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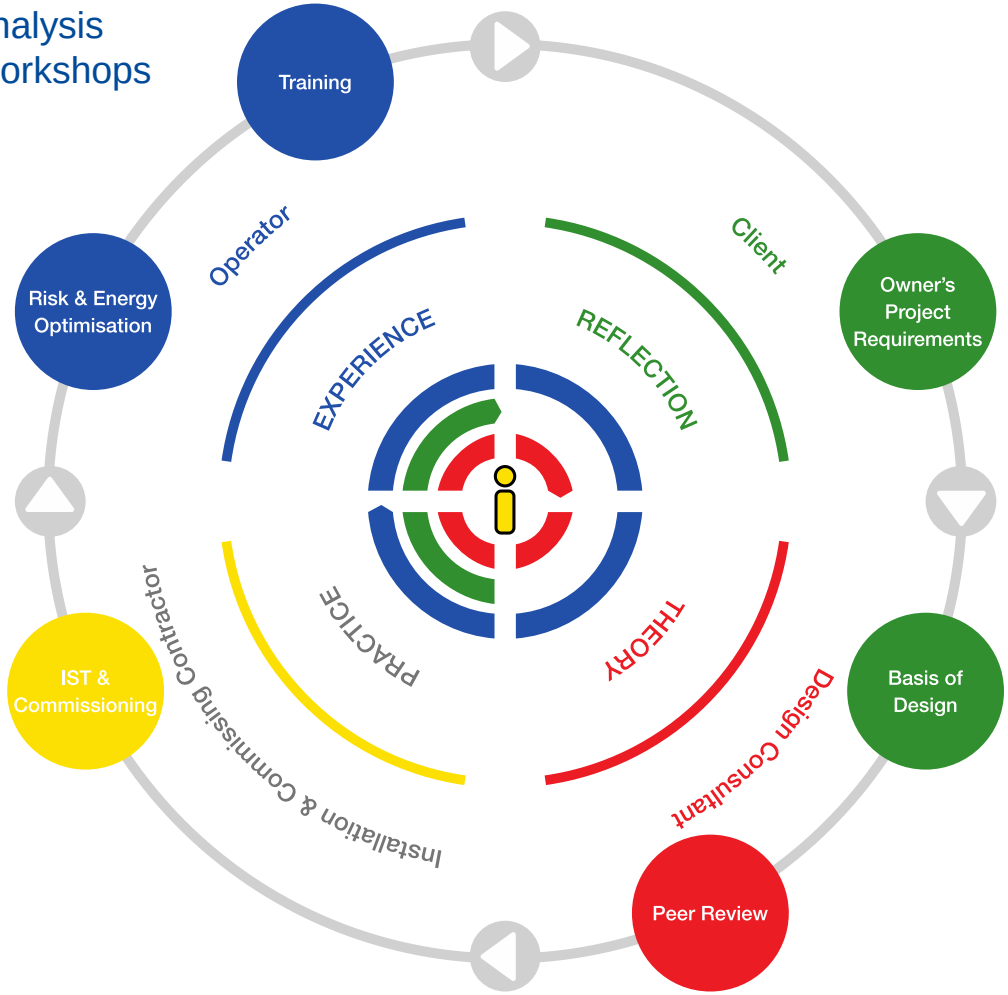
Total data centre environmental impact

