of COVID-19 was in Wuhan, Hubei province, China; the second epicentre was Europe; and the third epicentre is now in the USA. The global economy is in a 'lockdown' because of this Coronavirus / COVID-19 pandemic.

All countries respond with a range of strategies and actions, tailored to their needs and circumstances. These include injecting trillions of dollars to the market to save the economy and lives, mobilising resources, readapting supply chain and technology, stock piling critical raw materials and products, accelerating research and innovation (e.g. vaccine and ventilators), maximising data sharing and openness, increasing acceptance of digital technology. As such, the global supply chains are disrupted with immense pressure and are undergoing major revolution.



The ability of a country to bounce back quickly from COVID-19 would depend on the supply chain resources efficiency including financial resources, physical resources, infrastructure resources, human resources, data resources, material resources, natural resources, and their interconnectedness of their supply chain resources. These supply chain resources comprise of environmental, economic, and social capital. By capturing and quantifying these streams of capital for critical cycles of inputs and outputs, we can measure and manage supply chain resources sustainability more efficiently. Put simply, for instance, a bilateral resources deal between countries enable both to strengthen each other supply chains. Therefore, it is not just supply chains that compete, but also the strengths of their resources capital and resources sustainability. For example the shortages as a result of increased demand we are currently facing right now from COVID-19 are 'temporal outcome' of resource scarcity due to fragmentation of resource capital, inefficient resources management, and non-resilient supply chain resources sustainability (i.e. lack of such resources deal).

By identifying and managing the interconnectedness and overlaps in resource cycles will optimize the overall supply chain resources sustainability of specific product/service supply chains. This can be clearly evidenced in the way that organisations and nations converge their resources, capacities, capabilities and supply chains to address the COVID-19 challenges. For instance, the production of the urgently needed ventilators to save lives - the Ventilators Consortium in the UK including Rolls-Royce, Airbus, F1 etc. and the major industry-led and federal government-led effort in the USA including Ford, General Motor etc.; the construction of temporary hospital in 10 days (Nightingale) at Excel London from NHS and construction workforce, military engineers, logistics and transport firms and volunteers; and the fast mobilisation of doctors and nurses and personal protection equipment (PPE) between cities to the epicentre in China and the national level 'lockdown' enforced with strict monitoring. These are case evidence of how resource efficiency and supply chain resource sustainability are practised.

Economists have predicted that COVID-19's impact on the global economy will be 10x bigger than the 2008 Asia financial crisis. World Economy Forum has compared the global economic impact from COVID-19 to a global economic depression (not a recession). However, some economists predicted that the global economy will bounce back in the 4th quarter of 2020, recovering from the current nosedive of stock markets. If China's growth is 6% as predicted for 2020, then global market will be in a less worst scenario. The new world needs to prepare for the recovery from this global economy slowdown by accelerating the expansion of global supply chains but with the requirement to grow within the resources boundary.

It is absolutely key that all policy makers and industries globally must collaborate to see the role of resource efficiency and supply chain resource sustainability embedded in everything. A world where decisions are made with the above in mind, improving supply chain resource forecasting, utilization, and conflict resolution decisions, and contributes toward translating macro-level sustainability targets into specific production and operations objectives. More of these type of new supply chains will emerge from COVID-19 with win-win-win (economic, environmental and social) characteristics.

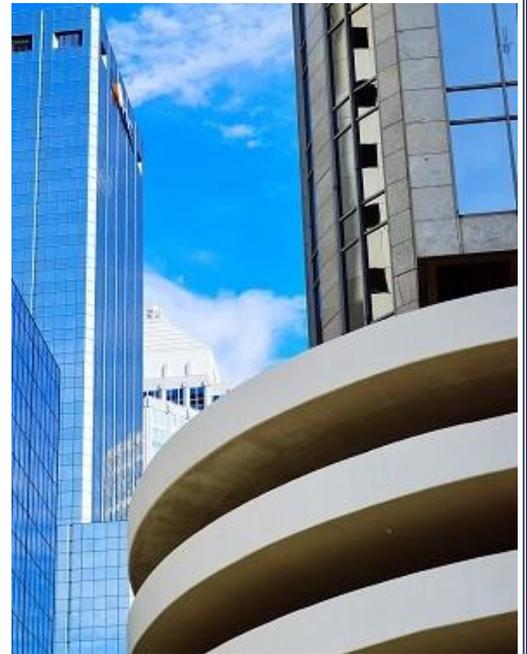
Why do Emerging Market Firms Engage in Voluntary Environmental Management Practices? A Strategic Choice Perspective

Professor Lenny Koh and collaborators have published a paper which investigates firms' decisions to engage in voluntary environmental management (VEM) practices within an emerging market context, in the British Journal of Management.

