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## Life Cycle Assessment for Cloud Hardware: Lessons Learned



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# Life Cycle Assessment for Cloud Hardware: Lessons Learned

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# Agenda

- Introduction
- What are LCAs & why are they important?
- Lessons learned from doing LCAs on Microsoft Cloud hardware
- Recommendations

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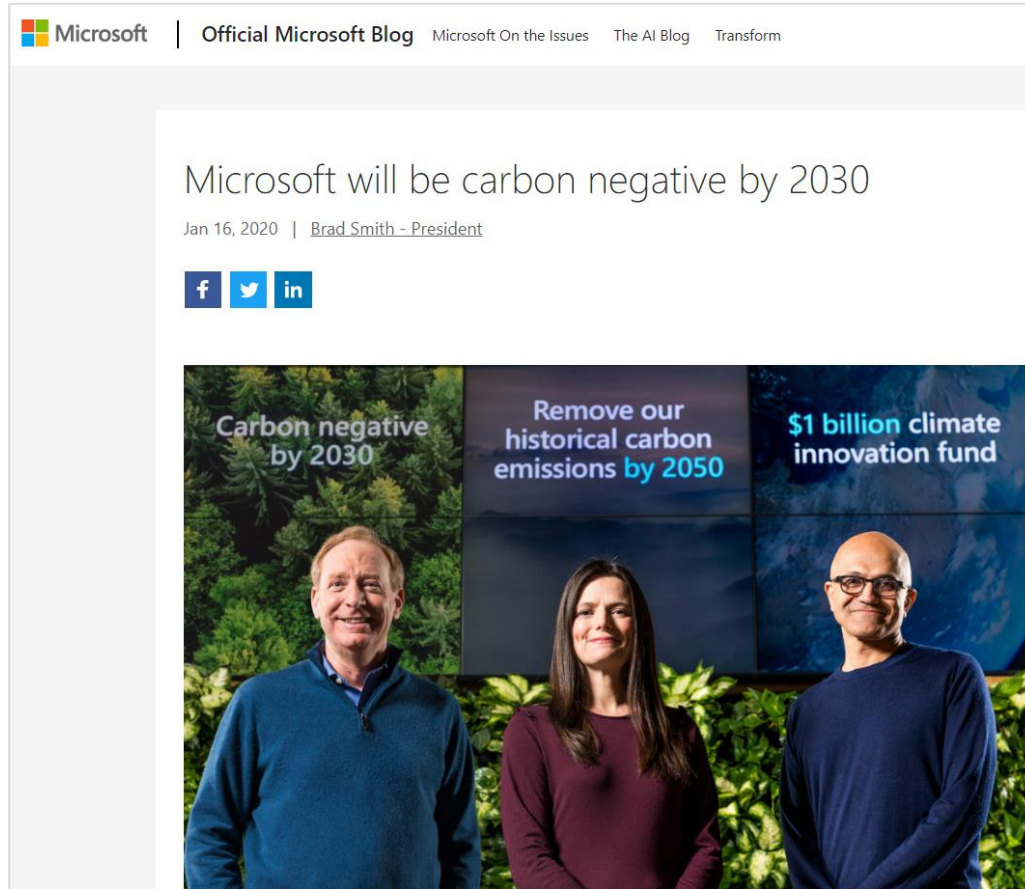