Sophia Flucker

OI services throughout the project cycle

Root Cause Analysis Workshops

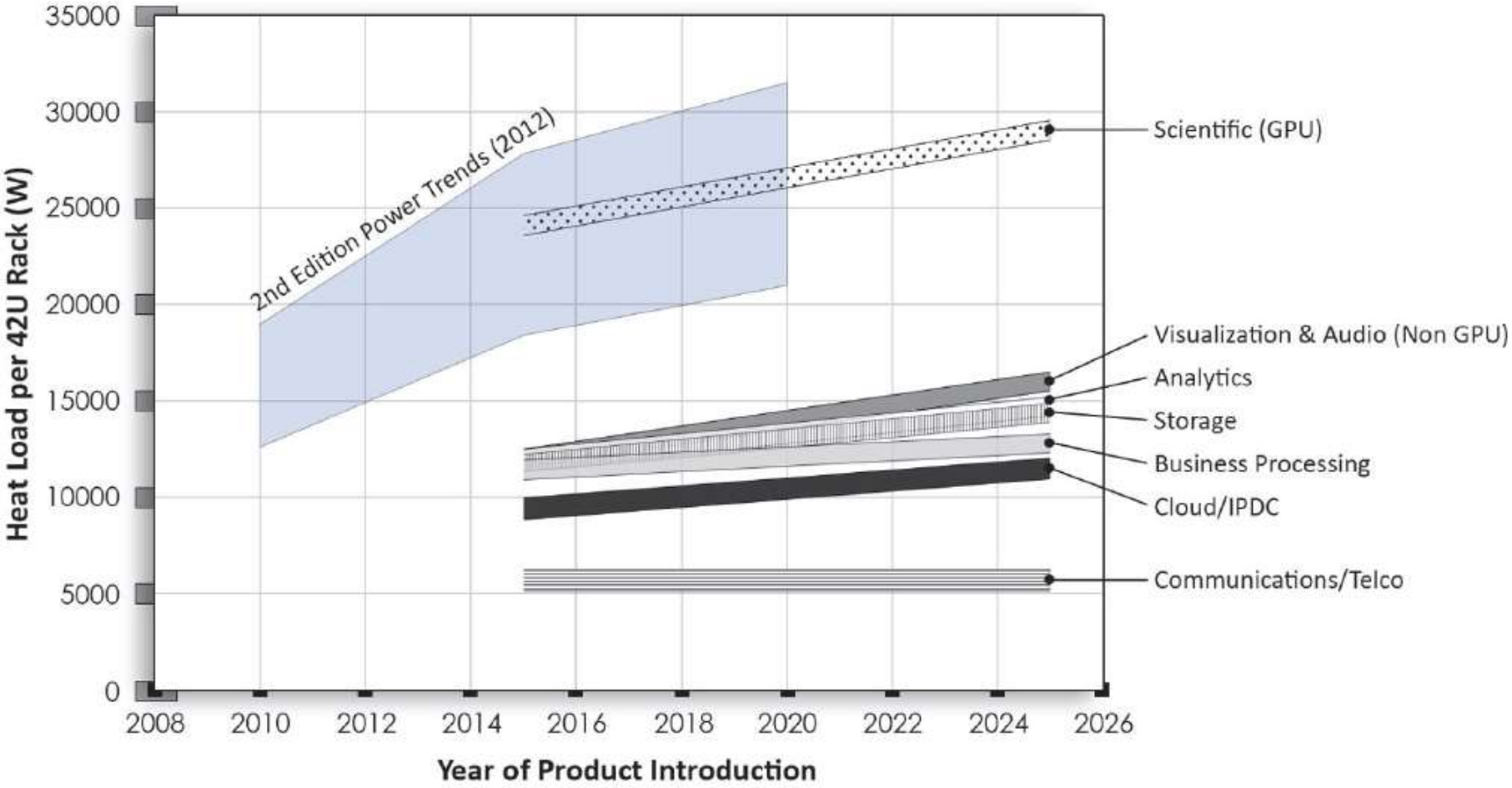
Operational Learning Cooling Workshops



Upgrade and testing of live facilities

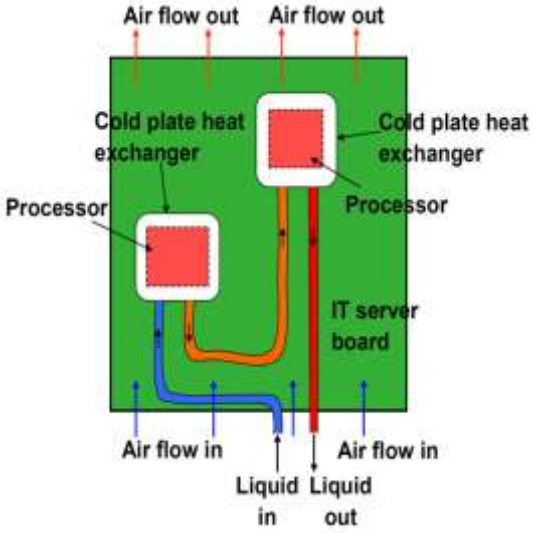
TRENDS

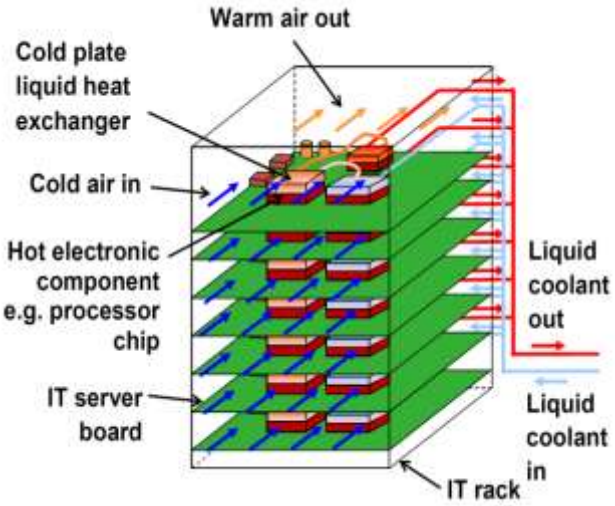
Load densities

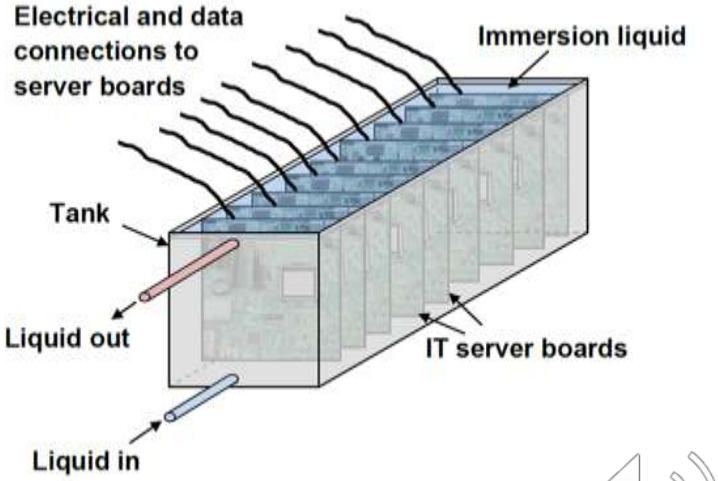


Air cooled 2U two-socket server power trends (ASHRAE 2018)

Liquid cooling





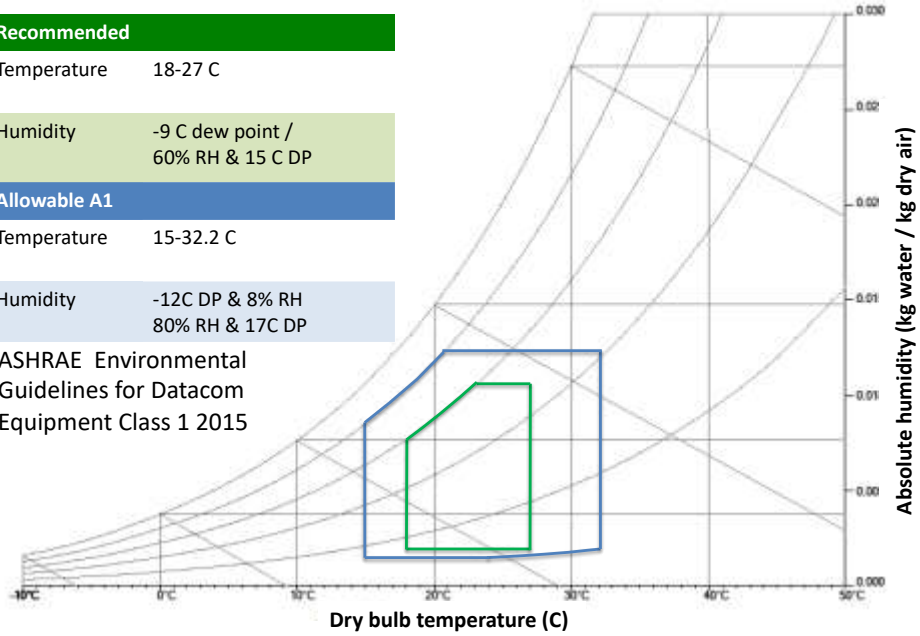


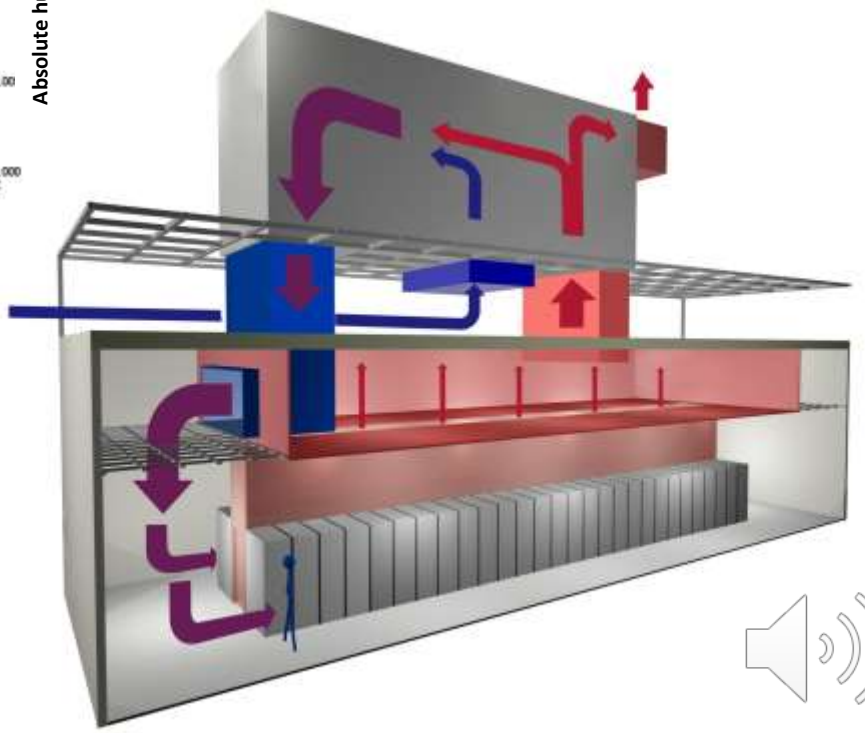
GreenSCIES (Green Smart Community Integrated Energy Systems)
https://www.lsbu.ac.uk/about-us/news/smart-energy-network-study-launches

