The University Of Sheffield.

Supporting Supply Chain Resource Sustainability

A workshop report

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Foreword

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The future is not about a supply chain competing against another supply chain. The future is about a resource sustainable supply chain competing against another resource sustainable future. The world is connected by multi layers of chain reaction, and resources are connecting these chains together. A more effective and efficient use of resources will lead to a more sustainable future.

Building from decades of research on resource planning, uncertainty management, information science and sustainability science in enterprises and supply chains, the vision of supply chain resource sustainability combines these bodies of research into an integrated infrastructure to reengineer future supply chains.

The Advanced Resource Efficiency Centre (AREC) is the infrastructure set up to work in partnership with industry to address the world grand challenges in supply chain resource sustainability. AREC integrates lower and higher Technology Readiness Level (TRL) innovations so that new technology, tool, model, method for supply chain resource sustainability can be achieved. Focusing on the 4 key capabilities domain of advanced materials and manufacturing; energy and nuclear; water; and agritech and food, AREC is positioned to addresses the resource sustainability challenges in these supply chains. AREC has strong backing from key stakeholders and is aligned with key government policies and innovation capabilities. For example, AREC has been included in the Sheffield City Region Strategic Economic Plan, and AREC has an existing compelling case.

Partners and Participants' Organisations

The University of Sheffield AMRC with Boeing Rolls-Royce Tata Steel Unilever Panalpina Mineral Metals Trade Association The Institute of Materials, Minerals and Mining KTN – Innovate UK Costain Skanska AQUA Ltd Sheffield City Region LEP Severn Trent DLA Piper PA Consulting Group Briga Consulting Emelo Consulting FWA Consulting Recovery Insulation Ltd CLCF Tecnalia SEERC

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I would like to thank the team, partners and participants of the Supporting Supply Chain Resource Sustainability (SCRS) workshop which helped shape the vision of AREC. This group of 51 industry representatives and academics explored supply chain challenges during a half day workshop held at the Advanced Manufacturing Research Centre to foster closer working relationships between The University of Sheffield academics and leading businesses in key strategic areas including advanced materials and manufacturing, energy and nuclear, water and agritech/food.

I am fully supported by a distinguished team of respected academics, led the Supply Chain Resource Sustainability (SCRS) workshop, helping to shape the vision and programme of supply chain resource sustainability research for translational and high impact performance. The workshop was very well attended, resulted in an informed and diverse range of opinions and identified key collaborative areas, capabilities and tools around supply chain resource sustainability needed by industry to address their resources supply chain challenges.

The workshop also successfully introduced the Advanced Resource Efficiency Centre (AREC), a facility for supporting the development of competitive advantage by creating world leading, resource sustainable supply chains through collaborative action between industry and academia, especially in the thematic areas where The University of Sheffield has deep expertise including (1) advanced materials and manufacturing; (2) energy and nuclear; (3) water; (4) agritech/food.

This report pulls together the key findings from the Supply Chain Resource Sustainability (SCRS) workshop and charts the next steps of steering group meetings for the development of project matrix in partnership between industry and academic.

Executive Summary

Innovation through collaboration

This report sets out the agenda for the Advanced Resource Efficiency Centre at the University of Sheffield that will provide a collaborative framework for addressing the key challenges regarding sustainable resource use within supply chains.

Shaping a vision for supply chain resource sustainability

Expert opinions were sought from a workshop with leading academics and industry, helping in defining the challenges for supply chain resource sustainability. The report draws attention to the key challenges and concerns raised by representatives of industries engaged in energy and nuclear; advanced materials and manufacturing; Agritech and food; and the water industry.

Industry cannot achieve resource sustainability by working in isolation. The UK has a target of reducing CO2 emissions by 80% by 2050, placing huge pressure throughout the supply chain internationally.

AREC is to build on these initial findings and establish a steering group that can develop and shape collaborative and practical research to meet these challenges.

"The need to determine resource sustainability is essential to enable businesses to operate over the long term"

Getting it right

What is needed is a fully collaborative and integrated approach that addresses the following:

- Innovation in evidence based decision making and mathematical modelling
- Generate breakthrough supply chains efficiency and sustainability capabilities to meet future needs
- Monetisation of the real value of resources
- Innovation through collaboration
- Adapting inter-disciplinary metaphors to generate innovation

The case for collaborative working

Collaboration and planning

To achieve sustainability objectives industry cannot work in isolation. There is a need for collaborative planning and development that sees industry, regulators, Government and academia working together to establish and promote sustainable innovations.

The UK Government is already committed to providing support to the UK's 4.8 million Small and Medium Sized Businesses (SMEs), developing an environment in which small companies can flourish (HM Treasury 2011).

However it is not just SMEs that require support. Large firms require support to understand unsustainable processes within their supply chains. The European Commission's 2011 report "A Resource Efficient Europe" highlights the importance of understanding the risks to resources such as rare earths; energy; and water (Commission of the European Union 2011). The complex nature of supply chains, and the scale and spread across which they operate requires co-operation at local, regional, national, and international levels.

"The University of Sheffield's AMRC has transformed a disused coal mine to a centre of international excellence".

Future supply chain is not about a supply chain competing against another supply chain; it is about a resource sustainable supply chain competing against another resource sustainable supply chain. For firms to compete in this environment there is a need to develop effective partnerships between industry and academia to share risk and reward in developing, implementing, and commercialising supply chain resource sustainability techniques, models, tools, methodologies and technologies.