Drawing on the strategic choice and the resource-based view perspectives, results were reported from a survey of VEM practices—a specific form of self-governance—drawing on a sample of 519 Turkish firms from various industries to identify important strategic antecedents of firms' decisions to engage in such practices.

Professor Lenny Koh commented *“Our study put an important spotlight on advancing the understanding of why firms practice voluntary environmental management within an emerging market. Our study found as firms become more customer focused, seek differentiation and subject to a higher level of strategy-oriented stakeholder focus, they tend to implement higher levels of voluntary environmental management practices.”*

[Link to the full paper](#)



Coronavirus: Ventilators requirement



Coronavirus (or COVID-19) is a global pandemic. First identified in Wuhan, China. The global spread has led to major international efforts in addressing the impact from Coronavirus. Amongst policy interventions such as lock-down, or the race to develop the vaccine needed, Coronavirus has had an immense impact on the global supply chain.

As part of the effort to address the Coronavirus issue, the UK Government has announced the requirement for ventilators, an international demand recognized by the USA government and UK government views/plans.

However due to the pandemic there is an international shortage in this life saving equipment.

Manufacturers in the UK such as Rolls Royce and Dyson have been asked if they can assist in the production of key medical equipment in particular ventilators to ensure we have sufficient supply.

NBC News interviewed Professor Lenny Koh, Director of AREC and Head of Communication, Partnership and Internationalization of Energy Institute at The University of Sheffield on this strategy.

The news article can be found here: [NBC News Ventilators](#)

Cold Sintering Process (CSP) is the most cost-effective, low-carbon way of sintering ceramics

Professor Ian Reaney and researchers from the Department of Materials Science and Engineering at the University of Sheffield and Pennsylvania State University have released a new paper which has established that the cold sintering process is the ideal technique to decarbonise ceramic manufacturing.

Professor Reaney, Head of AREC USA, collaborated with Professor Clive Randall from Pennsylvania State University and Professor Lenny Koh Head of AREC Global, to conduct a comprehensive analysis of different ways of sintering ceramics, to establish which had the best energy saving potential.

The process of sintering is by heating compacted powder to form a dense solid mass and represents one of the most energy intensive parts of manufacturing.

The paper shows that CO₂ emissions and energy consumption for ceramic manufacturers could be considerably reduced by using the Cold Sintering Process (CSP), the paper also presented that implementing this was the most cost-effective, low-carbon way of sintering ceramics.

Professor Reaney's paper forms a strong framework for the introduction of CSP to the manufacturers, with the opportunity for it to achieve its full potential and move from laboratory testing to industry use.

Professor Reaney speaking about his findings, commented: "CSP is a remarkable technique that was first developed at the Pennsylvania State University. Our research however, unambiguously establishes CSP as the go-to densification method in ceramic manufacturing for energy reduction and decarbonisation".

Professor Randall also commented, "The collaboration with Professor Reaney's group at the University of Sheffield has clearly demonstrated that CSP is the way forward for low energy, low carbon ceramic manufacturing".

Details of the research can be found in the paper published in the [Journal of the European Ceramics Society](#).

Significant Grant awarded by Agrifood Africa Innovation

Professor Lenny Koh, Director of AREC and her research team at The university of Sheffield in collaboration with two prestigious Ghanaian-based research institutes namely Gold Coast Sustainability and Governance Institute as the lead African research partner and the Food Research Institute under the Council for Scientific and Industrial Research (CSIR) Ghana have been awarded a significant grant by the AgriFood Africa Innovation Award.

The Grant Award: AgriFood Africa Innovation Award is funded by Global Challenges Research Fund (GCRF) under the Innovate UK Knowledge Transfer programme.

The research project will explore Triple bottom line sustainability of circular economy in Ghana's Agrifood value chain. The fundamental principle of Circular Economy (CE) is to ensure that the value chains of production systems are self-sustaining and support the reuse of resources to avoid making the environment a sink of waste. Circular Economy in agrifood chains, which links production and consumption supply chain activities, is about reducing food waste and consequently promoting global food security.



