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

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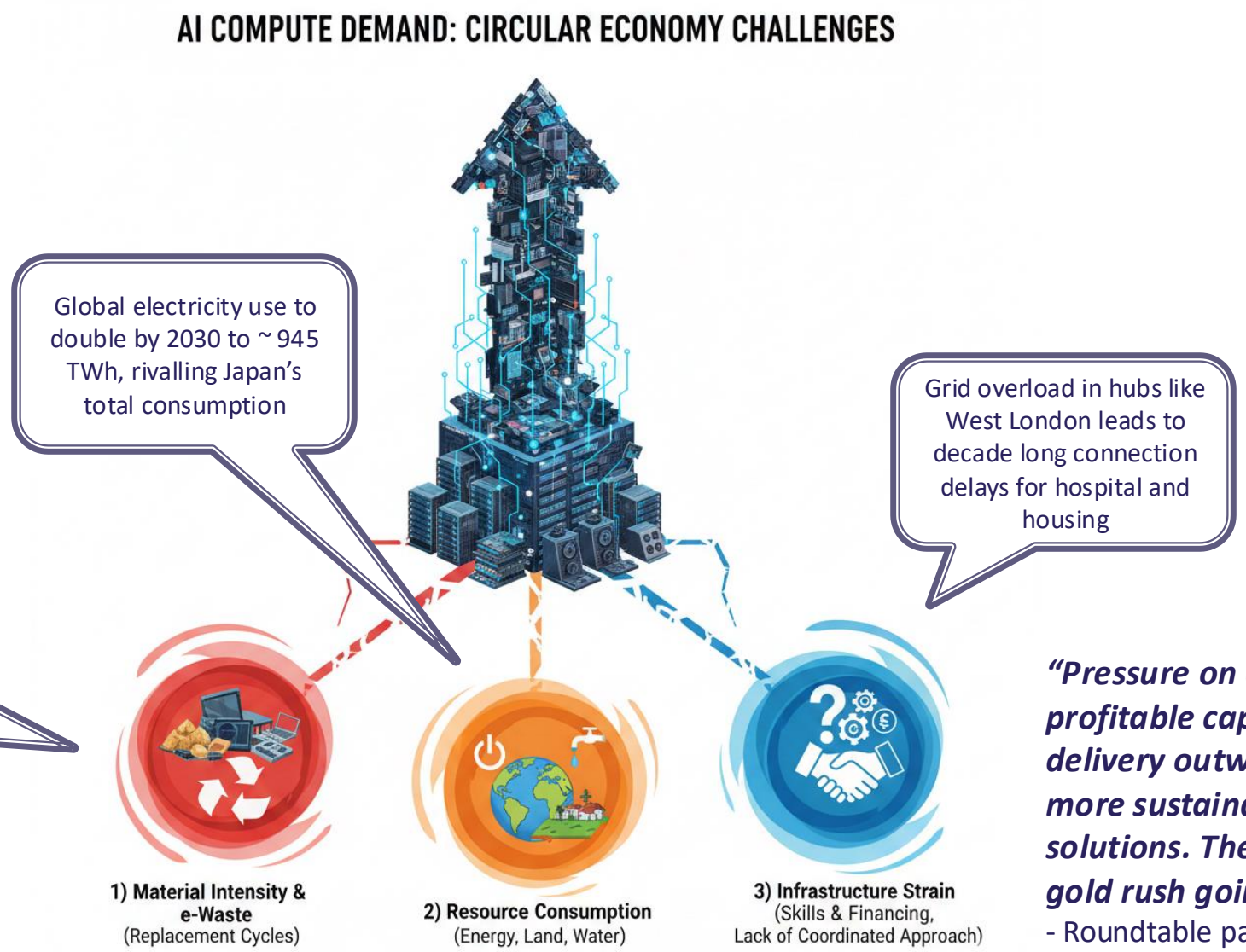
The AI-fuelled ‘gold rush’ is exposing a systemic bottleneck