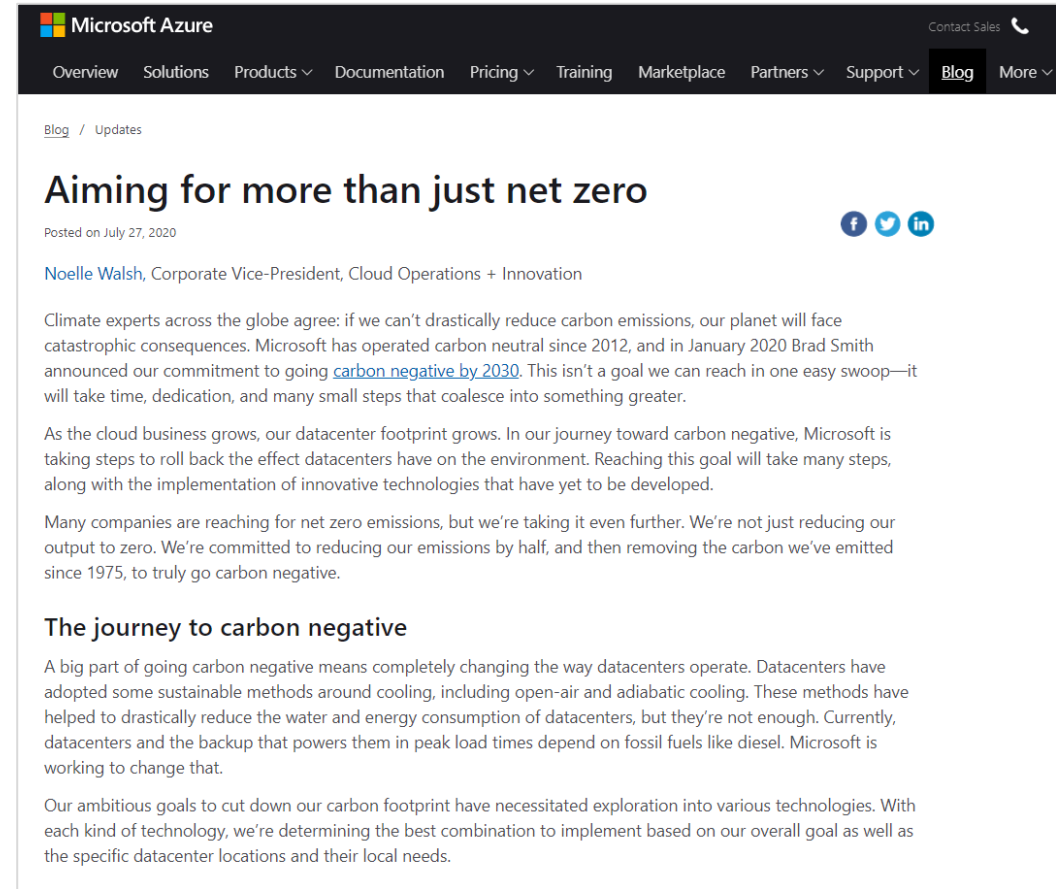
# Microsoft's Sustainability Pledge



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[Link: Microsoft will be carbon negative by 2030](#)



[Link: Aiming for more than just net zero](#)

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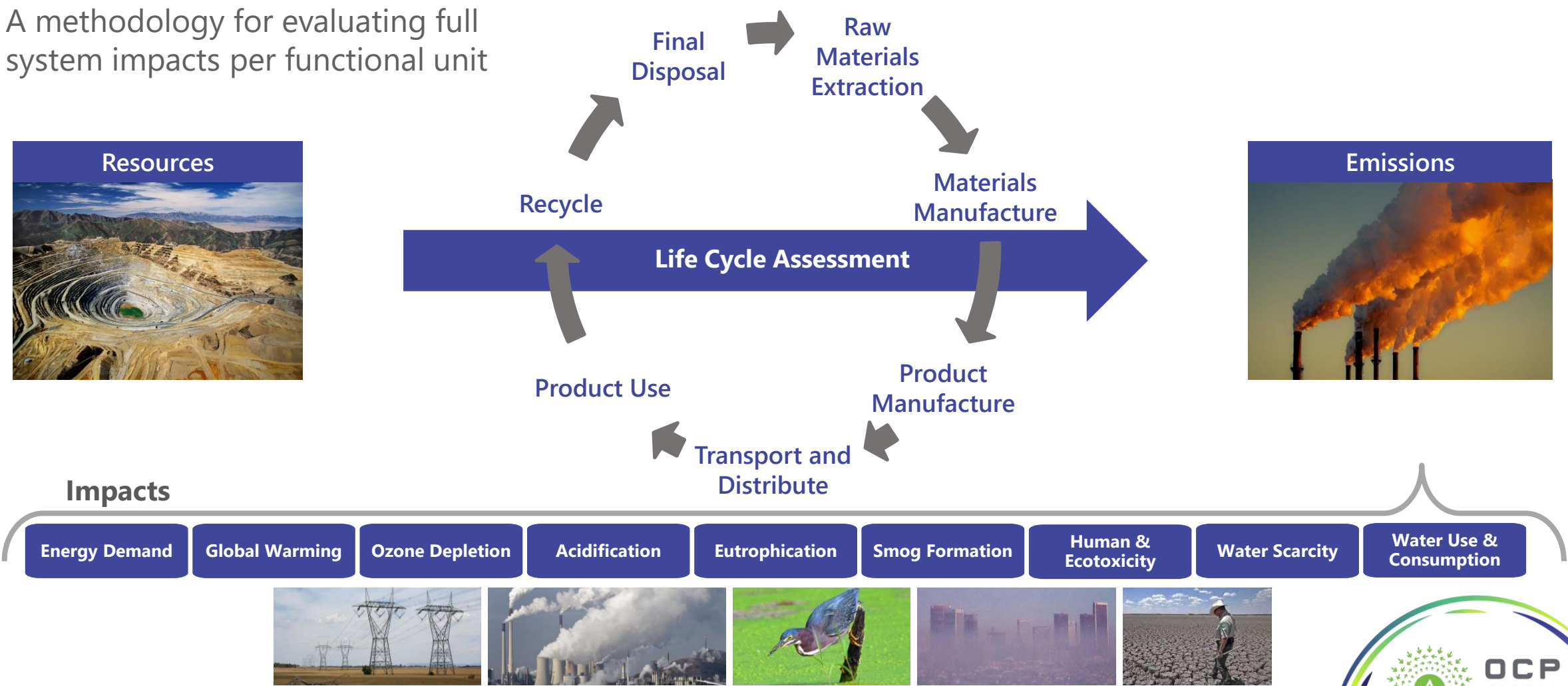




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# What is Life Cycle Assessment (LCA)?

