Data Centres in 2030: comparative case studies that illustrate the potential of Design for the Circular Economy as an enabler of Sustainability

Dr Deborah Andrews and Dr Beth Whitehead
What are Data Centres?
**Origins** ENIAC, IBM-American Airlines, CD 6600 supercomputer
Accelerating growth in technology

8.6 million data centres globally

60,000 in EU - 66% in UK, Germany, France & Netherlands
DIGITAL AROUND THE WORLD IN 2018

- **TOTAL POPULATION**: 7.593 billion
- **INTERNET USERS**: 4.021 billion
- **ACTIVE SOCIAL MEDIA USERS**: 3.196 billion
- **UNIQUE MOBILE USERS**: 5.135 billion
- **ACTIVE MOBILE SOCIAL USERS**: 2.958 billion

**URBANISATION**: 55%
**PENETRATION**: 53%
**PENETRATION**: 42%
**PENETRATION**: 68%
**PENETRATION**: 39%


**Hootsuite**: we are social

**Operational Intelligence**
Connectivity

INTERNET PENETRATION BY REGION
REGIONAL PENETRATION FIGURES, COMPARING INTERNET USERS TO TOTAL POPULATION

GLOBAL AVERAGE: 53%

Sources: Internet World Stats, ITU, Eurostat, Internet Live Stats, CIA World Factbook, Mediasmart, Digital, Facebook, Government Officials, Regulatory Authorities, Bureaucratic Minds. Note: Penetration figures are for total population, regardless of age.
Disparities: Iceland – 98% population / Somalia 2% / Eritrea 1%
Since 2007 rate of connectivity in developing countries has fallen
Women & rural poor ‘substantially excluded from education, business, and other opportunities that the internet can provide’
DC growth – 300% in EU by 2025 / 500% global 2030
Greatest impact - operational energy - emphasis on 24/7 operation and performance

Clean / renewable energy – Yahoo – hydro / Portugal Telecom – PV / Google - wind energy

Facebook - Lulea Sweden – ‘cool’ location

Leaner computing code / algorithms - reduce compute time, save energy
Embodyed impact - building life 60 years

15% of embodied environmental impact derives from building and facilities

equipment is regularly refreshed –
M&E - 20 years
batteries - 10 years
servers - 1-5 years

85% derives from IT equipment

20 million servers etc =
0.56 million tonnes materials
End-of-Life
DCI growth much quicker than reprocessing methods & infrastructure....
End-of-Life
DCI growth much quicker than reprocessing methods & infrastructure....

DC sector - major contributor to global total of 11.8 Mt/year of E-Waste

WEEE growing 3-5% / year in EU

Globally / EU
15% & 32% is collected and recycled

majority is sent to landfill / exported – is being stockpiled
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**CRM - EU**
- Dy, Nd, Pr, Tb
- Sb
- Co
- Mg
- Pd
- Be
- Si

**CRM - 0.2% by mass**

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**Image Credits:**
- [London South Bank University](https://www.londonmet.ac.uk)
- [Operational Intelligence](https://www.operationalintelligence.com)

- **Blue** – low risk
- **Red** – high risk

### Conflict Minerals
- Tungsten
- Tantalum
- Tin
- Gold

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Looking forward –
Data Centre Industry in 2030

500% increase since 2018

Connectivity – growth in China & India

DCs Cluster in W. USA, W Europe

Uber-hyper-centres in ‘cool’ areas / Arctic

Developments in IT – very rapid -
Product refresh ~ 6 months in UHCs / 1-2 yrs in small bespoke DCs (finance, health)

WEEE - increasing
Future Scenario 1: No change

Linear Economy

DC sector - Limited reuse / recycling and information about destination at EoL

Landfill sites in EU restricted – large % WEEE exported

Low value WEEE dumped in poorer countries

Companies ignorant about hazardous recycling / ‘can’t afford’ better recycling services

Direct impact - workers’ health / environment adversely affected

Many resources are lost
Future Scenario 1: No change
Linear Economy

China / Asia – take higher value WEEE & DC equipment - stockpile common metals & CRMs

Rich companies - buying land / reserves / mines in Africa etc.

Gaining control of materials’ supply chains for DC sector

Rising GDP = greater demand for electrical & electronic goods – not designed for disassembly, not durable

Increases demand for virgin CRM and other materials essential to DCI

Market instability - costs passed on to end users
Future Scenario 1: No change
Linear Economy

Not big problem in developed countries

Developing world - is a problem

Personal smart devices & network access - less affordable affects social mobility, increases poor health and social unrest

Political instability, corruption (e.g. the sale of mining rights) and conflict thrive with growing demand for virgin materials

Number of dispossessed, political and economic migrants grows

Supply chain disruption – adverse impact / threat to DC sector
Future Scenario 2: Change Circular Economy

disposal - change waste hierarchy include reuse / remanufacture
Future Scenario 2: Change
Circular Economy

DCI EU – recycling & reclamation infrastructure developed
Investment accelerated development –
increased throughput – system is economically viable

Reduced direct environmental impact / transport - ocean transport / more EVs etc.

Recycling is limiting landfill mining – better / controlled quality recyclates -
becoming cheaper than virgin materials

‘Data wiping’ technology improved & trust increased -
reuse & remanufacture increase / product life extended / waste reduced
Future Scenario 2: Change Circular Economy

WEEE flow to Africa etc reduced – short term negative impact on employment and income

Mid-long term - EU / Africa partnerships developing – combine low and high tech knowhow creates ethical, properly paid jobs

Increasing income = connectivity = access to education, health services etc

More recyclates = reduced demand for Conflict Minerals = improves political & social stability

Economically stable market for DC materials – has potential to reduce social inequality
The role and importance of Design in future scenarios 1 & 2

Scenario 1 / current – problematic

Need a Circular Economy

Dependent on Design
Design strategies – based on waste hierarchy

**Reduce**: dematerialisation – redesign housings etc

**Reuse**: improve data wiping / reduce shredding

**Remanufacture**: develop & apply D4D to extend life

**Recycling**: D4D – no adhesives / reduce materials mixing / composites

**Energy from Waste**: D4D will reduce waste / Combust non-recyclablables to generate energy

**Disposal**: reduce hazardous materials & reduce impacts from landfill

**Designers must develop** new meaningful applications for recycled polymers and/or substitute with other materials
Conclusion

DCI is essential to 21st C life importance / growth – increase concurrently technology & operation developed more quickly than reprocessing infrastructure

Linear Economy / no change – wide ranging negative impacts

Circular Economy could mitigate them - wide-ranging positive environmental, social, economic impacts

Scenarios illustrate power of design as enabler of sustainability

Will this be led by policy or by designers and innovators?
CEDaCI –
Circular Economy for the Data Centre industry

London South Bank University
Greent amsterdam region
Wuppertal Institut
TerraNova Développement

operational Intelligence
aliter networks
SIMS METAL MANAGEMENT
Dialasheep Ltd.
Thank you for listening – any questions?

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bethwhitehead@dc-oi.com