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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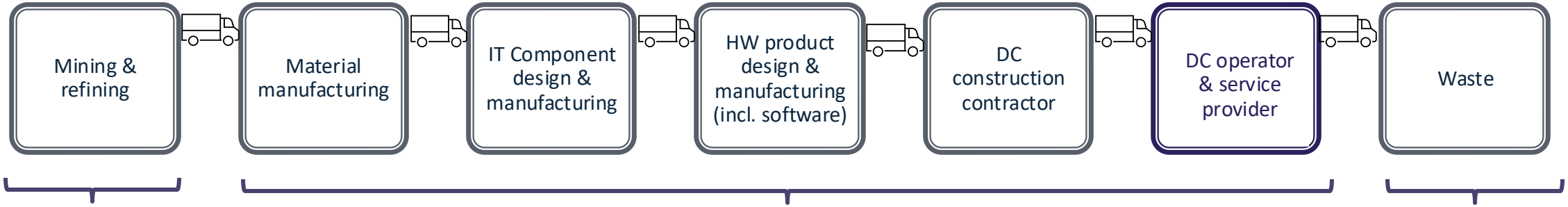
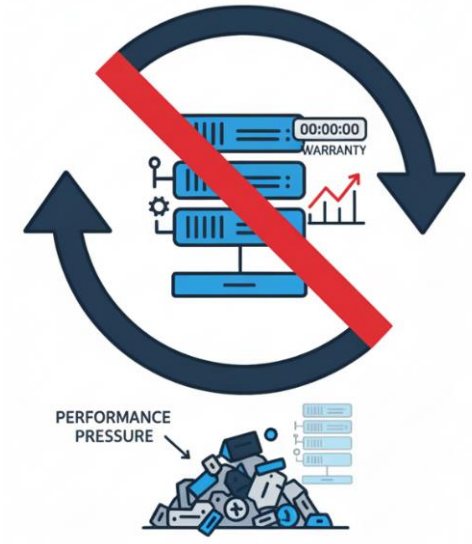
Our Linear Model is leaking Value and introducing volatility

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

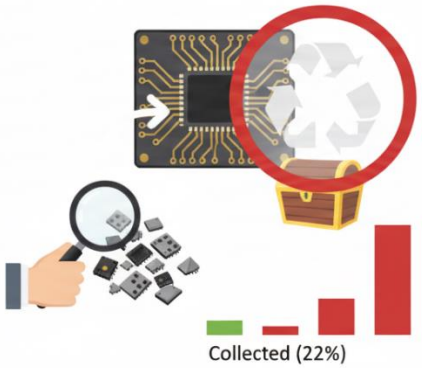


Over 70% of Critical Raw Materials (CRMs) for chips are concentrated in East Asia, creating a significant **supply chain risk**



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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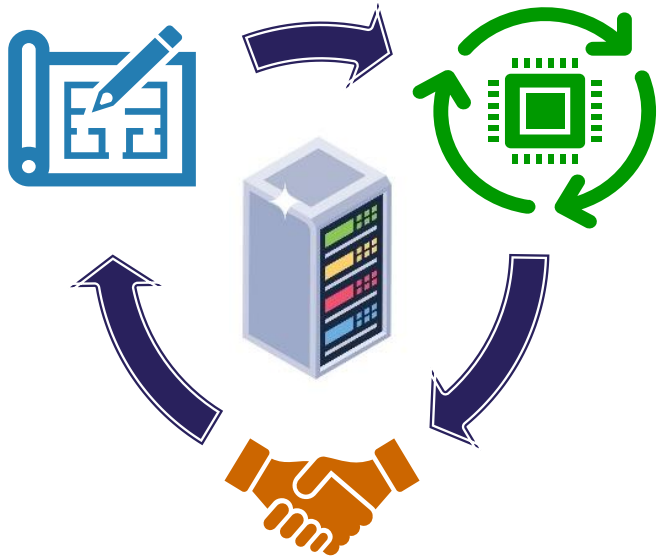
The Blueprint: Three Strategic Levers to Unlock Circular Value

