Life Cycle Assessment Approach to Address up and Coming Sustainability Challenges in the Design of Data Centre Equipment.

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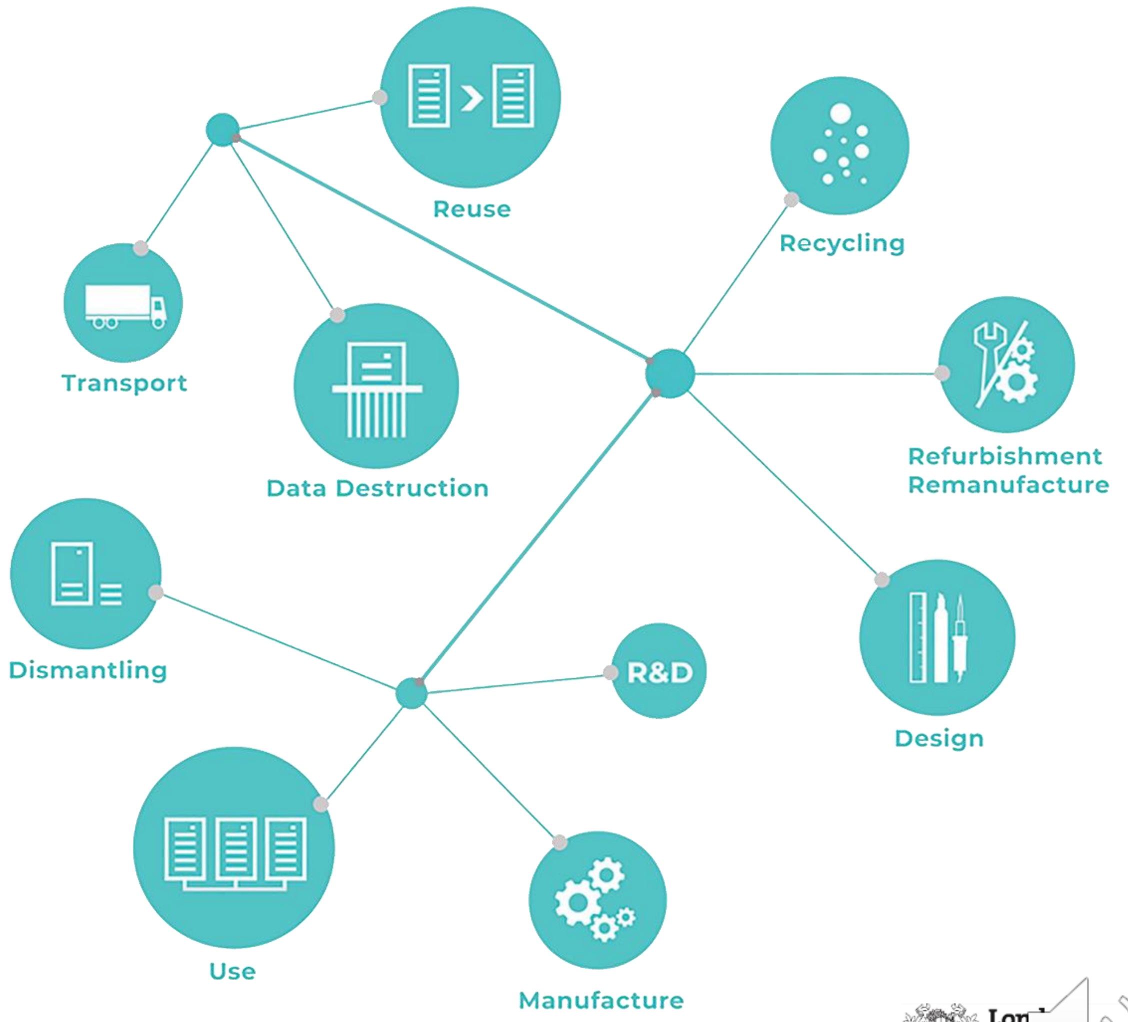
Circular Economy for the Data Centre Industry

Interreg North-West Europe CEDaCI

About CEDaCI Project

- 3-year Interreg-funded project led by LSBU
- A lifecycle approach to DCI e-waste and CRM recovery.
- Stakeholder collaboration to drive sustainability in industry
- Trans-sectoral learning through Co-creation Workshops
- Extended product use and refurbishment
- Implementation of the Eco-design Guidelines
- Circular Data Centre Compass (CDCC) – CEDaCI online decision-making tool