Despite the very positive conceptualisation and the potential sustainability benefits that CE can offer, very little research on the concept has been explored in the context of developing countries particularly those in the Sub-Saharan Africa region where there is high threat to food security. This research project therefore aims to close this gap by performing a triple bottom line (economic, environmental and social) sustainability analysis of agrifood value chains in a Sub-Saharan country, Ghana. The overall objective of the research is to develop theoretically grounded, methodological framework to assess the critical factors, benefits and key constraints of the CE of Ghana's agrifood value chain.

Professor Lenny Koh commented: *"This is an important international research collaboration involving UK and Africa (Ghana). Through this we will advance the understanding of circular economy innovation for Ghana's agrifood value chain, and the results will be showcased as a demonstrator for other developing countries."*

Workshop explores the future of electric vehicle supply chains

A recent workshop held at the University of Sheffield in collaboration with the Universities of Cambridge and Surrey brought together representatives from industry, government and academia to discuss the future of Electric Vehicle (EV) supply chains.

The circular economy industry road-mapping workshop was held at Halifax Hall, in Sheffield on 6th February 2020. Key leaders from industry, the government and academia were invited to the event to discuss opportunities for the EV supply chain.



Throughout the day attendees collaborated in three road mapping sessions to identify opportunities, barriers and research programmes presented by EV. The workshop was a tremendous success with common themes emerging during the road mapping sessions.

Researchers from the Energy Institute at the University of Sheffield will summarise and collate all the information from the workshop. This could lead to future collaborative opportunities for development of the EV industry.

Martin Wood, Department for International Trade, commented "It was a great chance to share views and opinions about the direction of travel and electrification in the UK".

Antony Cooper, London Electric Vehicle Company, commented "The workshop was a good opportunity to build relations between academia and the industry".

Neil Glover, Rolls Royce commented "It was interesting to hear other automotive views with lots of parallels, also differences and joint opportunities."

Dr Linus T. Fon, Manufacturing Technology Centre (MTC) commented *“Technology and innovation are the key drivers of the next industrial revolution. Businesses will need to explore and upgrade their existing capabilities in order to stay competitive.”*

Lee Bateup, Bentley, commented *“The event was well organised and facilitated by the University of Sheffield, resulting in a clear and inclusive (Full Lifecycle) problem statement, which enabled the multi-disciplinary participants to form a number of avenues of investigation and action. This is the first important step in a long and circuitous journey towards a future in which the transport sector can have near-zero negative environmental impact.”*

The event forms part of the work of the Advanced Resource Efficiency Centre which supports the development of resource sustainable supply chains by proposing new ways of reducing risk for partners in overcoming the challenges of resource availability.

Professor Lenny Koh, Energy Institute and Director of the Advanced Resource Efficiency Centre said *“Sheffield is well placed to support industry and the government on their journey to electrification with our cutting-edge research from materials science, manufacturing, energy, supply chain, circular economy and sustainability.*

We bring together our capabilities from the Advanced Resource Efficiency Centre (AREC), Advanced Manufacturing Research Centre (AMRC), Royce Institute and Energy Institute alongside the University of Cambridge’s IfM and University of Surrey engineering to make progress through research and innovation.

The transport sector, including the automotive and aerospace industries, and their supply chains are driving this forward alongside the UK Government’s commitment to achieving net zero by 2050 and the ban of all petrol and diesel vehicles by 2035.”

African Drone Forum 2020: A huge success

The African Drone Forum (ADF) 2020 strives to create an extensive stakeholder platform to progress the equitable and safe development of drone economies in Africa. The ADF 2020 was successfully held in Rwanda, Africa, on February 5-7.



The ADF was organised in collaboration with the Government of Rwanda, World Bank Group and partners including UK AID and the World Economic Forum. The three day event was officially opened by the President of Rwanda his Excellency Paul Kagame. The event explored what a future unbound by surface infrastructure could look like, how drone technology can promote development and increase access to essential services and opportunities for the African continent.

Bringing together engineers, regulators, government users, entrepreneurs, academics, development partners, and grassroots drone organizations, the three-day forum included:

Day One – The future of drones in Africa, Africa’s Drone Economy, the Fourth Industrial Revolution in Africa and Droneports and Infrastructure Services in Africa. The Ignite Talks presented the Flying Competitions teams and the technology on display during the Lake Kivu Challenge.

Day Two – A discussion on UAS technology use in specific sectors, through the keynote Future of Food Deliveries in Africa and plenary session Drones for Agriculture – a game changer for Africa. The speakers addressed how drones can be useful in surveying and mapping, as well as disaster risk management with breakout session on: Technology, Regulation, Connected Skies and Logistics.

