Digital Innovation & the Circular Economy

DICE NETWORK+
DIGITAL INNOVATION & CIRCULAR ECONOMY

Network overview &
Data Centre Workstream

Engineering and Physical Sciences Research Council
University of Exeter
The University of Nottingham
The Open University
Queen's University Belfast
University of Salford Manchester
University of Sheffield
University of Southampton
University of Surrey
Swansea University Prifysgol Abertawe

Project Overview

UKRI EPSRC funded Network+

3-year term: Jan 2025 – Dec 2027

Budget: £2,500,000

Industry & policy partners engaged with nine universities, including University of Exeter as lead, addressing two key challenge areas:

EMBED

Embedding sustainability and circularity within the design and development of digital and communication technologies, including material science.

SIEMENS Gamesa
RENEWABLE ENERGY

ENABLE

Realising the potential of the digital revolution to enable a circular economy across sectors.

materiom

University of Exeter

University of Southampton

Queen's University Belfast

University of Sheffield

The Open University

University of Salford Manchester

The University of Nottingham

University of Surrey

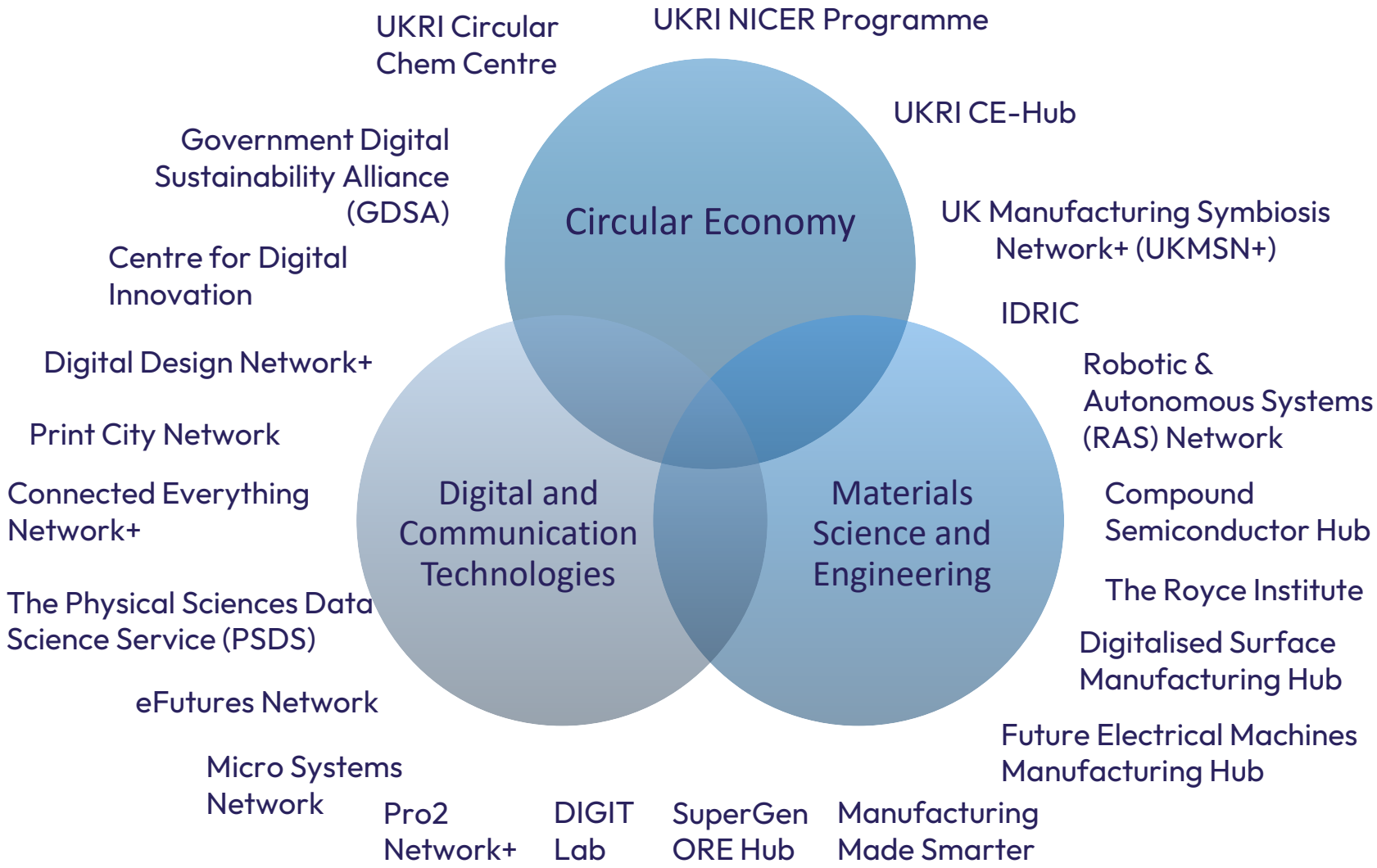
Swansea University Prifysgol Abertawe

Network of Networks Approach

Bringing together partners from across research, policy, and industry landscapes in interdisciplinary collaboration.

Building CE knowledge, sharing research & insight.

Providing the evidence base to unlock future funding and commercial focus.



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Key Pillars of Activity

1

Insight & Evidence

Drawing upon our network of networks, develop a comprehensive understanding of existing activities, challenges and opportunities to inform the 10-year vision & actionable roadmap towards digitally enabled CE.

2

Capacity Building & Knowledge Exchange

Develop an evidence-led knowledge base to inform, educate and upskill members of the community, facilitate knowledge exchange and support the development and adoption of digitally enabled CE solutions.

3

Research, Impact & Legacy

Facilitate mechanisms of interdisciplinary, cross-value chain collaboration, research and solution innovation, including Flexible Funding to support feasibility studies and demonstrator calls.

4

Inclusive Community

Build and coordinate an inclusive DICE community and enable and empower collaboration among diverse user groups.

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Flexible Funding

Knowledge Exchange Placements

£50,000 total fund available

Rolling application – 8 Dec 2025.

Up to £5k per placement to enable academic partners to spend time with industrial or government partners or academics from different disciplines to attend events conferences or work placements outside of their normal practice.

