



## Newsletter – January 2018

### RRfW meetings

#### **RRfW Annual Conference 2017 - Making the Business Case for Resource Recovery**

The RRfW Annual Conference ran on the 22nd November in Leeds and attracted around 70 participants from across academia, industry and government. The conference examined both the conceptual ideas and practical experiences on the formulation of business cases for resource recovery as a part of the circular economy.

Keynote speakers included Prof Ian Boyd (Chief Scientific Advisor Defra), Libby Peake (Green Alliance), David Fatscher (British Standards Institution), Prof Jan Jonker (Radboud University), Prof Phil Purnell (University of Leeds) and Dr Ian Archer (Industrial Biotechnology Innovation Centre - IBioIC). In addition, three specialist sessions were run covering creating value from wastes in the bioeconomy, recovering materials from mine legacy landfills, and new sustainability assessments and models.



The conference programme including all abstracts, copies of presentations and a report with conference proceedings are now available to download from the [conference webpage](#).

#### **INSPIRE end-of-project conference**

The Geoenvironmental Research Centre at Cardiff University's School of Engineering is organising a one day end-of-project Conference / stakeholder event for the [RRfW project INSPIRE](#) "IN Situ Processes In Resource Extraction from Waste Repositories", which is scheduled to take place on the 21st of Feb 2018, 9:00-16:30, at the Novotel Cardiff Centre Hotel.

This one day free CPD Conference will mark the end of the INSPIRE project funded by NERC. This conference will present the findings of INSPIRE, engage stakeholders on the important issues relevant to resource recovery from waste, as well as discussing the way forward for resource recovery from waste repositories. It will provide opportunities for feedback and project engagement. The conference will include a presentation from a

prominent European academic who will highlight the European perspective of resource recovery from waste including barriers and opportunities.

To register please visit the [Eventbrite website](#); a detailed agenda will be available due course.

## Publications

### RRfW Coordination Team

Two papers by the RRfW coordination team have now been published. The [first article, published in Sustainability](#), explains the rationale for initiating the RRfW programme, outlining the need for a circular economy that contributes to a resilient environment and human wellbeing. It also introduces RRfW's participation strategy, which aims to engage the multiple stakeholders that need to be involved in the transition towards a circular economy.

The [second paper, in Sustainable and Resilient Infrastructure](#), asks whether our current and planned waste and resource recovery infrastructure will be able to deliver the professed goal of a circular economy in the UK. While the discussion on anticipated over- and under-capacity for energy-from-waste infrastructure reaches boiling point over the Chinese "import ban", this review finds that the available evidence is inconclusive. A lack of coherent data and public investment, partly due to the current regulatory system, are impeding progress towards resource efficiency and circularity and suggests radical inventions - coordinated by a new Office for Resource Stewardship - may be necessary to move forward. A [RRfW blog](#) discussing the paper is now out.



### CVORR

A [critical review of metrics](#) for assessing resource recovery from waste in a circular economy was published, considering four key domains of value (environmental, economic, social and technical). The review concludes that the gap between multi-dimensional value of resource recovery systems and current metrics needs to be urgently addressed.

The next study proposes a novel approach that seeks to [assess how complex value is created, destroyed and distributed in resource recovery from waste systems](#). The approach expands beyond conventional methods of estimating value and seeks to lay the foundations for future advances in computational and assessment methodologies in the field of RRfW.

The third paper presents a [fully integrated modelling approach for value assessments for resource recovery from waste](#). The method tracks and forecasts a range of values across environmental, social, economic and technical domains by attaching these to material-flows, thus building upon and integrating uni-dimensional models such as material flow analysis (MFA) and lifecycle assessment (LCA). The model is then applied to an illustrative case highlighting links between the UK coal-based electricity-production and concrete/cement industries.

In addition to the research publications above, CVORR was also covered in an article for the September issue of the CIWM magazine, titled [Get good "value"](#) (see page 66). The article described how CVORR is co-creating

the next generation of analytical and decision support tools to maximise the gains delivered by resource recovery from waste in a more convenient, transparent and holistic way.