Trends

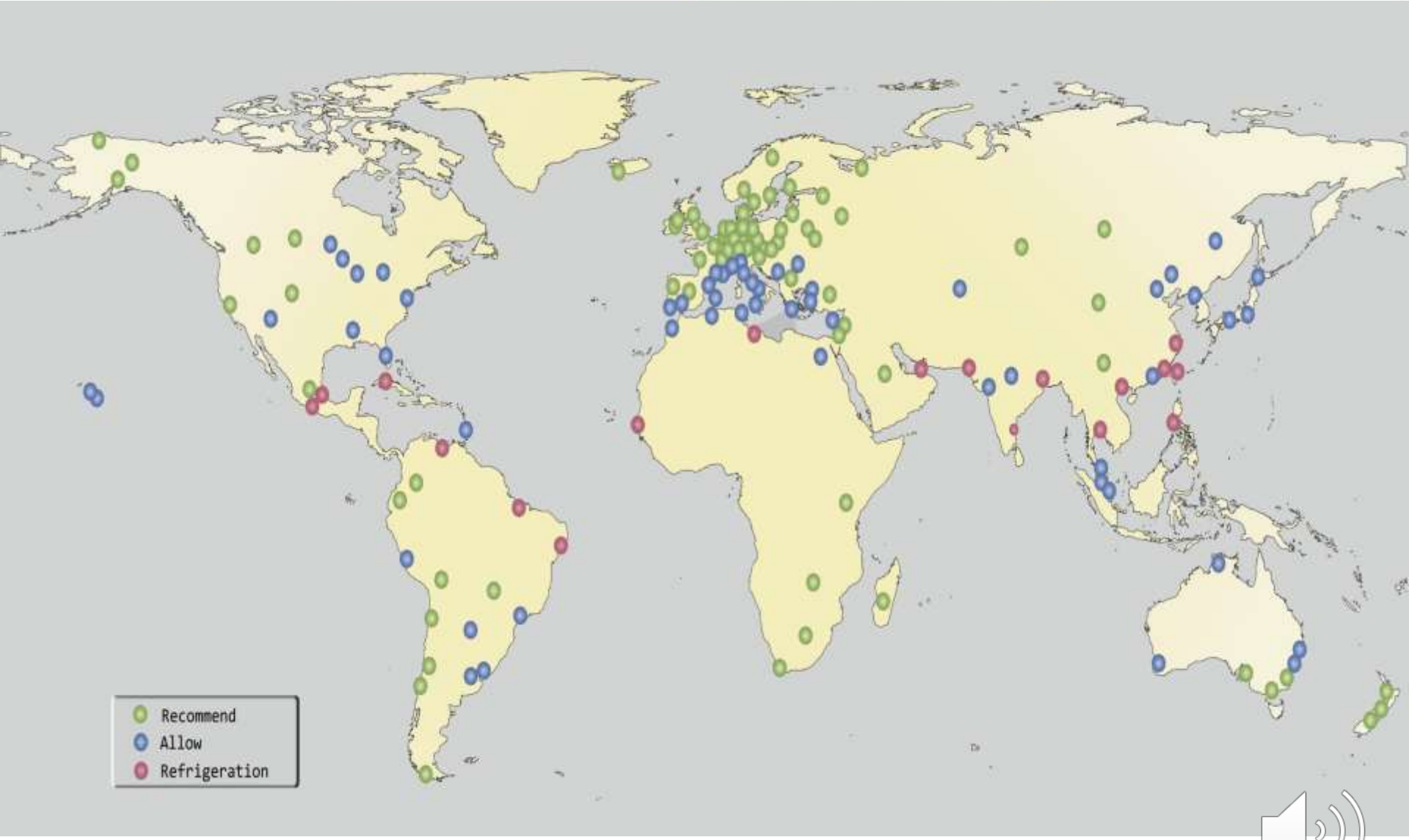
Recommended	
Temperature	18-27 C
Humidity	-9 C dew point / 60% RH & 15 C DP
Allowable A1	
Temperature	15-32.2 C
Humidity	-12C DP & 8% RH 80% RH & 17C DP