Feasibility Studies

£300,000 total fund available

First round closed & awarded

Up to £50k per study (80% FEC) to fund 6–9-month interdisciplinary studies that address cross-cutting challenges at different scales. New collaborations between sectors and disciplines, involving early carer professionals and industry partners will be encouraged

Demonstrator Call

£100,000 total fund available

Applications open early 2026.

Funds to support two projects, providing proof of concept and demonstration of ideas from the network activity. Each activity is expected to be 6–9-month collaboration between academics and industrial partners.

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Awarded Funds

Feasibility Studies: 41 applications, 9 shortlisted, 3 funded

Robotic and AI-enabled sensing for timber reuse: testing the feasibility of AI-ready material passports to unlock circular construction automation (UCL)

Busloads of Value: Circular, Digitally Enabled Business Models for Retrofitted Bus Fleets (Queens University Belfast)

SurplusMap: Feasibility of a City-Scale Digital Twin to Enable Surplus Food Redistribution in London (Nottingham Business School)

Knowledge Exchange Placements: 3 applications, 2 funded

Bridging local wisdom & scientific Innovation: a citizen science approach to climate resilience in the Mekong Delta (Vietnam)

Future Histories: Weaving Data into Digital Storytelling for Circularity

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Our Team

Prof Fiona Charnley
Professor of Circular Innovation & Co-Director of the Exeter Centre of the Circular Economy
University of Exeter

Dr Diego Bermudez
Research & Impact Fellow
University of Exeter

Georgie Hopkins
Network Manager
University of Exeter

Dr Oliver Fisher
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University of Nottingham

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Professor of Physical Chemistry
University of Southampton

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Associate Professor within the Centre for Environment and Sustainability
University of Surrey

Prof Roger Maull
Academic Director of the Initiative in the Digital Economy Research Centre
University of Exeter

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Swansea University

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Queen's University Belfast

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Professor of Business Innovation
University of Salford

Dr Silvia Tedesco
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University of Salford

Prof Ashutosh Tiwari
Deputy Vice-President for Innovation
University of Sheffield

Dr Divya Tiwari
Post Doctoral Research Fellow
University of Sheffield

Madeline Smith
Impact Consultant
Independent

Prof Gosia Swadzba-Kwasny
Director of the QUILL Research Centre
Queen's University Belfast

Prof Andrea Zisman
Professor of Computer Science
Open University

Collaborating with nine research projects from the same EPSRC funding call

Focusing on ***Research for a digitally enabled circular economy and sustainable digital technologies***

Title	PI	Host org.
Digitally Enabled Circular Healthcare Innovation (DECHI)	Fiona Charnley	University of Exeter
Robotic Triage for Value Retention in a Circular Economy (RoboTriage)	Yongjing Wang	University of Birmingham
PLASTIC: Plastics Analysis, Sorting & Recycling Technology through Intelligent Classification	Stuart Coles	University of Warwick
IDEAL: Reducing Carbon Footprints of IoT Devices through Extension of Active Lifespans	Klaus McDonald-Maier	University of Essex
Co-creating equitable circular food systems through a digital Hub: Digital Equitable Circular FooD systEms (DECIDE)	Lucy McCarthy (CoPI)	University of Bristol
	Anne Touboulic (CoPI)	University of Nottingham
Digitally enabled sustainable metals recycling for circular economies - SUMER	Panagiota Angeli	University College London
Reimagining digital research infrastructure in environmental science for a sustainable future	Kelly Widdicks	UK Centre for Ecology & Hydrology
Circular Robot 5.0: Industry-Wide Data-Driven Circular Economy of Industrial Robots	Sina Sareh	Royal College of Art
Towards a more sustainable High Performance Computing sector: a hardware/software co-design proof-of-concept	Sylvain Laizet	Imperial College London

Progress to date

Knowledge Exchange Placements – 2 awarded, £10k total
Feasibility Studies – Round A closed, 40+ applications, 3 awarded, £148k total
Round B to open Feb 2026, including Demonstrator call

Support letters for research projects and practitioner connections

ECR Community – 4 monthly meetings & 2 capacity building workshops

Informing policy - Government Buying Standards feedback

Bi-monthly Newsletter – 300+ subscribers
LinkedIn DICE News Wrap - 270+ subscribers
CE ITC procurement thought-piece (*Just published*)

Research, Impact & Legacy
£100K+ funds awarded

Insight & Evidence
10+ Network team publications

DICE Flywheel, integrates CE practices with Digital Tech (WIP)
CE Data Centre roadmap (WIP)
IDEALL roadmap

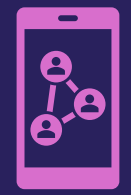
CE & DC position paper (WIP)
CBM & Finance report (WIP)

230+ partners engaged
30+ ECR members
20+ Networks engaged

Capacity Building & Knowledge Exchange
520+ connections & 50% engagement*

London launch event (80+), Data Centre roundtable (20+), Surrey Roadshow (30+)
Salford Roadshow in December

20+ events attended, including CE keynotes, panels, & presentations



520+ LinkedIn followers
Regular posts & 25,600+ impression

*Have engaged at least once

2025/2026 Workstreams

EMBED **ENABLE**

We've hosted our first roundtable with the partners shown below for the **Embed** challenge; insights and timeline on the next slides.

We are also developing case studies, policy briefs, and events for the **Enable** side of the project.

Data Centre Circular Econ. Vision & Roadmap

CBM & Finance Frameworks and Innovation

Reports

Webinars

Enabling Digital Technologies

Case studies

Consumer Devices & Policy

Case studies

Consultations

bsi. sustainable ventures defra RISE DEEP GREEN RED Engineering IBM Techbuyer

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The Circular Data Centre Infrastructure Blueprint: From Industry Bottleneck to Competitive Breakthrough

