Circular Economy for the Data Centre Industry

Interreg North-West Europe CEDaCI

Integrating Life Cycle Management for a more Circular Data Centre Industry

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LCM Conference Series

The 9th International Conference on Life Cycle Management
1st – 4th September 2019, Poznan, Poland

London South Bank University · Greenit amsterdam region · Wuppertal Institut · We Loop · team2 · TND · operational Intelligence · aliter networks · SIMS METAL MANAGEMENT · Dialasheep Ltd.

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LCM, **Circular Economy** and sustainability **strategy**.

Eco-design to implement sustainability.
Key Performance Indicators for progress.

Sustainability metrics based on Life Cycle Approaches.

Awareness raising and **training** to support sustainability implementation.

Support **communication** based on **sustainability performances**.

Trainings

Our expertise and multi-sectorial experience

Building and construction

EQIOM
A CRH COMPANY

ECIA

MEL
MÉTROPOLE
EUROPÉENNE DE LILLE

Metallurgy

Interreg
North-West Europe
CEDaCI

BEFESA

TND
La recherche des métaux rares

R&D – Innovation

innovation amélioration
économie de ressources
collaboration
performance env
cycle de vie
réduction des impacts

HORIZON 2020

Plastics

Roll-Gom

Interreg
2 Seas Mers Zeeën