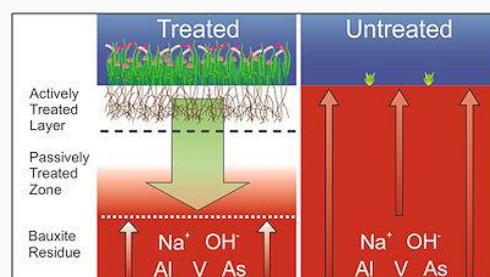
### MeteoRR

A short paper has been published that looks at the [role that microbiology can play in petroleum biotechnology towards ensuring sustainable consumption and production patterns](#) (UN Sustainable Development Goal 12). It focuses on microbially-mediated energy recovery from unconventional (heavy oil to methane), shale gas and fracking, bioelectrochemical systems using fossil fuel, and synthetic biology systems. Using wastes to support a more sustainable approach to fossil fuel extraction processes may support the move towards a more circular global economy.

In addition, another MeteoRR paper has been accepted for publication in the materials journal 'Small' (Wiley), titled: "Biosynthesis and Characterization of Copper Nanoparticles Using *Shewanella oneidensis*: Application for Click Chemistry". The paper demonstrates a novel, green biosynthesis method for the production of copper nanoparticles using the metal-reducing bacterium, *Shewanella oneidensis*. The biosynthesised copper nanoparticles were successfully tested in a range of 'click chemistry' reactions, synthesising 1,2,3-triazoles derivatives, compounds which have potential applications in the pharmaceutical industry due to their biological activity. The team are currently investigating the potential for these microorganisms to use copper from copper-containing waste sources to produce these high value nanomaterials. The paper should be released shortly.

### R3AW

A new R3AW paper addresses [rehabilitation of land contaminated by with bauxite residue](#), a high-volume alkaline waste produced by the alumina industry. The paper shows how simple amendment of the alkaline, saline metal-rich residue with a layer of sand, organic matter and appropriate plant seeds can lead to a sustained healthy chemical environment for vegetation communities to thrive nearly 2 decades after initial treatment. The work shows that simple, low-cost interventions can have lasting effects and minimise the environmental risks of this globally important waste, as well as returning waste sites to rehabilitated, functioning ecosystems.



### INSPIRE

Selective formation of [copper nanoparticles from acid mine drainage](#) taken from a legacy mine site in the UK was investigated using nanoscale zerovalent iron. The paper demonstrates this approach is effective for the one-pot and selective formation of  $\text{Cu}_0$ -bearing nanoparticles from acidic wastewater, with the technique therefore potentially highly useful for the selective upcycling of dissolved copper in wastewater into high value nanomaterials.

Industrial waste deposits contain substantial quantities of valuable metals and other resources, although often in a recalcitrant form that hinders their recovery. This second paper applied [electrokinetic processing to two different waste materials](#) - a mine tailings deposit and a metallurgical furnace dust - focusing on the lead and zinc they contained. The electrokinetic treatment improved the mobility of the metal fractions, suggest that the process may facilitate metal recovery. This, combined with its applicability to fine grained materials and mixed environments, demonstrates that the technique may be particularly suited to both remediation of, and *in-situ* resource recovery from, such materials.

RRfW is currently working to bring all our publications together on our [website](#) and on [Researchgate](#). Watch this space to find out more about the latest results from our projects.

## Funding news

### A policy focus for the RRfW Programme in 2018

A NERC Policy Impact Award has been granted to the RRfW programme to support further policy engagement work in the next few months.