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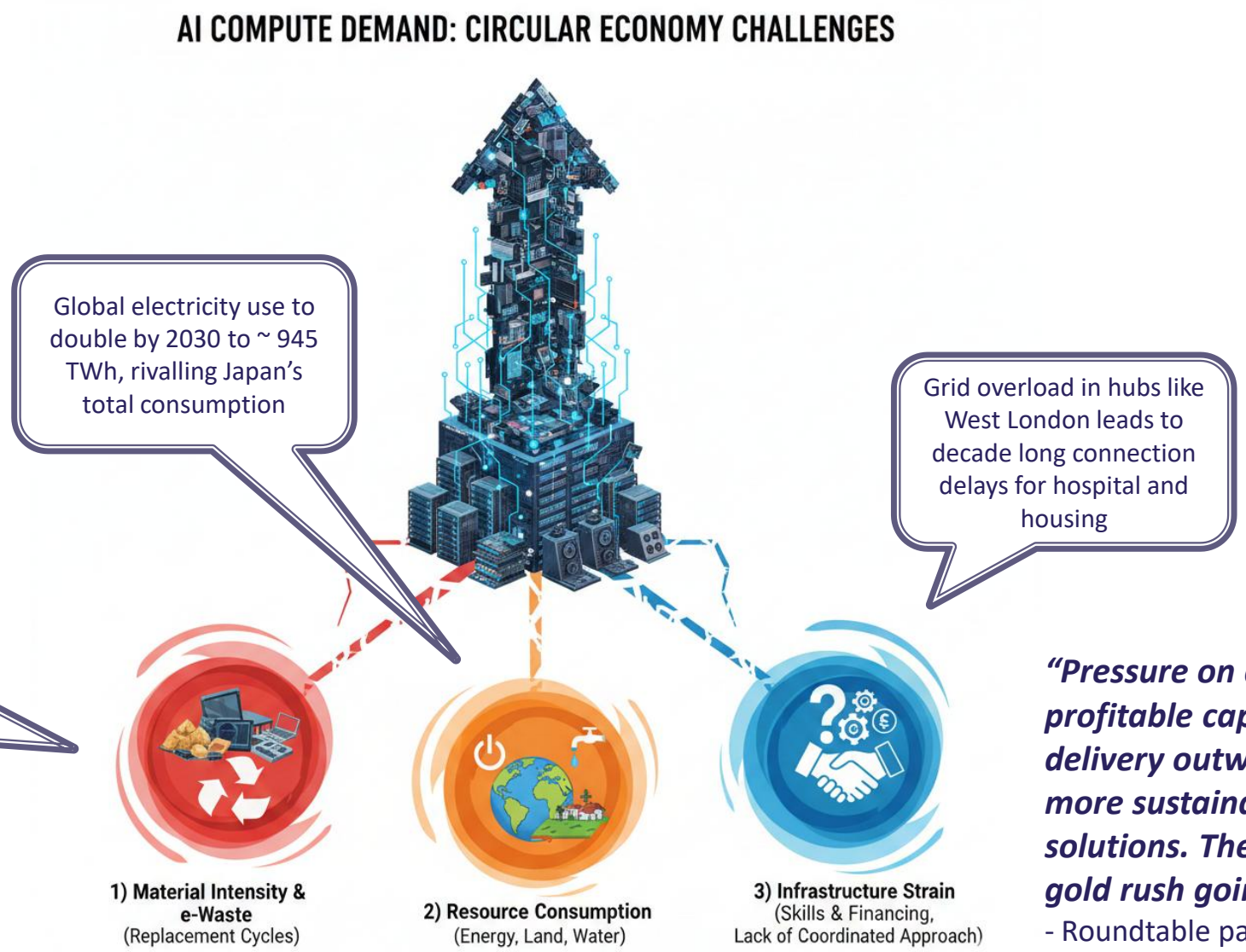
The AI-fuelled ‘gold rush’ is exposing a systemic bottleneck

The unprecedented growth & AI compute demand, fuelled by investments like Microsoft’s $30 billion investment, projects the UK market to grow 20% in the next five years.

Current business models prioritise service efficiency and uptime over long-term circularity and sustainability, running on short annual Capex cycles instead of longer-term Opex, leading to a misalignment of financial incentives.



“Pressure on a highly profitable capacity delivery outweighs more sustainable solutions. There’s a gold rush going on.”
- Roundtable participant

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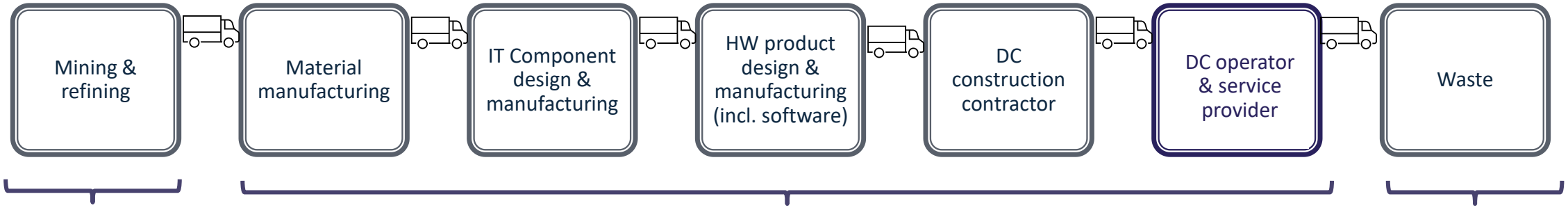
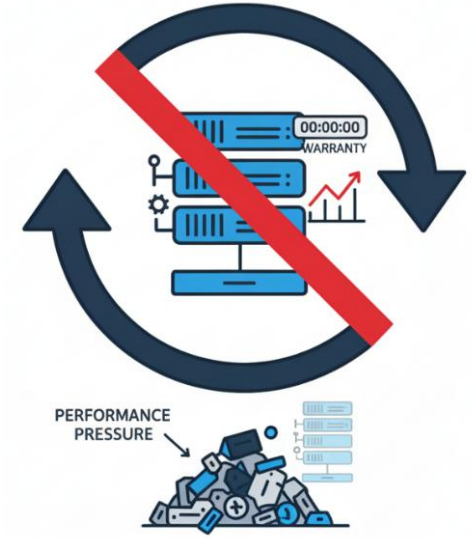
Our Linear Model is leaking Value and introducing volatility

The current linear ‘take-make-dispose’ economic approach results in **substantial financial and resource losses** while **increasing market volatility.**

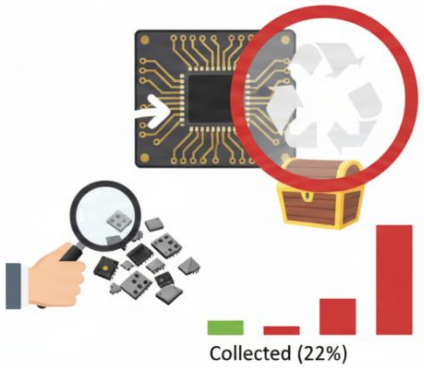


Over 70% of Critical Raw Materials (CRMs) for chips are concentrated in East Asia, creating a significant **supply chain risk**