This vision is in line with existing policy direction in the UK. e.g. the 2012 "Resource Security Action Plan" from the Department for Business, Innovation and Skills (BIS) states: "Government's objective is to bring better resource use criteria into the mainstream, so they routinely included in the range of minimum and best practice product standards"

The long term vision to achieve this objective is set out, stating:

"The Government is putting innovation and research at the heart of its growth agenda through greater investment and increased collaboration"

Introduction to the Advanced Resource Efficiency Centre (AREC)

The Advanced Resource Efficiency Centre (AREC) is a facility to promote the collaboration between industry and academic, and provide a platform for access to policy makers in order to meet the challenge of promoting resource efficiency and sustainability across supply chains.

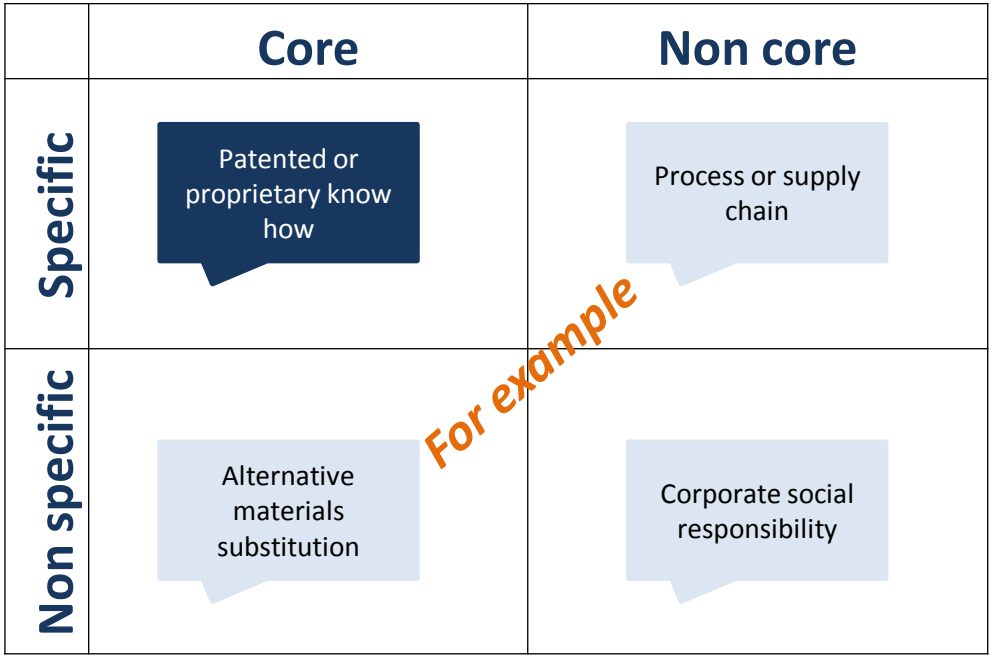
The concept of AREC as a facility to enable the creation of competitive advantage through developing resource sustainable supply chains builds on a strong foundation of government policy initiatives.

AREC would provide partners with:

- Both short and long term innovation.
- Access to cutting edge development.
- World leading expertise in academia and industry.
- Collaborative and joint capability.
- Branding and CSR.
- Access to funding.
- Access to skills.
- Access to facilities

Policies supporting the case for SCRS /AREC

Resource Security Action Plan (BIS, 2012)	**"Resource Security Action Plan"** from the Department for Business, Innovation and Skills (**BIS**) states: ***"Government's objective is to bring better resource use criteria into the mainstream, so they routinely included in the range of minimum and best practice product standards"*** The long term vision to achieve this objective is set out, stating: ***"The Government is putting* innovation *and research at the heart of its growth agenda through greater investment and increased collaboration"***
Infrastructure Carbon Review (HM Treasury, 2013)	The UK is committed to driving forward the delivery of strategic new infrastructure alongside the renewal and maintenance of existing infrastructures. These initiatives aim to embed low carbon practices into business activities, leading to reduced energy demand and pressure on resources
Climate Change Act 2008 (HM Government, 2008)	The UK set out legally binding requirements for the UK to reduce CO_2 emissions by 80% against 1990 levels by 2050. The European Union (EU) issued similar directives in 2011, proposing cuts in Greenhouse Gas Emissions of "80 to 95%" by 2050 (Commission of the European Union, 2011).
A Resource Efficient Europe – Flagship Initiative under the Europe 2020 Strategy (Commission of the European Union, 2011)	EU outlined the need for promoting a "resource efficient" Europe, one that is less reliant on scarce fuels and materials, with greater levels of food and energy security, and therefore increase EU member state's resilience against global commodity and energy prices
Eight Great Technologies (Willet, 2013)	The UK Government's vision of future scientific research into the "8 Great Technologies", developing great research with practical industrial application influence the focus of sectors and their supply chains in Supply Chain Resource Sustainability.



AREC is proposing new ways of collaborative working that reduces risk for partners

Understanding supply chain resource sustainability requires a consideration of these distinctive operations across different industries. Each industry will have different operations that are core, and those which are non-core. There are also differences between what are specific and non-specific. For example, in scenario 1, businesses are left to focus on their core and specific operations (e.g. patented technology in-house) and leave their partners to deal with the other three operations: Core and Non-Specific (e.g. alternative materials substitutions); Non-Core and Specific (e.g. a particular manufacturing process or a particular supply chain); Non-Core and Non-Specific (e.g. Corporate Social Responsibility). In Scenario 2, businesses work with partners in some core and specific activities (in a very well defined project) but also work in partnership for the other three areas.

It is ultimately a low cost solution for industry to reap these benefits. The grand vision of AREC centres on the belief that in the future every company will compete on the basis of supply chain resource sustainability. This is not just internal vision but by viewing everything as a resource (For example: water, energy, carbon, waste, time, money, human capital, infrastructure, materials, data) then decision making will be made from the supply chain resource sustainability perspective rather than organisational perspective. This vision is in line with existing policy direction in the UK, e.g. the 2012 “Resource Security Action Plan” from the Department for Business, Innovation and Skills (BIS) and others which were mentioned in the previous page.