Resource efficiency is likely to be high on the political agenda in the coming years as pressures of inefficient resource use have negative consequences both socially, economically and environmentally. Using case studies and research outputs arising from the RRfW programme we will be actively engaging with policy makers and advisors to facilitate knowledge transfer from the six RRfW projects. Dr Rachel Marshall will be working alongside the PCT team as a Policy Impact fellow starting in January 2018, with a focus on reviewing and consolidating the policy relevant outputs from the RRfW programme. Collaboration is key to the success of this work and the policy team at RRfW aims to engage relevant stakeholders throughout the process to understand both the scope of research covered in the programme and where it fits in the policy and regulatory landscape. In addition to working closely with the wider RRfW programme, the policy team will be attending a number of meetings including the [Westminster Energy, Environment and Transport forum](#) on the 18th January and will be looking for opportunities to further build on our network of policy, industrial and academic stakeholders. This work will be presented as a Policy Briefing note later in 2018 and at a ministerial briefing event in Summer 2018.

For further information or to if you wish to contribute to the discussion please contact [Rachel Marshall](#).

### Lancaster extends the work of AVAnD with two new projects

The AVAnD team at Lancaster University have secured two new grants to support their on-going work.

The £6.8M RECIRCULATE project will focus on “joining up” the different ways in which water supports communities, from sewage disposal to energy generation and water used in food production (Paul, N.D., Semple, K.T. et al. - GCRF, 2017-21. Driving Eco-Innovation in Africa: capacity building for a safe circular water economy, £6,840,704). RECIRCULATE will bring together leading researchers in the UK, Ghana and Nigeria with African entrepreneurs, policy makers and community leaders, to deliver the innovative approaches needed to integrate the different uses of water, and which support sustainable, equitable development. Further details on this project are available in the following [news article](#).

In addition, Lancaster University and Stopford were awarded a grant by Innovate UK / BBSRC Agritech for a follow on project to AVAnD, looking at the use of bioenergy waste residues for sustainable food production in Africa (Semple, K.T. NERC – International Opportunities Fund 2017, Bioenergy waste residues as alternatives to conventional inorganic fertilisers for sustainable food production in sub-Saharan Africa, £42,600). A new appointment to the team will be joining Stopford in January 2018 to build on the ‘proof of concept’ work performed in the AVAnD project and develop the formulation aspects of using ash and digestate as alternative fertilisers. In addition, the IOF Pump Priming fund will support the delivery of four workshops in Ghana, Kenya, Malawi and the UK under the theme of resource recovery from waste, with particular focus on the use of bioenergy wastes products as sustainable alternatives to conventional fertilisers. The outputs from this project will include reports summarising the key outcomes from the workshops, a peer-reviewed scientific journal article, and further international research proposals to build on this work.



### **New funding for MeteoRR follow-on**

Jon Lloyd, University of Manchester, has recently been awarded a new 3 year grant from the BBSRC, building on the work of MetoeRR. The new project is titled “Molecular engineering of high activity multi-functional bio-metallic catalysts for clickable chemistries”, and will focus on developing novel bio-metallic catalysts for producing high value chemicals for use in industrial biotechnology. As part of this, they will investigate the potential for using waste streams as feedstocks for the synthesis of these catalysts.

### **New EU training grant on Circular Economy - CRESTING**

Dr Pauline Deutz, University of Hull, has recently been awarded a €3.8 million EU Horizon 2020 Marie Skłodowska-Curie Innovative Training Network research grant for the project ‘Circular Economy: Sustainability implications and guiding progress’ (CRESTING).

Establishing a Circular Economy - to maximise the use made of resources and minimise waste generation - is a major policy area within the UK, European Union and elsewhere. Explicitly seen as increasing economic competitiveness and laying a foundation for environmental employment, Circular Economy policies are designed to increase resource efficiency and decrease carbon dependency. Previous and ongoing research into the Circular Economy, however, has been largely concerned with strategies for implementation. The many different fields of activity involved (e.g., re-use, recovery, recycling, design for the environment amongst others) operate with varying degrees of effectiveness in different places and for different materials. These fields of activity have not been critically analysed as an interrelated social, technical, environmental and, geographical phenomenon.

