

Demand for data and digital services is expected to continue its exponential growth over the coming years, with global internet traffic expected to double by 2022 to 4.2 zettabytes per year

10 Bn

5 billion mobile internet users by 2025

The Internet of Things (IoT) connections is expected to double from 12 Bn to 25 Bn

For ICT, the answer is in wholly circular, carbon negative data centers based on the 3 Opens of Technology (open source software, open hardware and open data)

Adoption of an open technology platform across hardware, software and data (3 Opens) and carbon accounting frameworks as the critical backbone in enabling circular, carbon negative data centres.

Open source software enables release of licenced and copyrighted source code;

Open Source Hardware enables the release of the designs of tangible artifacts;

Open Data relies on the notion of transparency and that data should be freely available to everyone.

All rely on the principles of collaboration and public benefit which is key to an effective circular economy.

OpenUK has formed a diverse, international consortium (see PDF attachment) to develop a blueprint for the carbon negative data centre

DECARBONISATION

DEMATERIALIZATION

CIRCULARITY

BLUEPRINT

Reduction and offset of product transportation miles

Arrangement for onsite/offsite repair and lifecycle extension of parts

Reuse of servers and components

Electrification of onsite fossil fuel processes such as steam

Full energy efficiency in the built environment

Power data centers via renewable energy sources

Local or district level heat recovery solutions

Electrification of transportation fleet

Adoption of responsible packaging solutions

Share learnings to partners in supply chain

Designing out waste and pollution

Keeping products and materials in use

Decarbonization of all key layers of the data centers.

Regenerating natural systems in the process

We would love the opportunity to share this blueprint at COP26 as an engaging and dynamic Computer Aided Design (CAD) model that will take industry, government, and prosumer participants on a journey which educates them on the true environmental cost of a data centre

## Building

Repurposed

Environmental  
Product  
Declaration  
(EPD)

## Energy

Purchased

On-Site  
Consumption

Carbon Capture  
/ Offset

Heat Redirect

## Hardware & Software

Rack scale IT

Open  
Architecture

Cooling & Heat  
Recapture

## Open Technology

## Regulatory

Transparency &  
reporting  
requirements

## Circularity

### Operations

People commute

Transport Fleet

Waste Mgmt

## Network

5G / Edge

## Approach

## Potential Impact

## Resources

### Building

Repurposed

Environmental  
Product  
Declaration  
(EPD)

With flexible working and edge computing as rising trends, there will be less office and retail space requirements in city centres and more central data centre requirements for edge computing.

Combining these trends presents an opportunity to reuse existing buildings, minimising reliance on new construction materials, and eliminating most of the embodied carbon associated with new buildings.

Refurbishing to high environmental standards will also improve site energy efficiency, waste management and heat reuse.

Embodied carbon savings of [up to 88%](#)

### Resources

[The greenest data centre is the one that's never built](#)

[Can we reboot office buildings as data centers?](#)

[The factories of the past are turning into the data centers of the future](#)

[Recycled Buildings. Abandoned properties are being turned into data centers](#)

### Case Studies

[Holistic cooling at the world's most efficient data center](#)

[Chilled efficiency building Boden's type data center one](#)

## Approach

## Potential Impact

## Resources

### Building

Repurposed

Environmental  
Product  
Declaration (EPD)

Open software and open data as the enablers to transparently communicating the environmental performance and impact of building materials.

Market differentiation

Regulatory and legal compliance

Shared learning / collaboration

### Resources

[A simple guide to Environmental Product Declarations \(EPD\)](#)

[Open EPDs](#)

### Case Studies

[Microsoft: Reducing Embodied Carbon in Construction](#)

## Approach

## Potential Impact

## Resources

### Energy

Purchased

Carbon Capture  
/ Offset

Heat Redirect

While the ultimate goal is to source 100%, verified renewable energy, this may prove difficult in many cases today. A transitional approach is required which includes:

Offsetting through carbon capture programs. Purchasing Renewable Energy Certificates (RECs) for these programmes should only be treated as a transitional step.

Initially establish green supply agreements with local utilities, then transition to achieving 100% renewable energy matching through Power Purchase Agreements (PPAs).

24x7 Renewable Energy, 100% of the time by combining PPAs with local storage capacity

Transparent, open data reporting across energy sourced, consumed, offsetting and matching.