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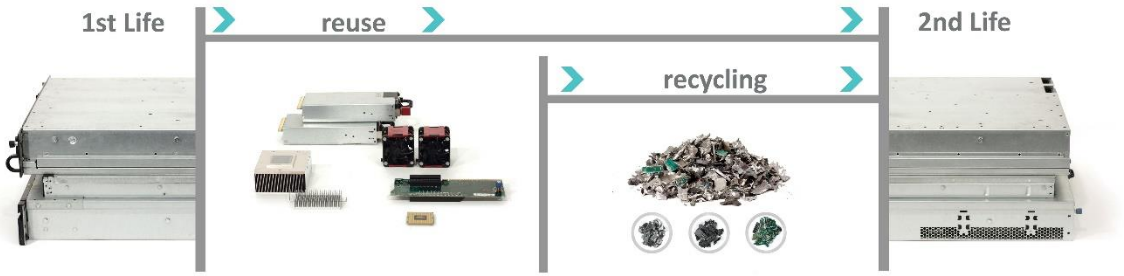
Aim of this session



- Highlight the constraints Data Centre Industry is facing in its efforts towards optimum energy efficiency and sustainability
- Proposes a Life Cycle Assessment (LCA) approach as a decision-making instrument
- Promote design thinking for the Circular Economy

The role of the Data Centres

Data Centres support every possible part of our lives processing and managing digital data in every conceivable activity across society and contributing hundreds of millions annually to the economy making them a crucial part of the national infrastructure.

There are many different types of Data Centres with different business models such as: Hyperscale, Colocation, Enterprise, Edge etc.

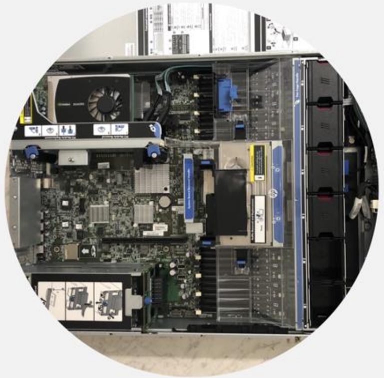
The problem

- 300% increase in global internet traffic between 2015 and 2019
- Predicted to reach 4.2 trillion gigabytes by 2022
- Sectoral energy demand is predicted to reach ~200TWh by 2021
- Between 21% and 61% of DC total energy can be allocated to cooling
- Over 50% of Data Centre energy is used by DCPI
- Cooling equipment plays an important part in DC efficiency

Current solutions

1. Air-cooled server
2. Direct-to-chip liquid cooling
3. Fully-immersive liquid cooling
4. Chassis-based liquid cooling

Some Larger Data Centre facilities are adopting hybrid solutions.