CRESTING will train 15 Early Stage Researchers (PhD level) in cutting edge systematic analysis of the process of transformation to a Circular Economy (CE). This programme will advance the critical analysis of the concept and sustainability implications of the CE through in-depth analyses of CE-related activity and initiatives in a range of geographic and economic settings within a carefully integrated framework. The purpose of this is to translate critical assessment to lessons for managing the transformation to a CE. The project has academic partners from across the EU, and partners in industry, government and NGOs including the City of Hull, WRAP and Environmental & Management Solutions (EMS) Ltd in the UK. It also includes Nanjing University, China and Ibadan University, Nigeria. We will shortly be recruiting 15 early stage researchers between the eight universities, researchers must not have spent more than 12 months in the last three years in the country where they are to be hired. Follow @crestingITN for announcements, or email [cresting@hull.ac.uk](mailto:cresting@hull.ac.uk) for information.

## **Partner news**

### **Dr Siddharth Gadkari starts** fellowship supported by MeteoRR

In November 2017, NERC funded fellowships attached to the Resource Recovery from Waste (RRfW) programme. The RRfW project MeteoRR (Microbial Electrochemical Technology for Resource Recovery), led by the University of Newcastle, has supported a fellowship for Dr Siddharth Gadkari at the University of Surrey. Dr Gadkari started his 3.5 years NERC UKRI Industrial Innovation Fellowship “Mathematical analysis of bioelectrochemical systems” (NE/R013306/1) on 2nd Jan 2018. He will split his time between the Centre for Environment & Sustainability and Chemical & Process Engineering at University of Surrey. In this project, Dr Gadkari will work with Dr Jhuma Sadhukhan, who is leading the Sustainable Development theme of the MeteoRR project, and her team, on developing comprehensive dynamic and life cycle assessment models to study bioelectrochemical systems performance.

### **AVAnD researchers contribute to Government report 'From Waste to Resource Productivity'**

AVAnD researchers contributed to the Government Chief Scientific Adviser's report 'From Waste to Resource Productivity', which was published on 14th December 2017. This report consists of two sections and explores how we can realise the potential of waste as an important resource and increase efficiency in the UK's use of waste. The main report is authored by the former Gov Chief Scientific Adviser, Sir Mark Walport, and the Chief Scientific Adviser for Defra, Professor Ian Boyd. It is accompanied by an evidence report that brings together case studies and evidence from a range of stakeholders including from the AVAnD team. The reports can be downloaded from the following [Government publications webpage](#).

### **INPSIRE project contributes to European COST network on mining the anthroposphere**

Dr Peter Cleall (Cardiff University) and Dr Danielle Sinnett (University of the West of England) presented findings from the [INPSIRE](#) project (In-situ processes in resource recovery from waste repositories) at the MINEA working group meeting in Vienna. This included work on the physio-chemical composition of mine wastes and their co-location with ecological and cultural designations in south-west England and Wales, [published in Resources, Conservation and Recycling](#).

The presentation focussed on the feasibility of recovering metals from mines wastes in England and Wales, examining both the metal content of mine wastes and its potential economic value as well as the risks and opportunities of resource recovery to sensitive sites protected for their ecological and cultural value (e.g. Sites of Special Scientific Interest and World Heritage Sites). It also included the preliminary findings from a series of workshops with residents of mining landscapes that sought to examine the value they place on their mining heritage and their priorities for its long-term management. Workshops took place in six locations in south-west England, the Pennines, and in Wales in Autumn 2017. These suggest that residents are more likely to be supportive of resource recovery in areas where water quality is at risk and the technology can be combined with remediation and restoration activities.

[MINEA is a European COST network](#) that aims to accelerate the classification and reporting of material resources / reserves in the anthroposphere.

### **Dr Jhuma Sadhukhan coordinates Researcher Links workshop**

A week long Researcher Links Workshop on "Energy from Economic Development and Welfare" (23-27 October, 2017) was a resounding success, resulting in commitment to bi-lateral cooperation between early career researchers in the UK and India.

