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

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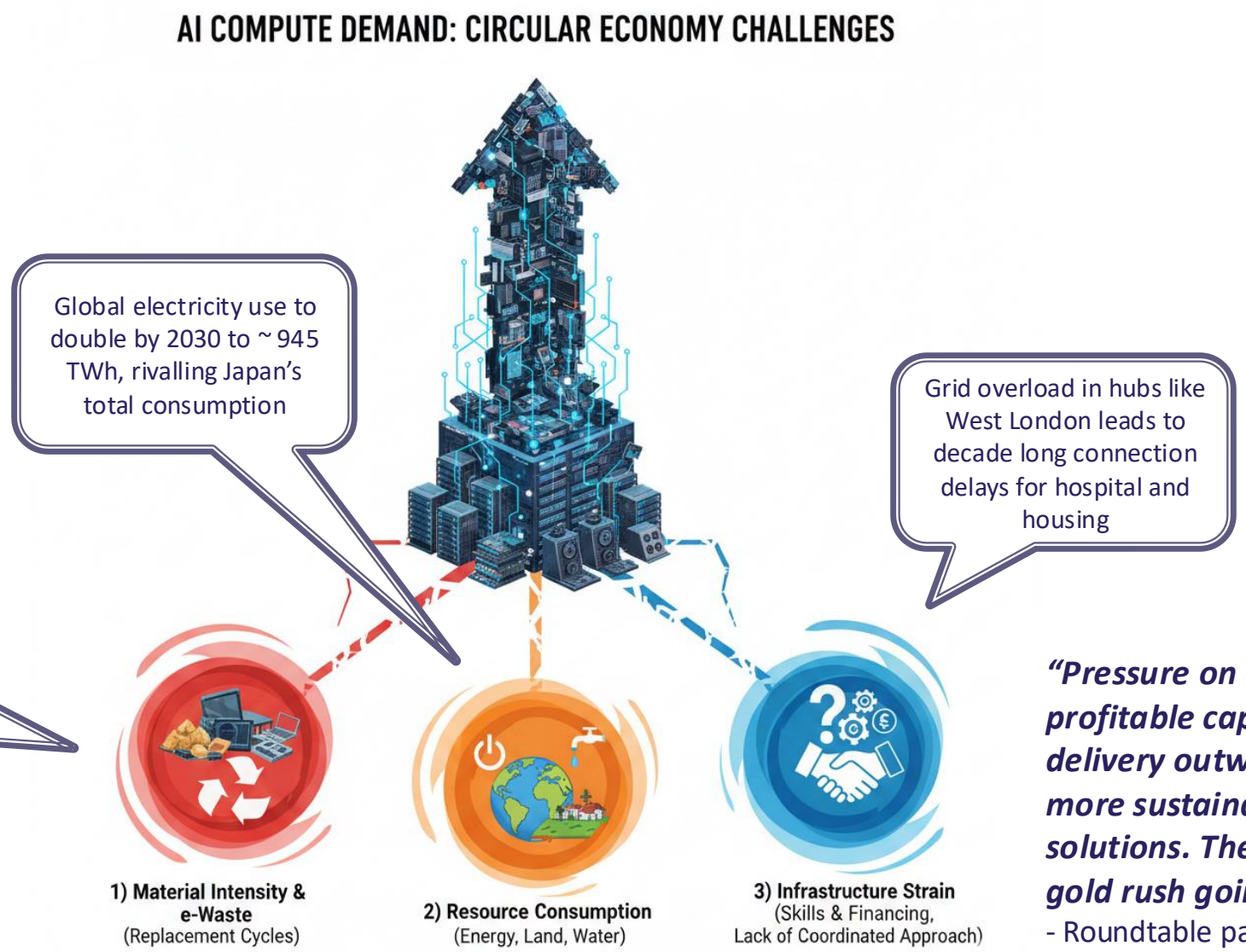
The AI-fuelled ‘gold rush’ is exposing a systemic bottleneck

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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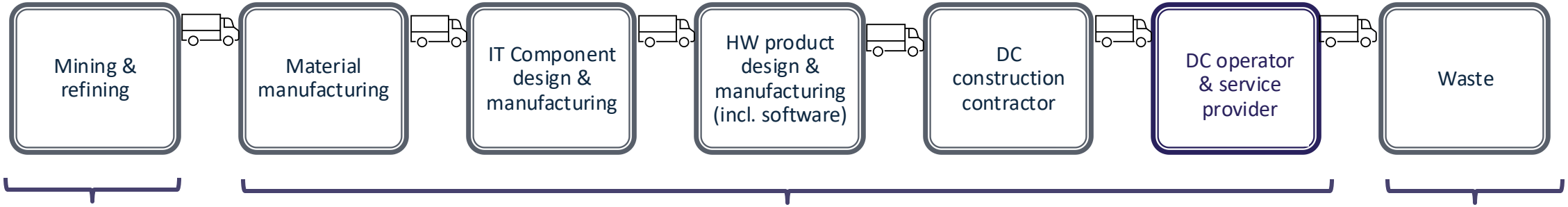
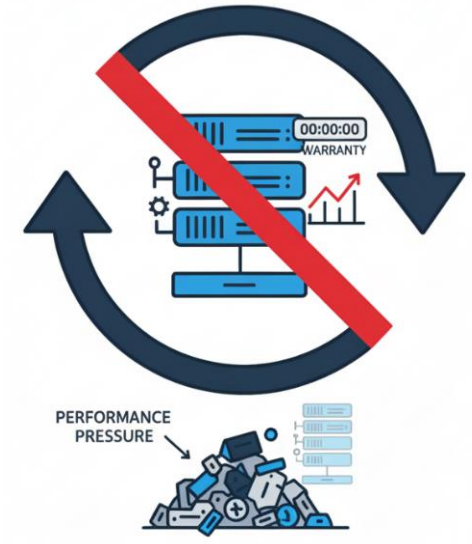
Our Linear Model is leaking Value and introducing volatility

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

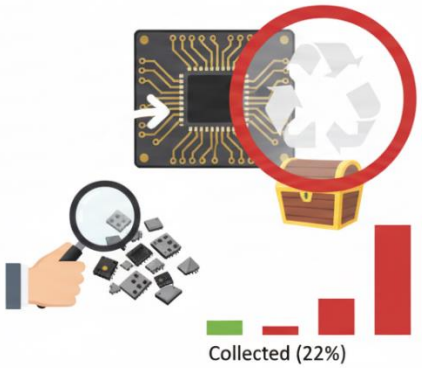


Over 70% of Critical Raw Materials (CRMs) for chips are concentrated in East Asia, creating a significant **supply chain risk**



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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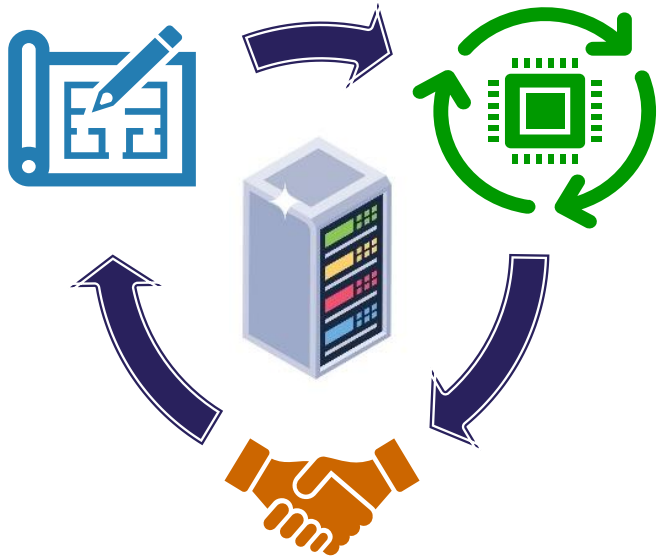
The Blueprint: Three Strategic Levers to Unlock Circular Value

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 the most crucial, achievable, and impactful solutions** across **three key areas**.