The AREC is proposed as a vehicle to support and translate this grand vision into reality. It will connect lower technology readiness level (TRL) activities with higher TRL activities. The underpinning scientific research on supply chain resource sustainability has been in the making for decades, and the concept of AREC has been in the making for several years and is realised in Strategic Economic Plan of the Sheffield City Region Local Enterprise Partnership with strong policy backing.

What matters to industry?

Traditional view of industry

The biggest challenge, and one which not often considered in academic research, is that it's difficult to get support from the Board for sustainability improvements unless there is a legal requirement or a definitive and clearly defined financial benefit. Specific modelling and data requirements are very much seen as secondary barriers.

Alternative position

In this age, many shareholders do not want to be seen to associate with companies whose response to green issues is weak or, worse still, negative. This is also true for social issues. Investors may want these "desirable characteristics" *as well as* financial returns (but not *instead of)*. This gives some leverage to green and wider sustainability issues where the cost/benefit balance is long-term positive or neutral. This is true of customers; industry has to make more concessions to win customers.

If firms are seen to be less "green", less "socially responsible" either in the design of products or in their operations than their competitors, then customers may choose to go elsewhere.

"What is a business case? A business case shows how the idea that you are proposing will pay for itself".

This ultimately feeds back to shareholders, as these lost orders soon translate to lower returns; hence the pressure will shift towards improving sustainability.

Some investors do have a longer-term view – and these investors are more likely to understand, and to back CEOs who support the idea that long-term success lies in achieving a transparently fair and sustainable balance between rewarding all of the stakeholders in the business, not just the shareholders. These other stakeholders include: customers, suppliers, employees and, increasingly, the communities within which the business operates.

Supply chain dynamics and values

"Value" is not simply a financial measure but can have different meanings to different people. "Triangle of Tension", a simplistic way of representing the inherent trade-offs in supply chain decision-making. In this view of supply chain dynamics it is appropriate to consider "delivery" as lead-time, "quality" as "on time in full" (i.e. meeting the committed lead time with no losses, damage or sub-standard parts) and "cost" is the direct cost of the operation (i.e. manufacturing, assembly, and logistics). If one of these parameters is changed then this change will impact on at least one of the others. In order to assess the business case for a "green initiative", an evaluation of how its implementation affects the delivery, cost, and quality parameters is required to determine if there has been an improvement. The problem with this simple assessment is that sometimes the value of parameters is non-linear. For example, for a supply chain to work, a specific lead-time must be achieved. A late lead-time may greatly reduce value (or even eliminate it). Conversely, early delivery may also cause problems for the customer (for example due to issues of storage). Therefore assessment of sustainability requires complex methodologies.

Logistics and transports

Distribution and delivery requires a balance between lead-time against the combined aspects of cost, energy and carbon. For example, the cheapest transport is usually sea and rail. These are also perceived to be the "greenest" in terms of energy use and carbon emissions, so from a cost, energy, and environmental perspective these are the optimum transport medium to use. However rail and sea are also slower in comparison to air transport, and less controlled than road transport. The extra costs incurred from building up buffer stocks due to increased likely-hood of missed, or delayed deliveries is likely to outweigh the benefits from using the "green" option.

Distribution and transport is linked to storage. Having one large, central warehouse can introduce unnecessary distribution journeys if all goods and services must be shipped through a single large distribution centre. The opposite end of the spectrum of having lots of smaller warehouses can lead to excess inventory, which ties up cash, uses energy and resources without contributing to value added processes.

Each of these centres require their own managers, finance people, HR people and other indirect costs, as well as increasing the probably of carrying duplicate stocks because of the inherent inefficiency of multiple stores. In considering the logistics, there is a potential direct clash between reducing the operational cost in total by reducing lead-time and improving OTIF against reducing direct shipping cost AND improving energy/carbon at the expense of lead-time.

Business Needs

To improve the ability for businesses to incorporate supply chain resource sustainability into their operations, there is a need to develop frameworks that enable better ways of visualising, understanding, and calculating the full impacts of “green” and sustainability (including social) improvements.

This requires taking into account energy use, carbon emissions, resource use, corporate social responsibility, and cost for both the initial investment decision, and the operational aspects. To do this, industry requires better tools to model and evaluate these interventions to create business cases for change.

Introduction to the SCRS Workshop

51 industry representatives and academics explored supply chain challenges during a half day workshop held at the Advanced Manufacturing Research Centre to foster closer working relationships between Sheffield University academics and leading businesses in key strategic areas including advanced materials and manufacturing, energy and nuclear, water and agritech/food.

Professor Lenny Koh, supported by a distinguished team of respected academics, led the Supply Chain Resource Sustainability (SCRS) workshop, helping to shape the vision and programme of supply chain resource sustainability research for translational and high impact performance. The workshop was very well attended, resulted in an informed and diverse range of opinions and identified key collaborative areas, capabilities and tools around supply chain resource sustainability needed by industry to address their resources supply chain challenges.

A workshop on challenges, efficiency improvement and collaborative solutions

The workshop also introduced the Advanced Resource Efficiency Centre (AREC), a facility for supporting the development of competitive advantage by creating world leading, resource sustainable supply chains through collaborative action between industry and academia, especially in the thematic areas where Sheffield University has deep expertise including:

1. Advanced materials and manufacturing
2. Energy and nuclear
3. Water
4. Agritech/food.

Advanced materials and manufacturing

Introduction to AMM at the University of Sheffield

Materials research underpins many 21st Century technologies whilst novel manufacturing and raw materials conversion processes allow for efficient, high throughput and low cost production. The convergence between modern materials and their manufacture is reflected in the relationship between many of the departments within the University of Sheffield.