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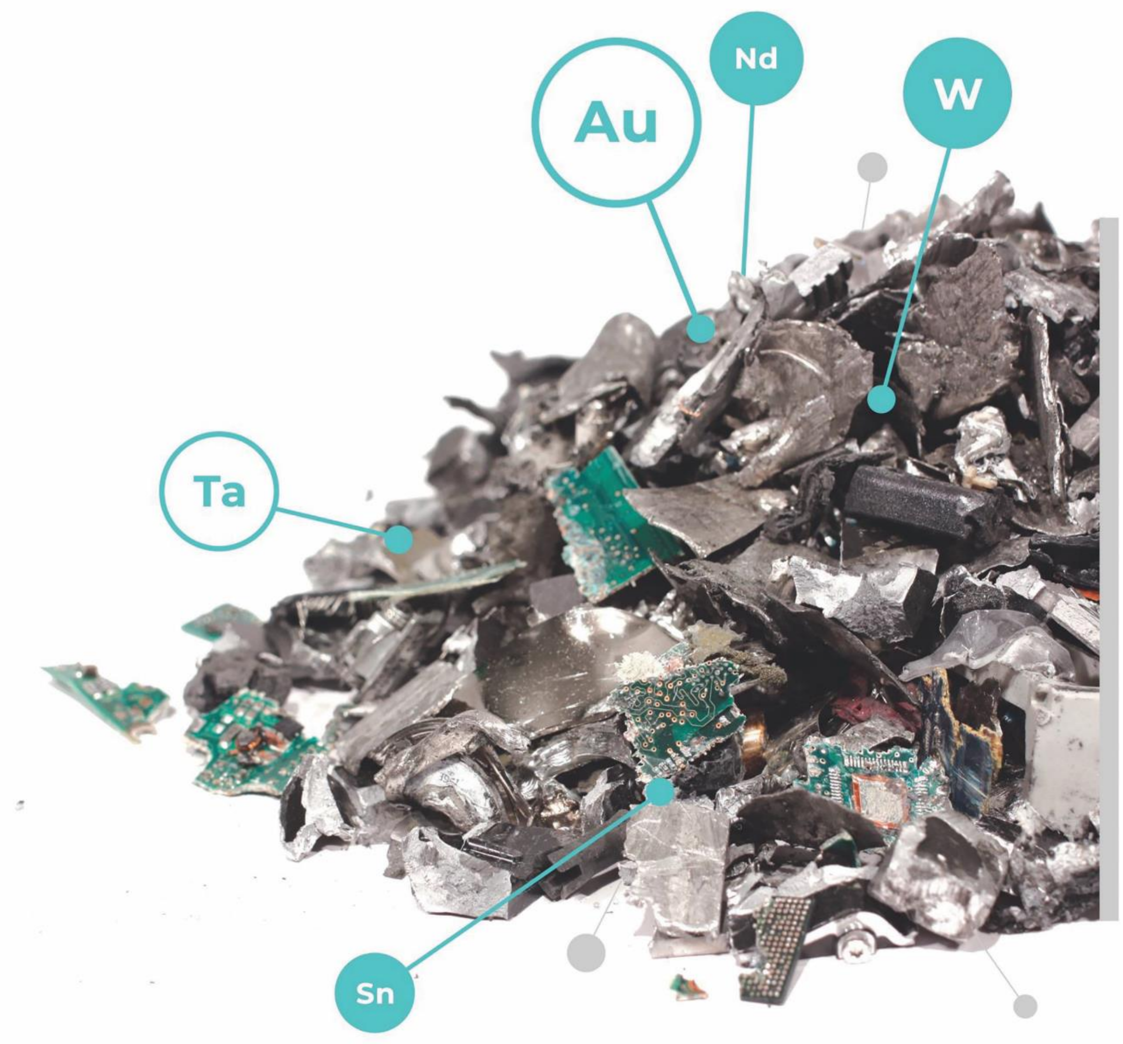
Pros & Cons of the current solutions

- Direct-to-chip Liquid Cooling
  - ✓ Captures 50%-80% of heat, suitable for retrofitting
  - Computer Room Air Conditioning (CRAC) and Fans are still required, added equipment complexity, prone to dielectric leakage
- Fully Immersive Liquid Cooling
  - ✓ Up to 95%, of heat reduction, no fans, no Power Supply Units
  - Not a standard, specialist equipment and procedures for maintenance
- Chassis-Based Immersive Liquid Cooling
  - ✓ Similar to Fully Immersive, can be used in a standard rack, no fans
  - Additional materials used in manufacturing
- Air-Cooled DC Equipment
  - ✓ Prime technology in DCI, established re-use and recycle markets, can be modified to be energy efficient, D4D, use of materials decreased
  - Prone to failure if not maintained

Circularity of the equipment

- Lack of standardisation in design
- Prime focus of design on operation and performance
- Refresh rates range between 9 months to 4 years
- PGM and a limited number of CRM are being recovered from e-waste
- High volume of materials is being lost during the recycling process