ASHRAE Environmental Guidelines for Datacom Equipment Class 1 2015



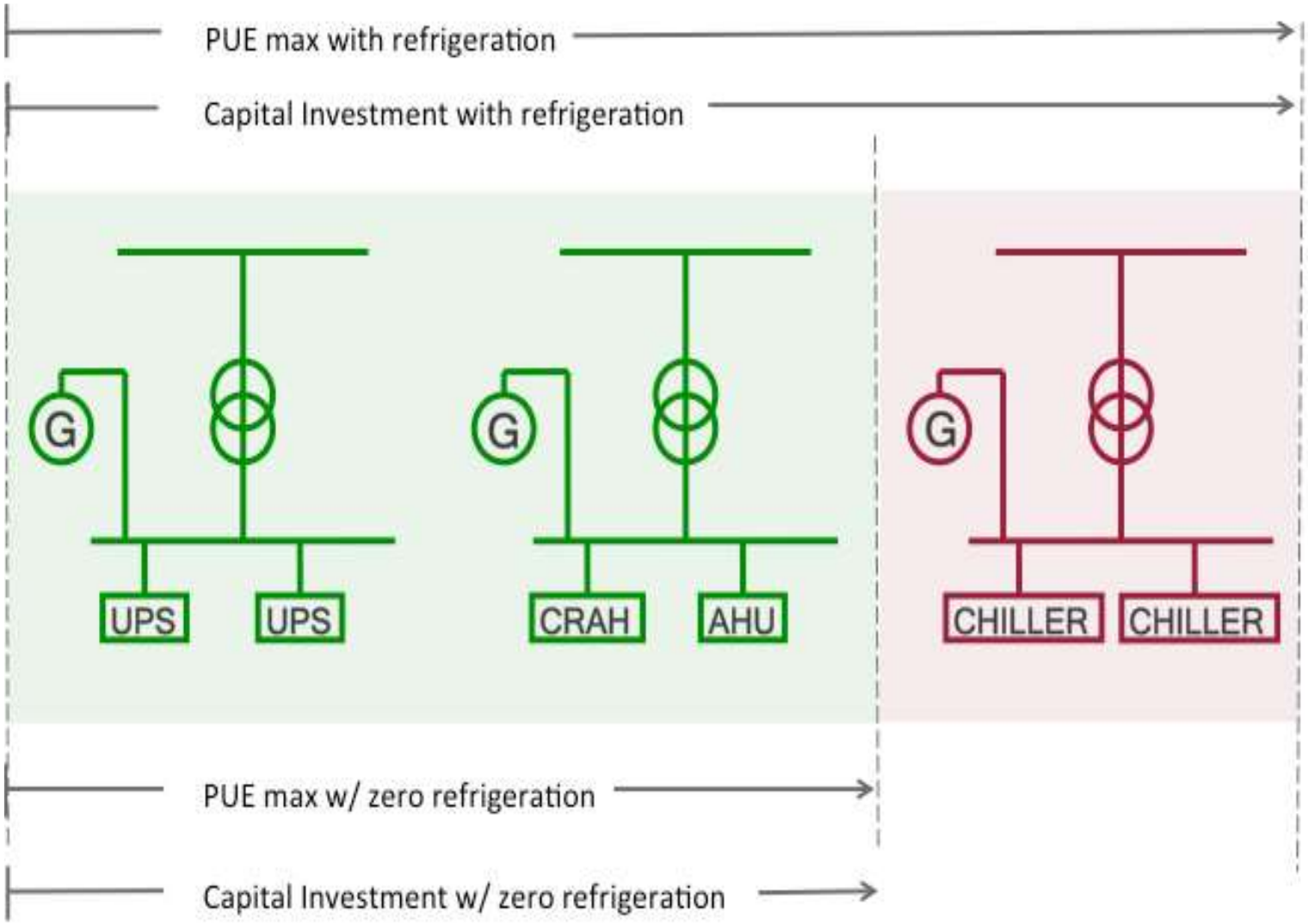


Zero refrigeration potential



Indirect Air-Side Free Cooling, approach of supply air at 27C to wet bulb is 4K

Additional plant and capacity requirements with refrigeration



REGULATION

Regulation

- EU GHG Emission Trading Scheme
- Generator Emissions (Medium Combustion Plant Directive, Industrial Emissions Directive, Environmental Permitting Regulations)
- ESOS (Energy Savings & Opportunity Scheme) for large companies
- Climate Change Agreement (Colos)
- Lot 9 Ecodesign requirements for servers

The Green Grid White Paper 44 Energy Policy Research & Implications for Data Centers in EMEA (UK, France, Germany, Spain, Netherlands, Italy, Switzerland, South Africa, Russia, UAE, Saudi Arabia, Qatar)

EN50600

- Concept
  - 1 General Concepts
- Design & Build
  - 2.1 Building Construction
  - 2.2 Power Distribution
  - 2.3 Environmental Control
  - 2.4 Telecoms Cabling Infrastructure
  - 2.5 Security Systems
- Operation
  - 3.1 Management & Operational Information
- KPIs
  - 4.1 Overview
  - 4.2 PUE
  - 4.3 REF
- Best Practices
  - TR 99-1 Energy Management
  - TR99-2 Environmental Sustainability
  - TR 99-3 Guidance on Application of the Series

Voluntary initiatives

- ISO 14001 Environmental Management ISO 50001 Energy Management
- Metrics (PUE, CUE, WUE, REF…)
- EU Code of Conduct for Data Centre Energy Efficiency https://e3p.jrc.ec.europa.eu/communities/data-centres-code-conduct
- Green Public Procurement for Data Centres https://susproc.jrc.ec.europa.eu/product-bureau//product-groups/458/documents
- Building Energy Assessments (BREEAM & LEED)

EU Code of Conduct for Data Centres

Requirement for government tenders

Clicking Green (Greenpeace)

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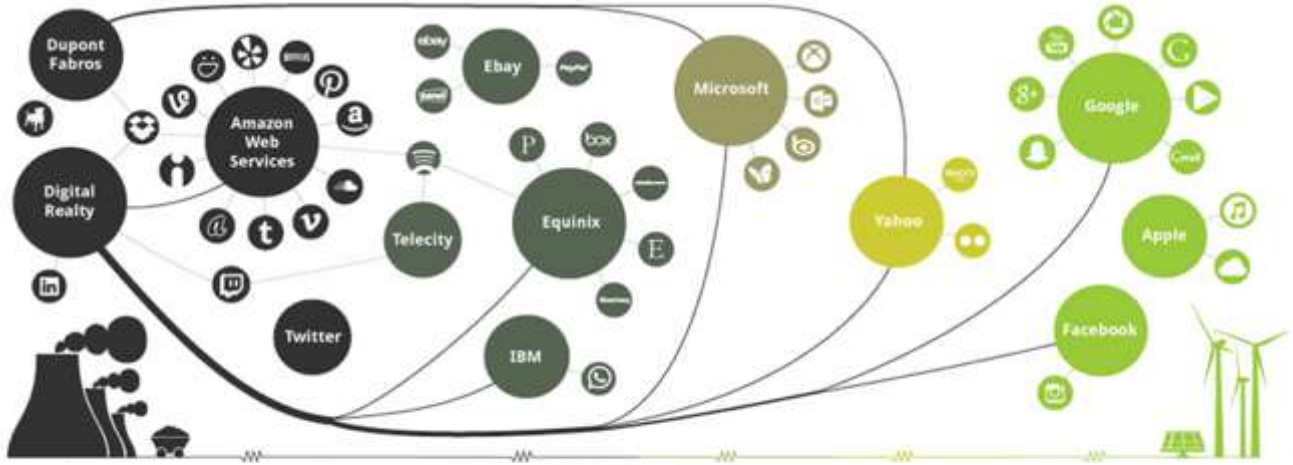
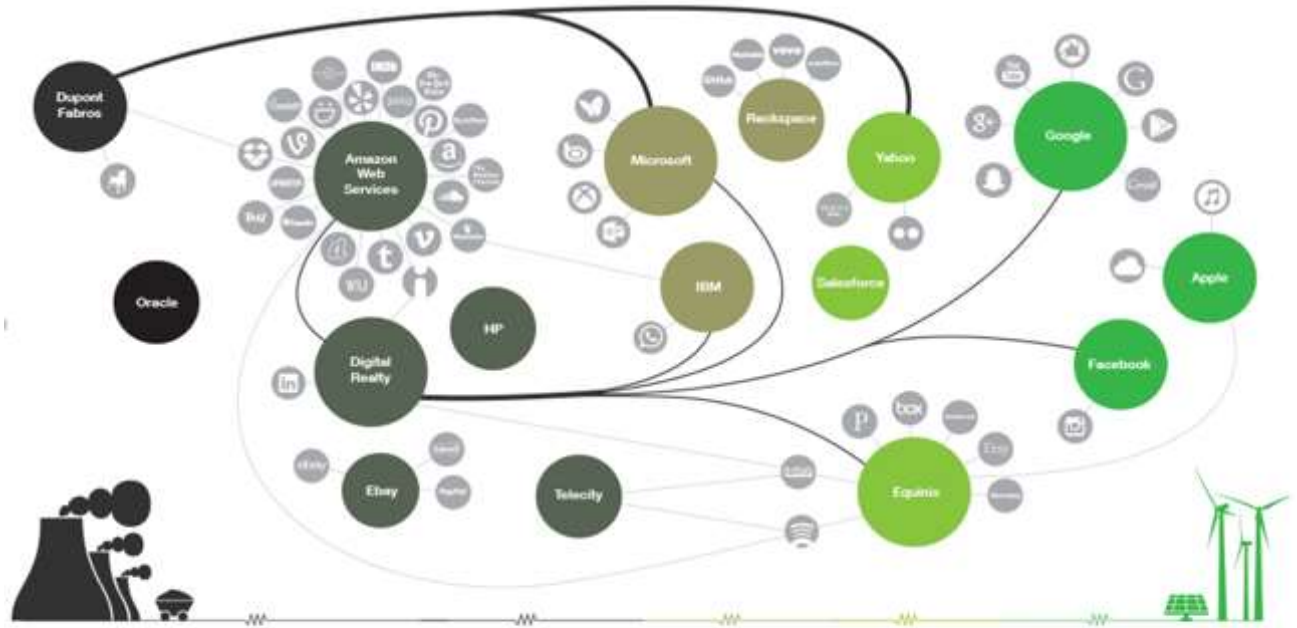