This presentation focuses on **Lever 2 and provides 3 interventions and a roadmap**

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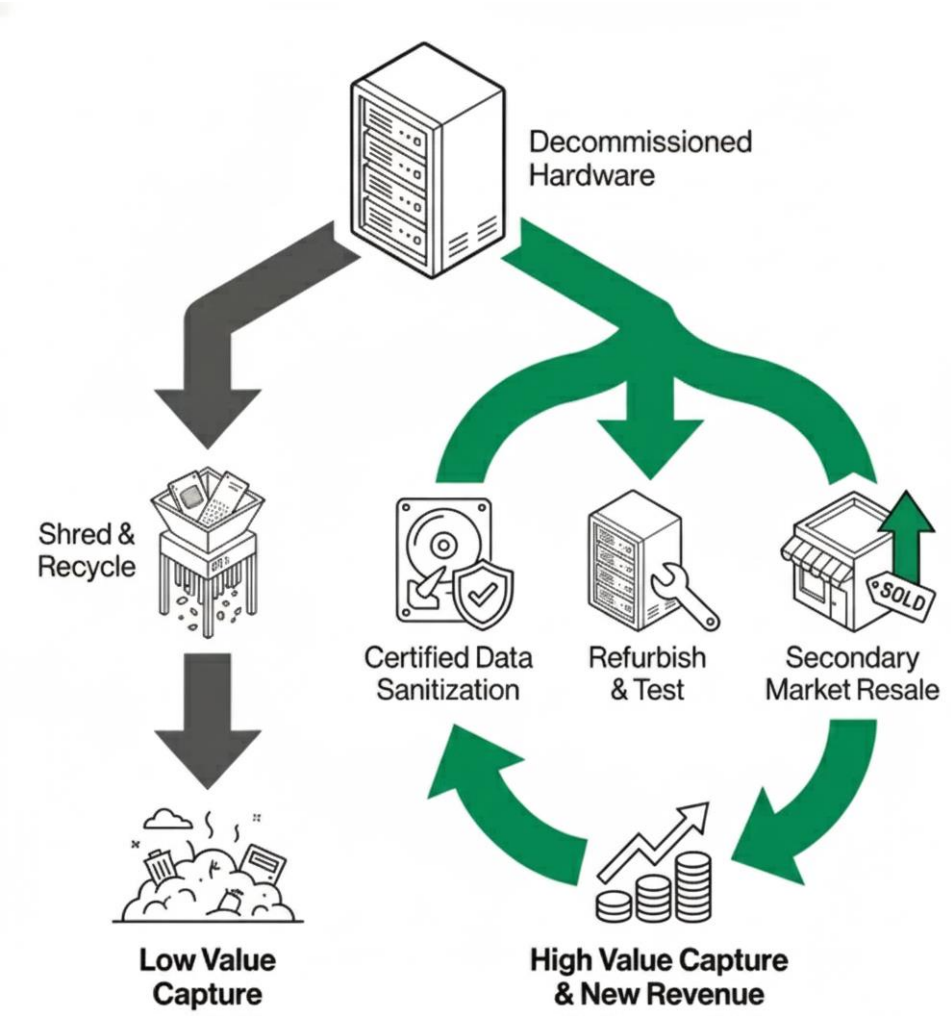
Turn Decommissioned assets into New Revenue Streams

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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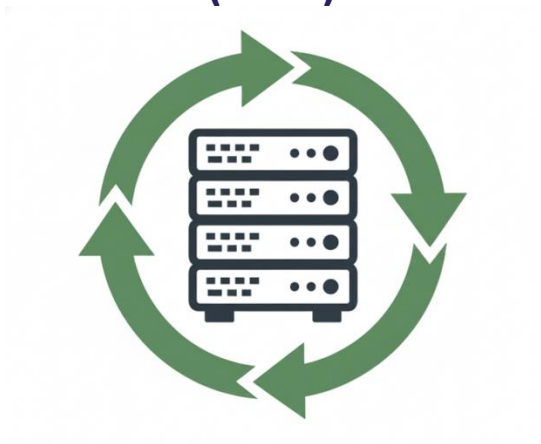
Lever 2: Maximise Reuse and Resource Recovery

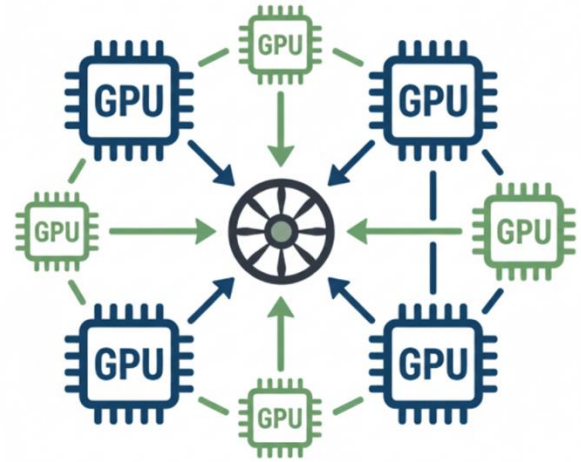
The Next Frontier: From Hardware Ownership to Service Models

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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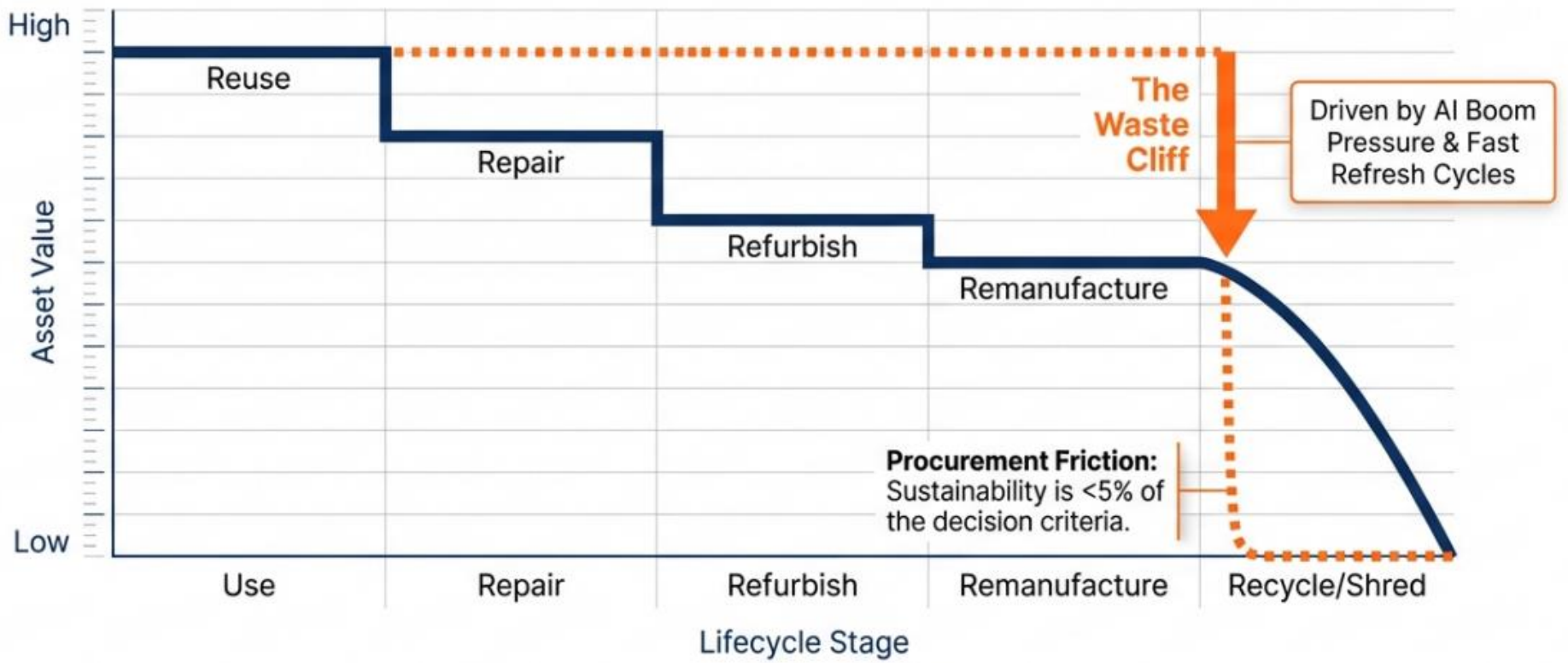
Lever 2: Maximise Reuse and Resource Recovery