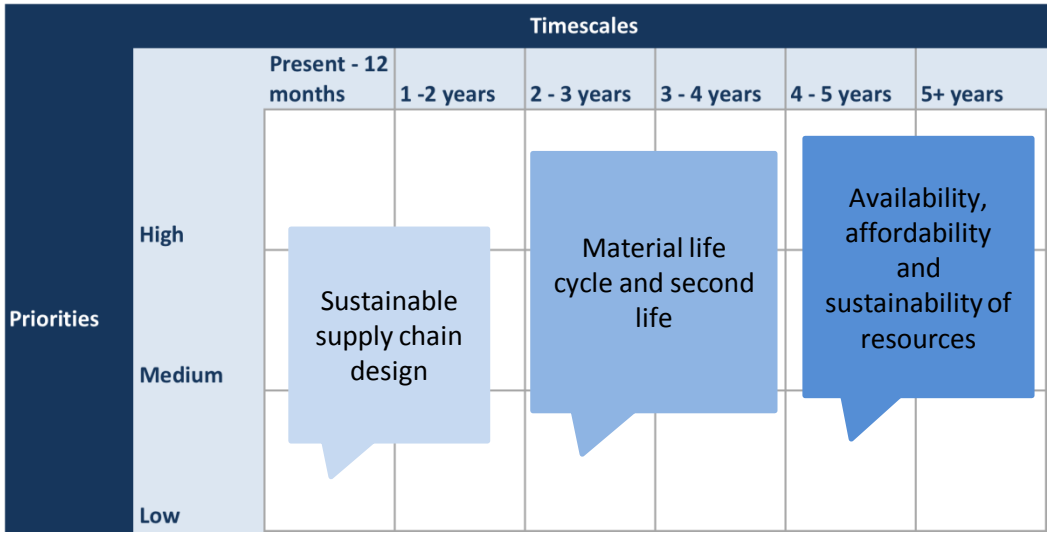
Materials and manufacturing R&D is conducted across a number of departments, notably Materials Science & Engineering, Mechanical Engineering, Chemical & Biological Engineering and Electrical & Electronic Engineering. The broad and interdisciplinary nature of our work is enriched by collaborations with science departments such as Chemistry and Physics & Astronomy delivering the highest quality fundamental research, whilst development at higher technology readiness levels includes the participation of the Advanced Manufacturing Research Centre with Boeing. Further translational research is underpinned by close collaborations between the Schools of Medicine and Dentistry and the more traditional engineering disciplines, allowing our researchers to exploit their understanding of underlying physical phenomena for the public good.

Participants strongly expressed an interest in developing AMM during the workshop

List of centres that do AMM research

1. Advanced Manufacturing Research Centre (AMRC) with Boeing
2. Mercury Centre
3. Composite Systems Innovation Centre
4. Research Centre for Surface Engineering
5. Functional Materials Group
6. Centre for Advanced Additive Manufacturing
7. Leonardo Centre for Tribology and Surface Science
8. Centre for Glass Research
9. Centre for Biomaterials and Tissue Engineering
10. Immobilisation Science Laboratory
11. Polymer Centre
12. Sheffield Centre for Advanced Magnetic Materials and Devices
13. Centre for Cement and Concrete
14. Sheffield NanoLAB
15. Sorby Centre for Electron Microscopy and Microanalysis
16. X-Ray Diffraction Laboratory (XRD)
17. EPSRC Centre for Doctoral Training in Advanced Metallic Systems
18. Characterisation Small Research Facility (SRF)
19. Logistics and Supply Chain Management (LSCM) Research Centre
20. Centre for Energy, Environment and Sustainability (CEES)

AMM breakout group synthesis



Sustainable supply chain design

- Consideration of end of life implications of product design / material choice
- Design efficient cost effective supply chain

Material life cycle and second life

- Comparability of 'greenness' of competing materials and processes.
- Material life cycle analysis for renewable and second life
- Customers often has prices in mind not carbon emission cost of product

The single biggest issue is the availability of critical materials for ensuring future supply chain resource sustainability.

Availability, affordability and sustainability of resources

- Availability of key irreplaceable materials.
- Availability of affordable resources
- Availability of resources critical to industry (can be due to regulatory or track blockages)
- Quality of scraps (competition, product requirement)
- Reduction /renewal of RE elements in materials
- Reduce energy costs associated with ceramic processes
- Regulation, compliance and cost
- Competition for CAPEX

Innovations needed to address supply chain resource sustainability challenges in advanced materials and manufacturing:

1. Advanced materials recovery and recycling methods.
2. End-of-use product, process and supply chain design and manufacturing for recycling and second life.
3. Tools and methodologies that can account for total supply chain resource sustainability including materials availability, criticality and affordability.
4. Supply chain risk and resilience for uncertainty management of critical and irreplaceable materials and resources e.g. rare earth materials, integrating climate adaptation and mitigation, geo-political tension, economic uncertainty and so on.
5. Alternatives to and substitution of critical/rare earth materials, critical resources and their supply chains.
6. Acceleration model for licensing and exploitation of sourcing of alternative supply (e.g. mining).
7. Overcoming the regulatory challenges including EU ETS limitation and meeting regulations at both national and supra-national levels is a concern to industries of all sizes, but is a particular concern to SMEs, who may lack the capacity to adequately comply with all the required regulatory criteria. For example, in the steel industry the EU ETS places costs for carbon emissions on steel producers. However even by substituting virgin steel for recycled steel incurs carbon emissions from the electricity required to melt the scrap metal and raises concerns for where the industry can make financial savings from this industry.
8. Long-term planning requires understanding of the long-term regulatory regime to make sustainability interventions into supply chains. For example the aerospace industry estimates that integrating new techniques into a historical product line must deal with a 30-40 year lifespan of existing techniques.
9. Supply chain formation as there are implications for activities to be relocated to areas of lower environmental regulation (the problem of “carbon leakage”).