The Global Air Drone Academy, from Nigeria, was selected as the winner of the African Drone Business Challenge finalists with MicroMek from Malawi and JembeKilimo from Tanzania runners up.

Day Three – A discussion on the Plenary Heavy Lift followed by discussions around airspace management, drone regulations in Africa, drone integration into supply chains, and drones for malaria eradication followed by the Africa Next announcement.



One of the highlights of the forum was the Lake Kivu Challenge, consisting of three flying competitions with ten teams participating across seven countries. The competition showcased the drone technology including vertical take-off and landing aircraft, unmanned traffic management hardware/software, and beyond visual line of site drone delivery operations.

Rwanda is committed to fostering innovation and entrepreneurship, as a key pillar for transforming our country and our continent, both socially and economically.

His Excellency Paul Kagame, President of the Republic of Rwanda commented, “*Why limit ourselves to just using drones? We can also design and manufacture drones in Africa, as demonstrated by examples at this forum. This allows the technology to be tailored to our specific needs, and to help create new industries that generate employment and prosperity*”.

Makhtar Diop, World Bank Vice President for Infrastructure said “*Drones can be a key enabler to future economic growth, poverty reduction and shared prosperity in Africa. They have the potential to create new business models and transform industries like agriculture, mining, e-commerce and health, saving lives by making medicines and vaccines reach the most isolated communities. The African Drone Forum aims to ¹⁷transform the lower skies of Africa into a resource for sustainable mobility, promising efficiency, innovation and opening new opportunities for the population. For this reason the World Bank is helping countries develop their potential and several of our projects already*

EXAMPLES OF RECENT PUBLICATIONS

[Why do Emerging Market Firms Engage in Voluntary Environmental Management Practices? A Strategic Choice Perspective](#)

Ekrem Tatoglu, Jędrzej George Frynas, Erkan Bayraktar, Mehmet Demirbag, Sunil Sahadev, Jonathan Doh, S.C. Lenny Koh
British Journal of Management, Vol. 31, 80–100, Published January 2020

[Spark plasma texturing: A strategy to enhance the electro-mechanical properties of lead-free potassium sodium niobate ceramics](#)

Rui Pinho, Alexander Tkach, Sebastian Zlotnik, M Elisabete Costa, Jacques Noudem, Ian M Reaney, Paula M Vilarinho (2020)
Applied Materials Today, Volume 19, Publication: June 2020

[Tailoring the Mechanical and Degradation Performance of Mg-2.0Zn-0.5Ca-0.4Mn Alloy Through Microstructure Design](#)

Ehsan Mostaed, Malgorzata Sikora-Jasinska, Lifei Wang, Ali Mostaed, Ian M. Reaney, Jaroslaw W. Drelich (2020)
Biodegradable Materials for Medical Applications, Published: 06 March 2020

[Cold sintered CaTiO₃-K₂MoO₄ microwave dielectric ceramics for integrated microstrip patch antennas](#)

Dawe Wang, Shiyu Zhang, Ge Wang, Yiannis Vardaxoglou, Will Whittow, Darren Cadman, Di Zhou, Kaixin Song, Ian M. Reaney
Applied Materials Today, Volume 18, Published: March 2020

[Increasing urban tram system efficiency, with battery storage and electric vehicle charging](#)

Teng Zhang, Rui Zhao, Erica E.F. Ballantyne, David A Stone
Transportation Research Part D: Transport and Environment Volume 80, 102254, Published: March 2020

[Comparing the economic value of virtual water with volumetric and stress-weighted approaches: A case for the tea supply chain](#)

Benjamin H. Lowe, David R. Oglethorpe, Sonal Choudhary
Ecological Economics, Volume 172, 106572, Publication: June 2020

[Dataset on the in-stream and off-stream economic value of water](#)

Benjamin H. Lowe, David R. Oglethorpe, Sonal Choudhary
Data in Brief, Volume 30, 10543, Publication: June 2020

[Blockchain in transport and logistics – paradigms and transitions](#)

S.C. Lenny Koh, Alexandre Dolgui, Joseph Sarkis
International Journal of Production Research, Volume 58, Issue 7, Published 2020

[The fourth industrial revolution \(Industry 4.0\): technologies disruption on operations and supply chain management](#)

S.C. Lenny Koh, Guido Orzes, Fu (Jeff) Jia
International Journal of Operations & Production Management, Vol. 39 No. 6/7/8, pp. 817-828, Published: 2019

[Blockchain applications in supply chains, transport and logistics: a systematic review of the literature](#)

