

CE-HUB

Part 1b. Narrative Report January 2021-April 2022











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Introduction

The UKRI National Interdisciplinary Circular Economy Hub (CE-Hub) is the coordinating Hub for the NICER Programme, a four-year £30 million UKRI funded programme working to provide the evidence base needed to deliver a resilient and restorative Circular Economy for the UK. The Hub works with the five UKRI National Interdisciplinary Circular Economy Research Centres and brings together academics, industry practitioners, policy makers and civic society to deliver, accelerate and upscale CE research and innovation.

The CE Hub's vision is to **harness** and **scaleup** the UK's leading research capabilities, providing the **evidence base**, **inspiration**, and **capacity** to accelerate the transition towards a global circular economy. To achieve this ambitious vision we have three overarching aims and associated key performance indicators (KPIs).

Objectives	Desired Outcome	KPIs (Headline and Sub-Category)
Leadership & Influence	Engaged and collaborative CE-Hub network of stakeholders* sharing needs and challenges to influence relevant research, utilising research outputs to co- design solutions	Breadth and influence of CE-Hub network Maturity of relationships, Amplification of NICER outputs New interdisciplinary collaborations across network.
Knowledge & Capability	Knowledge and training curated and created by the CE-Hub is used to inform stakeholder* decision making and increase levels of CE understanding, capability and capacity	CE-Hub knowledge outputs influencing practise Evidence based decision making Increased CE understanding across stakeholders* Amplification of NICER knowledge outputs.
Adoption & Implementation	Whole system adoption of circular economy solutions demonstrated across value chains / resource flows and informed by CE-Hub generated evidence and research outputs	Evidence and evaluation of CE Implementation Number of partnerships, Change in mindset and / or behaviour.

Table 1: CE-Hub aims and KPIs

* Industry leaders, practitioners, interdisciplinary academics, CE Centres, policy makers and government officials, citizens

This narrative document is Part 1b. of the Year 1 Report for the UKRI Strategic Advisory Board, UKRI and the CE-Hub Executive Management Group. Part 1a. Progress Report provides a detailed account of progress made over the first year of the programme towards our objectives and KPIs (Figure 1). Part 1b., describes and demonstrates the contribution that the CE-Hub is making to the wider interdisciplinary and cross value-chain academic, industrial, political, technical and societal landscape through a series of case studies and stories of change.



Summary of Key Outcomes and Impact

Table 1 summarises our headline outcomes during Year 1 against our three objectives and KPIs spanning our four work-packages led by CE-Hub team members and a diverse range of external stakeholders and collaborators. We have narrated stories of change which reflect the dual role of the CE-Hub: to provide national leadership and influence and overall co-ordination of the NICER programme and the five national Circular Economy Centres.

Under leadership and influence we present three examples.

The CE showcase held in London, our first programme level face to face meeting to build, expand and deepen engagement with a diverse national CE community and the NICER programme.

A CE-Hub Policy Cluster has supported a range of engagements and collaboration with policy teams and individuals to ensure NICER research is embedded with Policy stakeholders and develop a common understanding of the wider policy landscape (not just within DEFRA or the English administrations but across the whole of the UK) and pathways to policy impact.

A cross programme case study with the Met4Tech Centre signature product case study on rare earth element (REE) permanent magnets to demonstrate whole system, and cross value chain approaches around a common and consistent value chain taxonomy. This case study has now matured into a significant project within the Government's Integrated Data Service programme.

Under knowledge and capability we showcase examples of industrial collaboration and training, with a specific emphasis on SMEs.

We demonstrate engagement and collaboration with SMEs, the barriers and enablers to their engagement, adoption and implementation of CE. In doing so we have developed a deeper understanding of behaviours to increase the relevance of solutions and embed NICER within this key community for the UK economy. We highlight an initial portfolio of case studies to inspire and influence other SMEs. We have designed and delivered several new courses and training events specifically to influence their behaviour.

Under Adoption and Implementation we focus on work we have undertaken on road mapping and translation of CE at a sector level, in his case the NHS.

A synthesis of over 500 road maps has been completed to better understand the how these have been used to structure and communicate opportunities and how they have been delivered to create change. This work provides the basis for shared learning across NICER and ways to integrate CEC road mapping activity at programme level.