Energy and nuclear

Introduction to E&N at the University of Sheffield

The key challenges for energy concerns the future security of supply and energy mix. Traditionally has been a reliance on fossil fuels, which brings about a host of socio-political issues regarding the extraction of fuel sources (in particular oil, but increasingly natural gas).

Replacing old generation nuclear infrastructure is a major challenge for the energy sector in the long term. There is a £1.6bn spend on the supply chain for decommissioning existing nuclear power stations nearing the end of their life. These schemes must compete under an extreme environment for 60 years, the UK therefore must demonstrate its workers are highly skilled and of high quality.

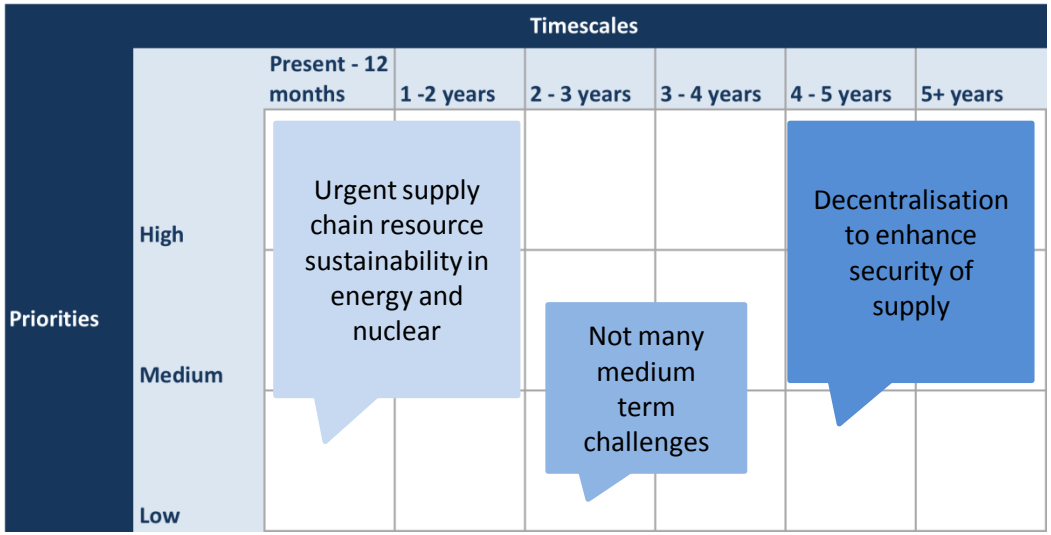
The University of Sheffield's research on energy and nuclear is World leading and ground breaking with the capabilities across excellence in science, engineering and social science – spanning from understanding of the fundamental of origin to supply, generation, capture, storage, distribution, transmission, demand and recovery – the energy and nuclear supply chain systems.

The UK is embarking on an energy infrastructure revolution which will transform generation, distribution, supply and demand.

List of centres that do E&N research

1. Nuclear Advanced Manufacturing Research Centre (NAMRC)
2. Nuclear Fission DTC
3. Immobilisation Science Laboratory
4. Logistics and Supply Chain Management (LSCM) Research Centre
5. Centre for Energy, Environment and Sustainability (CEES)
6. Centre for Low Carbon Futures (CLCF)
7. UK Centre for Carbon Dioxide Utilisation (UKCDU)
8. EPSRC Energy Storage CDT
9. EPSRC e future CDT
10. ESRC Whiterose CDT
11. Sheffield Solar Farm
12. Siemens Wind Research Centre
13. Sheffield Urban Institute
14. Grantham Centre for Sustainable Futures / Project Sunshine

Energy and nuclear breakout group synthesis



Urgent supply chain resource sustainability in energy and nuclear

- Define supply chain in energy and nuclear
- Lack of recent supply chain experience in nuclear new build
- What are the barriers to entry and how are they overcome?
- Develop whole life cycle assessment models to better compare competing technology and feed into investment decision
- Method to deal with nuclear waste that is more publicly acceptable.

A major uncertainty is whether new nuclear infrastructure will be built in time to address security of supply issues given concerns over critical materials supply chain.

- High costs associated with nuclear private-government SMES from government-industry nuclear supply chain
- Skill shortage in nuclear sector if we have a high nuclear scenario by 2030/2050
- New nuclear technologies are all overseas units. How do UK suppliers qualify?
- Potential UK suppliers to nuclear are too expensive
- Security of raw materials supply (stock piling, opaque supply chains in 'exotic materials', lack of investment in European raw materials, China Exchange)
- Price volatility of raw materials

Decentralisation to enhance security of supply

- Decentralised energy production (distributed generation and smart grids)
- Technological and sustainable supply chain development (renewable + storage + smart grid)
- Integrate renewable and nuclear energy into chemical storage
- Hydrogen fuel cells
- Renewable to liquid fuels local vs. distributed approach

Each new generation nuclear infrastructure scheme is worth up to £20bn and the developers wish to place 60% of the work and technology in the UK.

Innovations needed to address supply chain resource sustainability challenges in energy and nuclear

1. Complete cradle-to-cradle understanding of what the energy and nuclear supply chains look like (from raw material to final product)
2. Develop whole life cycle assessment models to better compare competing technology and feed into investment decision
3. Define nuclear supply chain in energy and nuclear
4. Setting a realistic carbon price
5. Carbon as a resource not a waste, e.g. development of CDU.
6. Labelling of critical materials in energy value chain, e.g. indium (PV), niobium (steel making), silicon (PV) and research on critical materials substitution programs.
7. Training and skills programme for UK nuclear
8. Nuclear waste and nuclear supply chain methodology
9. Nuclear new build supply chain research programs
10. Sustainability objectives balancing economic, environment and social – short term (cost and CO2 reduction), medium term (energy mix and security), long term (cost reduction and scalability)
11. Decentralisation of organised supply mix (considering transportation, logistics etc).
12. Achieving substantial decarbonisation through the development of greater levels of renewable electricity generation technologies, smart grids, and decentralisation.
13. Tools and methodologies for determining the true economic value of new technologies, weighing up future costs against those of the present, and accurately providing a price of carbon.