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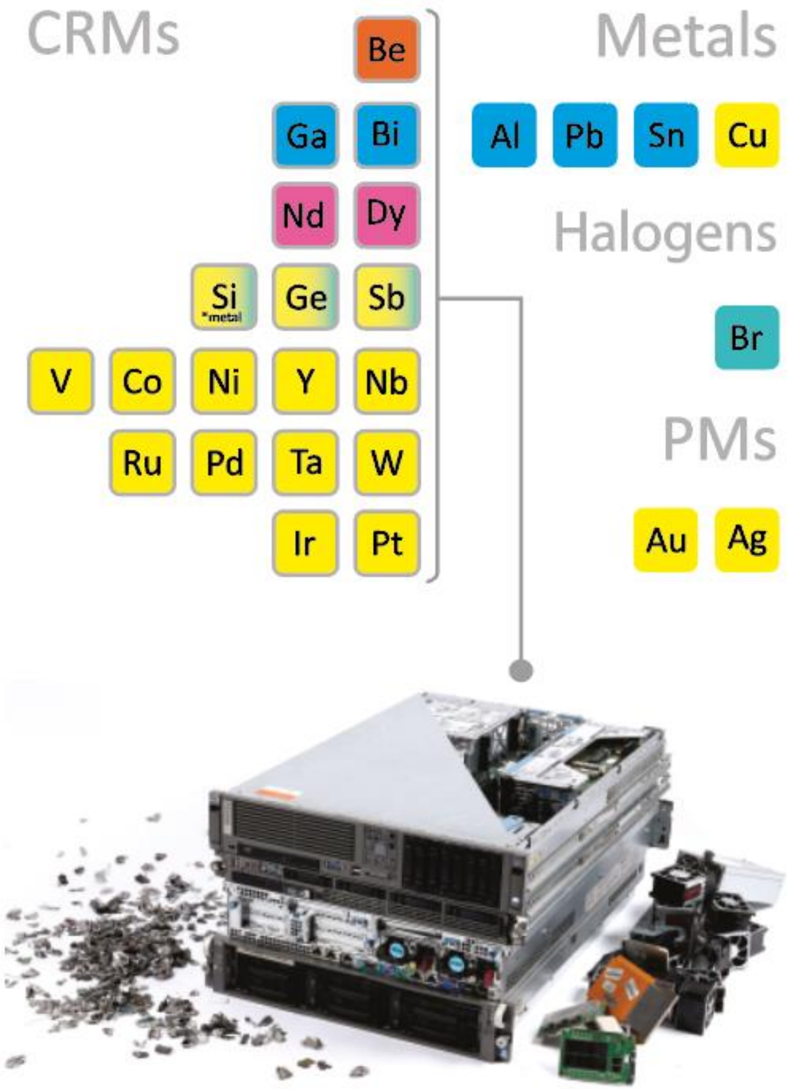
Design thinking for CE

ITRenew Data Centre Impact Report:

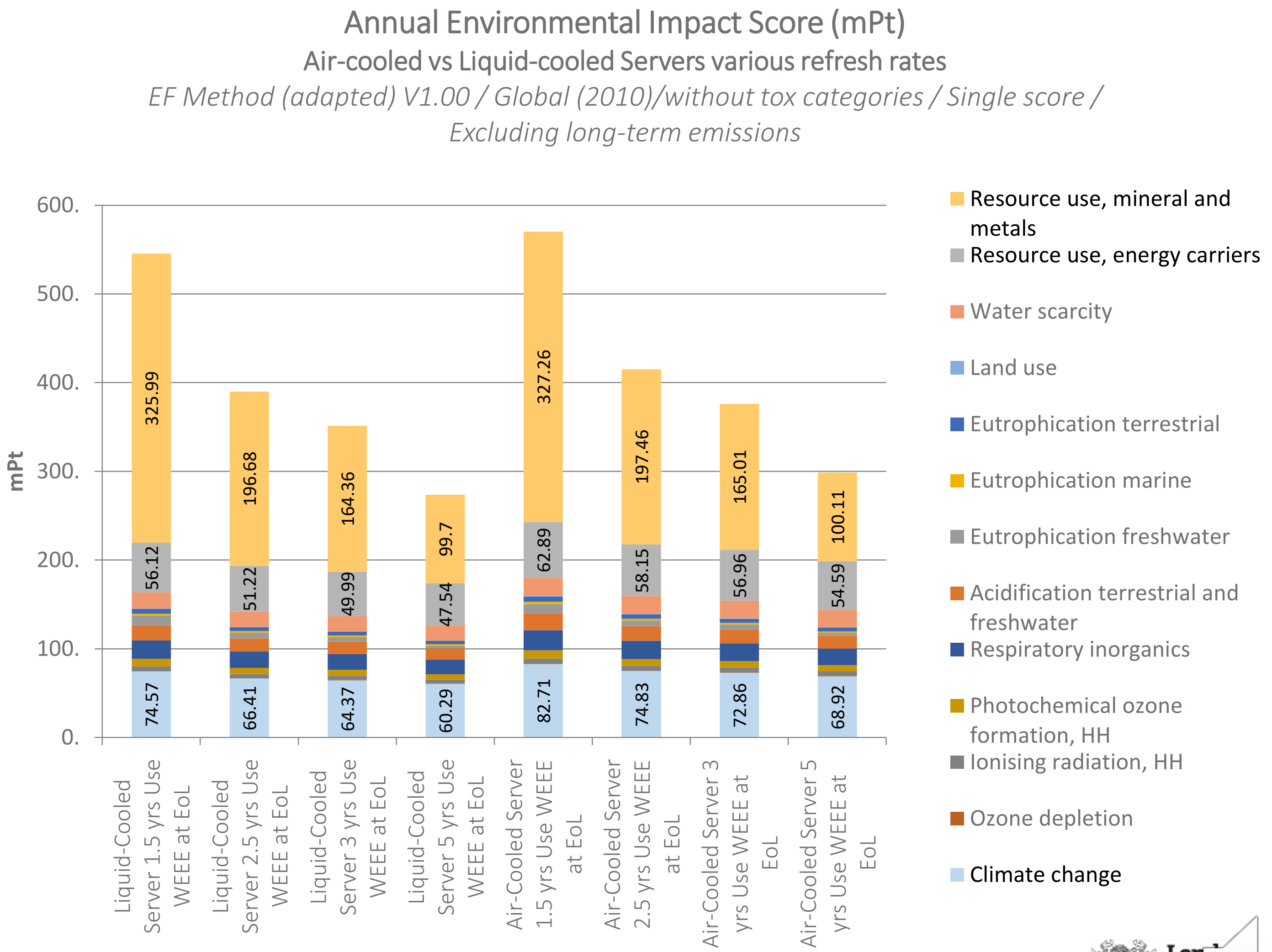
- 77% of the CO2 emissions comes from “Pre-Use”
- 22% form a lifetime operational energy