We present a road map we have produced in collaboration with an SME partner to implement a fully circular medical textile system to replace 95% of all single use medical textiles PPE in NHS Wales by 2030.

Finally, we summarise a major study undertaken on translating CE into the NHS medical device supply chain to support net zero ambitions.

Overall, we believe we have created a portfolio of activities, outputs and initial outcomes aligned with NICER programme aims and outcomes which provide a platform for increased depth and impact in year 2 and beyond. We are also aware of some Programme aims that are less well advanced, which we will priorities in Year 2.



Objective and lead KPI CE-Hub theme and outcomes Alignment to NICER programme aims Leadership and Building a National CE Ensure research is embedded with policy Influence community (showcase) stakeholders Breadth and influence Influencing Policy Consolidating cross centre learning and of CE-Hub network creating a common understanding of definitions Working Across and language for the tools used to deliver Value-Chains: REE Magnets circularity Case Study Undertaking generic whole system research on how to optimise circularity and interrelationships Consolidating cross centre/wider learning and creating a common understanding of definitions and language for the tools used to deliver circularity Knowledge and Building a CE Community: Offering further understanding of behaviour to capability **CE** Showcase increase the relevance and uptake of solutions. **CE-Hub knowledge** Industrial Engagement: Ensure research is embedded with SME outputs influencing **SME** Focus stakeholders practise Offering further understanding of behaviour to increase the relevance and uptake of solutions Identifying opportunities for change at different stages within the whole-system and across research, policy, business and individual consumers. Ensure research is embedded with stakeholders by involving businesses, policymakers, consumers and society, the third sector, at every part of the programme Adoption and Towards CE Roadmap Ensure research is embedded with policy Implementations stakeholders Accelerating Net Zero in **Evidence** and NHS Consolidating cross centre learning and evaluation of CE creating a common understanding of definitions Implementation and language for the tools used to deliver circularity Identifying opportunities, and delivering

roadmaps for change

Table 2: Indicative alignment of CE-Hub activity and outputs to NICER aims (non-exhaustive)



Leadership and influence

Building a Circular Economy Community: CE Showcase

The design and implementation of the CE cannot be achieved solely through technical solutions. It requires changes in mindset and behaviours, new mechanisms of cross and inter value chain engagement, interdisciplinary collaboration and the development of new competencies through education and training. To build and coordinate an inclusive CE community, enabling and empowering collaboration between diverse user groups, is a key objective of the CE-Hub. An important activity towards building the CE-Hub as a leader in CE has been the inaugural NICER Programme Annual Circular Economy Showcase.

On the 2nd and 3rd of March 2022, the CE-Hub hosted the inaugural Circular Economy Showcase in Westminster, London (see Figure 1). As captured in the event video, the day provided the opportunity for our CE Community to network, share experiences and stories. Bringing together representatives from government, academia, global industry and small businesses, the event shared a diversity of expertise, experience and approaches to CE. Key objectives of the event included the facilitation of networking and identification of areas for collaboration across both the NICER programme and the wider CE Community and to showcase inspiring and innovative CE Community and to CE stories and experiences from across our network. Our delivery of the inaugural CE Showcase and plans for subsequent annual events are helping us to achieve all three of the CE-Hub core objectives.



Leading Change: Building an engaged and collaborative CE network

Building an engaged and diverse CE Community is a core objective of the CE-Hub. The CE Showcase brought together representatives from academia, global industries, SMEs, policy, local and national government in person for the first time. The schedule allowed for significant networking time, including dedicated speed-networking sessions. To encourage and foster new connections across the community and identify areas of collaboration and shared experiences. Initial feedback suggests participants appreciated being able to meet people from a diversity of sectors and backgrounds with one attendee saying the CE Showcase "was a wonderful opportunity to meet a varied and inspiring group of people". Furthermore, 100% of survey participants felt they had met new people and grown their network and 91% intend to actively engage with the NICER Programme moving forward. Participants also remarked on "the enthusiasm in the room". the "genuine sense of a community coming together" and how although "there is still a lot of work to be done on CE, the CE Hub offers a community to do so with".