Food & retail

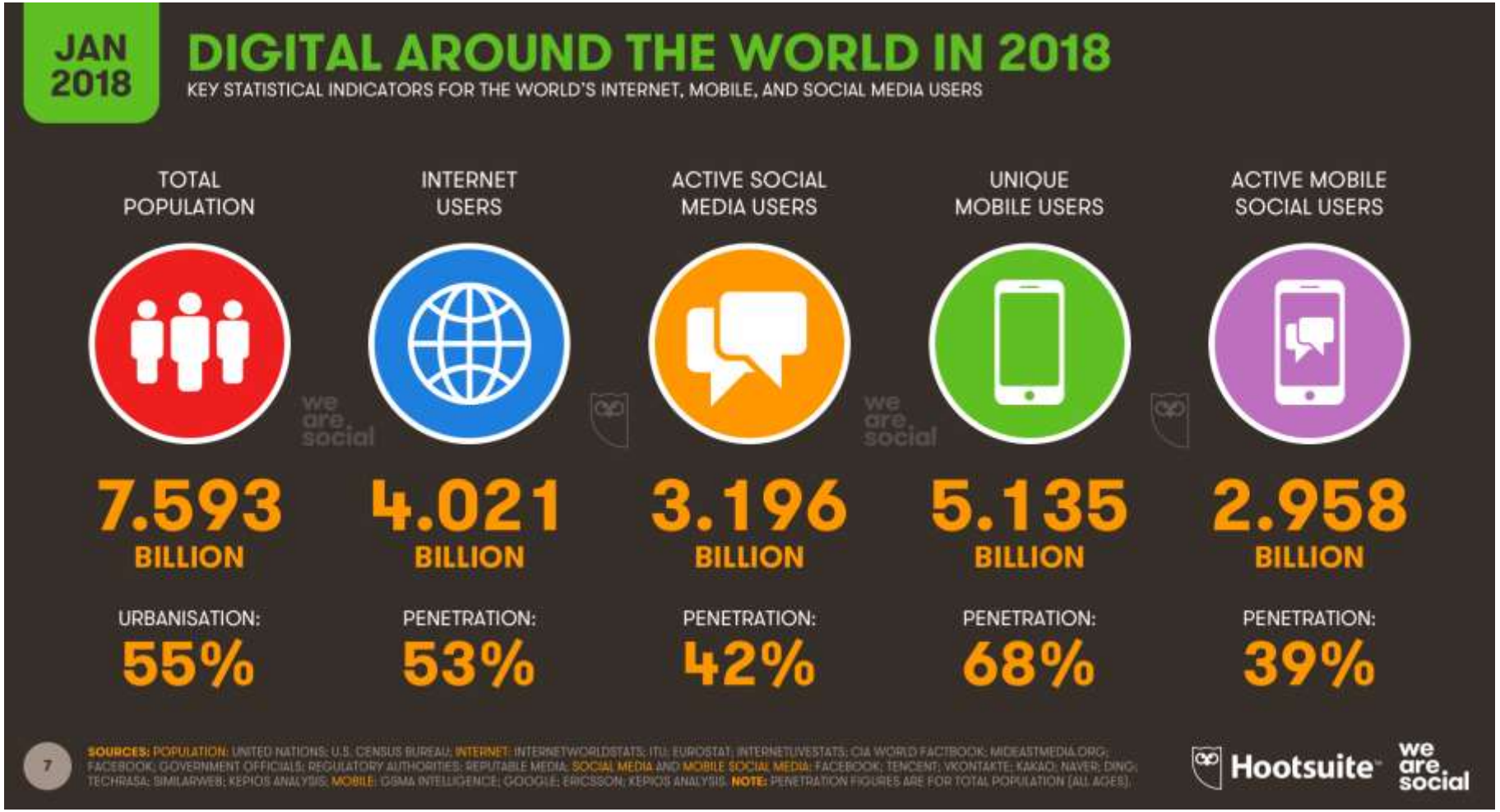
COLRUYT
GROUP

Textile

H2O at Home

Context

Connectivity – very rapid growth at global level



Context

What are data centers?

~ 8.6 million **data centres** globally

~ 63,000 in EU - 66% in UK, France, Germany & Netherlands

Predicted growth – 300% by 2025 / 500% by 2030



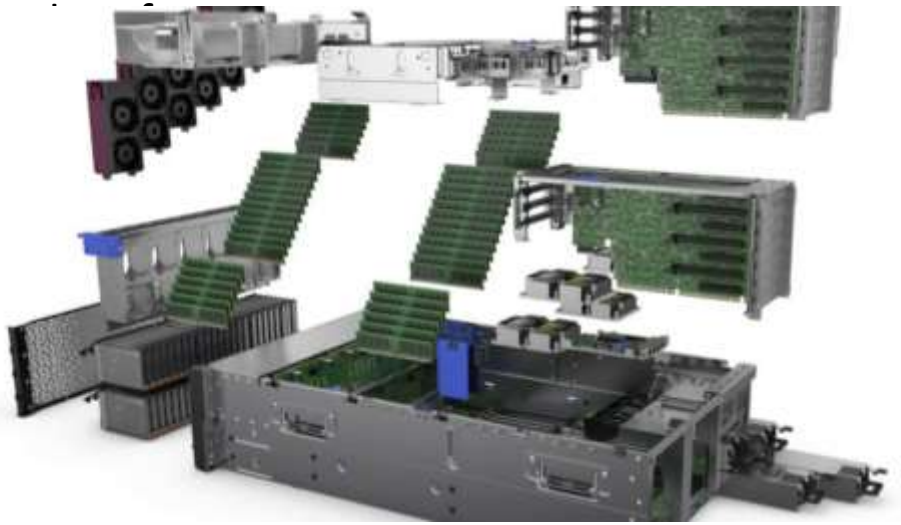
DC industry - emphasis on 24/7 operation & uninterrupted performance

reducing operational energy consumption



Context

Embodied impact -building life 60 years
15% -from building and facilities / **85% -from IT equipment**
20 million servers etc = 0.56 million tonnes materials



CEDaCI – objectives

- ✓ Create stable and secure materials supply chain for DC sector
- ✓ reduce sectoral waste and environmental impact by……

- Increasing recycling / reclamation of CRM
- Improving design for disassembly/ manufacturing
- Extending product life – refurbishing
- Base CE in NWE Europe to grow business

Circular Economy
for the Data Centre Industry

Interreg
North-West Europe
CEDaCI
European Regional Development Fund

London South Bank University
EST 1892

Greenit
amsterdam region

Wuppertal Institut

team2
l'innovation pour l'économie circulaire

TND
La recherche des métaux rares

operational® Intelligence

aliter networks

SIMS METAL MANAGEMENT

Dialasheep Ltd.