Wasted Capital:
Rapid **3–5-year** hardware replacement cycles discard valuable hardware that could last **8-10 years**
+ **Waste Heat**

Lost resources:
Less than 1% of global CRM is met by recycling e-waste (**22% e-waste** collection rate)



The “Sustainability Sandwich”
“In many procurement decisions, sustainability criteria are squeezed to 5% while price is 95%, systematically devaluating circularity.”
- Roundtable Insight

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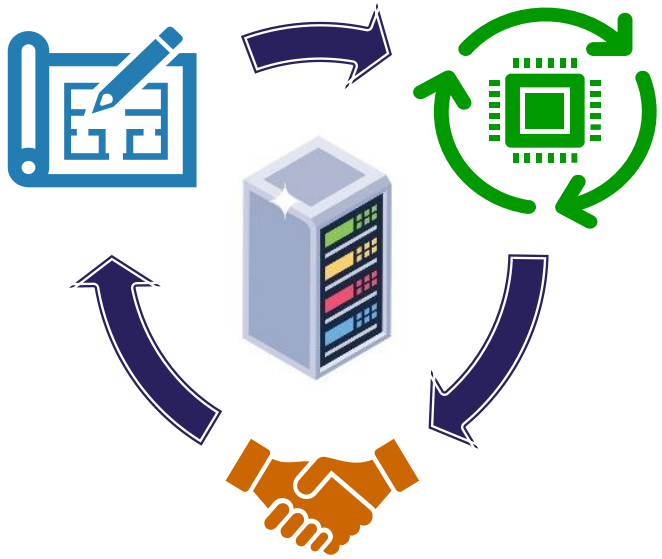
The Blueprint: Three Strategic Levers to Unlock Circular Value

Lever 1: Design for Value Retention

Building circularity into hardware and infrastructure from the start to maximise its lifespan and potential reuse.



Lever 2: Operate for Maximum Recovery

Transforming end-of-life processes and integrating Circular Business Models to capture the full value of physical assets, including components, servers, and waste heat.

Lever 3: Collaborate for Systemic Change

Creating the Market conditions, policies, and cross-sector partnerships required for a circular ecosystem to thrive.

The **DICE Network** convened key stakeholders to identify **critical challenges and opportunities** for a **circular economy in data centre infrastructure blueprint**

Moving beyond discussion to **prioritise and deep-dive into the most crucial, achievable, and impactful solutions** across **three key areas**.

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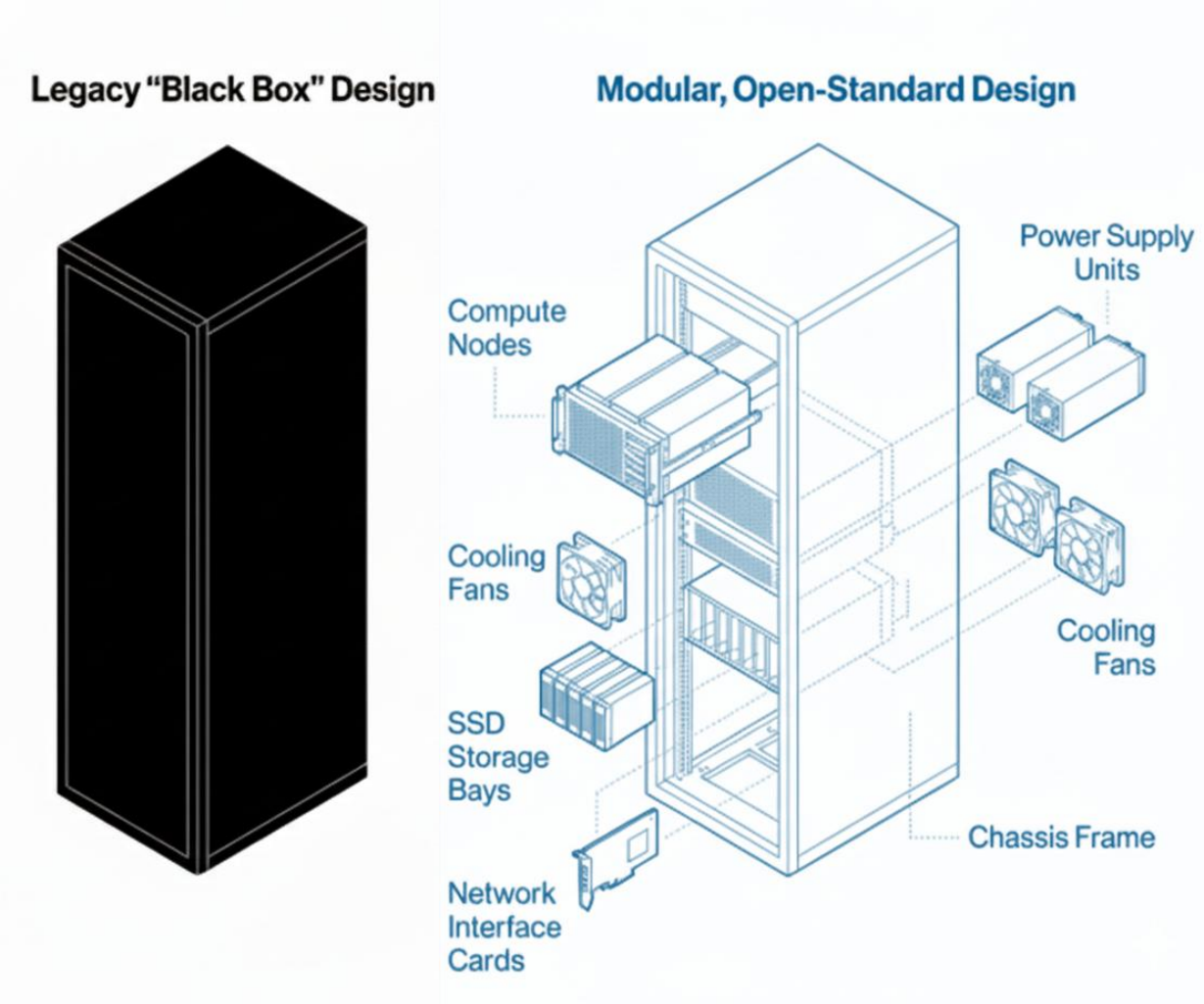
Shift the **design focus from optimising solely for performance and cost to a whole-lifecycle approach** that prioritises repairability, upgradability, and material recovery.