Water

Introduction to water at the University of Sheffield

Around the world, water resources are already under pressure. Innovative approaches are needed to manage the challenges of ageing infrastructure, climate change, and increasing population and increasingly demanding customers. The UK water sector must also manage sustainability challenges such as rising resource costs, attracting investment and skills shortages.

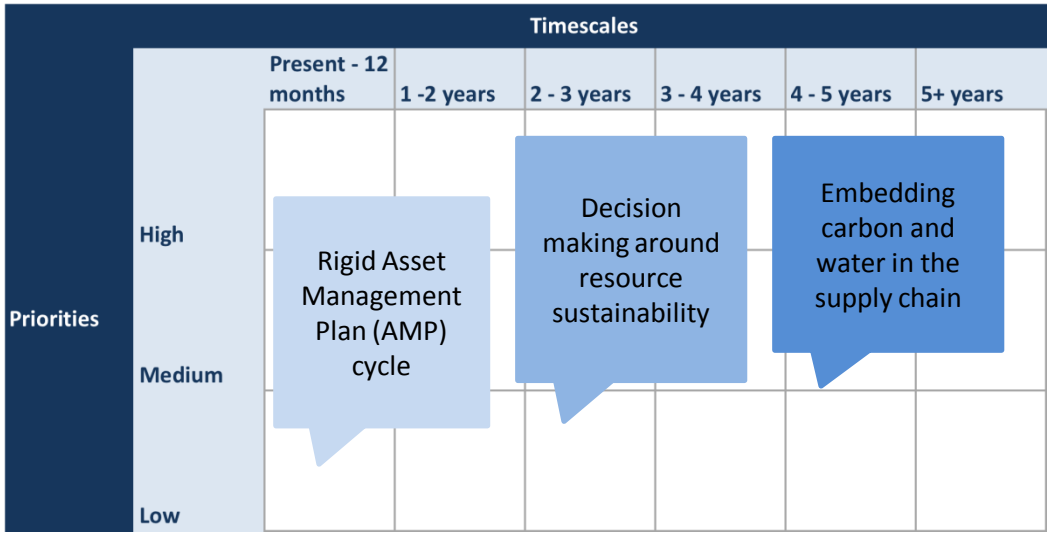
The University of Sheffield has a long standing track record in water research and is home to internationally renown 'Pennine Water Group', which is unique in winning three consecutive platform grants from EPSRC since 2001 for its industry related research programmes, as well as funding from many other bodies. By uniting our broad expertise from several disciplines – in water science and technology, applied economics, social sciences and energy sustainability – we deliver high-impact research that is directly market relevant and meets the sector's objectives going forward into Asset Management Programme 6 – Delivering totex (total expenditure) programmes in the water sector (AMP6).

The water sector is very different from the rest of industry in the way in which it is regulated and invests.

List of centres that do water research

1. Pennine Water Group
2. Catchment Science Centre (Ursula)
3. Green Roof Centre
4. Advanced Water Research Centre
5. Logistics and Supply Chain Management (LSCM) Research Centre
6. Centre for Energy, Environment and Sustainability (CEES)

Water breakout group synthesis



A major issue is how water companies will plan long term investment as the sector opens up to competition.

Rigid Asset Management Plan (AMP) cycle

- Aging infrastructure needs renewal
- Initiative overload prevents ideas from going below middle management
- Need implementation of sustainable procurement practices
- Sharing risk with other organisations , e.g. Environmental Agency.
- No exchange of best practices
- Little innovation and limited direct competition

Decision making around resource sustainability

- Evaluation of tendering procedures – are the decisions made the best ones?
- How does the industry define customer's water footprint?
- Carbon management requires a different culture. How can this support business benefits – i.e. cost reduction

Embedding carbon and water in the supply chain

- Staff training to share good practice and knowledge to different parts of the water companies
- SIM SCORE
- Integrate carbon and water foot printing of supply chain.

Innovations needed to address supply chain resource sustainability challenges in water

1. Tools and methodologies that recognise that the challenges facing the water industry differ from those associated with manufacturing. The Asset Management Plan (AMP), a 5 year regulatory cycle drives decision-making within the water industry. The AMP sets out for the water industry for (Ofwat 2014):
    - The company's overall strategy and the implications for price limits and average bills;
    - Its strategic objectives in terms of service performance, quality, environmental and other outputs;
    - The activities necessary in the period to meet these objectives;
    - The scope for improvements in efficiency.
2. Models of risk sharing in long term infrastructure investments to enable the water companies to fulfil their regulatory requirements in the short term and ensure sustainability in the industry over the long term.
3. Setting up formal innovation programmes on R&D partnership and knowledge exchange.
4. New business models to progress innovations through layers of management while meeting the water companies' regulatory and business requirements to ensure supplies of clean water to all customers, and general satisfaction with the service that they receive (the Service Incentive Mechanism – SIM).
5. Supply chain tools and methods to benchmark sustainability and carbon performance against peer group companies and UK industry.
6. Strategic training for tier 1 and tier 2 managers to ensure that processes are undertaken because they are the most sustainable activities and not simply 'the way it has always been done' with too much emphasis on lowering financial costs.

Agritech and Food

Introduction to Agritech and Food at the University of Sheffield

The UK government is committed to feeding a growing World population without damaging our natural environment. Its focus is to remain at the forefront of agricultural innovation by solving problems around sustainable intensification. To do this it published its UK Strategy for Agricultural Technologies in 2013.