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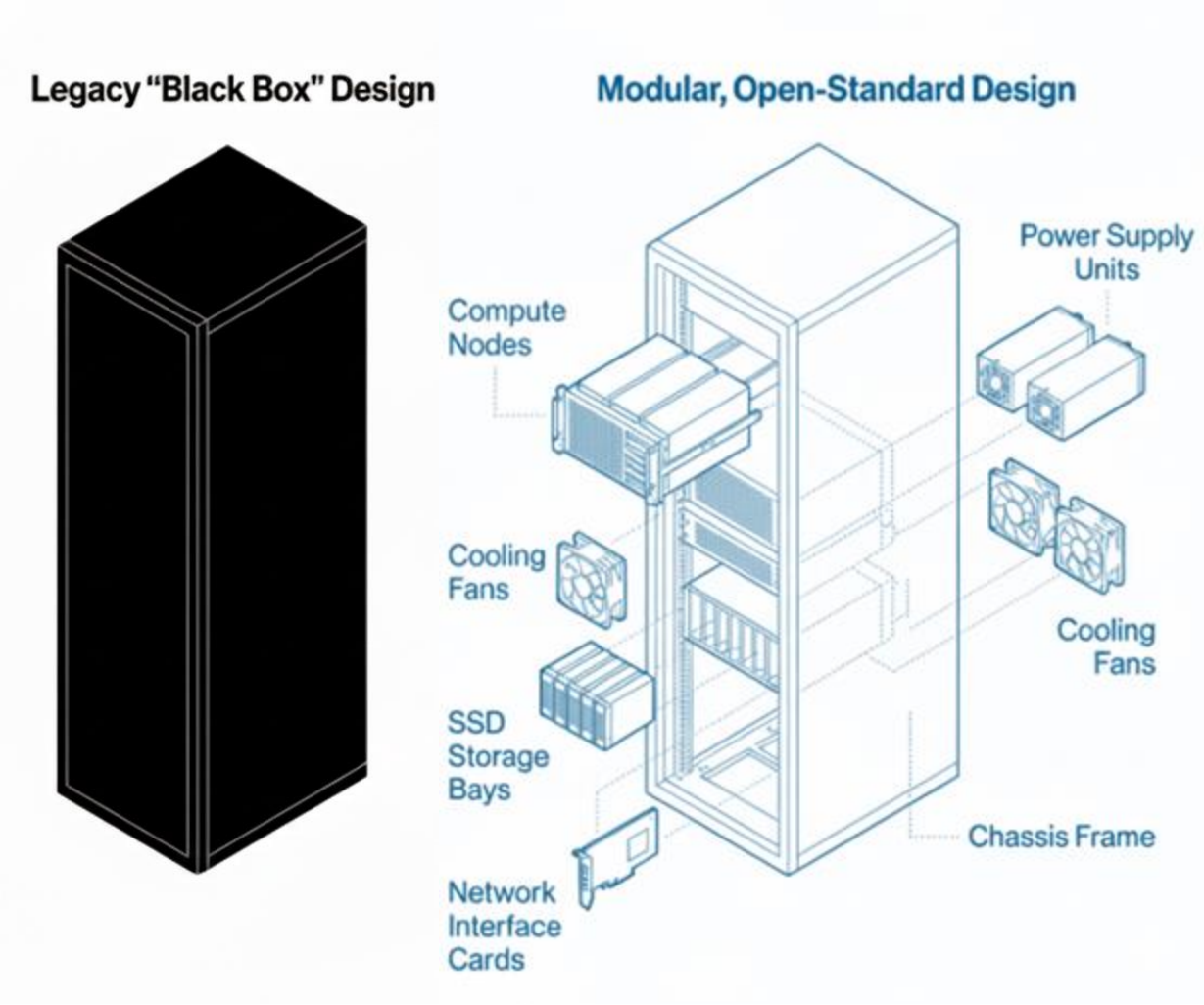
Shift the **design focus from optimising solely for performance and cost to a whole-lifecycle approach** that prioritises repairability, upgradability, and material recovery.