### Resources

[How data centre operators can transition to renewable energy](#)

[Renewable energy for data centres](#)

### Case Studies

[Google's solar deal - Nevada data center would be largest of its kind](#)

**Energy**

Purchased

Carbon Capture / Offset

Heat Redirect

Approach	Potential Impact	Resources
<p>Offsetting should be treated as a temporary and transitional solution to achieving 100% Renewable Energy in the data centre.</p> <p>Offsetting through the purchase of Renewable Energy Certificates, need to exclusively be based on carbon capture programs (tree planting or technology) which respect local bio-diversity and ecosystems (including indigenous communities).</p> <p>Open Data and Open Software should be adopted to transparently report across offsetting requirements, RECs purchase, and programmes behind RECs</p>		<p><b>Resources</b></p> <p><a href="#">How data centre operators can transition to renewable energy</a></p> <p><a href="#">Renewable energy for data centres</a></p> <p><b>Case Studies</b></p>

**Energy**

Purchased

Carbon Capture / Offset

Heat Redirect

**Approach**

Heat generated in data centres, which is traditionally considered as waste, should be repurposed towards applications which can benefit from it, for example sustainable agriculture, or leverage an edge-based architecture to recycle heat into the homes of marginalised communities in order to reduce costs and replace the reliance on natural gas.

**Potential Impact**

[Up to 30%](#) savings on air conditioning costs

**Resources**

[Heat recovery from data centres: A win win situation](#)

[Utilisation of waste heat in the data centre](#)

**Case Studies**

[Blockheating and ITRenew](#)

Hardware & Software	Approach	Potential Impact	Resources
<div data-bbox="173 205 467 256">Rack scale IT</div> <div data-bbox="173 267 432 347">Open Architecture</div> <div data-bbox="173 365 432 445">Cooling &amp; Heat Recapture</div>	<p data-bbox="546 158 1058 365">Open hardware, optimised by open software, with a circular model in order to keep assets in highest utility value for as long as possible, maximising lifetime value and sustainability. This requires:</p> <div data-bbox="585 407 1020 436">Internal repair, reuse and reclaim</div> <div data-bbox="585 478 913 507">Rack scale recertification</div> <div data-bbox="585 549 991 611">Remanufacturing for edge form factors</div> <div data-bbox="585 653 1029 720">Recertification and remarketing of components</div> <div data-bbox="585 762 875 791">Responsible recycling</div> <p data-bbox="546 833 1020 969">This recertification avoids corresponding amount of emissions tied to manufacturing and enables a zero carbon IT supply chain.</p>	<p data-bbox="1112 158 1421 223">Combined with an open architecture approach:</p> <div data-bbox="1112 265 1503 294">Capex Reduced by up to 50%</div> <div data-bbox="1112 336 1487 365">Opex Reduced by up to 30%</div> <div data-bbox="1112 407 1474 469">GHG Emissions reduced by up to 25%</div> <div data-bbox="1112 511 1441 578">Dematerialisation of Data Centre by up to 90%</div>	<p data-bbox="1559 158 1705 187"><b>Resources</b></p> <div data-bbox="1559 216 1860 322"><a href="#">Open Compute Project (OCP) reference designs</a></div> <div data-bbox="1559 363 1874 500"><a href="#">How the circular data center model benefits the environment and the bottom line - ITRenew</a></div> <div data-bbox="1559 541 1874 642"><a href="#">3 Reasons to adopt new data center models - ITRenew</a></div> <div data-bbox="1559 683 1870 745"><a href="#">Open Hardware and the Circular Economy</a></div> <p data-bbox="1559 787 1738 816"><b>Case Studies</b></p> <div data-bbox="1559 858 1860 887"><a href="#">ITRenew and Atlanticis</a></div>



Hardware & Software	Approach	Potential Impact	Resources
<div data-bbox="171 205 432 254">Rack scale IT</div> <div data-bbox="171 268 467 348">Open Architecture</div> <div data-bbox="171 364 432 445">Cooling &amp; Heat Recapture</div>	<p>An open architecture enables the circularity required to achieve carbon zero.</p> <p>Open hardware leverages standard components, enabling recertification, reconfiguration, testing and integration to lower capex and opex while reducing GHG emissions from extended lifetime and delayed reliance on new materials.</p> <p>Open systems firmware enables updates and security across multiple lifetimes, lowering opex.</p> <p>An open architecture is also best suited for enabling innovation through its broad support, cost accessibility and flexibility.</p>	<p>Combined with server and racks approach:</p> <p>Capex Reduced by up to 50%</p> <p>Opex Reduced by up to 30%</p> <p>GHG Emissions reduced by up to 25%</p> <p>Dematerialisation of Data Centre by up to 90%</p>	<p><b>Resources</b></p> <p><a href="#">The future of power efficient data centers</a></p> <p><b>Case Studies</b></p> <p><a href="#">Comcast Central Office showing 90% dematerialisation</a></p>