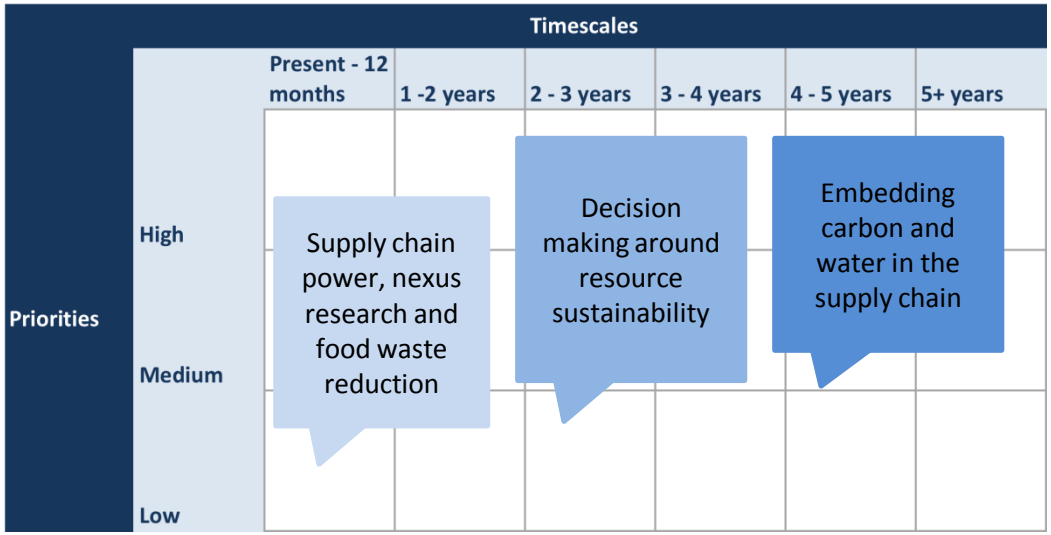
The University of Sheffield hosts areas of expertise that directly fit with the food security challenges identified. These include: 1) biological research with internationally recognised work on crop protection and production as well as underpinning soil science: 2) sociological research on issues such as justice, nutrition and people's personal relationships with their food; and 3) economic and management work around innovative supply chains and (in)formal economies. Collectively the University has a strong understanding of the issues that need to be addressed and are working with partners to develop solutions.

The Agritech and Food sector is essential if we are to meet the needs of a growing population.

List of centres that do Agritech and Food

1. Grantham Centre for Sustainable Futures
2. Project Sunshine
3. Logistics and Supply Chain Management (LSCM) Research Centre
4. Centre for Energy, Environment and Sustainability (CEES)
5. Sheffield Sustainable Food Futures (SheFF)
6. Robert Hill Institute
7. Plant Production and Protection (P3)

Agritech and Food breakout group synthesis



Supply chain power, nexus research and food waste reduction

- Engage with retailers to create buy in, interest and power
- Working with nexus point (i.e. the power of the big 4 global supermarkets) to identify bottlenecks and develop research and development
- Reduce food waste in the supply chain

The power of supermarkets influence the structure and effectiveness of the supply chain in managing resources sustainably.

Decision making around resource sustainability

- Regulation and governance frameworks (and supporting evidence base)
- Energy efficiency and sustainability across the agritech field (production, harvesting, transport, storage, consumption)

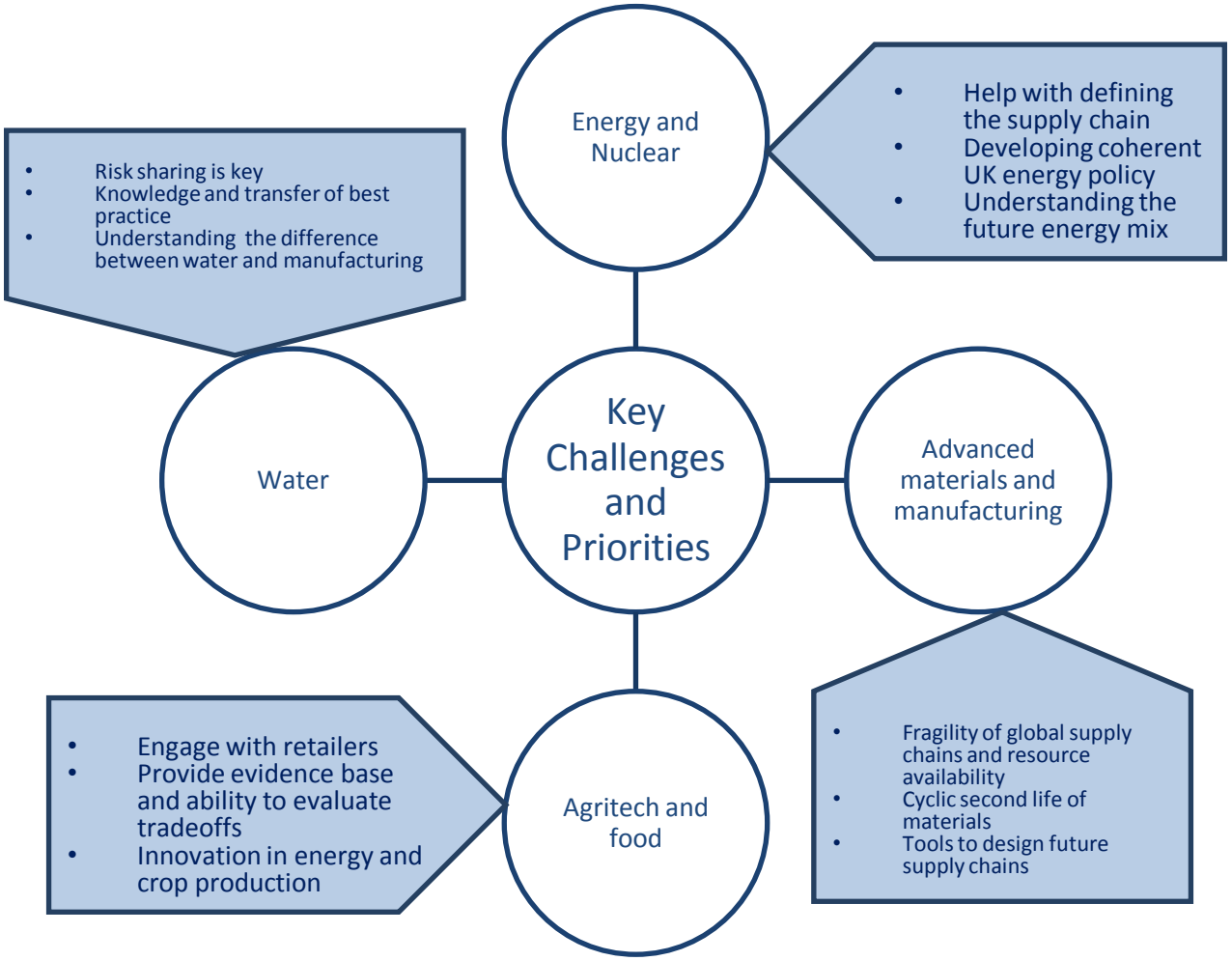
Embedding carbon and water in the supply chain