A methodology for evaluating full system impacts per functional unit



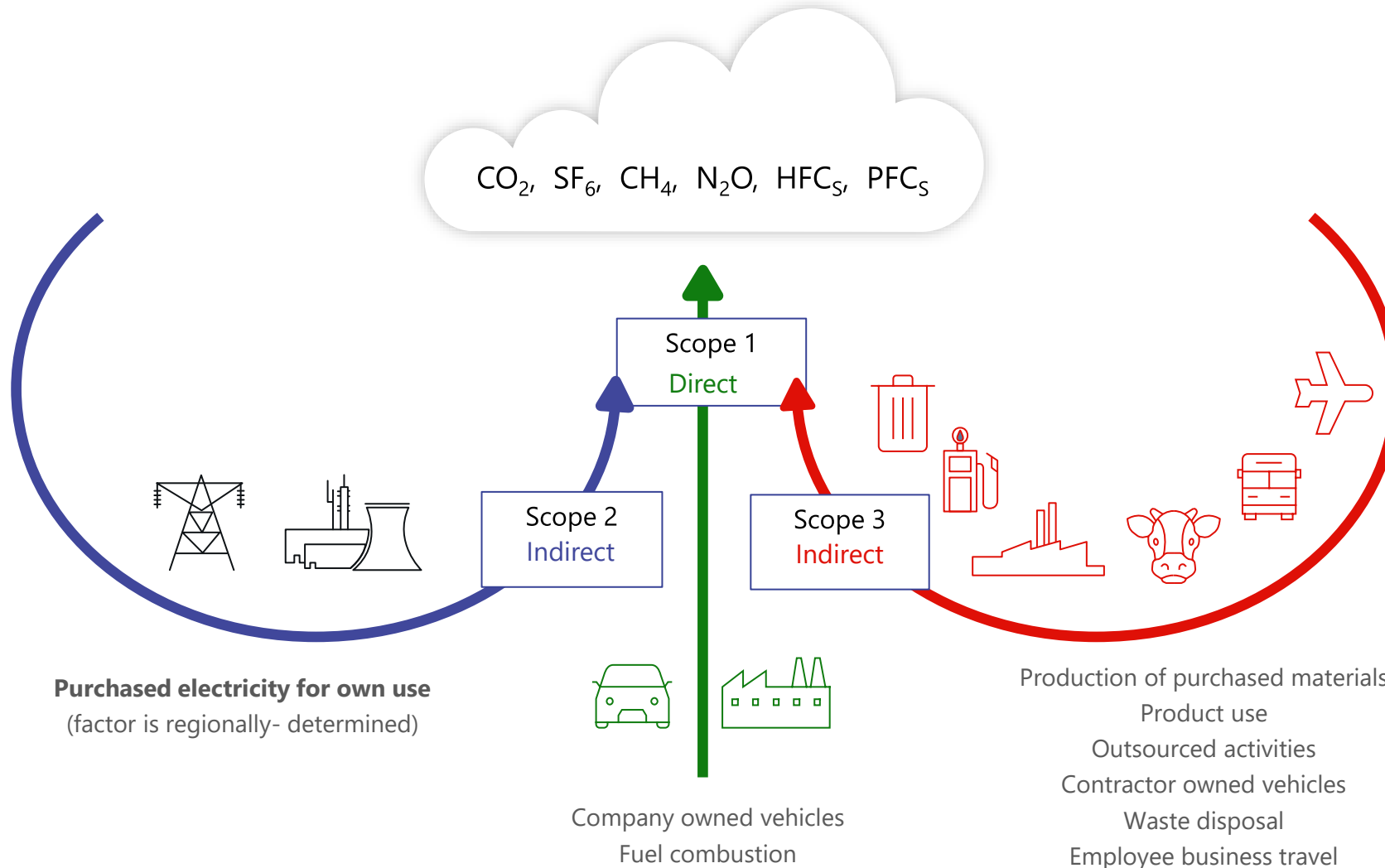
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# Cloud Carbon Emissions & Scopes