The Linear Model is ‘Wasted Capital’

Value Retention Ladder



The Goal is to shift from End-of-Life Management to High Asset Value Retention

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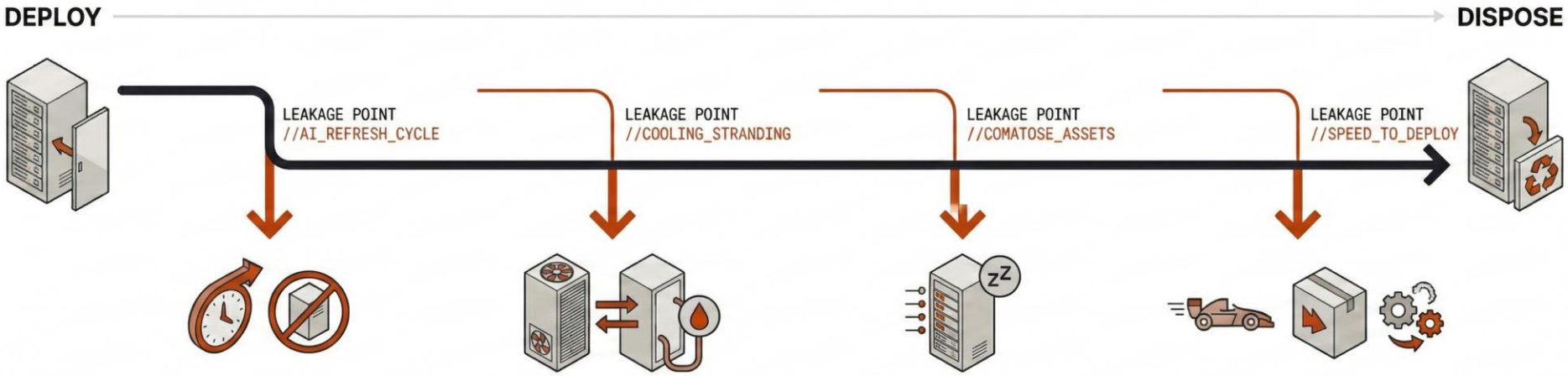
Lever 2: Maximise Reuse and Resource Recovery

Operational Pressures Drive Premature Obsolescence



Rapid Obsolescence

AI boom creates 6–12 month refresh cycles. High-density compute renders functional hardware "unfit" despite residual life.

Cooling Transitions

Shift to liquid cooling strands legacy air-cooled racks. Retrofitting deemed too risky or costly.

The "Comatose Asset"

Risk aversion leads to legacy servers remaining powered but unused to avoid outage fears.

Speed-to-Deploy

Operators default to buying new for speed, viewing refurbishment as too slow.

The Barrier is Trust:

Asset Visibility
We don't know where the kit is. Poor inventory data prevents reuse planningv

Data Security
Fear of imperfect sanitisation drives physical destruction policies

OEM Lock-in
IP restrictions block repair specs, incentivising new hardware sales.

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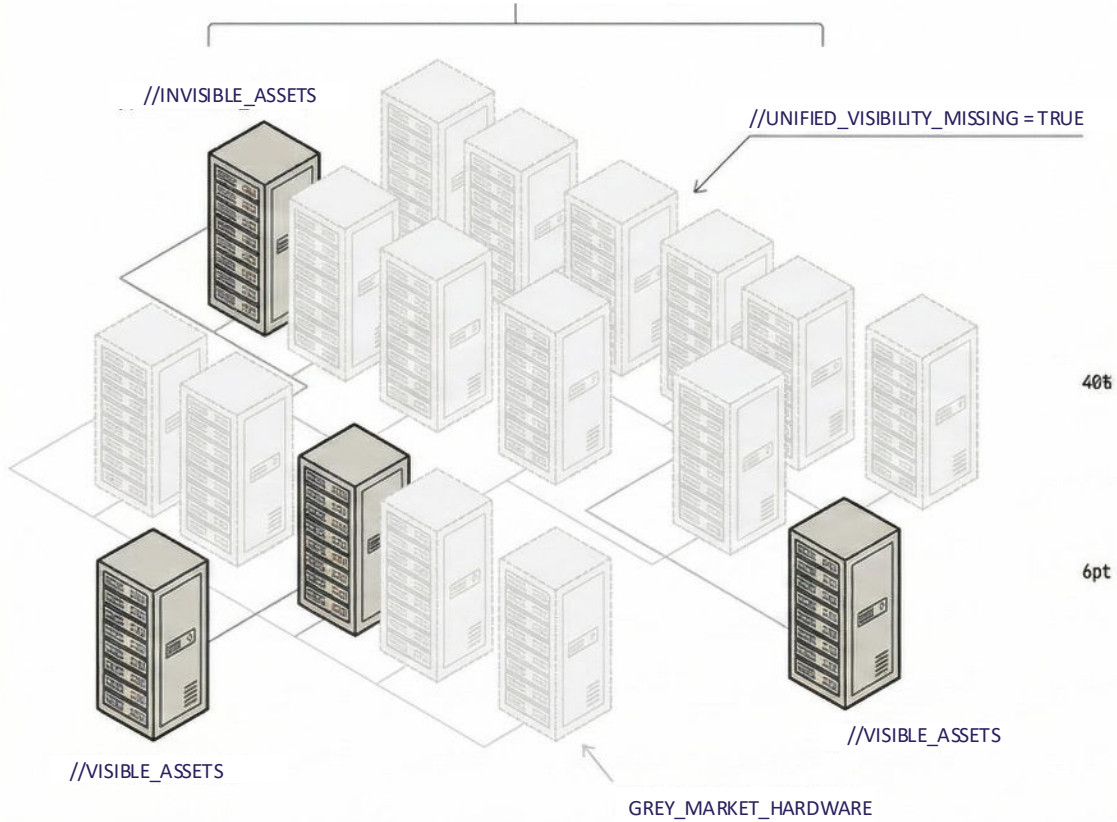
Lever 2: Maximise Reuse and Resource Recovery

Linear Business Models Block Second-Life Potential

The Visibility Gap

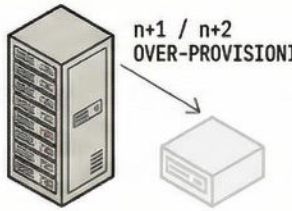
Lack of Asset Visibility



Barriers To Second-Life Potential

2pt

PROCUREMENT PSYCHOLOGY

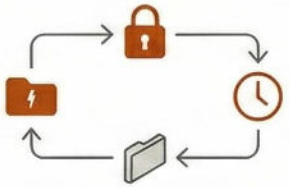


The 'More is Safer' (n+1/n+2) mindset leads to **over-provisioning. Surplus servers** sit unused until they become waste.

//SURPLUS_HARDWARE_FACTOR > DEMAND

LINEAR INCENTIVES

4pt

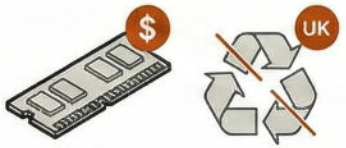


OEM models favour **new hardware sales**. **Firmware lock-ins** and **software support windows** force **early retirement.**

//FIRMWARE_LOCK_IN = TRUE; //SUPPORT_WINDOW_LIMIT

6pt

COMPONENT VOLATILITY



Memory shortages make **older components valuable**, but **lack of UK circular (i.e., Refurbish, Remanufacture & Recycle) infrastructure limits recovery**.