- **Embrace Open Standards:** Use frameworks like the Open Compute Project to eliminate vendor lock-in and enable interoperability, allowing flexible components to be swapped and upgraded.
- **Design for Disassembly:** Create hardware where components can be easily separated, accessed, repaired, and replaced, extending the life of the entire system and extracting EoL value (CRMs).

Right-to-repair and ESPR policies are critical enablers

A Critical Window of Opportunity: "GPUs are still in an early development phase and it is not clear how to decommission them; there is an opportunity to influence design."
– Roundtable Insight



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Lever 1: Design for longevity, modularity, and disassembly

In Practice: Industry Leaders Are Already Proving the Model

Case Example 1: Microsoft's Circular Centres

Action: Microsoft is establishing centres to increase the reuse of servers and components, aiming to reuse 90% of its cloud computing assets by 2025.

Impact: Extends the lifecycle of server hardware, reduces e-waste, and creates a supply chain of refurbished parts for its own data centres.

Case Example 2: Kao Data's OCP-Ready Infrastructure

Action: Kao Data designs its new facilities to be "Open Compute Project-Ready," supporting modular, standardized infrastructure.

Impact: Provides customers with greater flexibility, avoids vendor lock-in, and ensures the infrastructure can adapt to future hardware evolutions, enhancing longevity.

Case Example 3: AWS re:Cycle Reverse Logistics hub

Action: At AWS, used components are tested, repaired, and restocked in a dedicated internal inventory.

Impact: These hubs supply 13% of all spare parts needed for server repairs, directly reducing the need to procure new components and lowering operational costs.

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Lever 1: Design for longevity, modularity, and disassembly

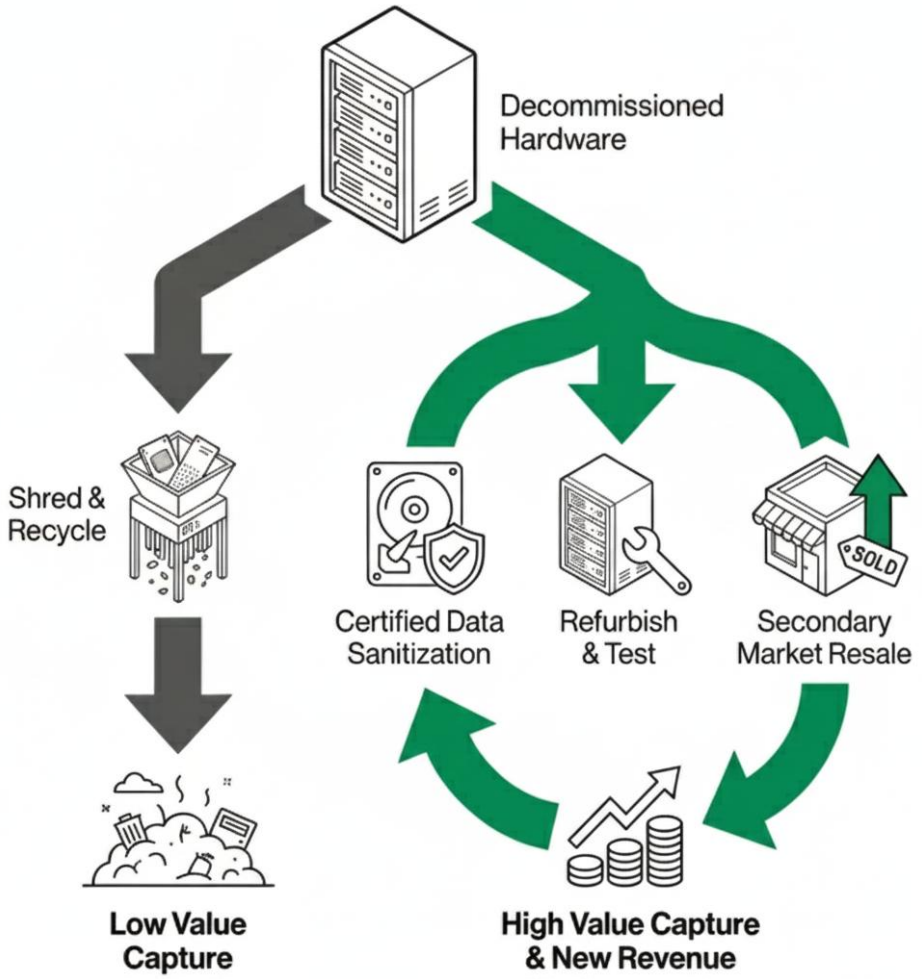
Turn Decommissioned assets into New Revenue Streams

The **global secondary server market is a thriving ecosystem** that extends the functional life of hardware well beyond the initial 3–5-year refresh cycle with an **easy-to-implement approach**.

Key Actions:

- **Prioritise Reuse:** Implement **robust end-of-life management processes** that prioritises direct reuse and refurbishment over recycling (i.e., trade back and trade-in).
- **Overcome Barriers:** Systematically address security & performance concerns through **SLA-aligned certified data sanitisation & testing protocols**, **warranties**, other limiting standards; removing a key blockers to reuse.
- **Enable the Market**: OEMs can actively support the secondary market by providing **certified repair training**, **authentication services**, and **access to and transparency of parts (i.e., DPPs)**.