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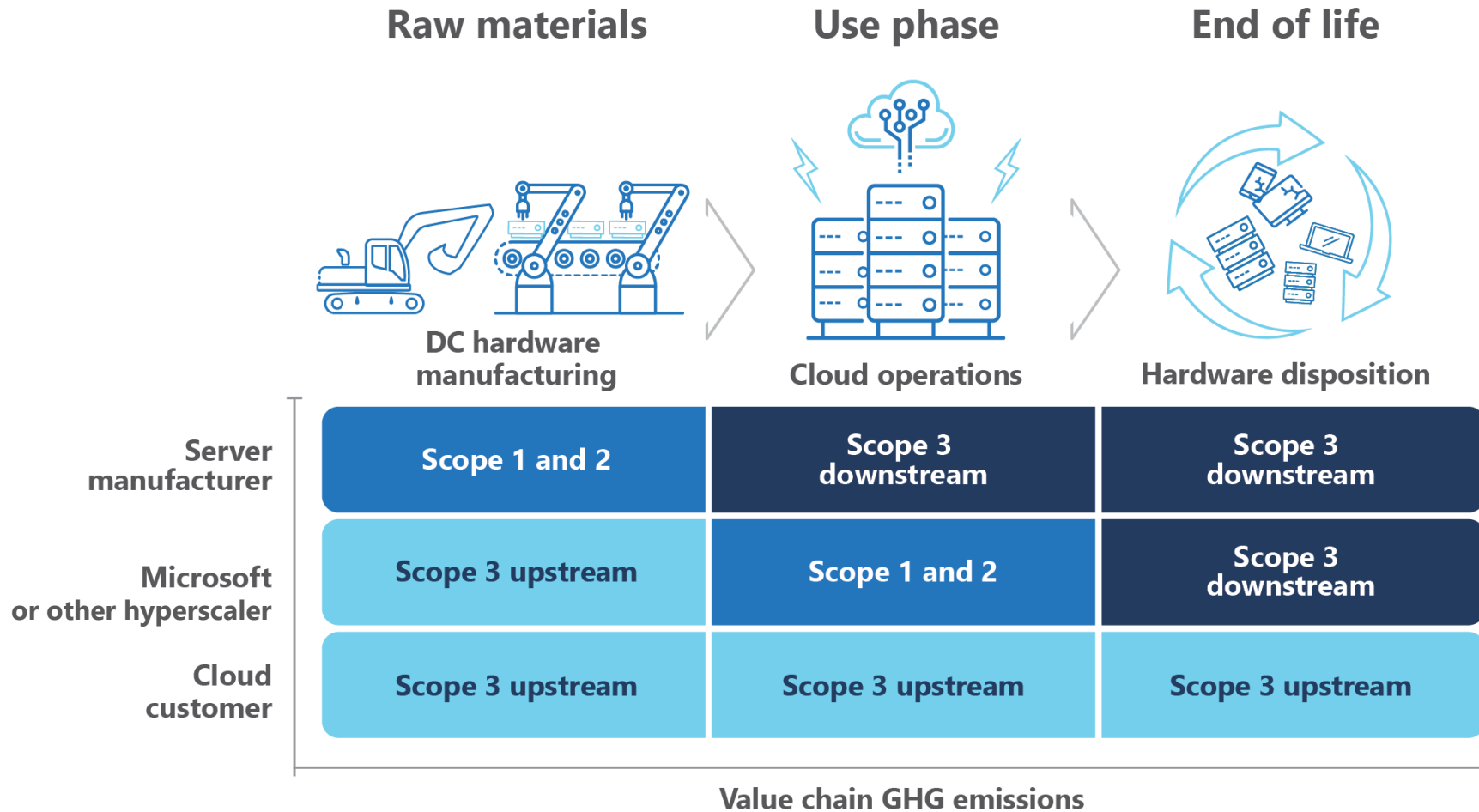
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# Life Cycles vs Emission Scopes



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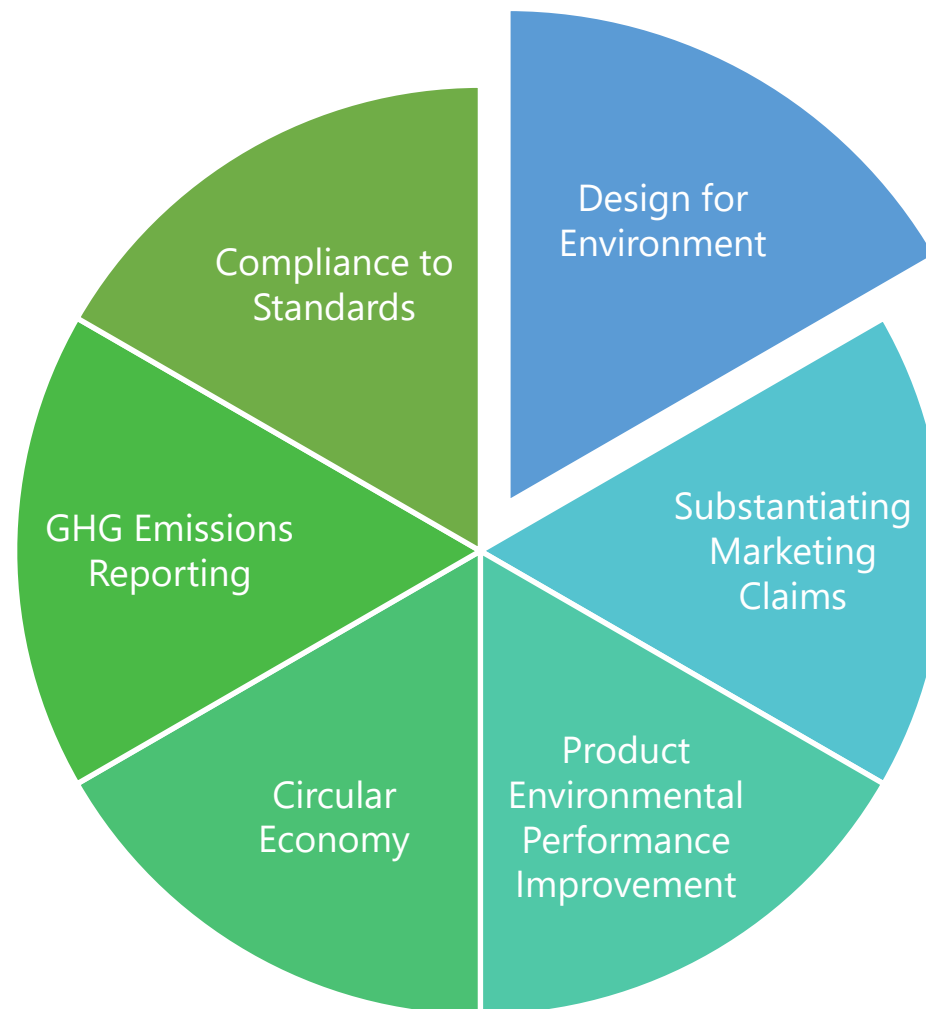
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# Why do an LCA?