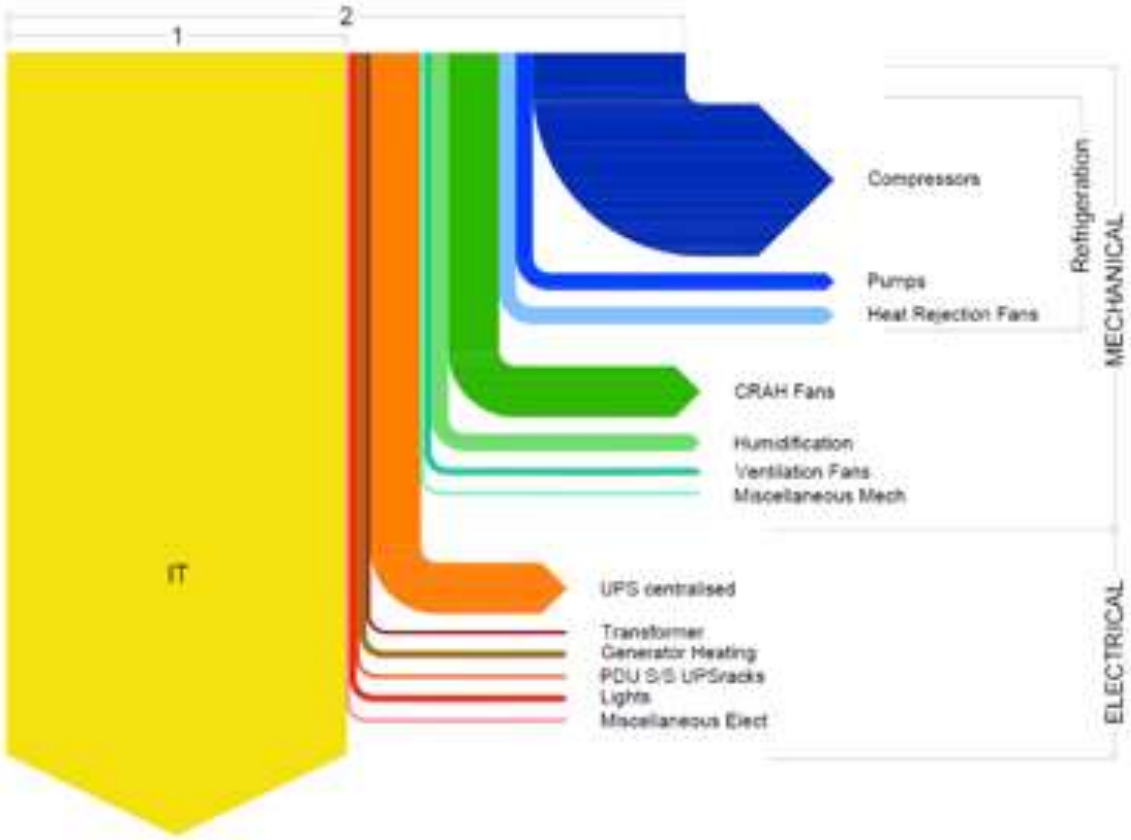


Stuck in dirty energy past: Efficiency only, using mostly dirty energy, have taken few or no steps to switch to renewables

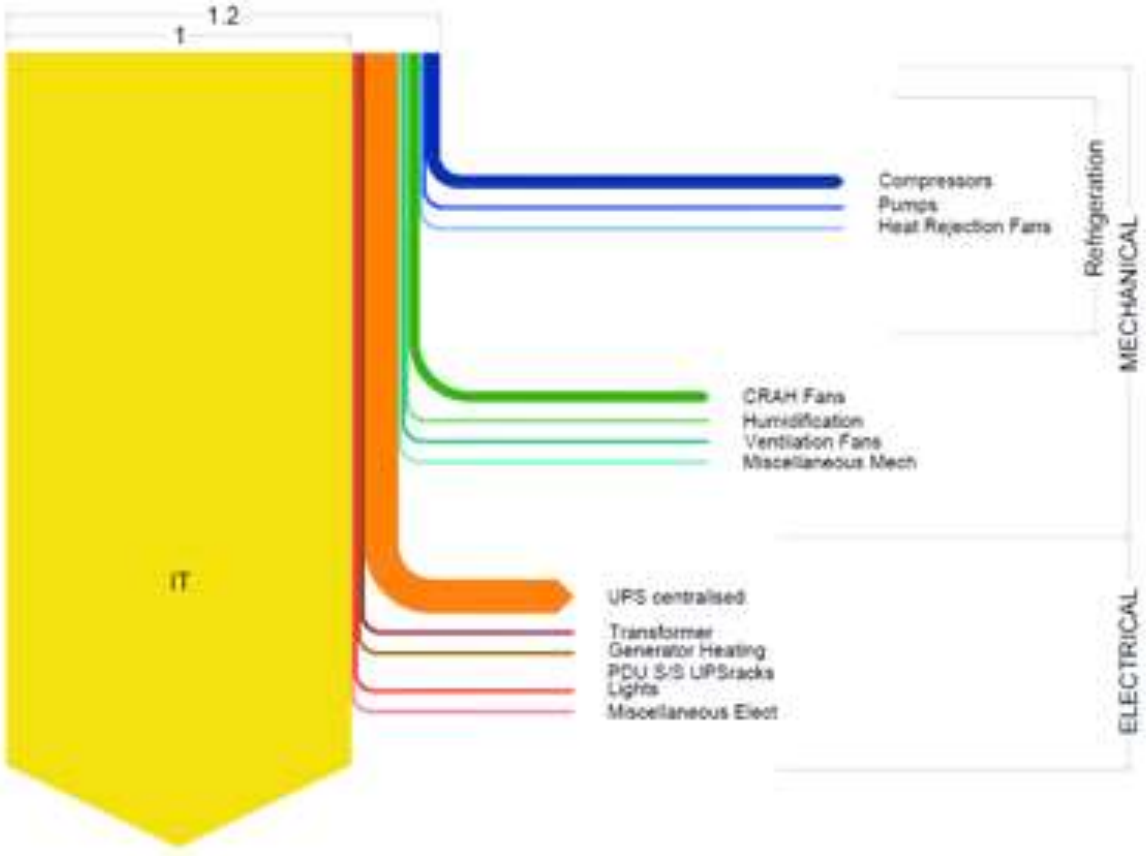
Middle of the Road: Taking steps toward a greener internet, but not leading the way.

Green Internet Innovators: Committed to 100% renewable energy. Their leadership is helping to make our lives, online and offline, greener.