- LCA can be used as decision-making instrument to highlight the hot spots and encourage design for circularity, promoting standardisation, simplification, modular design and the use of environmentally friendly materials on all assembly levels



Life Cycle Assessment

- LCA included estimated data on: manufacturing, operational energy and EoL as WEEE
- Greatest impact comes from the resource use in manufacturing and remain a significant burden at shorter refresh rates



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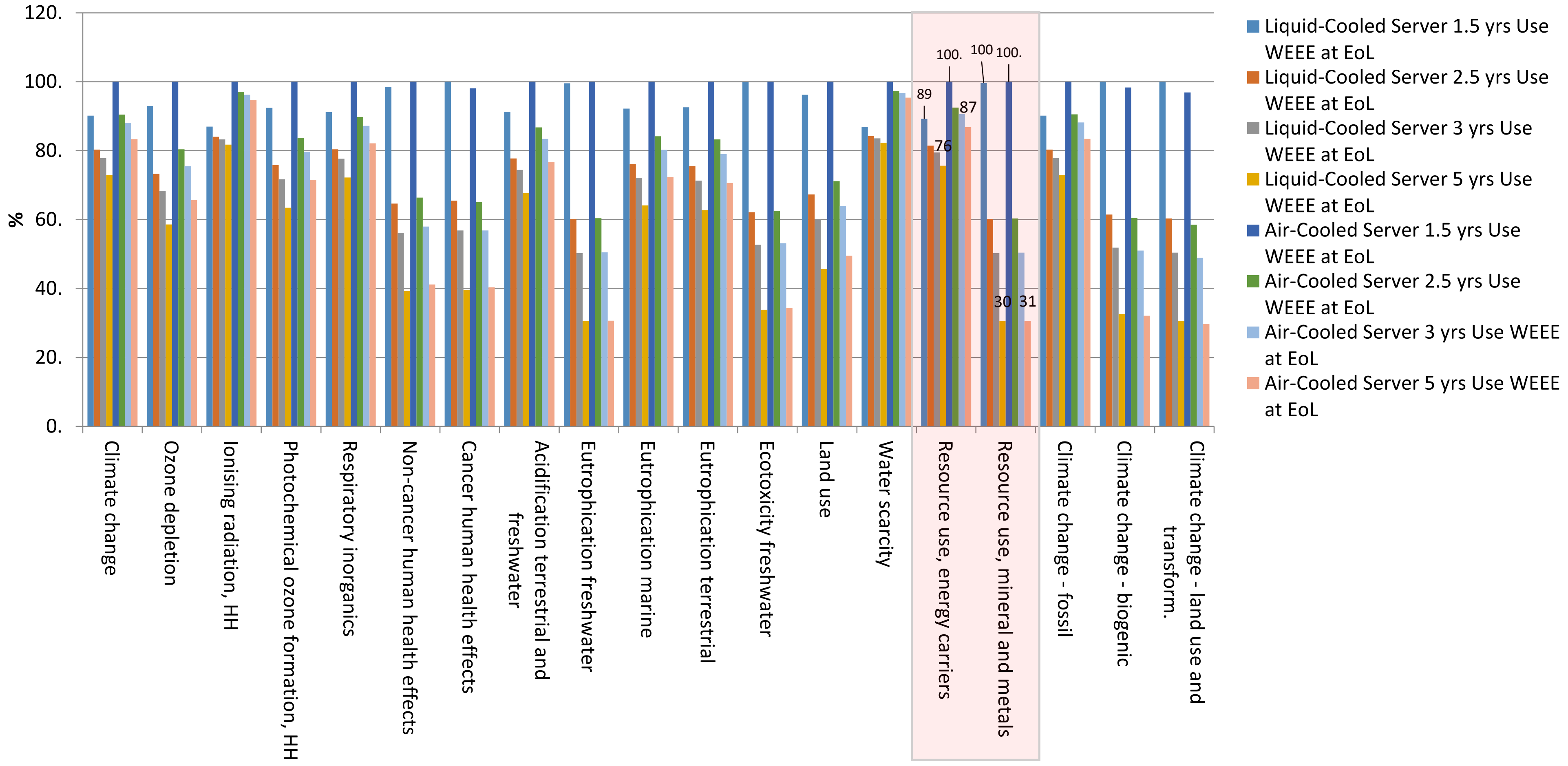
Annual Environmental Impact Characterised Results (%)