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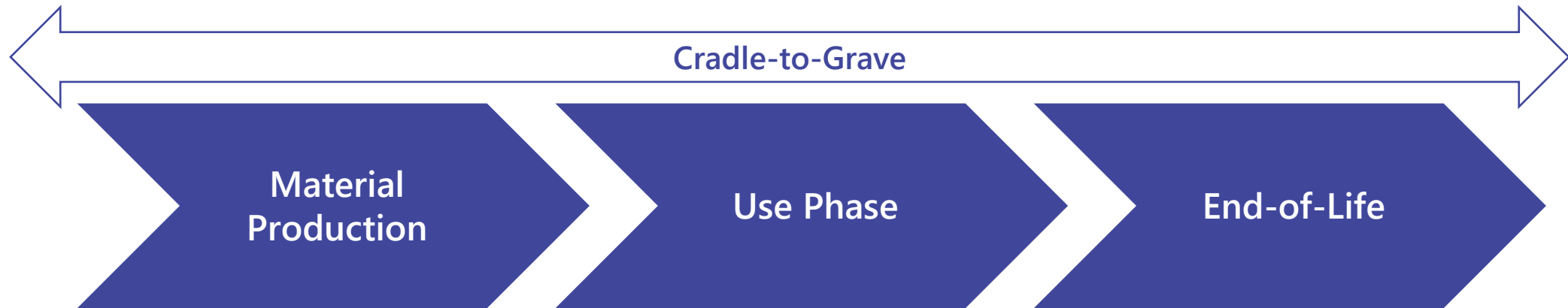




# Cloud Ecosystem



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- Raw material inputs to datacenter
- Material manufacturing inputs such as heat, power, water, production of servers, racks, tanks and supporting equipment\*
- Replacement components

- Use phase energy
- Use phase water

- Waste treatment of equipment and other inputs e.g., recycling, landfill, incineration

## Environmental impacts indicators per functional unit

- Climate change (kg CO<sub>2</sub>e)
- Energy (MJ)
- Blue water consumption (L water)
- ...

## Parametric/sensitivity analysis

- Parameter 1
- Parameter 2
- Parameter 3
- ...

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# Determining Functional Unit



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## Energy

- Generation/grid
- Renewables

## Data Center

- Building, land...
- Support equipment, Mech, Elec, Tele...

## Server

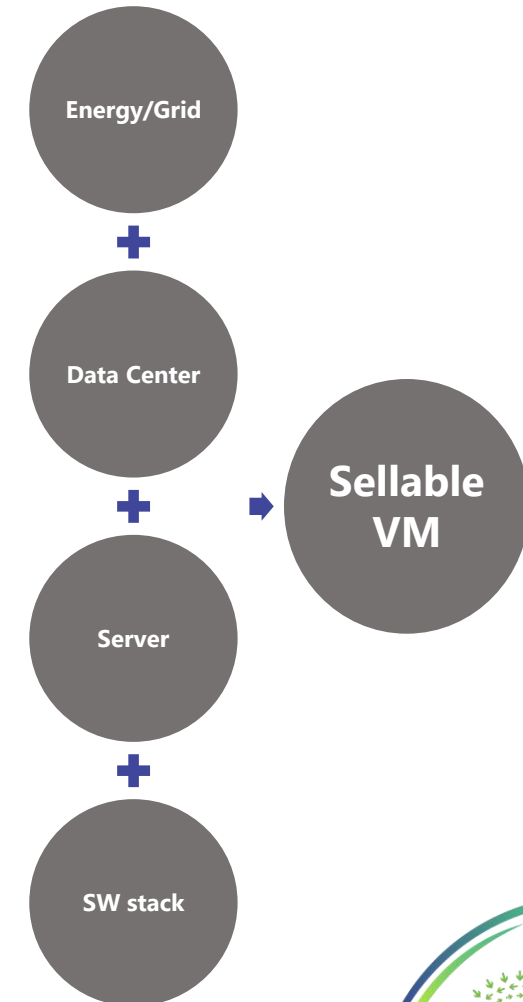
- DIMMs, Flash, CPU
- HDDs, MBs, chassis