//COMPONENT_VALUE_SPIKE; //CIRCULAR_INFRASTRUCTURE_GAP

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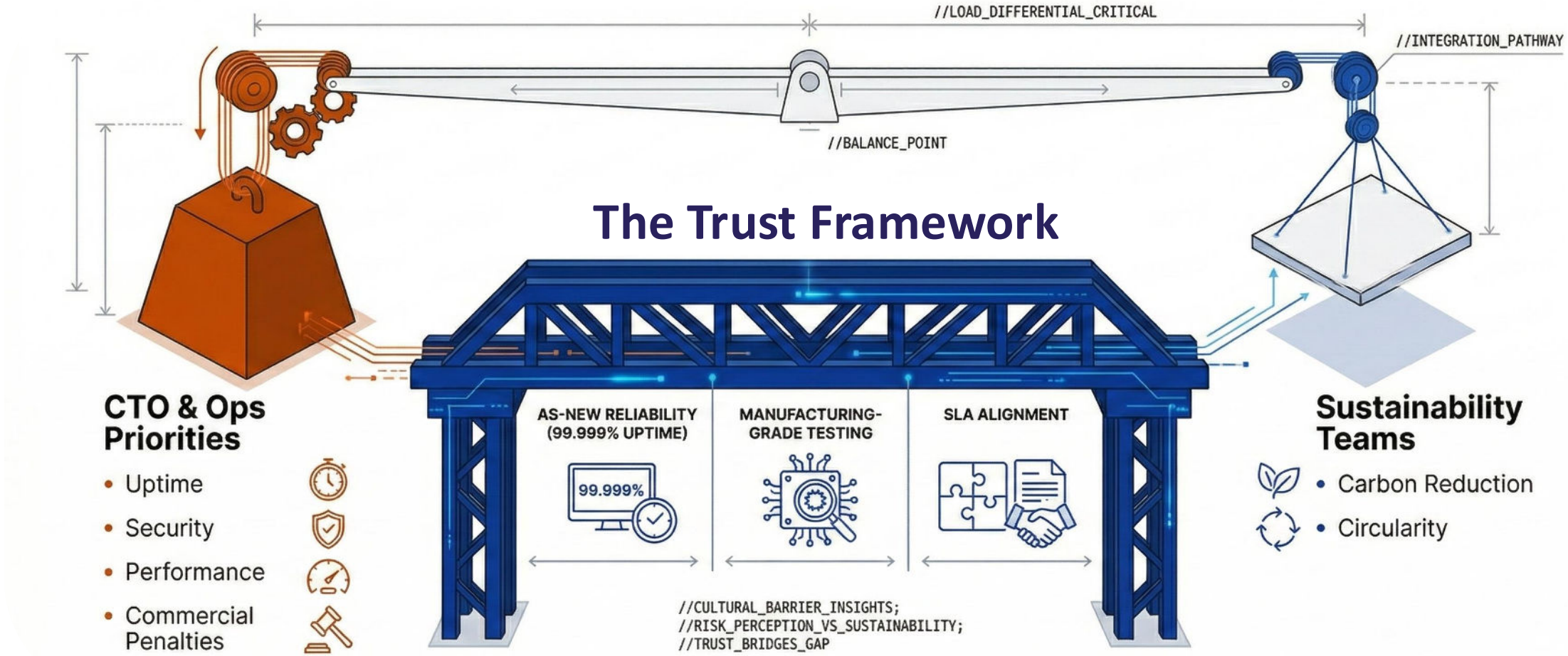
Lever 2: Maximise Reuse and Resource Recovery

The Biggest Enabler is Not Technology, But Trust



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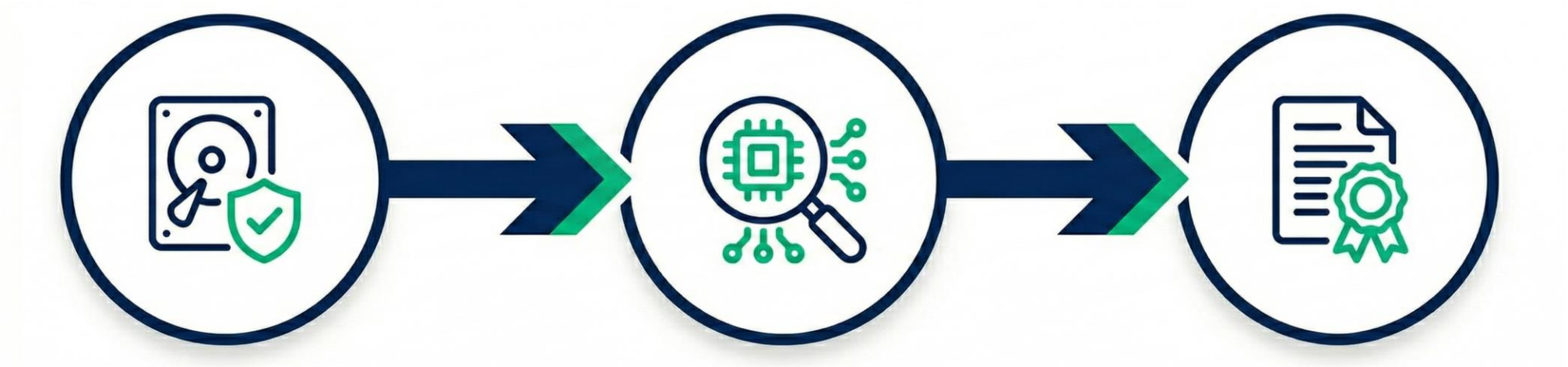
Lever 2: Maximise Reuse and Resource Recovery

Intervention 1: Operate for Maximum Value Retention

Transforming End-of-Life into Mid-Life Intervention



Certified Sanitisation
Auditable software wiping (e.g., Blancco standards).

Automated Grading
Standardised definitions (Grade A, B, C) for market clarity.

SLA-Aligned Warranties
Third-party guarantees to de-risk second-user adoption.