Knowledge Exchange: Sharing stories, challenges and successes in CE

Our three expert panel sessions shared insights into Circular Design, Circular Innovation and Industrial Implementation. Key messages taken from the sessions include: incorporating 'design' thinking from early on to focus on reducing waste and improving material recovery, citizens should be considered as 'custodians' and not simply as 'consumers' and that industrial partners are already taking action but for this to happen at scale, we need to work collaboratively and across the whole system. These key messages are synthesised into an interactive event summary which will be shared with our community through the CE-hub Knowledge Platform and website.

Participants highlighted the importance of being able to engage with "*live examples of CE in action*" to inform and inspire. Through the CE Showcase, 89% of participants felt their understanding of CE had increased and 83% learnt something knew which they will implement in their own work.

Building Capacity for Implementation of a collaborative CE

Day two of the CE showcase focussed on building collaboration and shared understanding of CE within the NICER Programme. Workshops were designed to develop connections across the wideranging sectors and disciplines of the NICER Programme, to help identify areas of collaboration and knowledge exchange across Centres and to build a shared understanding of Circular Economy by exploring the CE through different lenses. Findings from these workshops have been written into



a <u>summary report</u> which has been shared across the NICER Programme to highlight the importance of interdisciplinary working, both within and across Centres.

Workshop participants worked in mixed groups, with representation from the different Centres and CE-Hub and from different career stages, from PhD students to senior Professors. Participants felt that through these workshops they had "learned more about the ambitions of the other centres and the ambitions of the Programme", gained "a better understanding of shared challenges across the CE Centres and CE Hub" and identified that the Programme "will need to work together to deliver a CE inspired future".



Lessons Learnt and Next Steps

Overall, the inaugural CE Showcase was a success, despite all involved navigating Tube Strikes in London over the event days. Feedback has suggested that participants felt inspired and motivated to work collaboratively and to take action in their own work to implement their learnings. Future events could be improved by greater input and presence from the NICER Programme Centres to share their activities and learnings. A greater focus on facilitating more structured conversations between stakeholder groups (for example: academia and business, policy and business, SMEs and policy etc) could further enhance the meaningful relationships developed through these in person events. Similarly, increased 'mixing' of centre colleagues in workshops such as those on Day 2 would enable colleagues to meet a greater number of people from different Centres. As such, the CE-Hub will continue to engage with our network and varied stakeholder groups and facilitate focussed cross-sectoral collaboration through a series of round table discussions. The CE Showcase will remain a flagship annual in-person event for the CE-Hub and NICER Programme, providing an opportunity to share knowledge, expertise and gain new connections.

Influencing Policy

There is universal support for a holistic, integrated and strategic approach to resource management based on circular principles. However the UK's current legislative framework is formed from disparate policies aimed at managing 'waste' rather than keeping materials in circulation, and some elements are regarded as genuine blockers to circularity. Our work has established a new network of policy makers and practitioners which is increasingly seen as a 'go to group' for authoritative, representative advice on the policy changes needed to transition to a circular economy, and which will deliver benefits to the economy, environment and society.

Leading Collaboration: A new network for policy makers and practitioners

We have established a Policy Cluster to support the CE-Hub and NICER programme, which brings together 35 practitioners and policy experts from central government departments and the devolved administrations, local authorities, industry, regulators, NGOs and the NICER programme. The Cluster meets quarterly and provides a forum for practitioners to discuss their experiences and ideas, and co-create solutions which can be used as the basis for engagement with government departments. There was no previous forum for these discussions, and we have facilitated collaboration across administrations (England, Northern Ireland, Scotland, Wales), departments, (Defra and BEIS) and sectors (national government, local government, industry). With each meeting, the number of attendees showing increased engagement has grown, and members of the Cluster are tabling their own issues for consideration by the group.

Knowledge Exchange: Informing and influencing decision making

The diversity of Policy Cluster membership ensures that its advice captures, consolidates and balances a range of experiences and viewpoints. This is valued by policy makers at national and local levels: In the first 12 months of the NICER Programme, the Policy Cluster has provided advice on England's <u>Waste</u> <u>Prevention Programme consultation</u>, Defra's circular economy metrics and indicators, and ReLondon's Circular Economy Routemap 2.0. On Defra's request, the Cluster has shared ideas for policy change via a proposed Ministerial Policy Roadmap, and Policy Cluster representatives now sit on Defra's CE Policy Working Group. The fact that government are approaching us for advice is testament to our efforts to both increase stakeholder understanding of CE and inform their decision making. With the CE Hub acting as a credible voice and trusted source of intelligence.