"A huge challenge is speed of change in the core GPUs and CPUs themselves... but there isn't the system to broadcast decommissioned stock. We're missing the step of reuse."
– Roundtable Participant



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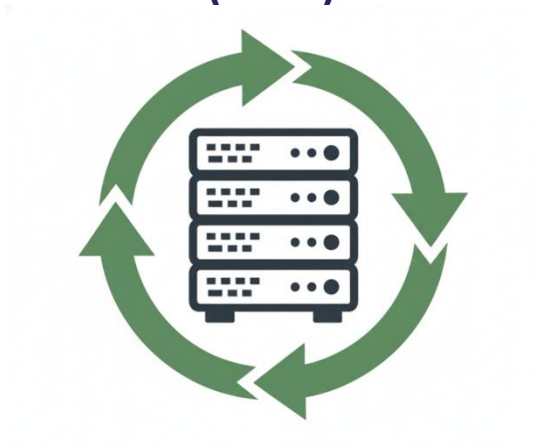
Lever 2: Maximise Reuse and Resource Recovery

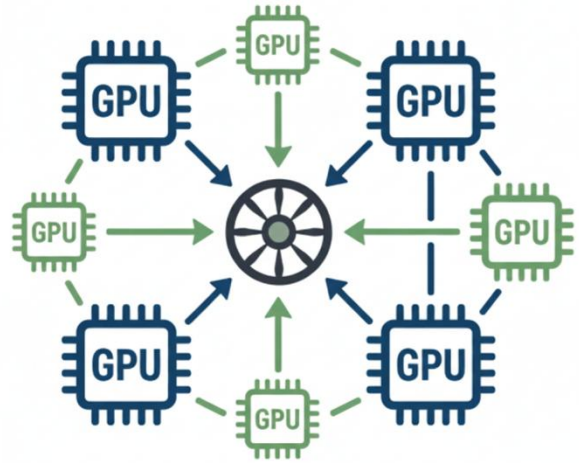
The Next Frontier: From Hardware Ownership to Service Models

Model 1: Hardware-as-a-Service (HaaS)



A **provider retains ownership and responsibility** for the hardware's entire lifecycle. This incentivises them to design for durability, repairability, and high residual value

Model 2: Peer-to-Peer Marketplaces



Platforms like Vast.ai **aggregate under-utilised GPUs from a wide range of owners**, allowing others to rent that capacity. This increases hardware utilisation and provides revenue from idle assets. Another example is using fit for purpose CPUs or other converting old smartphones into edge devices.

Model 3: Distributed Compute

Radical models like **Heata use a distributed network** of small server blocks in homes, where the 'waste' heat provides free hot water, turning an externality into a core part of the value proposition. Virtual Power Plants (i.e., Voltus) can also help manage decentralised energy assets.

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Lever 2: Maximise Reuse and Resource Recovery

Beyond PUE: Turning Waste Heat from a Liability into a Community Asset

The Problem

Over 90% of the electricity consumed by a data centre is **dissipated as low-grade heat**, yet UK heat recovery rates are a **dismal 3-5%.**

The Solution

Co-locate data centres with heat off-takers (i.e., district heating networks, greenhouses, public pools) to create a **symbiotic relationship**. Germany has already set a minimum 10% Energy Reuse Factor (ERF) for new data centres.

"For a data centre to be sustainable, it must recapture and redeploy the heat the servers generate. This requires systems thinking, and the coalition of the willing... There lies the challenge." – Roundtable Participant

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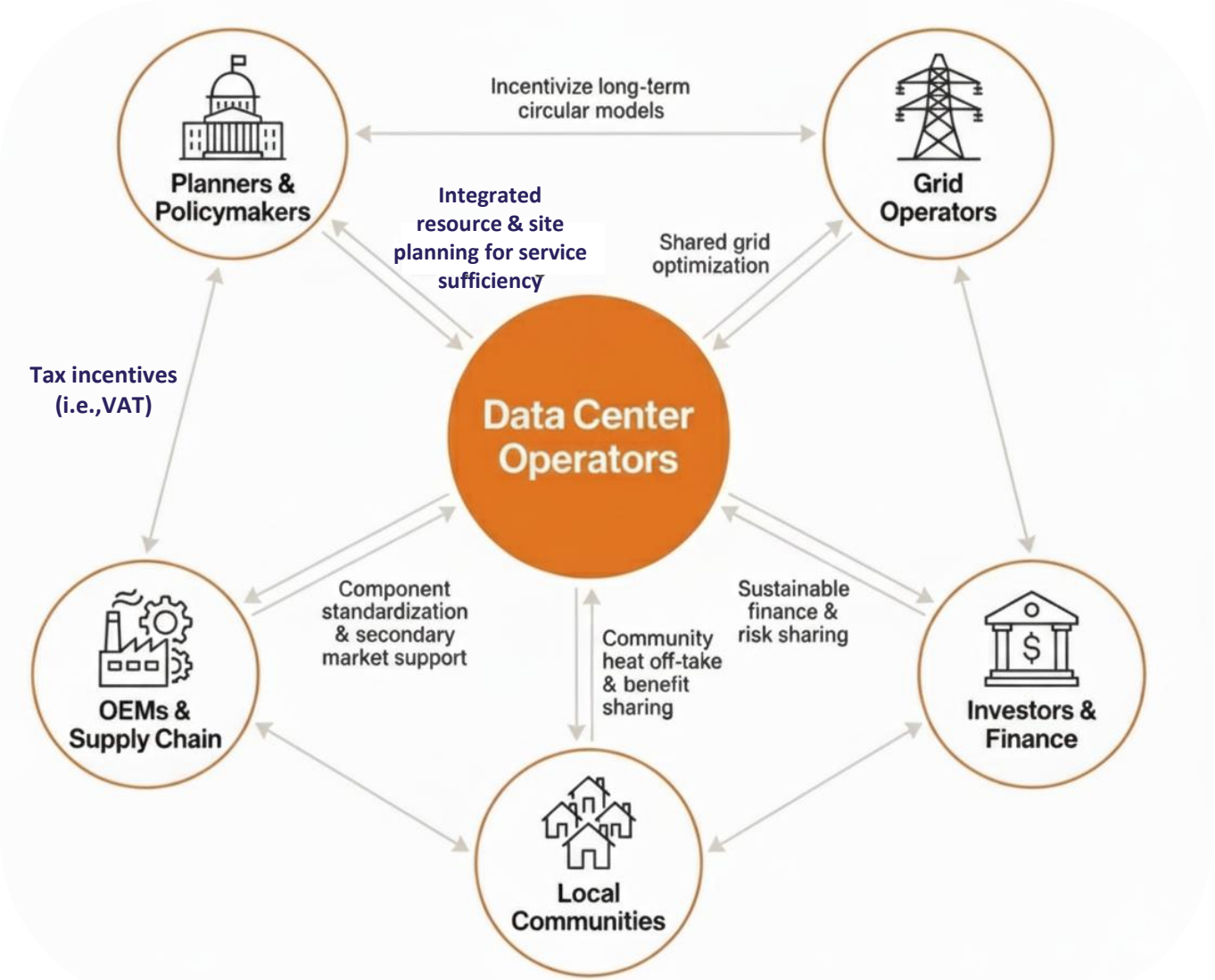
Lever 2: Maximise Reuse and Resource Recovery