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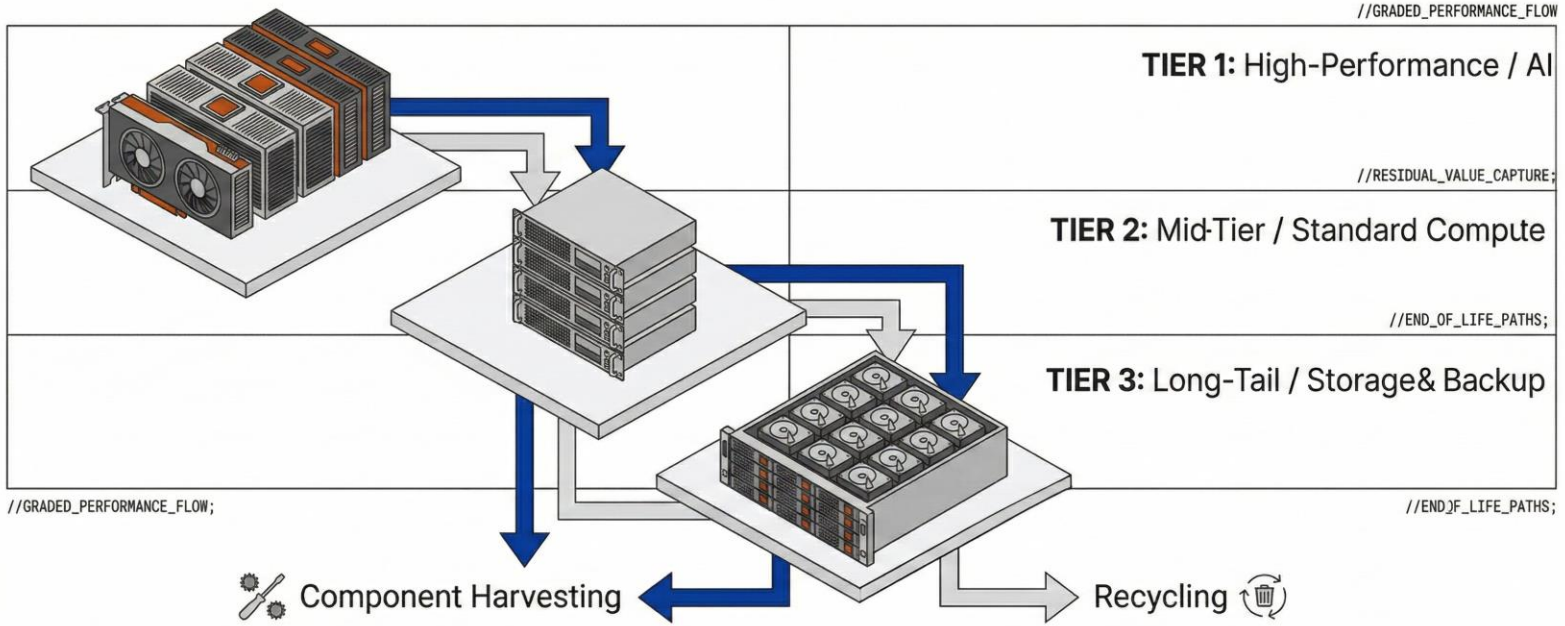
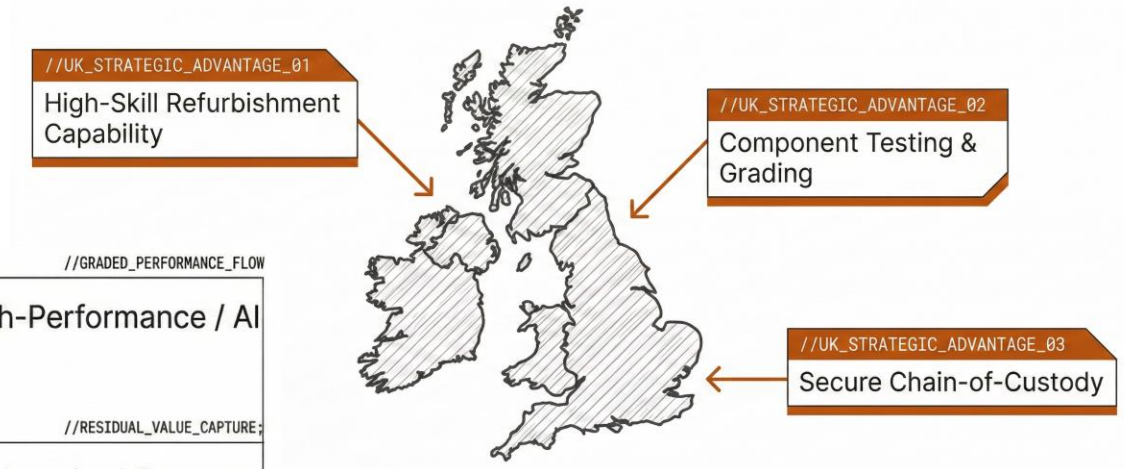
Creating a Common Language for Reuse: Standards & Grading

“Redefine the Data Centre as a Graded Performance System, not a binary new/old state”





UK Strategic Capabilities for Resilience

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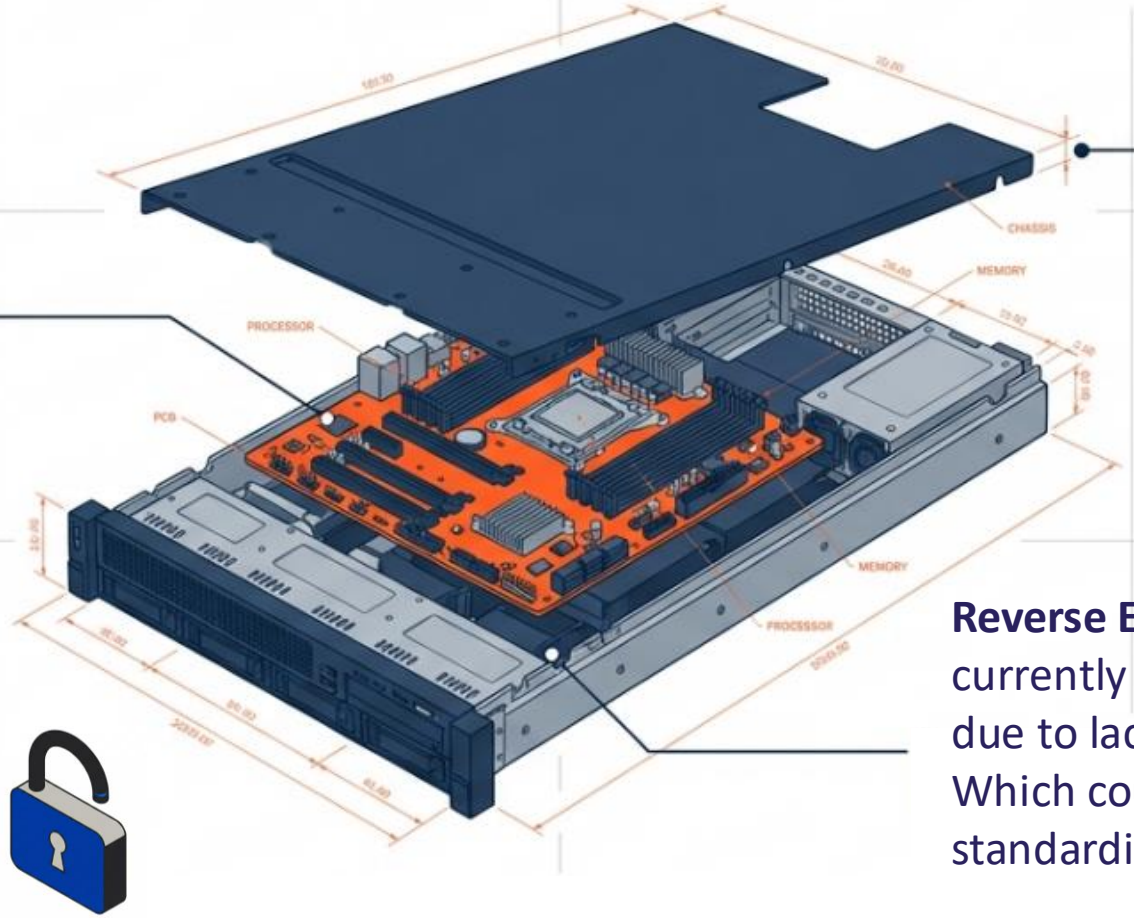
Intervention 2: Design for Re-Integration

Designing Open Server Hardware for Long-life and Seamless Component Recovery and Reuse

The PCB Challenge:
Currently shredded due to lack of extraction infrastructure. Future designs must easy component disassembly and allow tool-less removal.



Dematerialisation:
Reduce chassis wall thickness and rationalize components to cut material use.

Digital Openness
- Mandatory Firmware Release (Post-First Life)
- Enterprise Right to Repair
- Open Standards for Diagnostics

Reverse Engineering: Third parties currently must reverse engineer systems due to lack of OEM documentation. Which could be reduced through standardised or open layouts.