Facilitating Solutions: Supporting CE implementation

The Policy Cluster recently facilitated an Innovate UK workshop to share best practice on value retention policies (particularly relating to remanufacturing) across the devolved nations and identify policy opportunities which align with UK priorities for industrial carbonisation, green industry and innovation. Through its members, the Policy Cluster was able to draw on a range of expertise at short notice, which Innovate UK will use to develop a joint value retention policy strategy between Defra and BEIS to support scaling up of value retention solutions via public and private investment.



Lessons Learned and Next Steps

The activities detailed above have shown that there is need for a cross-administration/ cross-sector forum to steer and shape the development of CE policy. In the last 12 months policy variations between the devolved administrations have become apparent, and an immediate priority is to identify existing good practice which can be shared (particularly in light of COP26 outcomes). We will also build on the success of the roundtable approach, taking a steer from government representatives on key issues where the CE-Hub / wider NICER programme could provide advice. Finally, we will prioritise capability building within our early career researcher cohort, by establishing partnerships with policy makers across government departments, which will provide mentorship on the evidence and research outputs which are of greatest value in policy development.



Whole system approaches working across Value Chains: REE Magnets Case Study

Establishing effective CE configurations at scale requires the need to be able to observe the performance of the current system and to predict the impact of future, potential CE-configurations. The objective of the CE-Hub National CE Data Observatory (WP1) is to provide visibility to inform and inspire decision makers to fully embrace CE to reduce the overall material and carbon footprint of the UK economy, drive up resource productivity and reduce the impact of the current linear economic model.

The Challenges: high fragmentation and disjointed conceptual frameworks

Currently the establishment of the required visibility on current and potential future flows is inhibited by multiple constraints.

- The silo-conundrum: limited data visibility on the up- and downstream activities and resource stocks and flows
- The dark-side of the moon void: many of the future value chain configurations, especially for innovative technologies (e.g. the Electric Vehicle revolution) do not yet have established, effective post-use CE infrastructure in place or their effectiveness has not been sufficiently structured or measured
- The Babylonian confusion: as CE-configurations needs to integrate different perspectives of actors with a diverging set of perspectives, roles, interests, measurements and definitions at different levels of aggregation, establishing a joint and shared understanding at systems level is challenging

The Solution: Pragmatic System Level CE-Taxonomy

To pragmatically address these challenges the CE-Hub in collaboration with the M4T-CEC have developed a simple and robust taxonomy to provide a skeleton for mapping current and future CE-configurations in a material, component and product agnostic manner and tested it for one of the M4T priority materials (Rare Earth Elements (REE), component (REE-magnet in traction motors) and product (Electric Vehicle (EV) configuration (Fig 1). The corner stones of the agnostic approach consists of:

- a) A CE-enhanced representation of a value chain configuration explicitly taking into account the need to differentiate granular circular reverse flow options, which will apply to different CE value creation opportunities (e.g. recycling at material level vs. component refurbishment at component level)
- **b) A multi-layer perspective** to describe the different perspectives of relevant actors, (see figure 1) including:

- A bio-physical material-flow focus to understand the mass balance and physical transformation of materials across the CE-system (e.g. refinement of REE-oxides out of mined ore or physically integrating REE-magnets into an EV-motor)

- An activity-based layer to measure environmental impacts (e.g. via LCA) and to describe the required technology to perform this activity (e.g. sintering and casting of magnets), which is an important driver of, for instance, operational performance metrics (e.g. throughput, product yield, energy consumption)

- A value add-based focus, which is important to measure the economic relevant attributes of the underlying activities (esp. the resulting operating



margin of producing the (semi-finished) product for given underlying technologies and input factors and to associate the different activities to market actors (esp. firms and households)

- A sector-aggregation focus, which groups different actors into units of measurement and aggregation at the national accounting and import/ export coding schemes (e.g. automotive manufacturers, tier-1 suppliers, rawmaterial importers) in order to facilitate the consolidation of current practices and the forecasting of changes to potential future CE-configurations at macro-economic national account level (e.g. multi-regional input/output statistics MRIO), which form input to strategic decision making at governmental level.

