Sustainability Opportunities in Cloud Storage

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AGENDA

• Carbon Emissions Landscape

• Datacenter Industry - Carbon Goals

• Storage – Capacity Growth & Carbon Growth

• Major Contributors of Storage Infrastructure Carbon

• Opportunities for Storage Carbon Footprint reduction
Carbon Emission Landscape
IT Communication & Tech (ICT) Industry’s Contribution to Carbon Emissions

Half of entire Transportation sectors’ current Emissions

4X

Sources: Science Direct: Assessing ICT global emissions footprint: Trends to 2040 & recommendations

Source: US Environmental Protection Agency
Green Datacenter Market Revenue Prediction – 2022 to 2030

Sources: Fortune Business Insights
Datacenter Industry – Carbon Goals
Industry Carbon Emission Reduction Goals

2025
- AWS
- Google Cloud
- Microsoft

2030
- Dell
- Google Cloud
- HPE
- IBM
- Meta
- Microsoft
- Schneider Electric
- Seagate

2040
- AWS
- Google Cloud
- HPE
- Intel
- Meta
- Microsoft
- Pure Storage
- Schneider Electric
- Seagate

2050
- Dell
- HPE
- Microsoft
- Samsung
Microsoft Sustainability Goals 2030

**CARBON NEGATIVE**

2030: Offset or remove more carbon from the atmosphere than we emit

2050: Remove an equivalent amount of carbon Microsoft has emitted, since we were founded in 1975

**WATER POSITIVE**

2030: Replenish more water than our global consumption

**ZERO WASTE**

2030: Reducing, Reusing and Recycling to drive no waste direct-to-landfill

Source: [MSFT Sustainability Report 2022]
## Carbon Emission Categories

<table>
<thead>
<tr>
<th>CATEGORIES OF EMISSIONS</th>
<th>DESCRIPTION</th>
<th>SUB-CATEGORY OF INTEREST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope 1</strong> Carbon Emissions</td>
<td>“BURN” Carbon emission due to direct combustion / burning of fuel purchased. (Direct sources of emission)</td>
<td></td>
</tr>
<tr>
<td><strong>Scope 2</strong> Carbon Emissions</td>
<td>“BUY” Carbon emissions associated with purchased electricity/energy. (Indirect sources of emission)</td>
<td>Operational Carbon (Power)</td>
</tr>
<tr>
<td><strong>Scope 3</strong> Carbon Emissions</td>
<td>“BEYOND” Carbon emissions due to all the other products, machinery, services, etc. that one uses or powers.</td>
<td>Embodied Carbon</td>
</tr>
</tbody>
</table>
Carbon Emissions – Microsoft - 2022

- Largest section of emissions
- Includes “Embodied Carbon” as a major contributor

Detailed 2030 Sustainability Goals:

- **Scope 1,2**: Near Zero Emission Target
- **Scope 3**: Reduce by more than half from 2020 baseline

Source: [MSFT Sustainability Report 2022](#)
Storage – Capacity Growth & Carbon Growth
Nearly ~175 Zettabytes
Data Created - 2025

~5 zettabytes storage media installed base - 2025

~17% compound annual growth of installed capacity
Major Contributors of Storage IT Infrastructures’ Carbon Emissions

Total Carbon Emissions by Storage Infrastructure

SCOPE 2 – Operational Carbon

SCOPE 3 Embodied Carbon

*Cloud Storage Provider’s Perspective

Power utilization by Storage IT Racks

Manufacturing
Transport
Installation
Total Cost of Ownership (TCO)

- Upfront Cost
- Operational Cost

Per unit performance

Total Carbon Cost of Ownership (TCCO)

- Embodied Carbon
- Operational Carbon

Per unit performance
## Major Carbon Contributors of Storage IT Infrastructure

<table>
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<tr>
<th>HDDs</th>
<th>SSDs</th>
<th>Memory</th>
<th>Processors / NICs / ICs</th>
<th>Chassis / Enclosure</th>
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**Limitations** - in Comparing Carbon Reports from various devices / vendors:

- Lack of ready Carbon Assessment reports (via LifeCycle Assessment (LCA))
- LCA methodologies not industry standardized

**Attempt** – To run a similar assessment methodology for comparison on all device categories
Major Carbon Contributors of Storage IT Infrastructure

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<tr>
<td><strong>Embodied Carbon (Scope 3) Contribution</strong></td>
<td>Med</td>
<td>High</td>
<td>High</td>
<td>Med</td>
<td>High</td>
</tr>
<tr>
<td><strong>Operational Carbon (Power - Scope2) Contribution</strong></td>
<td>Med</td>
<td>Low</td>
<td>Med</td>
<td>High</td>
<td>--</td>
</tr>
<tr>
<td><strong>% of Storage Fleet Infrastructure</strong></td>
<td>High</td>
<td>Med</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
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Storage – Carbon Reduction Opportunities
Opportunities – Design For Sustainability

High Embodied Carbon

- Design for longer device Lifespan
- Design for reuse enablement (Circularity)
- Design for recycle enablement

Extend lifespan for devices while delivering to key product metrics & power
Ability to confidently & securely wipe stored data & reuse (Circular Economy)
Enable easy recycle of components / Sub-components
Opportunities – Design For Sustainability

- Closer monitoring of power & utilization of devices
- Enable usage of low power states with manageable latencies for systems
- Minimizing device power usage to reduce the aggregate power

Additional - Continuous Effort to use Renewable Energy for Power Usage
Longer Term Opportunities –
New media with lower Carbon Footprint

- SILICA
  - Recyclable media material
  - No power used in the Storage phase (after writing data)
  - Less data refreshes needed as the storage media lasts longer

- DNA / Molecular
CALL TO ACTION

With rapid growth of Cloud Storage,

• Design for reducing embodied carbon
• Design for reducing operational carbon
• Explore new media with lower carbon footprint
THANK YOU!