Air-cooled vs Liquid-cooled Servers various refresh rates

EF Method (adapted) V1.00 / Global (2010)/without tox categories / Characterisation / Excluding long-term emissions



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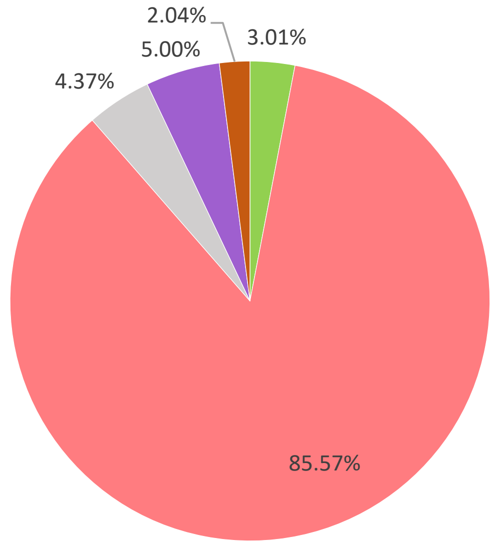
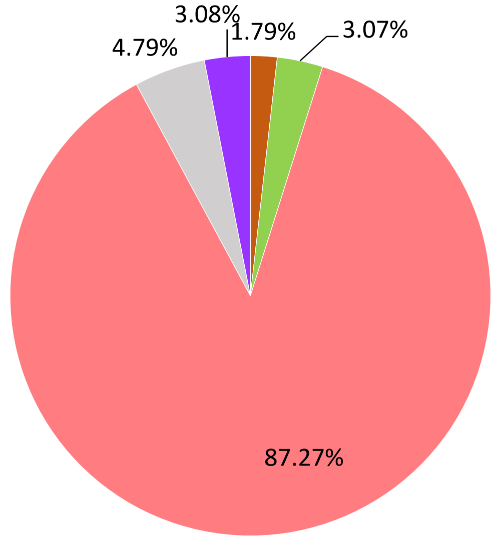
Liquid-Cooled Server Embodied Impact



- Hard Drives
- Motherboard, CPUs, other PCBs & Batteries
- Power Supply Unit customised for Liquid-Cooling
- Steel/Al—Chassis and Enclosure, Heatsinks, Brackets, Screws, Cables etc.
- Cooling Assembly: Dielectric, Cooling loop (Pumps, Clips, Tubes, Heat Exchanger, etc.)

Air-Cooled Server Embodied Impact



- Cooling Assembly: Fans, Air Bezel, clips etc.
- Hard Drives
- Motherboard, CPUs, other PCBs & Batteries
- Power Supply Unit
- Steel—Chassis, Heatsinks, Brackets, Screws, Cables etc.

Conclusion

- At R&D stage LCA can assist designers in comparing the environmental impacts of the materials, manufacturing processes, use stage and EoL scenarios between different designs
- Focus on the right areas of concern
- Promote circular design of the equipment
- Minimise waste.

Thank You.

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