Figure 1: An agnostic CE value chain heuristic for mapping research insights and gaps for specific products and resource flows (illustrated for REE magnets)



c) A CE-intervention perspective, which describes the required initiatives to transform the specific material, component and product configuration from its current (linear) state to a more circular value chain configuration. The structuring of the CE-interventions along core CE-building blocks (design, reverse/process capabilities, business models and enablers) allows us to map these across the value chain and to assign them to different actors to create

a full system perspective on the required CE-transformation. This in turn provides the framework to measure both the progress of any underlying initiatives or intervention, but also to link that to the impact at systems level across the different KPIs (from economic, environmental to social).

The resulting taxonomy and the adjacent methods for measuring and modelling current and future CE-configurations forms the basis for the CE-Hub data observatory.



The results of this joint CE-Hub and M4T exercise was evaluated against various critical aspects.

- Applicability at concept level was confirmed, as the agnostic model could be quickly tailored to capture the highly complex technological value chain of REEmagnets across a full systems perspective
- Meaningfulness for issue prioritisation at strategic level was confirmed as with a limited number of interviews with stakeholders across the REE-magnet value chain the major pain points inhibiting a natural transformation towards more circular configurations could be identified see figure 2)
- Instrument for efficiently structuring and prioritisation of work was confirmed, as within the CE-hub the framework is used for instance to define data sources, metrics and KPIs, engage other centres (e.g., collaboration with the Metal Centre on an integration case study into M4T NVO) and within the M4T to structure the data collection and visualisation of REE-flows, to inform the agent-based-modelling work stream

- **Pragmatic recommendation prioritisation potential** was confirmed, as within the M4T CEC the pain-point diagnostic together with an initial assessment of available solution elements clearly identified the need to a) invest into responsible sourcing of REE-magnets into the UK to meet the increased demand in EV-technology, b) to invest into local refinement and revalorisation capabilities for local value capture and c) to establish cross-value chain monitoring and steering capabilities to inform decision making
- at firm and governmental level. These recommendations were taken forward by BEIS critical mineral intelligence initiative as core findings of the M4T CEC
- Stakeholder engagement and integration capability was confirmed as in numerous discussions with relevant entities from different actors e.g. at firm-level (Google, SAP, less common metals), at governmental level e,g. ONS, DEFRA, BEIS, HMRC) and other relevant research groups (e.g., driving the electric revolution, APC, Catapults) the relative simple system wide value chain representation and CE-taxonomy formed a skeleton to identify pragmatic points for collaboration, data sharing and synergies in delivering the required data-foundation to populate the CE-observatory







Figure 2: Pain points in current linear REE magnet value chain

Lessons Learned and Next Steps

The ambition for the next phase of the CE-Hub is to leverage the taxonomy into important areas to drive further impact of the CE-Hub

- a) Refinement of concept and operationalisation into digital asset: together with the M4T CEC the ambition is to populate the basic elements of the use case together with the extended partner network for the REE-EV-magnet case
- b) Refine the concept by application to other material, component and product configurations for the other CEC and material streams. Here initial collaboration with the other centres is aiming to establish an overarching representation that caters for the specific needs of the individual materials streams but allows meta-learning at the CE-hub level and programme level

c) Foster engagement of pivotal stakeholder to stimulate and guide immediate action. Amongst different

stages esp. an ongoing scoping exercise with ONS and HMRC is geared towards forming a group of capable practitioners at firm, user and governmental level to fasttrack the deployment of the concepts into tangible digital assets (e.g. for EV-magnets, wind turbines and construction materials incl. steel)



Knowledge and Capability

Industrial Engagement: SME Focus

Small and medium sized enterprises (SMEs) make up 99% of all businesses in the UK and employ 85% of the workforce. They are a source of innovation, support local economic resilience and are an essential part of many key UK and global supply chains. Our work to engage SMEs is not only helping us to achieve all three of the CE-Hub objectives but also helps us to embed NICER research with key stakeholders.