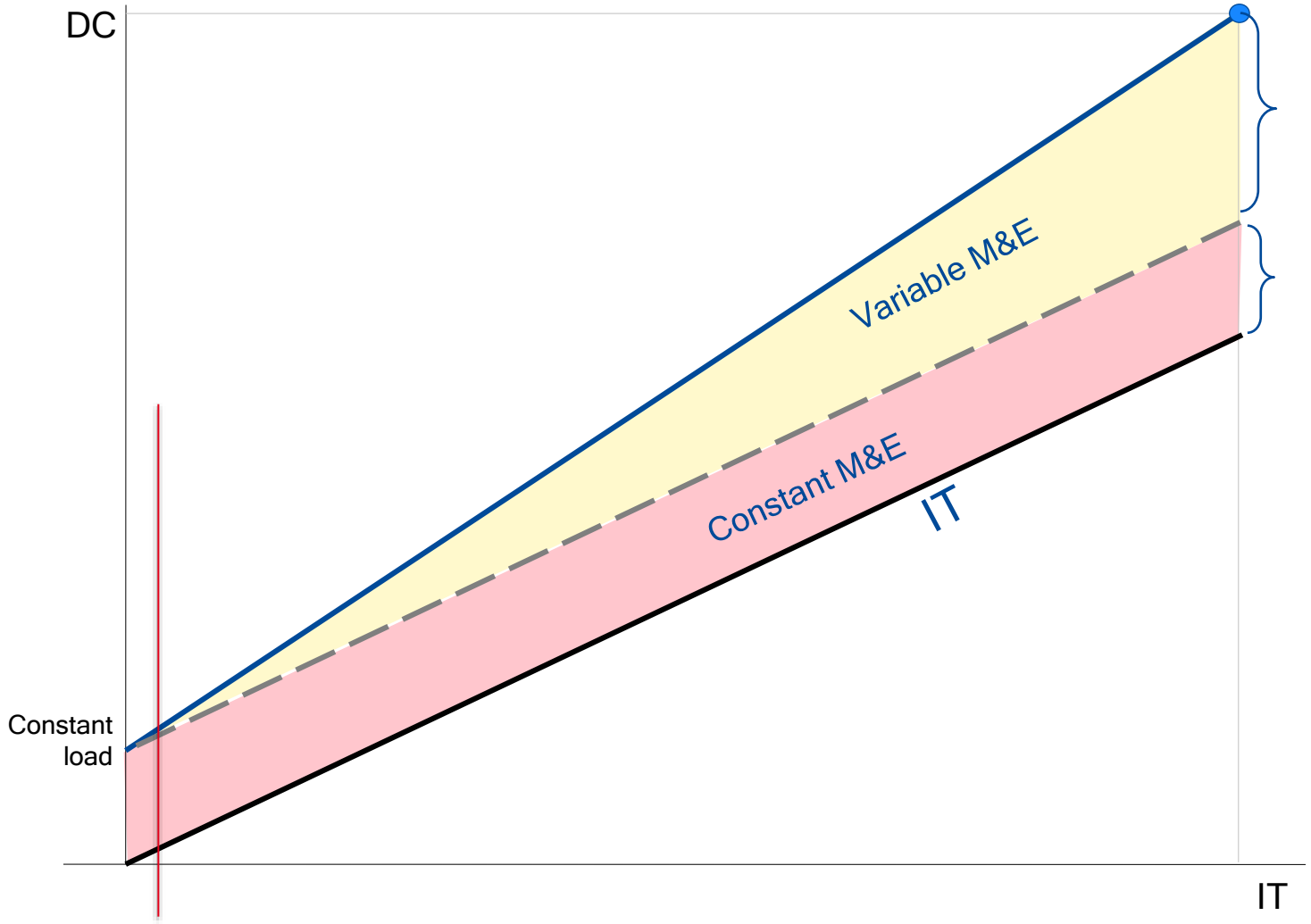
PUE legacy facility



PUE new build

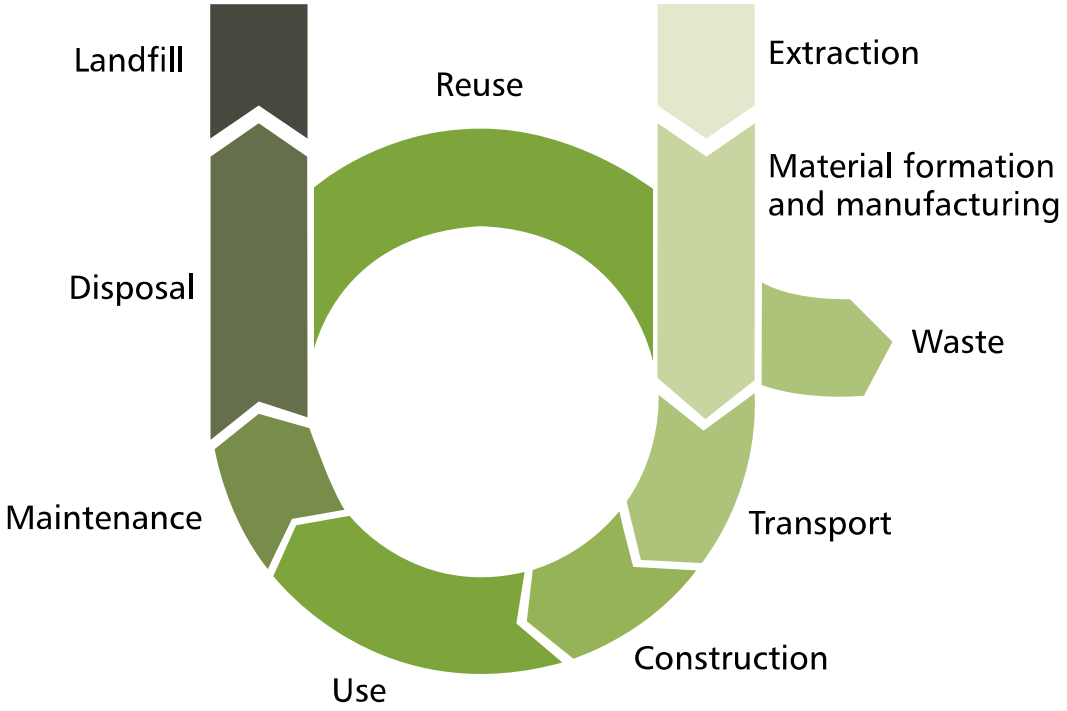


Scalability



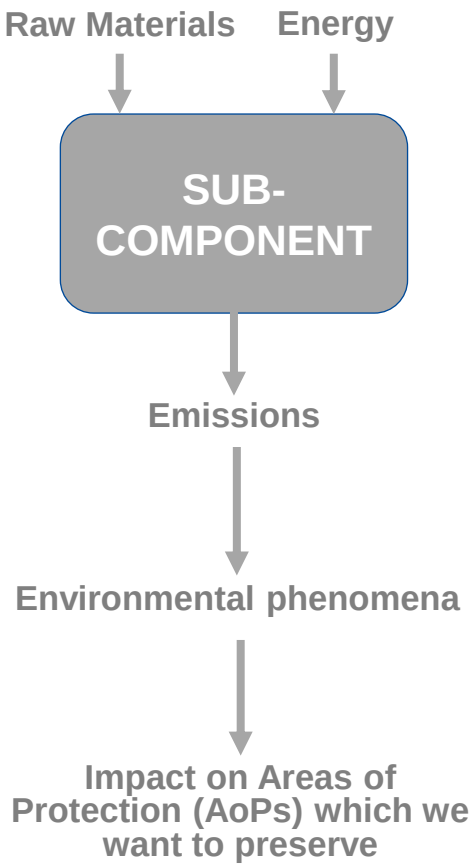
BEYOND ENERGY EFFICIENCY

Life cycle assessment (LCA)



reproduced with permission from CIBSE TM56 Figure 7 page 9

LCA



Manufacturing process

By products of manufacture are **emissions to the air, land and water**.