Hardware & Software	Approach	Potential Impact	Resources
<div data-bbox="171 205 432 254">Rack scale IT</div> <div data-bbox="171 270 432 348">Open Architecture</div> <div data-bbox="171 364 467 443">Cooling &amp; Heat Recapture</div>	<p data-bbox="531 158 946 256">Cooling accounts for up to 40% of all energy consumed by data centres.</p> <p data-bbox="531 300 946 540">Closed looped water cooling systems, combined with OCP architecture to leverage full power and space efficiency, is emerging as the leading cost-effective and environmentally friendly solution to cooling.</p>	<p data-bbox="1029 158 1400 223">Power and cooling costs reduced by up to 30%</p> <p data-bbox="1029 262 1400 327">CO2 and Pollution reduction of up to 30%</p>	<p data-bbox="1479 158 1632 185"><b>Resources</b></p> <p data-bbox="1479 212 1777 283"><a href="#">Data Centres and Environment - Submer</a></p> <p data-bbox="1479 311 1854 382"><a href="#">Ten Considerations for Data Center Direct Liquid Cooling</a></p> <p data-bbox="1479 409 1854 546"><a href="#">Waste Heat Utilization is the Data Center Industry's Next Step Toward Net-Zero Energy</a></p>
	<p data-bbox="531 584 975 933">Heat generated in data centres should be repurposed towards applications which can benefit from it, for example sustainable agriculture, or leverage an edge-based architecture to recycle heat into the homes of marginalised communities in order to reduce costs and replace the reliance on natural gas.</p>		<p data-bbox="1479 573 1835 638"><a href="#">Utilisation of Waste Heat in the Data Centre</a></p> <p data-bbox="1479 715 1665 742"><b>Case Studies</b></p> <p data-bbox="1479 780 1771 813"><a href="#">Nautilus and ITRenew</a></p> <p data-bbox="1479 851 1835 889"><a href="#">Blockheating and ITRenew</a></p>

## Approach

## Potential Impact

## Resources

### Network

5G / Edge

Deployment of an edge-based network architecture, enabled by 5G connectivity, can:

Increase speeds by up to 10 times that of 4G

Reduce latency by bringing compute capabilities into the network and closer to end users

Reduce commute time of employees and travel distance of transportation fleet

Enable local and district heat redirect solutions due to proximity of data centres

### Resources

### Case Studies

**Approach**

**Potential  
Impact**

**Resources**

**Operations**

People commute

Transport Fleet

Waste Mgmt

**Resources**

**Case Studies**

## Approach

## Potential Impact

## Resources

### Operations

People commute

Transport Fleet

Waste Mgmt

Electrification of the full  
transportation fleet.

### Resources

[The road to fleet  
electrification](#)

[Data - the key to fleet  
electrification](#)

### Case Studies

**Approach**

**Potential  
Impact**

**Resources**

**Operations**

People commute

Transport Fleet

Waste Mgmt

Adoption of responsible packaging solutions, including all packaging materials from recycled content and for them to be further reusable, recyclable, or compostable - eliminate single use plastic in IT asset packaging, and dramatically reduce packaging weight.

**Resources**

**Case Studies**

## Approach

## Potential Impact

## Resources

### Regulatory

Transparency & reporting requirements

Reducing critical Scope 3 emissions is highly dependent on the transparency, reporting and commitment from the entire supply chain.

Voluntary reporting has demonstrated inconsistency in data and lack of transparency, so the introduction of regulations to ensure full transparency and reporting across all scopes (1,2,3) is required.

Furthermore, governments should require full transparency and disclosure from their data centre supply chain.

An open data model is essential to enable collaboration and public benefit.

### Resources

[SDIA Open Data Hub](#)

[UK Government should have a centralised register of all its data centres](#)

### Case Studies

<https://www.scaleway.com/en/transparency/>