Leading Change: Raising awareness of SME activity in CE

On 2nd March the CE-Hub hosted the Circular Economy Showcase in Westminster, London. A major feature of this event was to showcase 16 innovative SMEs demonstrating CE implementation strategies including diversity in product design, business model innovation and enabling technologies. Each SME was able to pitch their business to the diverse audience during 'lightning round' sessions as a part of the main event schedule. To facilitate learning and knowledge exchange, we produced short filmed interviews with each SME explaining how they got started, their biggest challenges, their successes and their key learning from implementing CE in practice. As a result of this activity the CE-Hub was approached by Amazon and eBay keen to invest in these companies and promote their products via their global platform. We are using the films to promote awareness of how SMEs can apply CE principles and business models in practise to inspire others and inform policy makers.



Knowledge Exchange: Understanding Barriers and Enablers to Implementation

Our research and experience have indicated that SMEs would like to make the shift to CE but often face significant barriers to implementation. Dr Lucy Chamberlin (CE-Hub PDRF) has mapped out the most common barriers to adopting CE, through an analysis of academic and grey literature, two SME focused workshops with over 200 SMEs and an SME questionnaire. The most common and significant barriers to initiating CE, are: economic / market, policy / regulatory, social / cultural, technology / design and operational. Lucy found that common themes included a lack of finance and investment in CE solutions, a lack of regulatory and political support and infrastructure to support the transition to CE, many actors being stuck in the 'linear' status guo, and businesses constrained by uncertainty over reverse supply chains, return on investment and customer appetite. The findings of the research will be shared across the community via the CE-Hub Knowledge Platform and will inform targeted CE-Hub interventions, future events and roundtable discussions.



Training and Capability for Implementation

In response to the demand for new knowledge and capability amongst SMEs transitioning towards a CE, the CE-Hub has designed a new 4 week on-line course Circular Economy Implementation for Smaller Businesses, building on the success of our long standing Masterclass in collaboration with the Ellen MacArthur Foundation. Launched in March 2022, the course has attracted 24 smaller business keen to develop knowledge and confidence to initiate or scale up CE value creation. The course is structured to provide academic theory, inspirational case studies, expert speakers and a series of team-led challenges designed to take each participant from idea to action plan. Currently in progress, the initial feedback from this first innovation cohort is positive with a high level of engagement on the course platform, as exemplified by one participants feedback:

"The different ideas across industries/sectors are so helpful. There is enormous value from cross-functional and cross-industry collaboration to make the circular economy a reality."

Feedback from Course Participant

In addition to online courses, the CE-Hub is providing tailored 1-2-1 support and guidance to businesses as various stages of their transition towards a CE. Partnerships that have been developed over the last year as a result of CE-Hub activity and outreach include John Lewis Partnership, Philips, NHS, Amazon, Innovation Guelph, Capgemini, Institute of Directors Ireland and BAM Clothing.

Lessons Learned and Next Steps

The activities detailed above have shown that, aside from CE focused start-ups, the majority of SMEs have little or no knowledge of CE or its application. Those SMEs that we have engaged with have confirmed the need for case studies, dedicated training, tools and resources and the opportunity to learn with and from others to facilitate action. The CE-Hub will therefore continue to engage with SMEs through a variety of outreach and knowledge building activities including webinars, workshops, the knowledge platform and training. We will also facilitate cross-value chain collaborations to amplify the voices of SMEs and connect SMEs with the wider business and policy community though a series of round table discussions in collaboration with the CE Centres and other networks such as the BEIS SME Climate Hub.



Adoption and Implementation

Towards a Circular Economy Roadmap for the UK

There is a growing global effort to decouple economic growth and the provision of products and services from the depletion of earth's finite resources and towards value creation through resource regeneration and ecosystem conservation, a circular economy (CE). The colossal variety and diversity of literature, strategies, and measures designed to accelerate a transition to a CE reflects the complexity of the concept. Often (loosely) referred to as "Circular Economy Roadmaps (CERM)", these strategies and measures define the circular economy vision, goals, and desired outcomes, setting out preconditions, milestones and detailed steps required to achieve them. Some roadmaps go a step further and assign KPIs to their desired outcomes along with metrics to measure the KPIs.