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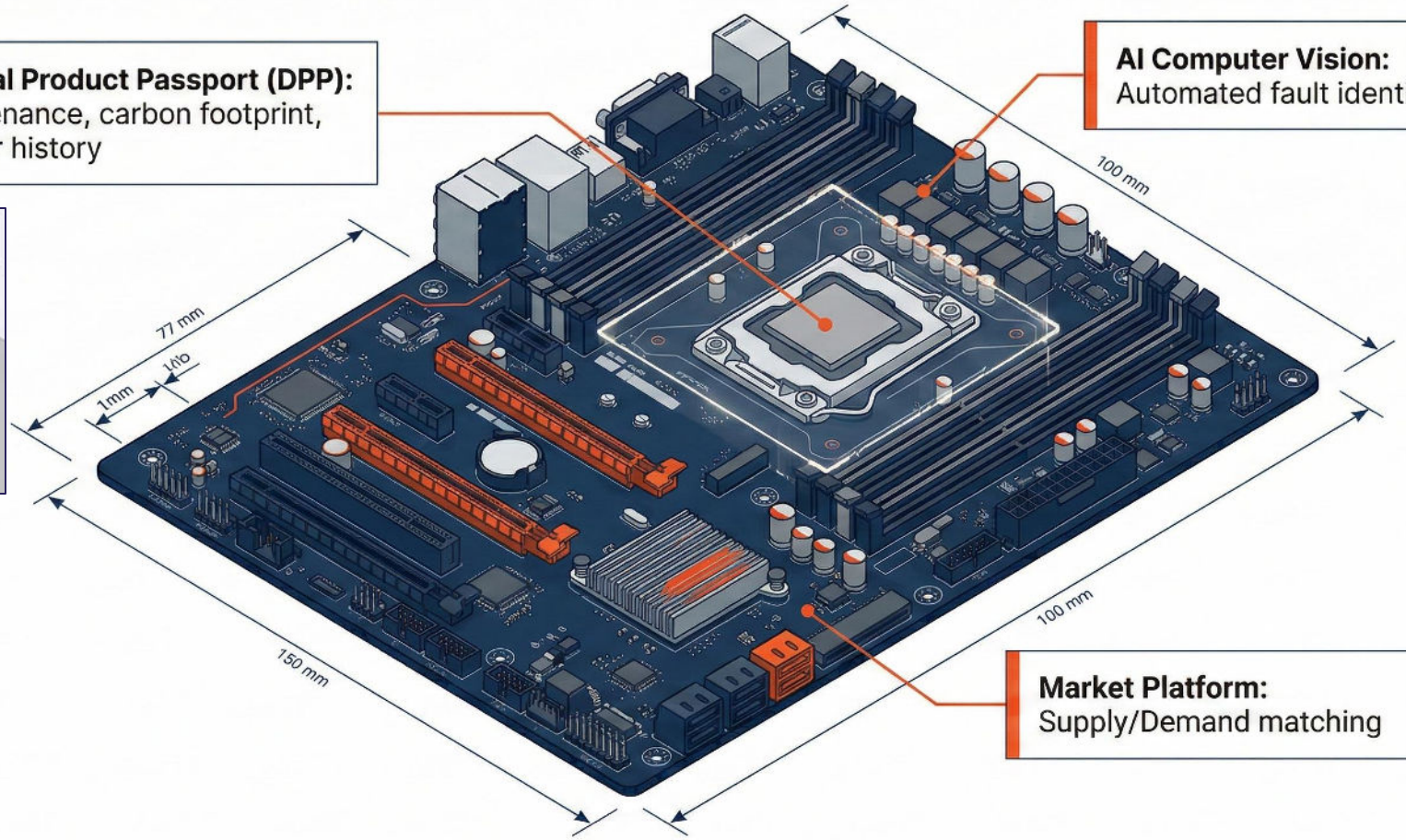
The Digital Bridge: From Opacity to Liquidity

Digital tools turn physical liabilities into liquid markets

Digital Product Passport (DPP):
Provenance, carbon footprint, repair history

AI Computer Vision:
Automated fault identification

DIGITAL PRODUCT PASSPORT // ASSET_DATA	
ASSET_ID	0x892A-B
STATUS	GRADE A / TIER 2
HOURS_ACTIVE	14,200
COMPONENT_HEALTH	99.8%
HISTORY	VERIFIED



Technology Stack

- **Digital Product Passports (DPPs):** Tracking asset history and provenance.
- **AI-Enabled Diagnostics:** Automated classification to verify condition.
- **System-Level Monitoring:** Optimising workload placement on older hardware.

Market Platform:
Supply/Demand matching

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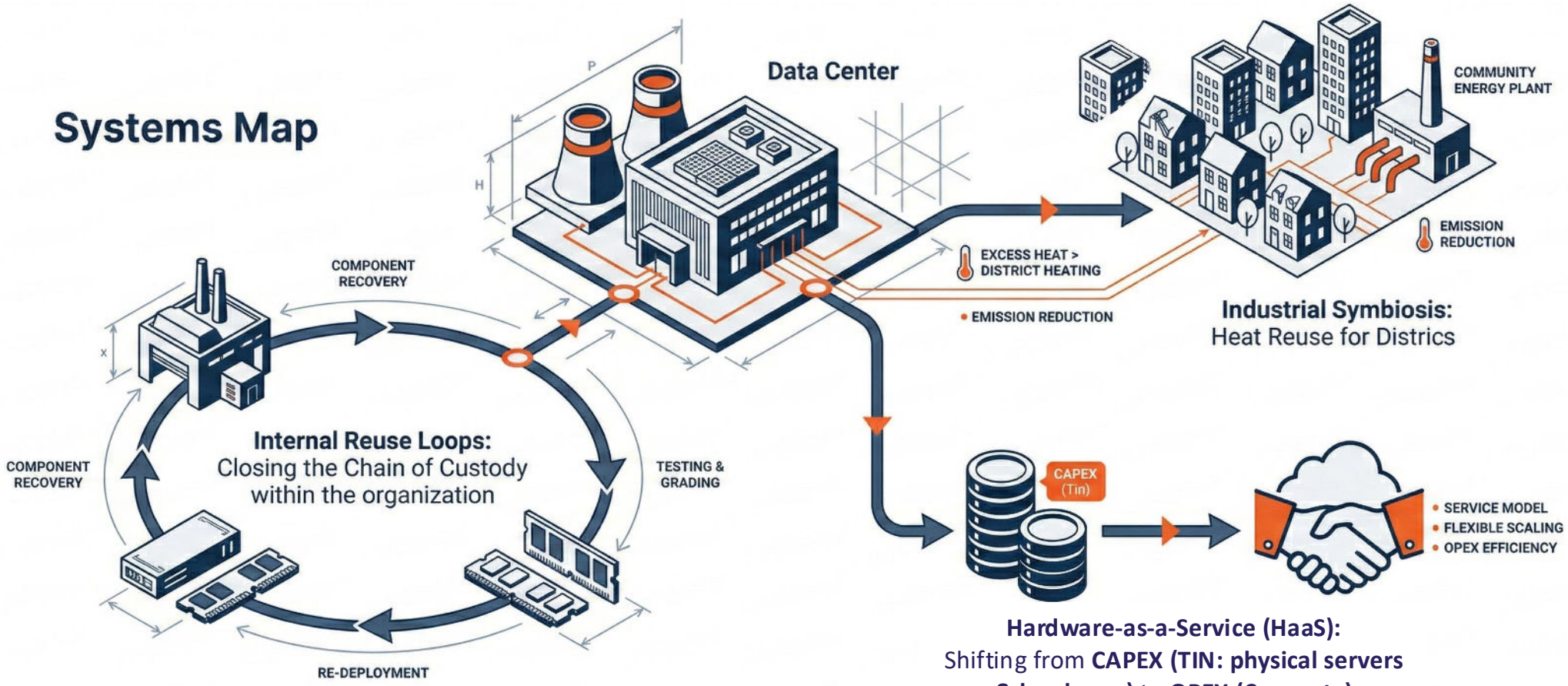
Intervention 3: Circular Business Models