- Improve crop production efficiency
- Norms and trade-offs between communities (communities of practice, societies, businesses etc.)

Innovations needed to address supply chain resource sustainability challenges in agritech/food

1. New models and methodologies to understand the changing relationship between business to business (b2b) and business to consumer (b2c) supplier aspects of the supply chain.
2. A whole system approach is needed, widening the focus of research into the supply chain of food beyond delivery to the supermarket; it must consider the retail processes alongside this, and research into food supply chains must have greater involvement with the retailers as well as the producers.
3. Additional support for how small scale producers can drive new initiatives beyond current areas, such as on improving crop production efficiency; the use of fertilisers and general operations relating to farming and harvesting (energy consumption, transport, storage), or on the impacts of regulation on the food industry.
4. Integrating resource sustainability data enabled by technology for improved decision making in the agritech/food supply chain.
5. Addressing the supply chain power fulcrum in the food supply chain to ensure academic research and industrial practices is aligned in terms of producing outputs of benefit for industry and society.
6. An evidence based system to demonstrate trade-offs both in the production and distribution/sales aspects along with better engagement with the retailers themselves.
7. New tools and methodology to quantify resource efficiency and waste in the agritech/food supply chain.

Summary of workshop findings and priorities



This diagram summaries the main findings and top priorities in each of the sectors that were highlighted during the workshop.

Conclusions

Innovation in evidence based decision making and mathematical modelling

The need for a strong evidence base to weigh up trade-offs and transfer best practices are common among the top three challenges facing all four of the sectors. It is this challenge that has implications for developing further strategies to address resource sustainability issues within the supply chain.

From the breakout groups, the need for data was emphasised in all of the sectors as a key requirement to present the evidence based business case in investing in supply chain resource sustainability.

Generate breakthrough supply chains efficiency and sustainability capabilities to meet future needs

Commonalities between the sectors are concerned with the tools to design and understand future supply chains in terms of their resource sustainability.

Support from the Government for industry is already being planned, with BIS (2012) emphasising the need for improving resource use criteria and establishing best practices and standards.

"What is needed is a fully collaborative and integrated approach"

Monetisation of the real value of resources

Valuing the resources of today to plan more efficient and effective use tomorrow is often at odds with the traditional view of delivering shareholder value, and implementing a clear sustainability strategy must incorporate uncertainty in future critical resource availability, government policy, and regulation.

Innovation through collaboration

As has been stated throughout this report, industry cannot achieve this in isolation; partnerships and collaboration are required to fully appreciate the sustainability issues throughout the supply chain.

The current research agenda reflects this distinction. What is needed is a fully collaborative and integrated approach.

Ability for industry to leverage research and innovation at The University of Sheffield for commercial and societal benefits.

The Advanced Resource Efficiency Centre (AREC) is the infrastructure set up to work in partnership with industry to address the world grand challenges in supply chain resource sustainability.

AREC integrates lower and higher Technology Readiness Level (TRL) innovations so that new technologies, tools, models and methods for supply chain resource sustainability can be achieved and can be used as a vehicle to realise greater collaborative results from the intellectual property developed at the University of Sheffield.

Adapting inter-disciplinary metaphors to generate innovation

Innovation in supply chains is cross cutting and enriched by metaphors that underlie principles and methods in related industries, sectors and disciplines. The innovation pipeline will benefit from the use of metaphorical investigation to express and structure its own priorities while stimulating creativity and constantly renewing and creating supply chain resource sustainability solutions.

Next steps

Formation of steering group

The next steps in the development of AREC are to form steering groups that can shape the agenda of supply chain resource sustainability, incorporating the findings from the initial workshop.

Exploration of project matrix

Stakeholders engaging with AREC will begin to design project opportunities to address their sectoral challenges and priorities, build partnerships and agree collaborative business models.

Agree business case to secure sustainable funding and contribution

AREC will be funded and obtain contribution through a variety of internal and external mechanisms and will develop innovative and investible propositions to attract committed stakeholders.

"This is a unique opportunity to partner with us to create world leading supply chain infrastructure"

Timeline for next six months

October 2014:

- Set up steering group meetings to develop project matrix.

January 2015:

- Prepare and issue business case for approval from key stakeholders.
- Series of proposals from key partners to raise funding and generate contributions.

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