Research Purpose: The CE hub is already engaged in many initiatives to deliver a UK CE through a concerted effort to bring together academics, industry practitioners, policymakers, and civic society. This project complements that effort by fostering a collaborative partnership with stakeholder groups such as the five "UKRI Interdisciplinary Circular Economic Centers of Excellence" to develop a strategic CERM that enables a holistic national transition toward a CE. The project aims to create an agnostic framework that allows for a standardised yet detailed configuration of processes culminating in a CERM. Assessing the Landscape: To gain an insight into the different varieties of CERM, a rigorous blend of scoping review and meta-analysis is being conducted on 377 identified materials, from now on referred to as quasi CERMs (Q-CERMs), comprising 170 journal articles, 33 white papers, and 174 roadmaps and policy documents. Initial findings have revealed that most national CERMs are naturally impacted by the political gravitational pull and typical resource flows of the dominant economic activities of the country in question. However, the sheer heterogeneity of the structure, underpinnings and drivers reflect the divergence in the motivations behind the CERMs and the methodologies adopted in their development. For instance, most European CERM agendas relate to resources and waste policy areas. The UK nations have already taken action to advance commitments made in their respective domestic waste strategies through ongoing measures. The prevailing themes in European CE strategies include:

- Taking steps to minimise the damage caused to the natural environment
- Decreasing and managing waste and doubling resource productivity without negatively impacting economic growth, the environment and society
- Special policies toward eliminating avoidable plastic waste
- More emphasis on phased revalorisation and waste-to-resource transformation



Leading Change: Standardising the defining characteristics of a CERM: To successfully capture the essence of the variety of global efforts towards a CERM, it is critical to develop an approach for standardising the key defining characteristics of a CERM. SITRA (2020) recommends the steps summarised in Figure 3 as a guide to creating a CERM.



Figure 3: An adaptation of SITRA's guide to CERM

While this guide offers a logical set of steps in the journey toward a CERM, it does not sufficiently help unify the core underpinnings that characterise a typical CERM, as evidenced by the literature. Therefore, there is a need to harness the most common denominators associated with existing Q-CERMs to inform the standardisation of their characteristics in the form of underpinnings. A meta-analysis of Q-CERMs has helped condense the common denominators into seven underpinnings: Focus Areas, Sector/Resource Ratio, Action Plans, CERM Driver(s), KPIs, Triple Bottom Line (TBL) Ratio and Policy Ratio, as illustrated in Figure 4.



Figure 4: CERM underpinnings from meta-analysis



Knowledge Exchange: Towards a typology of CERMs through a critical review of thematics hierarchies, drivers and underpinnings: This part of the review aims to provide an evidence-based foundation for an integrated multidimensional framework that enables the development of a faceted CERM, encapsulating the UK's entire intra/ inter-sectoral value chain landscape. Using a thematic data mining approach, the framework is being developed from a hierarchical typology of roadmaps defined by a set of underpinnings and common characteristics, including structure.

Early findings from the literature have revealed a typology of CERMs underpinned by a thematic hierarchy: Continental, Regional, National, Municipal, Sectoral/Material and Policy/Business models. Figure 5 illustrates the predominant hierarchical themes associated with national category of CERM.



Figure 5: The dominant themes underpinning a national CERM typology

Anticipated Outcome: The typological approach adopted is intended to enable a nuanced disaggregation of purpose necessary to cater to the CE concept's complexities. In this way, the framework leading to the CERM will accommodate inputs from a range of contributors and stakeholders from industry, government, and academia. Ultimately, the form and structure of the UK CERM will be determined by its typology and will be constructed by taking onboard inputs from all identified contributors.



A Road Map to Implement a Circular Economy Medical System for NHS Wales by 2030

One of our partners, Revolution Zero was invited by the NHS Wales Shared Services Partnership (NWSSP) in January 2022 to identify opportunities to decarbonise their supply chains. In discussion, it was agreed to begin with a 12 week innovation sprint to assess the appetite and potential impact of adopting a net zero, zero-waste, business model for reusable medical textiles.