- **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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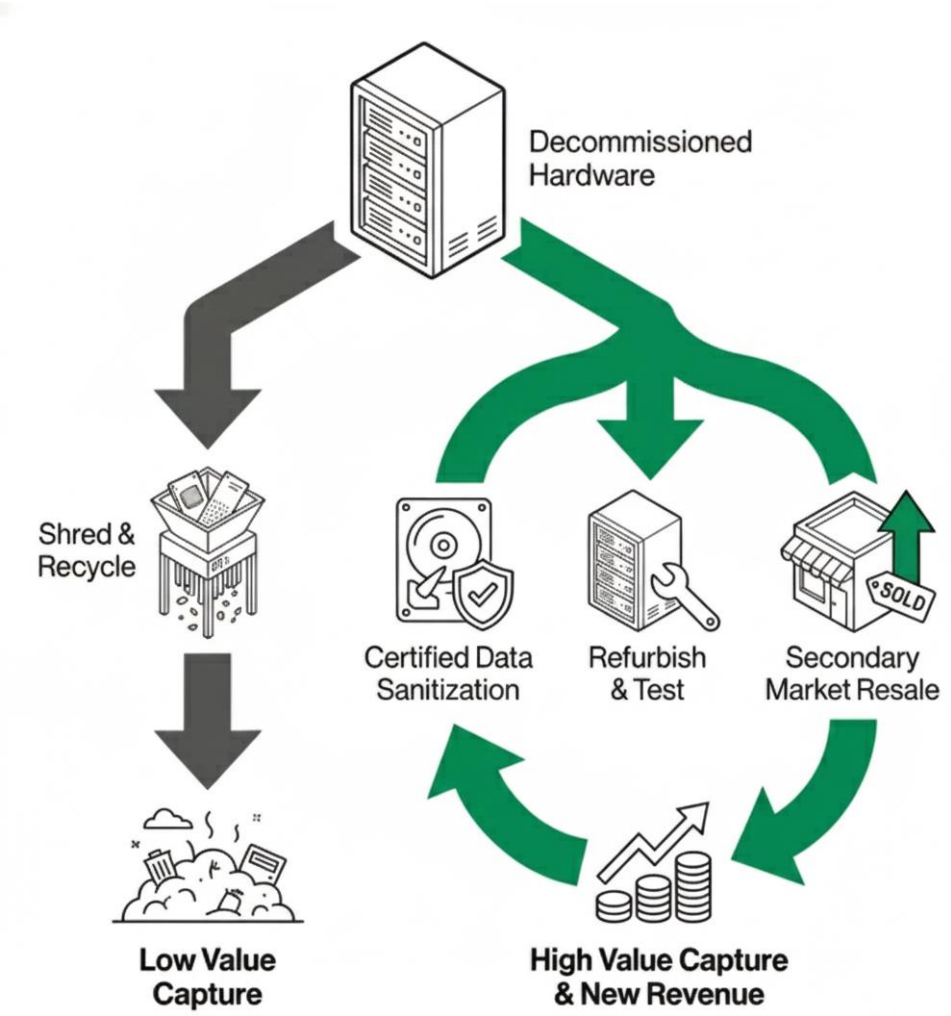
Lever 1: Design for longevity, modularity, and disassembly

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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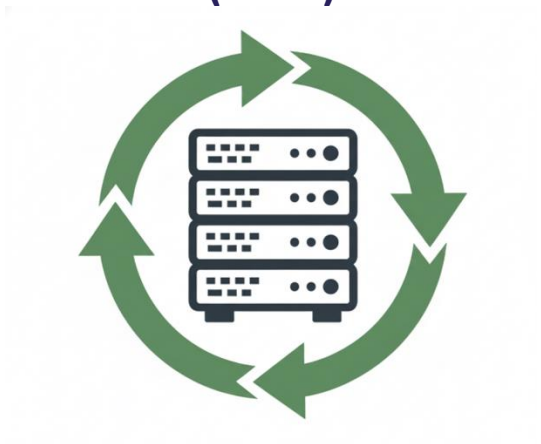
Lever 2: Maximise Reuse and Resource Recovery