The workshop was coordinated by Dr Jhuma Sadhukhan of the University of Surrey (Sustainable Development theme leader on the MeteoRR project) and Dr Thallada Bhaskar of the Council for Scientific & Industrial Research (CSIR) lab, Indian Institute of Petroleum. The workshop was supported by a Researcher Links grant under the Newton Bhabha Fund, which is funded by the BEIS and the Royal Society of Chemistry, and delivered by the British Council.



Through the week, researchers from the two nations made presentations on their research areas and projects, including one by RRfW Programme Coordinator Dr Anne Velenturf. The UK researchers emphasised the importance of source segregation of waste and System/Process Integration in order for effective valorisation into platform chemicals with multiple usages of their derivatives. The possibilities spanned a wide range of alternatives such as biofuels, cosmetics, pharmaceuticals, speciality chemicals, food ingredients, agrochemicals, pigments, biosurfactants, bioplastics, nutrients, sustainable energy such as solar and hybrid systems, energy storage systems, biodiversity and bioelectrochemical systems for resource recovery from

wastes and CO<sub>2</sub> reduction. Research impact and output were linked with the UN Sustainable Development Goals. Presentations from the UK also included sustainable toilet systems with energy generation, and resource recovery from industries in the UK for circular economy. The Indian researchers presented thermochemical, biochemical, biotechnological and chemical systems for waste valorisation into multiple products, fuel additives, biofuel testing in real-time driving conditions and life cycle assessment. They also showcased a range of innovations in catalytic systems, several of which have been patented. There was good synergy between various presentations showing complementary skills and expertise. Building on the presentations and visits to the impressively well-equipped CSIR-IIP laboratories, daily roundtable discussions were held to develop collaborative research projects which led to seven exciting project concepts in the area of waste valorisation for circular economy, hybrid energy systems, economic growth and sustainability.

### **Dr Jhuma Sadhukhan to serve as Editor on new Elsevier journal**

Dr Jhuma Sadhukhan is to serve on the Editorial Board of the new Elsevier journal '[Bioresource Technology Reports](#)'. This sister journal of 'Bioresource Technology' likewise focuses on the fundamentals, applications and management of bioresource technology. It will look to advance and disseminate knowledge in all the related areas of bioenergy, biotransformations and bioresource systems analysis, and technologies associated with conversion or production.

Another Elsevier journal, [Food and Bioproducts Processing](#), has initiated a new section on Biorefining and Integrated Bioresource Engineering, which welcomes original contributions in process integration needed for realising the concept of whole systems and life cycle thinking for circular economy. Dr Jhuma Sadhukhan is to serve on the Editorial Board for this new section of the journal, a publication of the Institution of Chemical Engineers and an official journal of the European Federation of Chemical Engineering.

## **Other news**

### **Green Alliance publishes report on "A new direction for UK resource strategy after Brexit"**

A study by think tank Green Alliance examines the environmental challenges facing the government from Brexit and assesses the risks. Amongst the impacts highlighted are:

- Backsliding on waste. The EU's current recycling targets expire in 2020, and there is no promise to replace them in the UK. Without ambitious new recycling targets, progress could slip on recycling provision and lead to the reopening of landfills. This is not what people want: 93 per cent of people in the UK say recycling is personally important to them.
- Poorer quality products. No longer applying EU ecodesign standards in the UK risks opening up the domestic market to substandard products from other countries, undercutting UK businesses and saddling consumers with the costs of poor quality goods (energy standards for lighting, vacuums, boilers and computers are saving UK households hundreds of pounds a year).

The [Green Alliance's report](#) sets out a series of recommendations for the new strategy that would avoid risks created by Brexit, including negotiating to stay in REACH, continuing to co-operate on EU ecodesign standards and adopting ambitious new targets for recycling and waste minimisation.