## SW stack

- Workloads
- VM allocation

## Examples of functional units

- Functional unit examples:
- Average compute server over x number of years
- Sellable VM
- Per MW capacity
- Per GB/TB of data stored



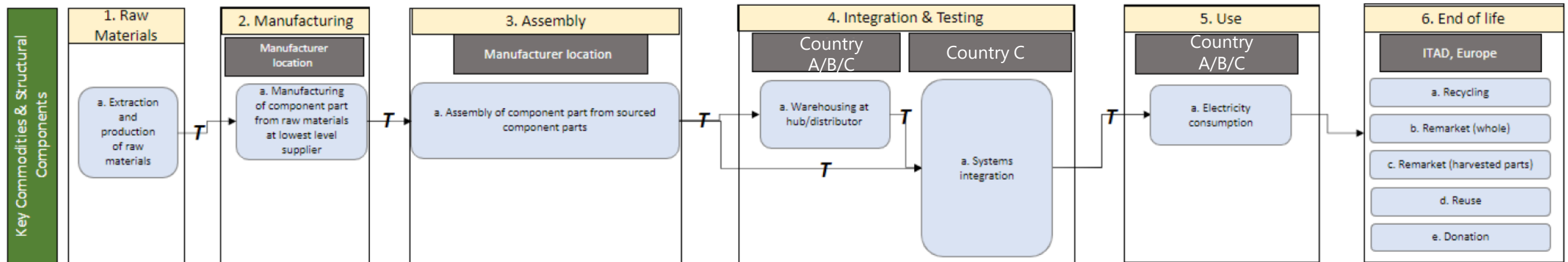
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# Cloud HW LCA Overview