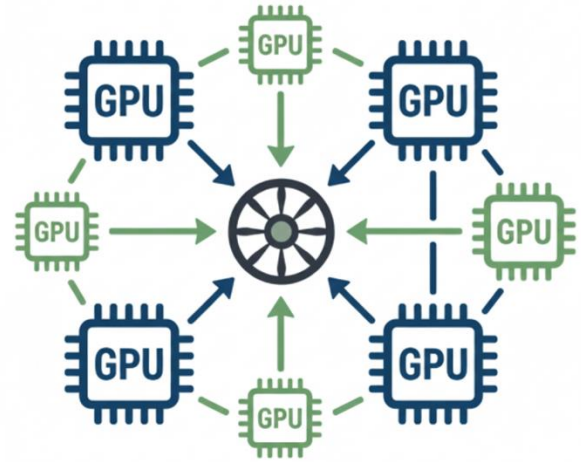
The Next Frontier: From Hardware Ownership to Service Models

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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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

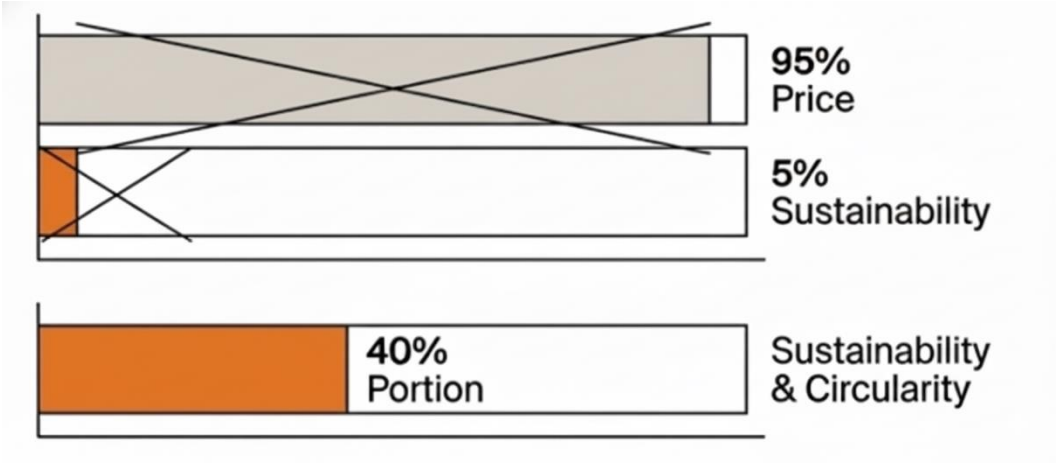
EU's Ecodesign for Sustainable Products Regulation (ESPR): Sets legally-binding **standards** for **durability, repairability,** and **recycled content** (i.e., France's 20% Refurb. IT devices).

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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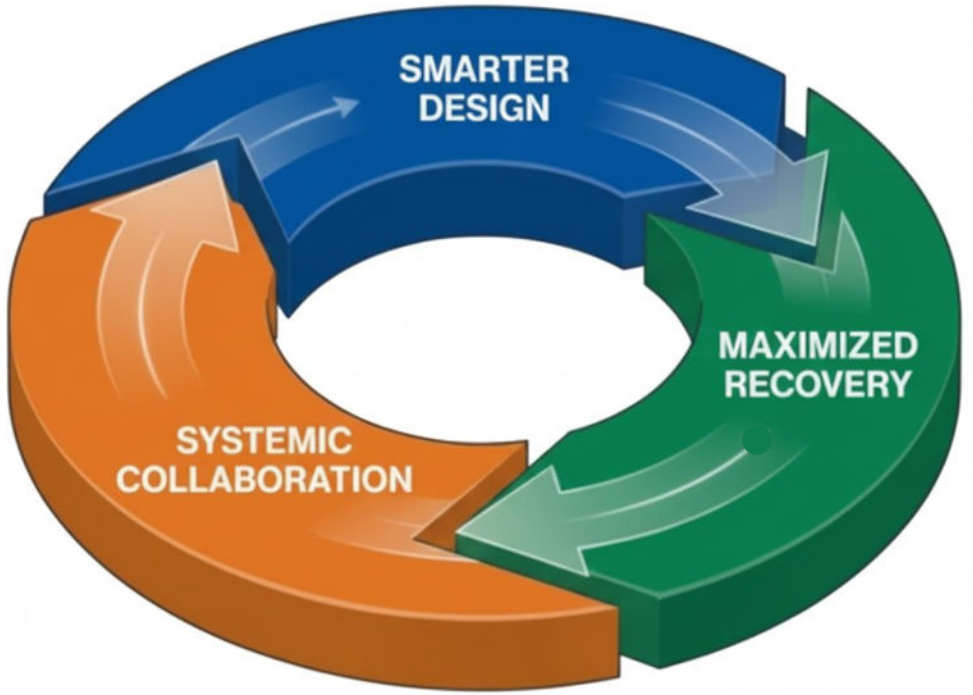
Lever 3: Reshape the Ecosystem through Strategic Collaboration