e.g. fuel combustion produces NO_x (nitrogen oxides), CO2, GHG, SO2

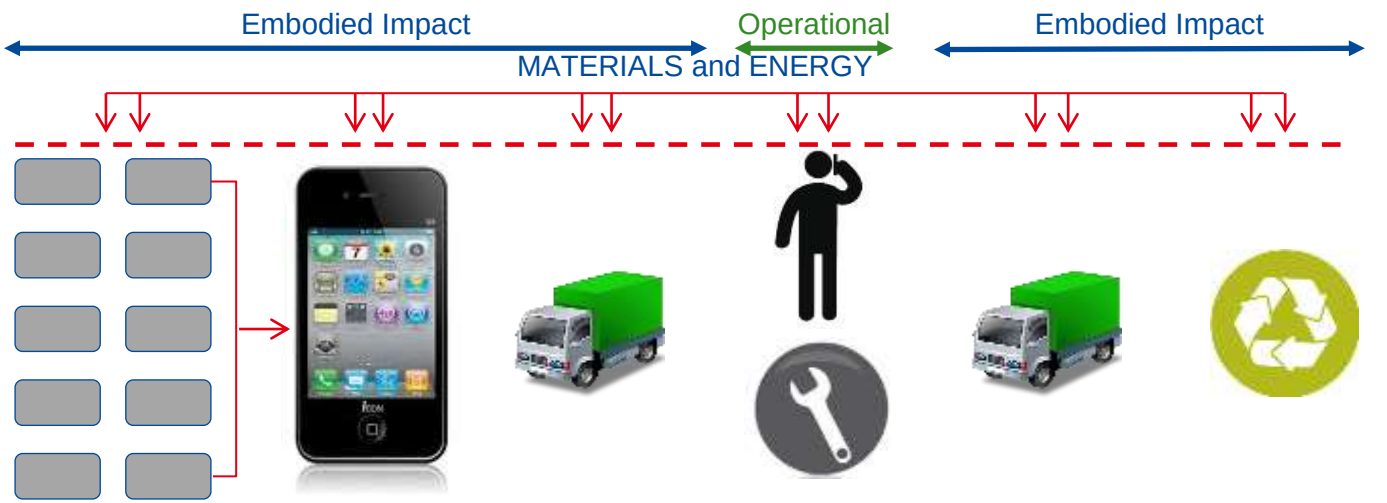
Emissions contribute to one or more environmental phenomena.

e.g. NO_x cause acidification of land, and increase the concentration of small particulates in the air.

Environmental impact: how damaging are phenomena to Areas of Protection (AoP).

Human Heath, Ecosystem Quality, Resource Depletion and Climate Change.

LCA



EMISSIONS

Each sub-component has been manufactured and emissions created.

EMISSIONS

Combining the components requires **more materials and energy** which create further **emissions.**

EMISSIONS

The product is transported to the user. Transportation requires **materials and energy** which create **further emissions.**

EMISSIONS

The product is used - electricity is used to charge it, and components may need replacing. These require **materials and energy** which create **further emissions.**

EMISSIONS

At the end-of-life of the product it is transported to the waste facility. Transportation requires **materials and energy** which create **further emissions.**

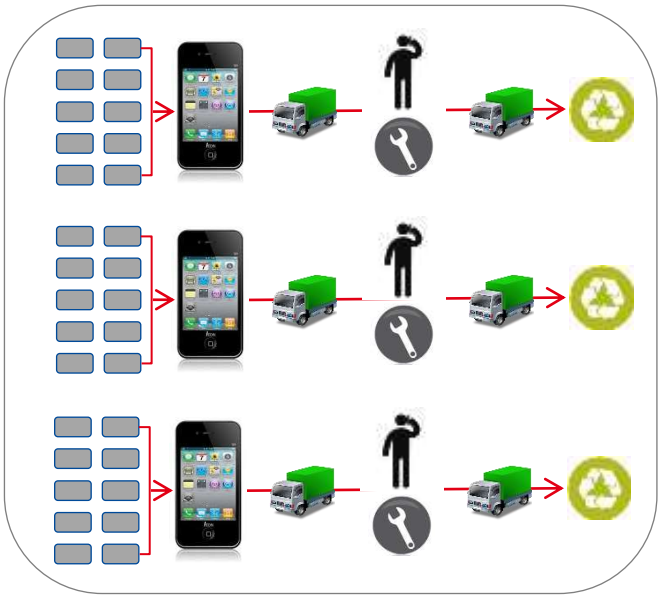
EMISSIONS

At the end-of-life of the product it is decommissioned and disposed of which requires **materials and energy** which create **further emissions.**

LCA

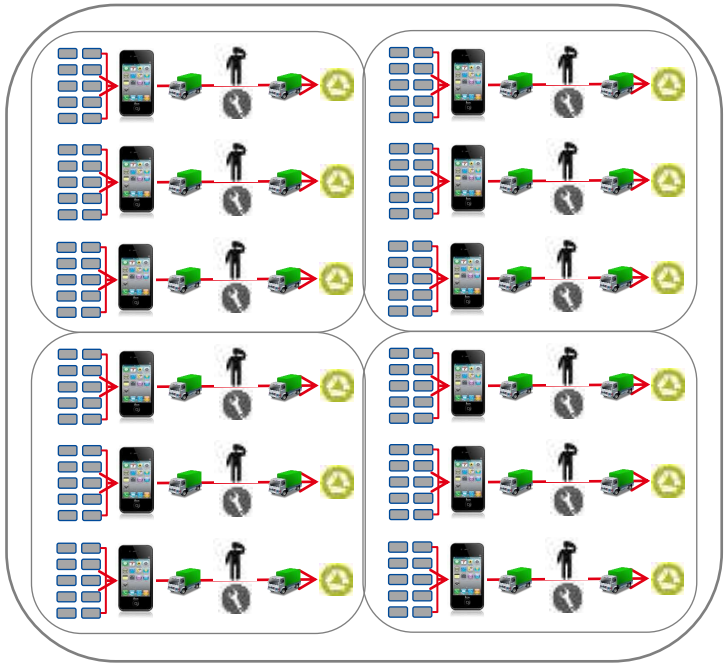
Now imagine the product is part of a system.

System

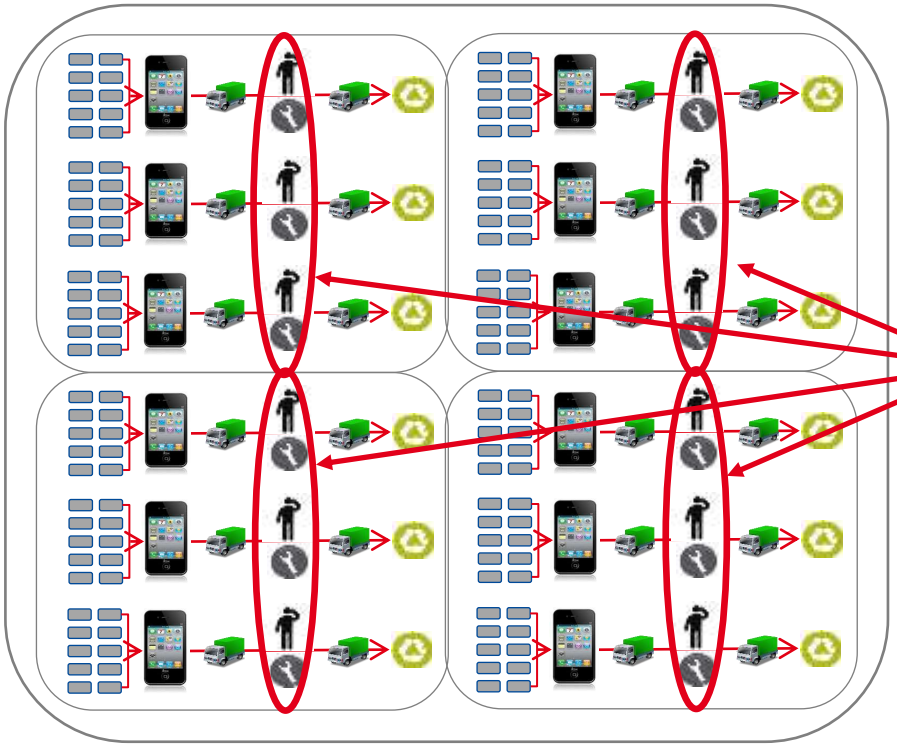


Which is one of many systems which make up a building.