Rethinking Value Creation through Systemic Design and Service-based Approaches



Hardware-as-a-Service (HaaS):
Shifting from **CAPEX (TIN: physical servers & hardware)** to **OPEX (Compute)**

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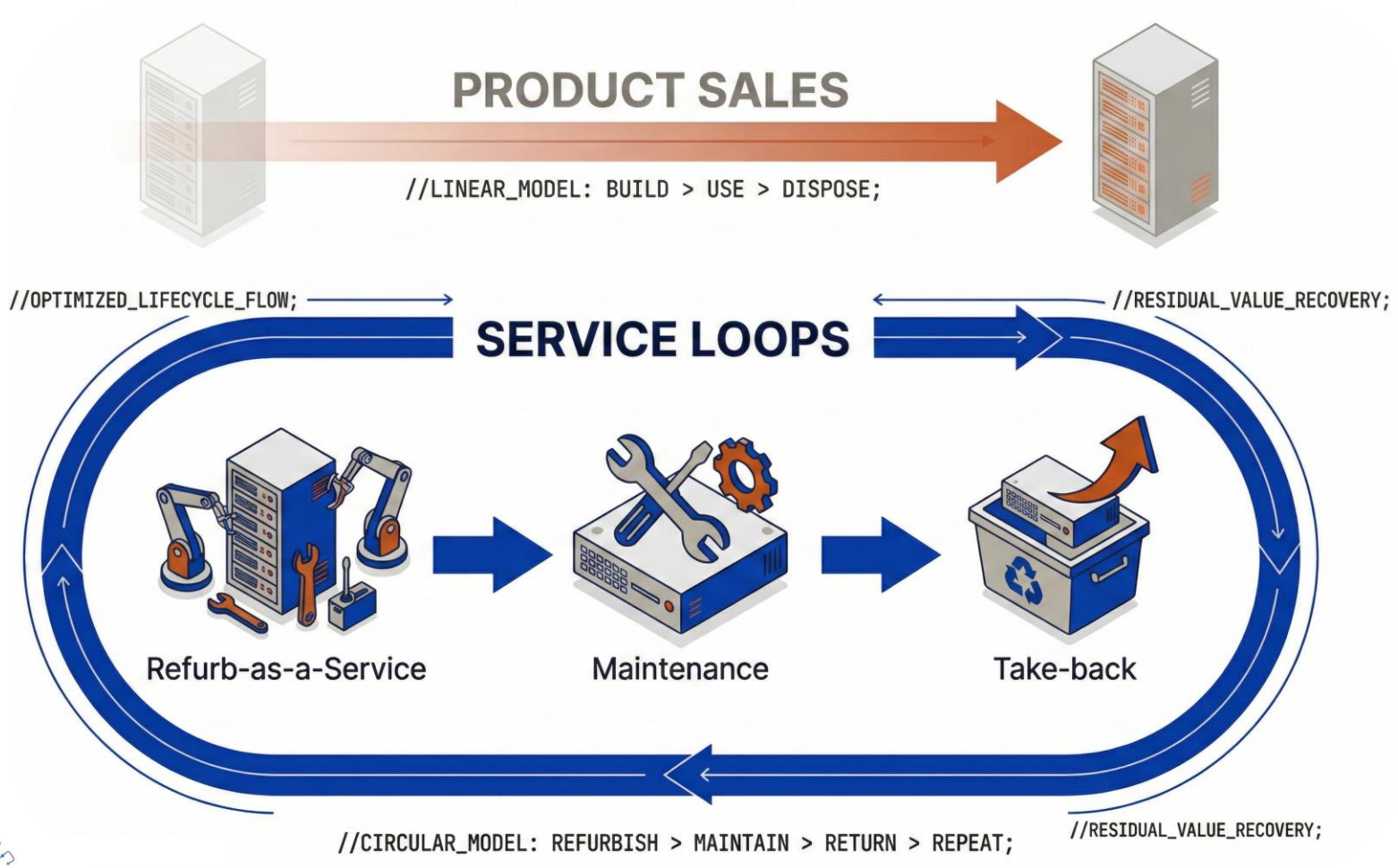
Shifting from Product Sales to Service Loops



COMPONENT HUB STRATEGY

Strategy: Component Reuse vs. Material Recycling

Focus on chips, memory, and drives. A materials hub is less viable in the UK (no refining capabilities), but a component hub addresses supply chain resilience.

Requirement: Transparent TCO and Vendor-Neutral Certification.

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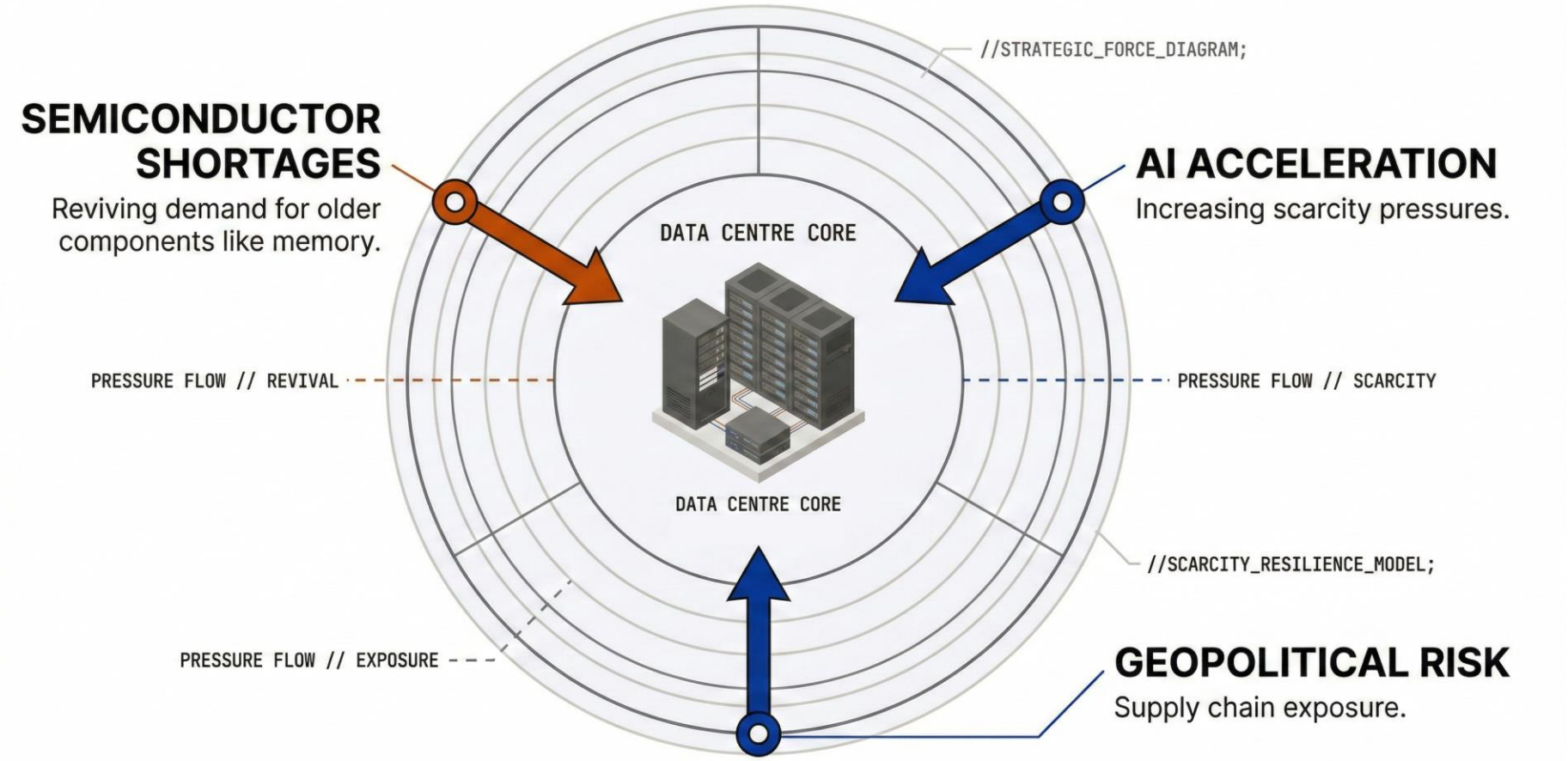
Scarcity and Resilience are the New Strategic Drivers



Circularity is a Resilience Strategy, not just a sustainability measure

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We must move from Mining Resources to Mining Urban Assets.