Building on a collaboration developed before the pandemic and matured as part of an SBRI award, the CE-hub took the lead with founder Tom Dawson to create a Road Map 2030 for Circular Medical textiles for Wales outlining a clear path for NHS Wales and the Welsh Government to adopt and implement a national circular economy medical textiles programme which will aid meeting Net Zero targets. The proposed system will: displace single use medical textiles with more economic and sustainable net zero alternatives; stimulate the economy and job creation; build resilience and autonomy; and allow increased control over service quality, costs and environmental impacts. The next step is awaiting approval.

Further content is currently confidential



Translation and Adoption of CE into new sectors: NHS Case Study

The National Health Service (NHS) is the largest supply chain in Europe, accounts for 10% of UK GDP, employs £1.4M employees and represents 4% of UK GHG emissions. The NHS Net Zero Strategy has set targets to reduce its 2036 footprint by 80% relative to 2018 (Figure 6). Our study calculated that in order to achieve this will require an 8% CAGR from 2022-2036 (see Figure 7), compared to an historical average of 1%, where the majority of savings has been achieved from decarbonising the grid.



Figure 6: The NHS Net Zero Strategy has set targets to reduce its 2036 footprint by 80% relative to 2018

Leadership and Influence:

Recognising that CE has a pivotal role to play in achieving these ambitions, members of the CE-Hub team collaborated with the NHS and Philips to investigate and demonstrate how the NHS and its suppliers can implement CE at scale. The study, published in March 2022 'Accelerating the Transition towards a Net-Zero NHS' is the first of its kind to demonstrate how circular approaches in the NHS are not only possible, but a vital enabler to the NHS achieving its net zero ambitions whilst supporting its core aim to deliver care for patients. Moreover, the shift away from the linear approach can be accelerated through many of the initiatives already underway or in place within the NHS.





Figure 7: In order to achieve the NHS Net Zero Strategy will require an 8% CAGR from 2022-2036

Knowledge and Capability: The report details three illustrative case studies featuring medical technologies - telehealth, digital pathology and low-helium MRI scanners – demonstrating different ways that medical equipment can impact scope 3 emissions (Figure 8). The same principles can be applied to everything else that the NHS procures. This ranges from medicines and chemicals to construction and catering.

Well-designed CE approaches can power true systems change, unlocking economic

savings, improving patient outcomes and access to health. While there are many barriers to overcome in such a large sector, adopting a CE mindset will accelerate transformational change – not only for net zero but also enhanced health outcomes, reduced costs, improved efficiency and managing workforce challenges. This requires NHS decision makers, commissioners and their partners, suppliers, industry and trade groups to incentivise faster progress (Table 3).



Table 3: Summary recommendations

NHS	Suppliers	Regulators
Embrace Circular Economy business models through incentivising and targeting upstream supply chain partners	Suppliers need to move beyond energy efficiency and incremental innovation to systemic innovation that embraces Circular Economy business models and long-term value creation	Continually adapt policy and regulation to incentivise and nudge the NHS and its suppliers towards the adoption of Circular Economy practices to achieve NHS net zero ambitions
Use procurement as a driver of emission reduction by underwriting Circular Economy compliance into the procurement process	Suppliers should align their products and services to the NHS Evergreen framework, showcasing Circular Economy solutions and evidence of reducing Scope 3 emissions	Policy and regulation should fund and provide a cross- industry platform in pre- competitive spaces to road-test innovation and ensure quality is assured
Become a test-bed for Circular Economy and green technology and develop carbon and financial savings use cases across a series of Circular Economy interventions	Ensure stringent progress on Scope 1 and 2 emissions through clean-energy-powered manufacturing and designing out unnecessary waste	Improve certification and the enforcement of Circular Economy standards to ensure viability of innovative services and avoid abuse

Figure 8: Aligning product specific cases to macro net zero contributions.





Lessons Learnt and Next Steps

This case study met all three of the CE-Hub objectives and a number of our KPI's. Not only did this collaboration provide an excellent opportunity to develop a new set of partnerships, working at a deeper level of engagement, but it also enabled us to apply and test our approach within a Healthcare context (a new application area). The resulting report demonstrates a broader understanding of CE via communication of a complex value chain through use of a simple framework and tangible case study. It is intended that the report will influence decision makers within both Philips, the NHS and our other work on medical textiles and the next steps are to continue the collaboration to ensure implementation of the recommendations being made.

We will also prioritise further sector level studies in the next phase.