The **industry's biggest challenges are shared problems** that **cannot be solved in a silo:**

- **Contractual & Warranty Limitations** for Secondary Markets.
- **Data Security & Liability Concerns** preventing Reuse and Donation.
- **Lagging Regulation & Standards** create Opaque Environments.
- **Fragmented Planning & Resource Allocation** failing to consider Local Environmental & Social Impacts that should be tied to Community Economic Valued Outputs.

A **lack of coordination** creates a "tragedy of the commons" where shared **resources** like grid capacity are **depleted**.



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Lever 3: Reshape the Ecosystem through Strategic Collaboration

Derisking & Catalysing the Market with Smart Policy and Procurement

Policy as a Catalyst

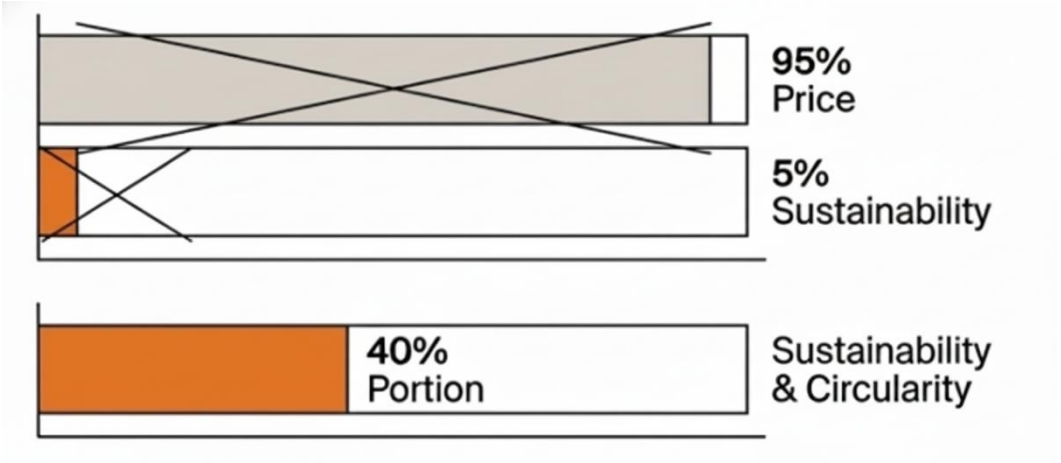
EU's Ecodesign for Sustainable Products Regulation (ESPR): Sets legally-binding **standards** for **durability, repairability,** and **recycled content** (i.e., France's 20% Refurb. IT devices).

Digital Product Passports (DPPs): Create **transparency on materials and repair instructions**, enabling a scalable circular economy. Mandating DPPs for hardware would be a game-changer.

Right to Repair: Laws that mandate manufacturers **provide parts, tools, and information for product repair**

Procurement as a Driver

Move beyond the '5% sustainability / 95% price' sandwich.



Government can lead the way. New UK government buying standards are coming to **incentivise the purchase of refurbished equipment**. These practices can be **translated into private sector with tax reliefs**.
DEFRA is already piloting a **"Refurb by default" policy**.

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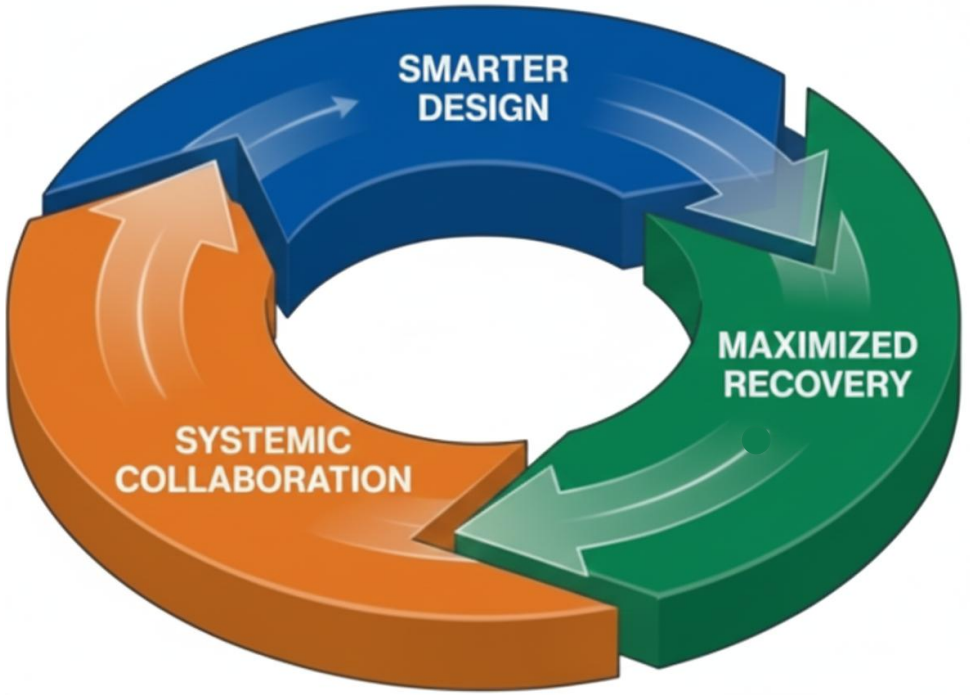
Lever 3: Reshape the Ecosystem through Strategic Collaboration

The Circular Flywheel: A Self-reinforcing System of Value

Smarter Design
(i.e., Modularity, DPPs)
Makes it easier to…



…Maximize Recovery
(incl. Reuse, Refurbishment),
which generating data and proves the business case, creating market demand for…

…even smarter Design

Systemic **Collaboration**
(new policies and standards),
which in turn creates powerful incentives and requirements for..