DC operators
Implement cascaded lifecycles, optimise temperatures, improve visibility.

OEMs & Suppliers
Design for modularity, unlock firmware, offer take-back. programmes).

Refurbishers
Build national component hubs, adopt AI testing.

Regulators & Policymakers
Set standards for grading and procurement.

Investors
Support new business models around reuse.

The Strategic Incentive: This is not just sustainability.
It is **Supply Chain Resilience** against **Geopolitical Disruption**

Call to Action: The technology exists. The barrier is mindset.
Start the audit today.

Integrating Circular Practices across the Ecosystem

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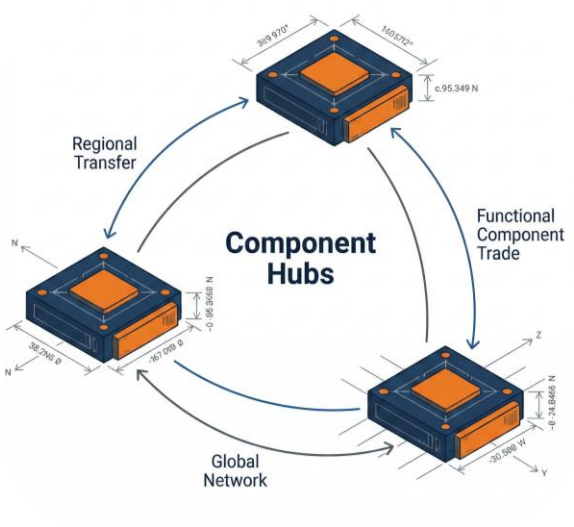
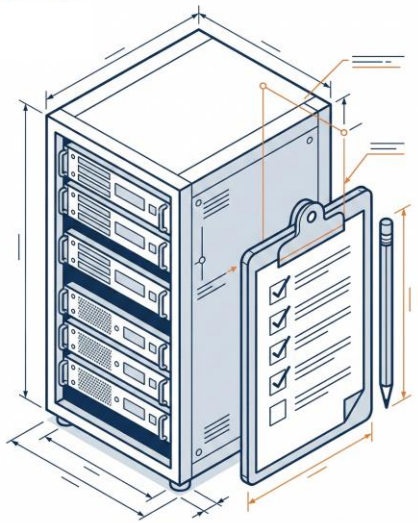
Circular Data Centre Infrastructure Roadmap



Phase 1: Foundation (0-12 Months)

Focus: Visibility & Compliance



- **Audit Inventory:** Locate hidden equipment, as visibility is required for reuse.
- **Stop Shredding:** Prevent disposal of non-critical items like racks and power supply units (PSUs). "If it's boxed, don't bin it".
- **Certified Erasure:** Use software wiping instead of physical destruction to keep assets functional.

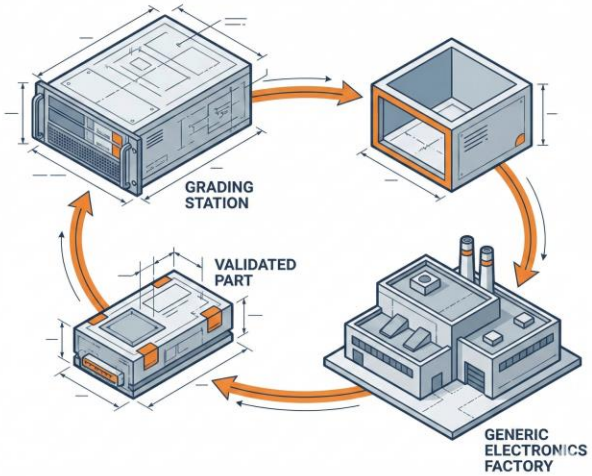
Phase 2: Scaling (1–3 Years)

Focus: Market Creation & Standardisation

- **Internal Reuse Loops:** Establish pilot programs to refurbish servers for internal, non-critical workloads, such as Test/Dev environments.
- **Fight for Transparency:** Create a procurement mandate to demand detailed part specifications from OEMs to bypass IP blocking.
- **Component Hubs:** Establish regional hubs (e.g., Asia/Europe) to trade functional components, moving the industry beyond simple materials recycling.

Phase 3: Systemic Integration (3+ Years)

Focus: Full ecosystem integration.



- **Standardised Grading:** Achieve industry-wide adoption of Grade A/B/C definitions that are accepted by risk officers and insurers.
- **Heat & Grid Integration:** Design new builds to function primarily as heat sources and grid-balancing nodes.
- **Cross-Sector Symbiosis:** Transform data centres into "Urban Mines" that supply validated parts to other electronics sectors

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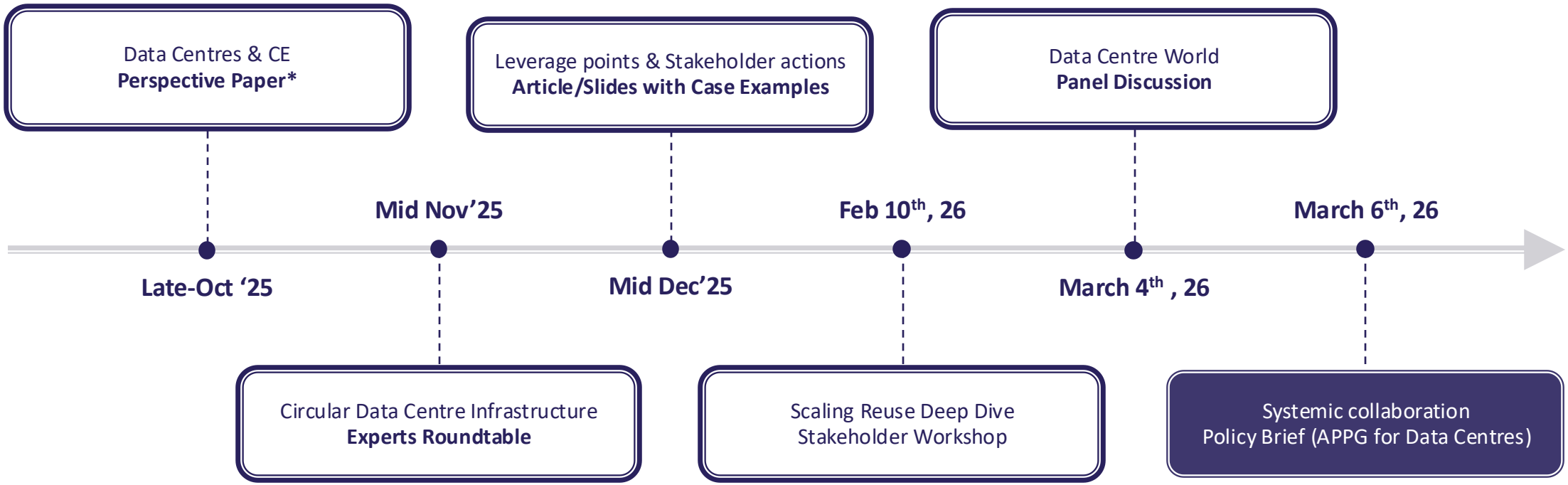
Lever 2: Maximise Reuse and Resource Recovery

The Circular Data Centre Infrastructure Blueprint

Timeline & Deliverables



*Submitted to Resources, Conservation, and Recycling Journal

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