## Report on biorefining potential in Scotland for a circular economy

A study has been carried out which gives the most detailed insight yet into the circular economy opportunities for bio-based waste and by-products generated in Scotland. In the [Biorefining Potential for Scotland report](#), bio-resource arisings in Scotland have been mapped to understand the scale and shape of the potential market. It shows there are 27 million tonnes of biomaterials produced in Scotland every year, with considerable scope of opportunity for development: thousands of tonnes of these valuable materials could be captured and put to high-value use. Due to data protection, it is not possible to release the mapping data online. Instead, please contact [Scottish Enterprise](#) for data requests on the location and availability of bioresource arisings.



A presentation was given at the RRFW Annual Conference by Ian Archer (IBioIC) on the Feedstock Mapping Model described in the report and is available on the [conference webpage](#).

## European Council Conclusions on Eco-innovation: Enabling the Transition Towards a Circular Economy

The European Council has adopted conclusions on eco-innovation to enable the transition towards a Circular Economy.

During the Estonian Presidency, eco-innovation has remained a priority area and was included as a topic for discussion at the informal meeting of Environment Ministers in Tallinn in July 2017. The conclusions adopted by the Council highlight the effort needed to move towards a Circular Economy and eco-innovation's role in this transition. As part of these conclusions, EU Member States are asking for a comprehensive EU policy covering the entire lifecycle of products which would help improve transparency and identify gaps. The conclusions encourage national governments to remove barriers to bringing innovative products to market, increasing the pace of their development through support from digital technologies. Further information and the council conclusions are [available here](#).

## "Research, Impact and the UK Parliament" training

The UK Parliament is offering regional training events for academics on how to use research to engage with Parliament. The training events give an overview of Parliament and then cover ways to work with the institution, including details on Select Committees, legislative scrutiny, the House of Commons and House of Lords libraries and the Parliamentary Office of Science and Technology (POST). The events take place monthly at venues around the UK, with the next three being in Leicester (15 Jan), Liverpool (21 Feb) and Plymouth (21 Mar). Further information is available on the [UK Parliament website](#).

## Funding calls

### Innovate UK sector competition: strand 1 Manufacturing and Materials

The manufacturing and materials strand aims to encourage and broaden innovation in the manufacturing and materials sector. Projects should target opportunities for significant changes in productivity and in cutting-edge innovations with significant potential for encouraging growth in all parts of the UK economy. Projects are welcomed from across the manufacturing and materials technology themes, including in: nanotechnology and

nanomaterials; resource efficiency; chemical and bio process; and material recovery and treatment. Projects should range in size from total costs of £50,000 to £2 million. Deadline for application is 31st January. Further details are available here on the [Innovate UK website](#).

### **Global Challenges Research Fund**

We have several interested partners to contribute and/or lead on GCRF proposals – visit the [GCRF website](#) for further information on funding scope and calls. Please [contact](#) us for further details on interested partners.

### **Zero Waste Scotland**

The [Circular Economy Investment Fund](#) is open to businesses and organisations in Scotland working in all business and social economy sectors. The scheme will run from 2016 to 2018.

## **Events listing**

**Westminster Energy, Environment & Transport Forum** - Priorities for UK waste and recycling policy and developing the circular economy, [London 18 January 2018](#). This event is CPD certified.

**IBioIC Annual Conference** - [Glasgow 25-26 January 2018](#)

**In-situ resource extraction from waste repositories** - CPD day Conference. [Cardiff 21 February 2018](#).  
INSPIRE end-of-project meeting.

**Circular Economy in Practice, Challenges and Opportunities**, [Cambridge 26 February 2018](#).

**Plastics in the Ocean: Challenges and Solutions**, [Cambridge 7 March 2018](#).

**Microbial Electrochemical Technology for Resource Recovery**, Newcastle University, 9-10 May. This is a celebratory conference for the end of the MeteoRR project and we hope to attract industrial, academic and government stakeholders. Further details to be announced shortly.



Any news, events or funding calls to include in our next newsletter in April 2018?

Email [S.J.Jopson@leeds.ac.uk](mailto:S.J.Jopson@leeds.ac.uk)

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