Each push on a lever makes the next push easier, building momentum towards a **fully circular and resilient data centre infrastructure**.

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A Collaborative Roadmap for Activation

Phase 1: Foundational (Next 12 months)

Goal: Establish common language and prove viability.

- **Form** a cross-sector task force on integrated grid and resource planning.
- **Adopt** standards for circularity measurement and reporting (e.g., BS ISO 59010:2024).
- **Launch** pilot projects to showcase the business case for high-value component reuse and secondary markets.

Phase 2: Scaling (1-3 years)

Goal: Mainstream circular practices and models

- **Implement** Digital Product Passports across major OEM product lines.
- **Integrate** heat reuse requirements into planning permissions for new large-scale DCs.
- **Scale** Hardware-as-a-Service, distributed, and secondary marketplace models.

Phase 3: Systemic (3-5+ years)

Goal: A fully circular ecosystem is the default.

- **Circular principles** are embedded in investment criteria & regulations.
- **A mature, liquid secondary market** is the primary source for non-leading-edge capacity, and other secondary and industry symbiosis opportunities.

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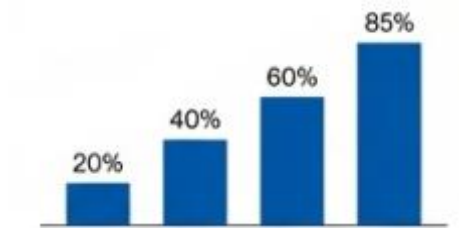
Measuring What Matters: From Total Cost of Ownership to **Total Value of Sustainability**

We need **new KPIs** to manage the transition and **measure success in a Circular Business Model, shifting from a narrow view of cost** to a **holistic view of value and resilience**.

Material Recovery Rate

% of materials (by value) successfully reused or remanufactured from decommissioned assets.

Hardware with DPPs

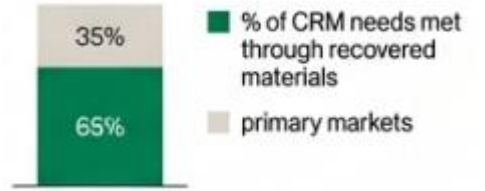


% of new equipment procured that includes a Digital Product Passport.

New Revenue Streams

Revenue generated from secondary market sales, HaaS models, and waste heat agreements.

Supply Chain Resilience



% of CRM needs met through recovered materials primary markets Percentage of Critical Raw Material needs met through recovered materials.

E-waste Generated

Zero Waste to Landfill goal Significant reduction in e-waste sent to landfills, targeting zero waste.

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The Future Data Centre Is Not Just a Facility… It is a Resource Hub

The Data Centre as a System Contributor:

- **Provides Compute:** Delivered with maximum efficiency and sufficiency.
- **Provides Heat & Energy:** Acts as a thermal source for communities and a stabilising asset for the grid.
- **Provides Resources:** Becomes an "urban mine" for critical materials, feeding the supply chain.

Academics & Research Partners
Develop new technologies, tools, and research programs to drive innovation.

OEMs & Suppliers
Design products for longevity and support the secondary hardware market (i.e., repair programs).

Circular Startups & Corporate Innovators
Create new circular business models and technologies that turn resource inefficiencies & waste into revenue.

Regulators & Policymakers
Incentivise circular practices and mandate reporting.

Financial Sector
Provides capital for profitable and resilient circular business models that increase resilience.

Business Corporates
Implement circular practices (i.e., hardware reuse and reverse logistics operations) and adopt innovative business models (i.e., HaaS).

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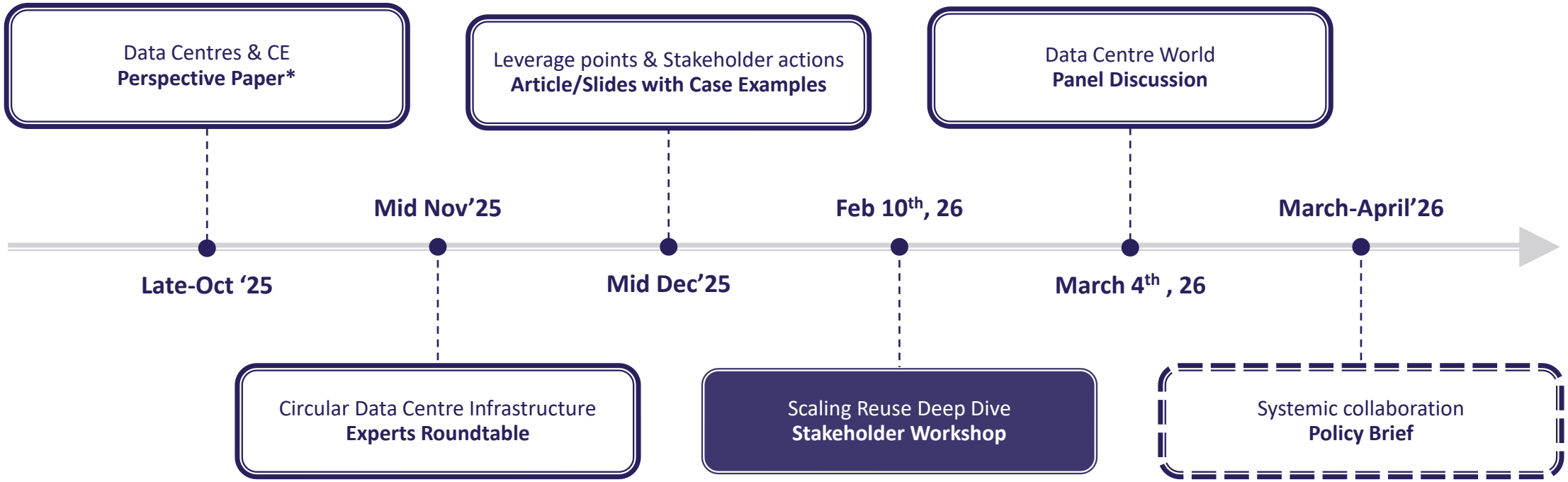
This **transition from bottleneck to breakthrough** is not just an environmental imperative; it is the blueprint for the long-term competitive advantage and resilience of our digital economy.

The Circular Data Centre Infrastructure Blueprint

Timeline & Deliverables



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*Submitted to Resources, Conservation, and Recycling Journal

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