Life cycle flow of a server



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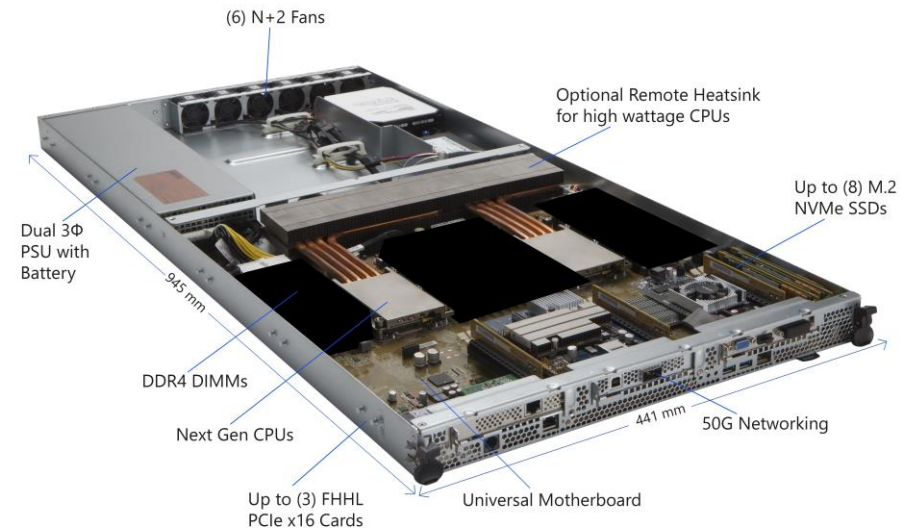
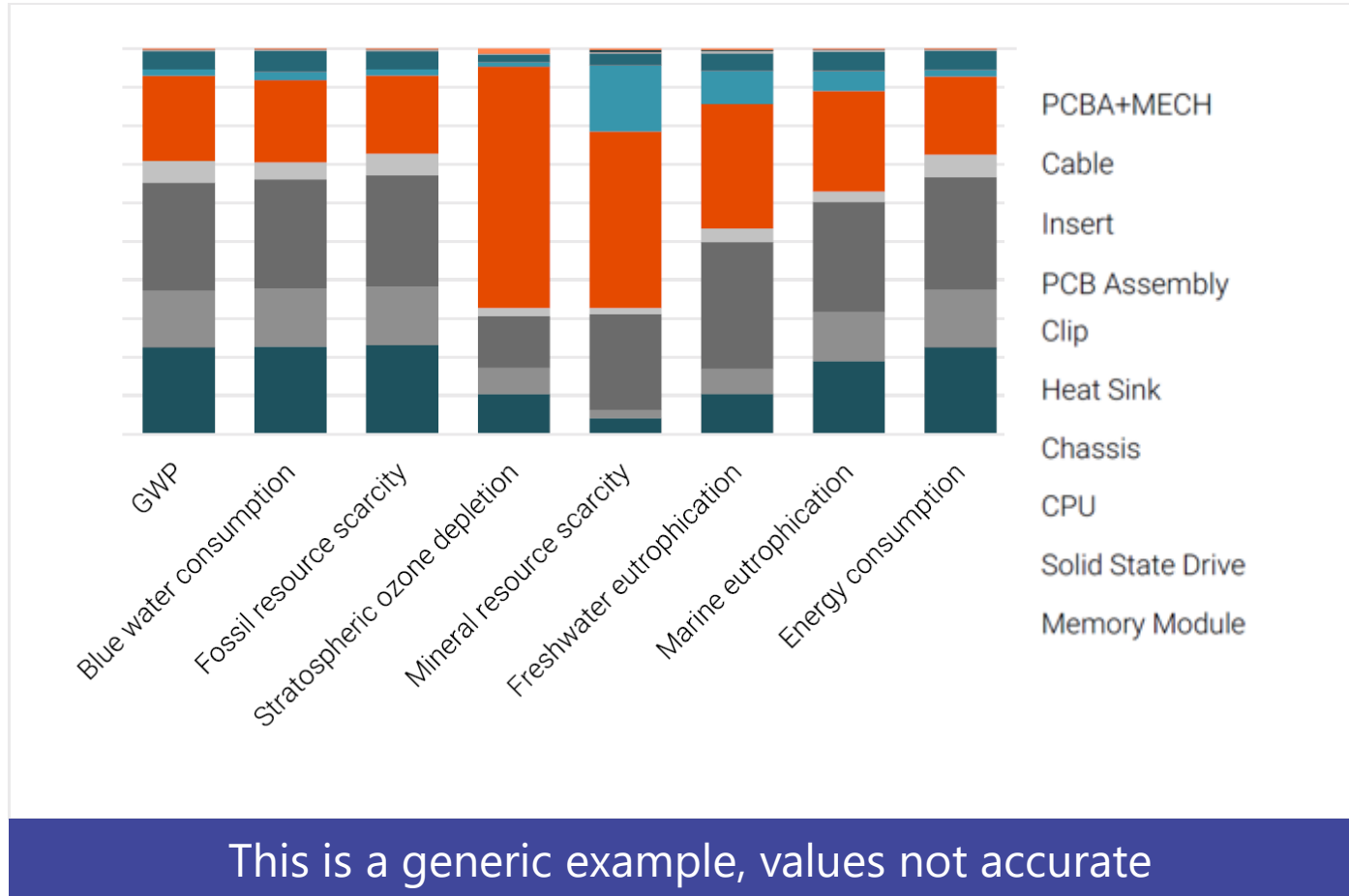


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# Server LCA result - Example



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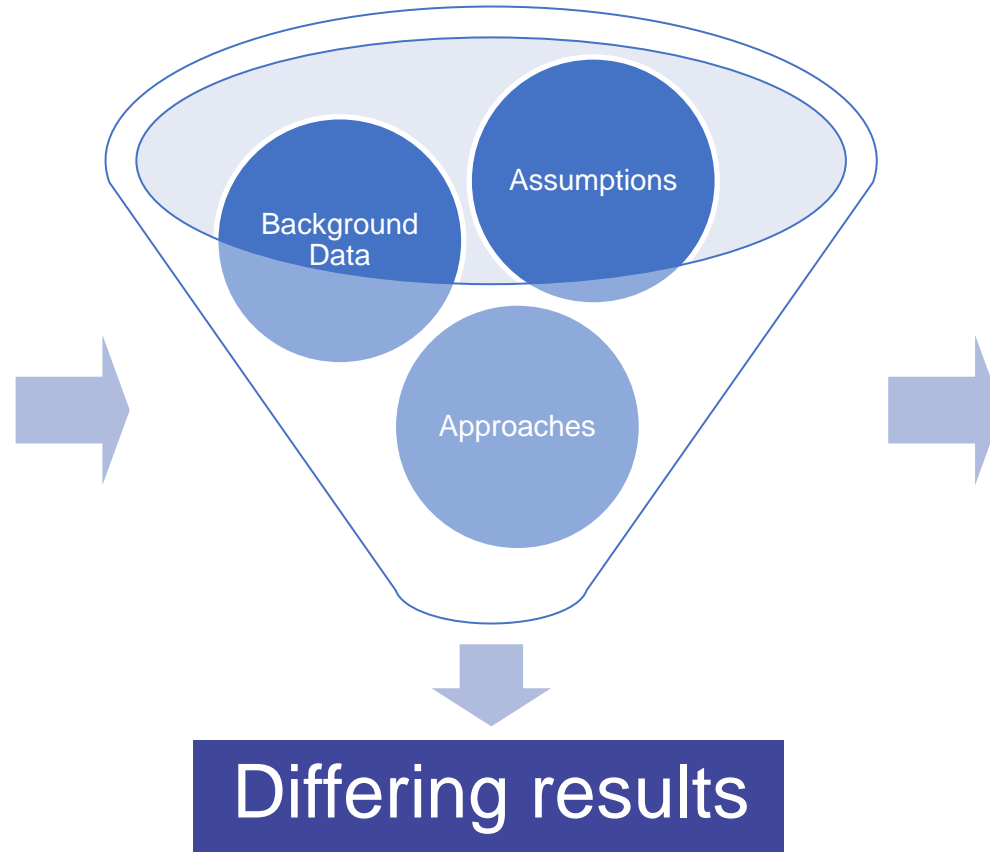