Mehrdokht Pournader, Yangyan Shi, Stefan Seuring, S.C. Lenny Koh
International Journal of Production Research, Volume 58, Issue 7, Published 2020

AREC TEAM MEMBERS AND MANAGEMENT STRUCTURE

AREC has a well-established management structure that facilitates its continuing growth and success. The centre is led by Professor Lenny Koh from School of Management. In addition, the centre's work is structured around four core research themes which are directed by experts from different departments from the University of Sheffield. This includes:

Academics	
Name	Position
Professor Lenny Koh	Director of AREC UK and AREC Global
Professor Panos Ketikidis	Director of AREC Europe
Ken Pan	Director of AREC China
Professor Ian Reaney	Co-Director of AREC USA
Professor Alicyn Rhoades	Co-Director of AREC USA
Dr Erica Ballantyne	Lecturer in Operations and Supply Chain Management
Dr Andrew Brint	Lecturer in Operations Management
Richard Bruce	Business Engagement Lead for the Grantham Centre for Sustainable Futures and Lecturer in Supply Chain Accounting & Finance
Dr Chantal C Cantarelli	Lecturer in Operations Management
Dr Sonal Choudhary	Lecturer in Sustainable Management
Professor Federica Cucchiella	University of L'Aquila
Dr Andrea Genovese	Senior Lecturer in Logistics and Supply Chain Management
Professor Jonathan Linton	Operations Management and Decision Sciences
Dr Stuart Maguire	Lecturer in Information Systems Management
Dr Robert Marchand	Lecturer in Operations Management
Professor David Oglethorpe	Dean, Sheffield University Management School
Professor Ian Reaney	Professor in Ceramics
Dr Antonino Sgalambro	Lecturer in Operations Research
Professor Ian Shellard	Rolls-Royce appointed Honorary Visiting Professor
Professor Andrew Simpson	Associate Dean External Business Advancement, Sheffield University Management School
Dr Mike Simpson	Senior Lecturer in Business Management
Professor Elaine Toms	Chair in Information Innovation and Management
Advanced Materials & Manufacturing Leads	
Professor Mark Rainforth	Professor of Materials Science and Engineering, Director of Mercury Centre and Royce Institute Lead
Professor Neil Hopkins/Dr Christophe Pinna	Professor of Mechanical Engineering/Senior Lecturer in Mechanical Engineering
Professor Derek Sinclair	Professor in Materials Science and Engineering
Dr Sam Turner/Dr Stuart Dawson	Chief Technology Officer of AMRC
Energy & Nuclear Leads	
Professor Peter Styring	Director of UK CDU, Dept of Chemistry
Professor Neil Hyatt	Professor of Nuclear Materials
Professor Mike Tynan/Dr Andrew Storer	Chief Executive of Nuclear AMRC
Professor Mohamed Pourkashanian	Head of University Energy Research, Energy Engineering Group, Department of Mechanical Engineering