Building



LCA

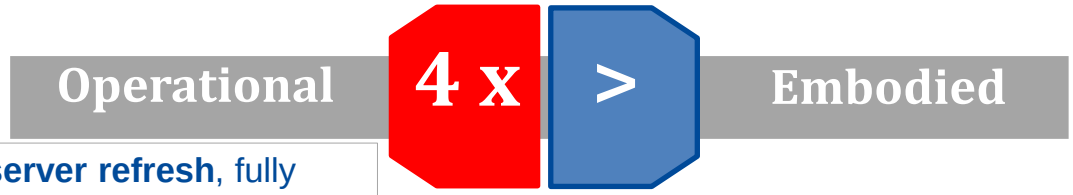


LCA provides a method to assess and minimise these omitted components.

Currently it's common to consider only a product's **use**, which means all the materials and all the energy used to **manufacture, transport and dispose of components, and the emissions created are ignored**.

Data centre LCA model

Scenario 1 - **BASELINE**



UK, **free cooling**, **3yr server refresh**, fully populated with servers that use **50% peak power** to **idle** and **30% utilised**

Scenario 2

- **Swedish** energy,
- **reduced energy** consumption (consolidation, virtualisation)
- **increased servers**

Scenario 3

- **UK** energy,
- reduced energy consumption,
- increased servers

Embodied impact of IT equipment & M&E

Damage Category	IT Eq	Facilities	Building
	(Pt/kW IT/year)		
Climate Change	6.54E-01	3.16E-01	1.48E-03
Ecosystem quality	1.20E-01	6.23E-02	2.64E-04
Human health	5.06E-01	2.70E-01	1.37E-03
Resources	7.42E-01	3.54E-01	1.26E-03
Total	2.02E+00	1.00E+00	4.37E-03
Ratio IT/Facil	2.0 (1.3 to 5.3)		
Ratio (IT+Facil)/Building	691 (400 to 1200)		

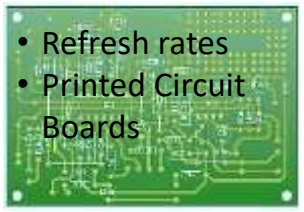
BEAM (Building Environmental Assessment Methods) do not consider IT equipment and Facilities!

Shah & Whitehead

Summary of key life cycle impacts

LIFE CYCLE ASSESSMENT (Pt/kW$_{IT}$/year)

	Equipment Impact	Energy Use	Energy Mix
Facilities M&E	• Scalability • Zero Refrigeration • UPS battery • Copper, Steel Aluminium	PUE	• Renewables • Off grid • Grid • Site • CO2
IT	• Refresh rates • Printed Circuit Boards	• Utilisation • Virtualisation • Open source, comp, stack	



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and communication
to drive sustainability
in the Data Centre Industry.

https://www.cedaci.org

Q&A

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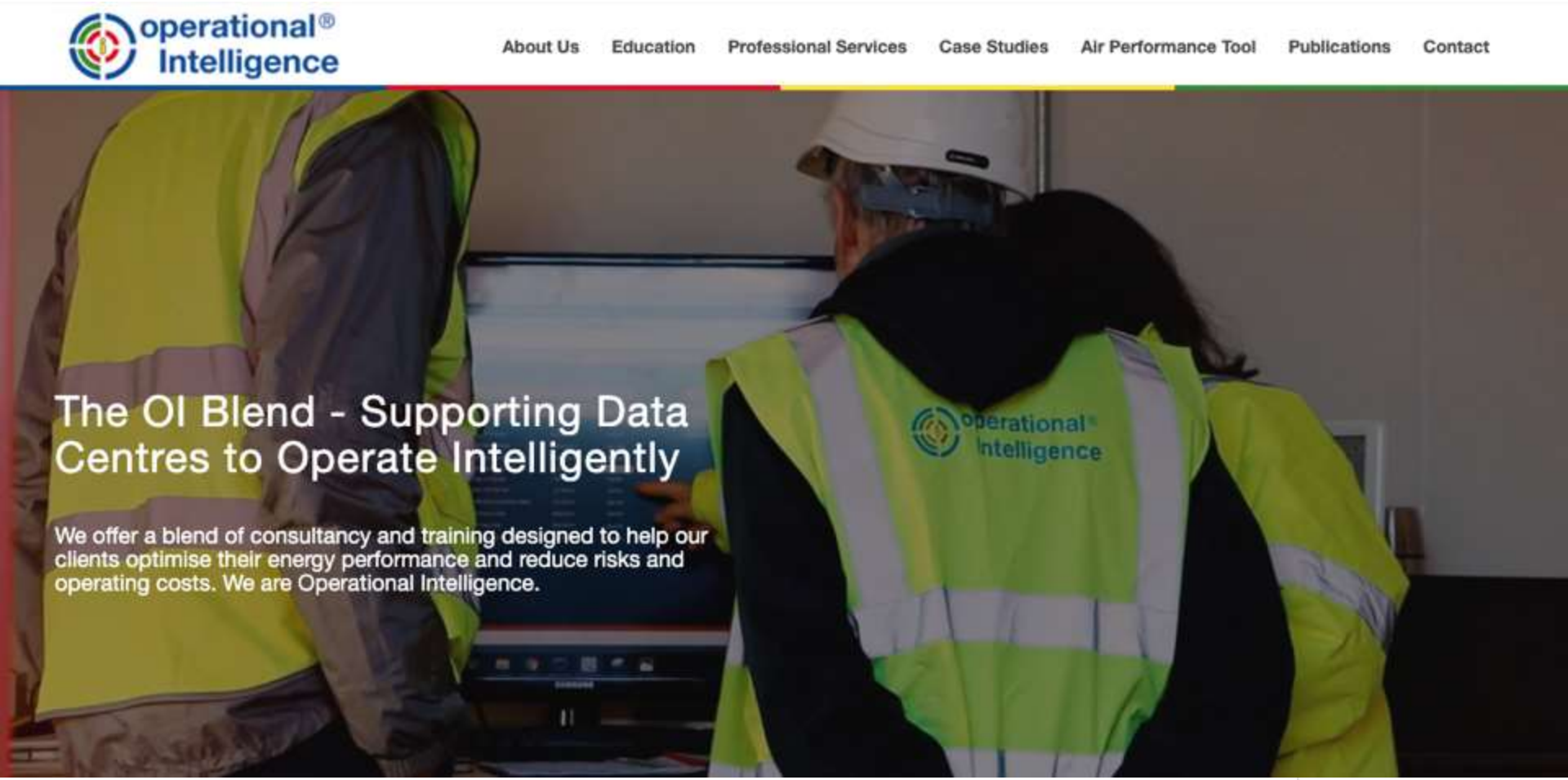

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