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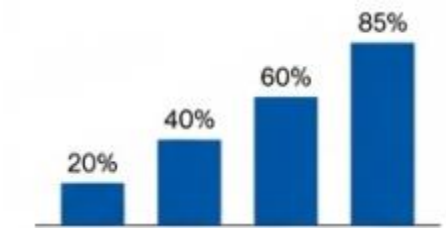
Measuring What Matters: From Total Cost of Ownership to **Total Value of Sustainability**

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

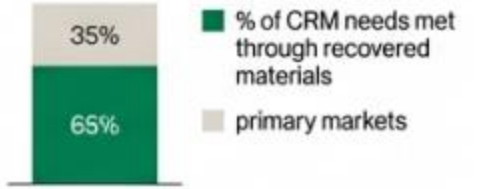


% of new equipment procured that includes a Digital Product Passport.

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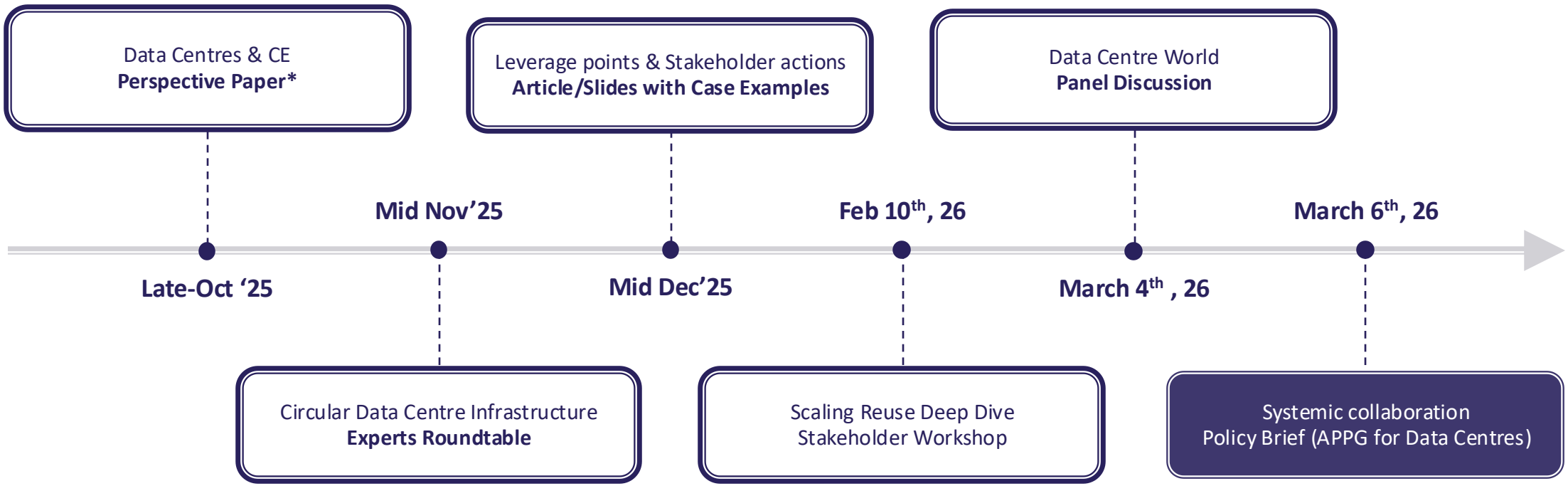
This **transition from bottleneck to breakthrough** is not just an environmental imperative; it is the blueprint for the long-term competitive advantage and resilience of our digital economy.

The Circular Data Centre Infrastructure Blueprint

Timeline & Deliverables



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*Submitted to Resources, Conservation, and Recycling Journal

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