Water Lead	
Professor Simon Tait	Professor of Water Engineering
Agritech & Food Leads	
Professor Jurriaan Ton	Professor & ERC research fellow - Department of Animal & Plant Sciences
Professor Peter Jackson	Chair of the Food Standards Agency's (FSA) Social Science Research Committee, Geography
Professor Duncan Cameron	Professor of Plant and Soil Biology, Royal Society University Research Fellow
Post-Doctoral Research Associates (PDRAs), Research and KE Fellows and PhD researchers	
Faisal H Abubakar	EPSRC e-futures DTC Doctoral Researcher (AREC researcher – energy, LCA and circular economy – supervised by Prof Lenny Koh and Dr Andrea Genovese)
Deepak Arunachalam	AREC Doctoral Researcher (AREC researcher – big data – supervised by Prof Elaine Toms)
Dolores Astudillo	EPSRC Energy Storage Doctoral Researcher (AREC researcher – energy storage and LCA – supervised by Prof Peter Hall and Prof Lenny Koh)
Andreas Bofinger	SEERC Doctoral Researcher (AREC researcher – green manufacturing – supervised by Prof John Cullen, Prof Lenny Koh and Prof Panos Ketikidis)
Dr Francesco Ciardiello	Research Associate (AREC PDRA – operational research – supervised by Prof Andrew Simpson)
Dr Seyed Ebrahimi	EPSRC JLR Simulife Research Associate (AREC PDRA – LCA and resource efficiency – supervised by Prof Lenny Koh, Dr Christophe Pinna, Prof David Wagg, Prof Constantinos Soutis and JLR)
Mengfeng Gong	Supply Chain Doctoral Researcher (AREC researcher – sustainable supply chain – supervised by Prof Lenny Koh and Prof Andrew Simpson)
Dr Liam Goucher	N8 KE Fellow (AREC research and KE fellow – agrifood LCA – supervised by Prof Lenny Koh, Prof Peter Horton and Prof Duncan Cameron)
Besart Hajrizi	SEERC Doctoral Researcher (AREC researcher – innovation model – supervised by Prof Panos Ketikidis and Prof Lenny Koh)
Dr Taofeeq Ibn-Mohammed	Research Associate - ESPRC - Management School (AREC PDRA – materials LCA – supervised by Prof Lenny Koh, Prof Ian Reaney and Prof Derek Sinclair)
Benjamin Lowe	Doctoral Researcher (AREC researcher – water sustainability – supervised by Prof David Oglethorpe and Dr Sonal Choudhary)
Stella Manoli	Mechanical Engineering Doctoral Researcher (AREC researcher – composite materials LCA – supervised by Prof Patrick Fairclough, Dr Chis Holland and Prof Lenny Koh)
Mauro Cruz Mercado	Food Doctoral Researcher (AREC researcher – food sustainability – supervised by Prof Peter Jackson)
Dr Jamal Miah	EPSRC R2REE Research Associate (AREC PDRA – road-to-rail energy storage LCA – supervised by Prof Lenny Koh and Prof David Stone)
Kamal Miah	EPSRC Materials DTC Doctoral Researcher (AREC researcher – manufacturing and sintering materials LCA – supervised by Dr Richard Thackeray and Prof Lenny Koh)
Ashish Momaya	Doctoral Researcher (AREC researcher – Blockchain technology – supervised by Prof Lenny Koh and Prof Jonathan Linton)
Dr Raymond Obayi	AREC Researcher (AREC PDRA – resource efficiency and knowledge management – supervised by Prof Lenny Koh and Prof David Oglethorpe)

Eunice Oppon	Leverhulme Trust LC3M and Grantham Centre for Sustainable Futures Scholar (AREC researcher – climate change LCA – supervised by Professor Lenny Koh and Prof David Beerling)
Dr Olga Siemers	Research Fellow, EU H2020 GOF4R (AREC research fellow – transport infrastructure policy – supervised by Prof Lenny Koh, Prof Elaine Toms and Dr Jonathan Paragreen)
Dr Victor Shi	AMRC Postdoctoral Researcher (AREC PDRA – servitisation – supervised by Prof Keith Ridgway)
Lucy Smith	Materials Doctoral Researcher (AREC researcher – materials LCA and indicators – supervised by Prof Ian Reaney, Prof Lenny Koh, Dr Taofeeq Ibn-Mohammed and Prof Mark Rainforth)
Karthik Suresh	Research Assistant - Management School (AREC researcher – risk modelling – supervised by Prof Lenny Koh)
Hui Sun (Avril)	ESRC WR CDT Doctoral Researcher (AREC researcher – food supply chain sustainability – supervised by Prof Lenny Koh and Dr Sonal Choudhary)
Andrew Timmis	Post Doctoral Research Assistant (AREC researcher – materials composite LCA – supervised by Prof Lenny Koh and Prof Alma Hodzic)
Dr Abiye Tob-Ogu	Postdoctoral Research Associate (AREC PDRA – sustainable transportation – supervised by Dr Andrea Genovese and Dr Erica Ballantyne)
Dr Adrian Solomon	AREC PDRA – paper cup recycling – supervised by Prof Lenny Koh and Prof Peter Styring)
Richard Bruce	AREC researcher – open book accounting in food supply chain – supervised by Prof John Cullen and Prof Lenny Koh
Dr Rafael Mauricio Eufressio Espinosa	AREC PDRA – Leverhulme Climate Change mitigation LCA – supervised by Prof Lenny Koh and Prof David Beerling
Business Development and Partnership	
Dr Mel Knight	Challenge Driven Support Manager – Research Services
Peter Caven	Challenge Driven Support Officer – Research Services
Jennifer Phaff	Challenge Driven Support Officer – Research Services
Dr Neil Lowrie	Business Development Manager
Dr Richard France	Senior Business Development Manager
Charles Wilby	Business Development Manager
Chris Baker	Partnership Manager
Lee Allman	Research Manager (AMRC/Engineering)
Dr Adrian Solomon	AREC Project Manager
Angela Booth	AREC Support Officer

AREC COLLABORATIVE STEERING GROUP (CSG) BOARD MEMBERS AND PARTNERS

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