# Tale of two LCAs...



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- LCA on identical assets
- Both LCAs following ISO standard
- Conducted using two different methodologies



- Keep consistent methodologies
- Expect variability
- Seek directionality

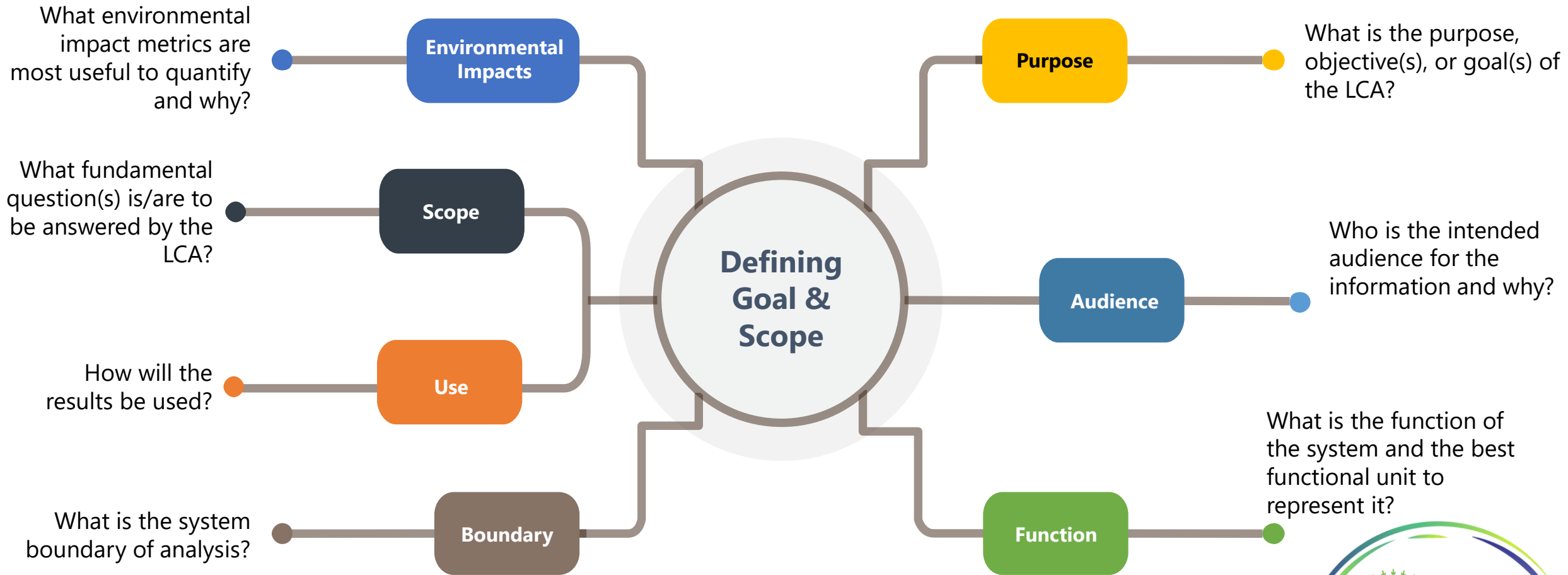
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# Ready to conduct your LCA? Consider this!



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*Fundamental questions that help define LCA goal and scope*

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# Lessons learned/recommendations

- Accurate data is hard to find!
- Data sets & tools impact results greatly
- Outdated IC datasets may lead to underestimations of impact
- Cross – disciplinary team/stakeholders needed for a complete picture
- You can not compare LCAs – create awareness, but assumptions vary
- Lack of public references, published LCAs
- Do LCAs!
- Share your data
- Integrate LCAs in your engineering processes & technology roadmaps
- OCP to Align on functional unit(s)

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## Join the OCP Sustainability Workstreams

Microsoft Contribution:  
LCA Specification & Guidance Whitepaper (link coming soon)

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# Thank you!