AfB social & green IT

IBM

amsterdam economic board

NEDERLAND ICT

ITPS

OVH

DIGITAL

Project steps

Situational Analysis and **Network** Building

EcoDesign / **Design for Circular Economy** prototype products and Guidelines

Co-creation activities, Tool Development and Testing and EcoDesign Guideline Finalisation

Improved **Recycling** methods and process for increased recycling and reclamation of CRM

Refurbishment business and Decision Making models

Communication / Long Term strategy

Situational Analysis and Network Building

Characterization of DC equipment (age, technology, etc.)

Inventory of stakeholders/case studies/BM **Building a network of the stakeholders** **Screening Life Cycle Assessment**

Data Centres in NWE

UK

C: 450, **20,32%**

E: 11500, **19,10%**

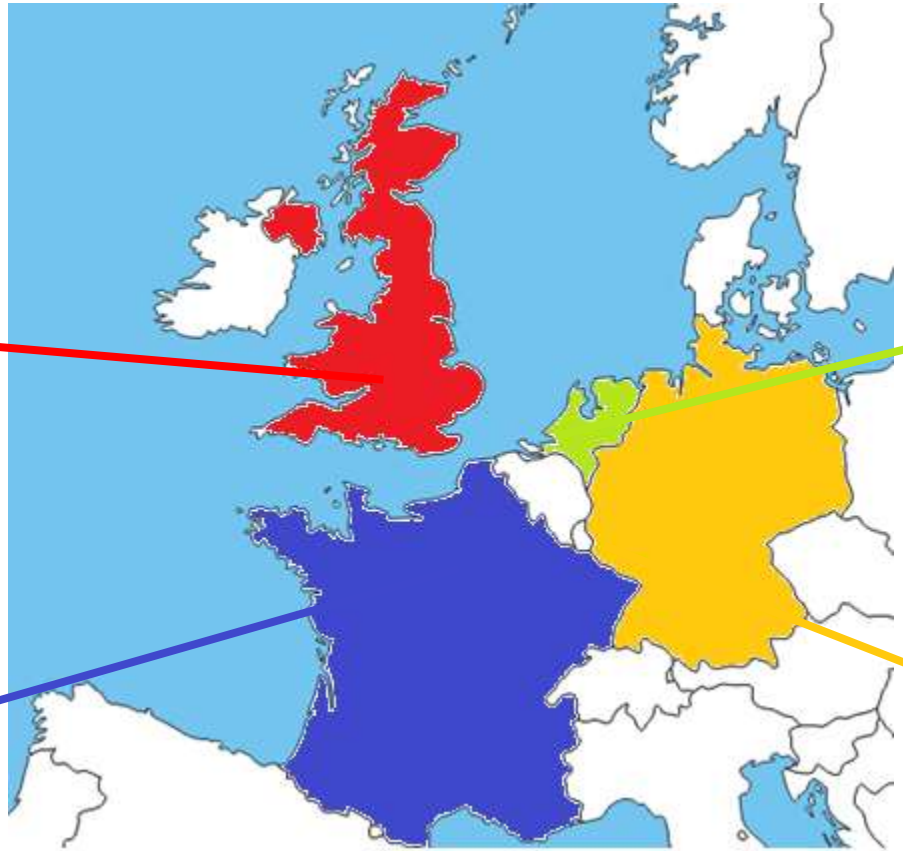
MSP: 25, **16,45%**

FRANCE

C: 270, **12,19%**

E: 8700, **14,45%**

MSP: 20, **13,16%**



NETHERLANDS

C: 250, **11,29%**

E: 5600, **9,30%**

MSP: 15, **9,87%**

GERMANY

C: 410, **20,32%**

E: 13200, **21,92%**

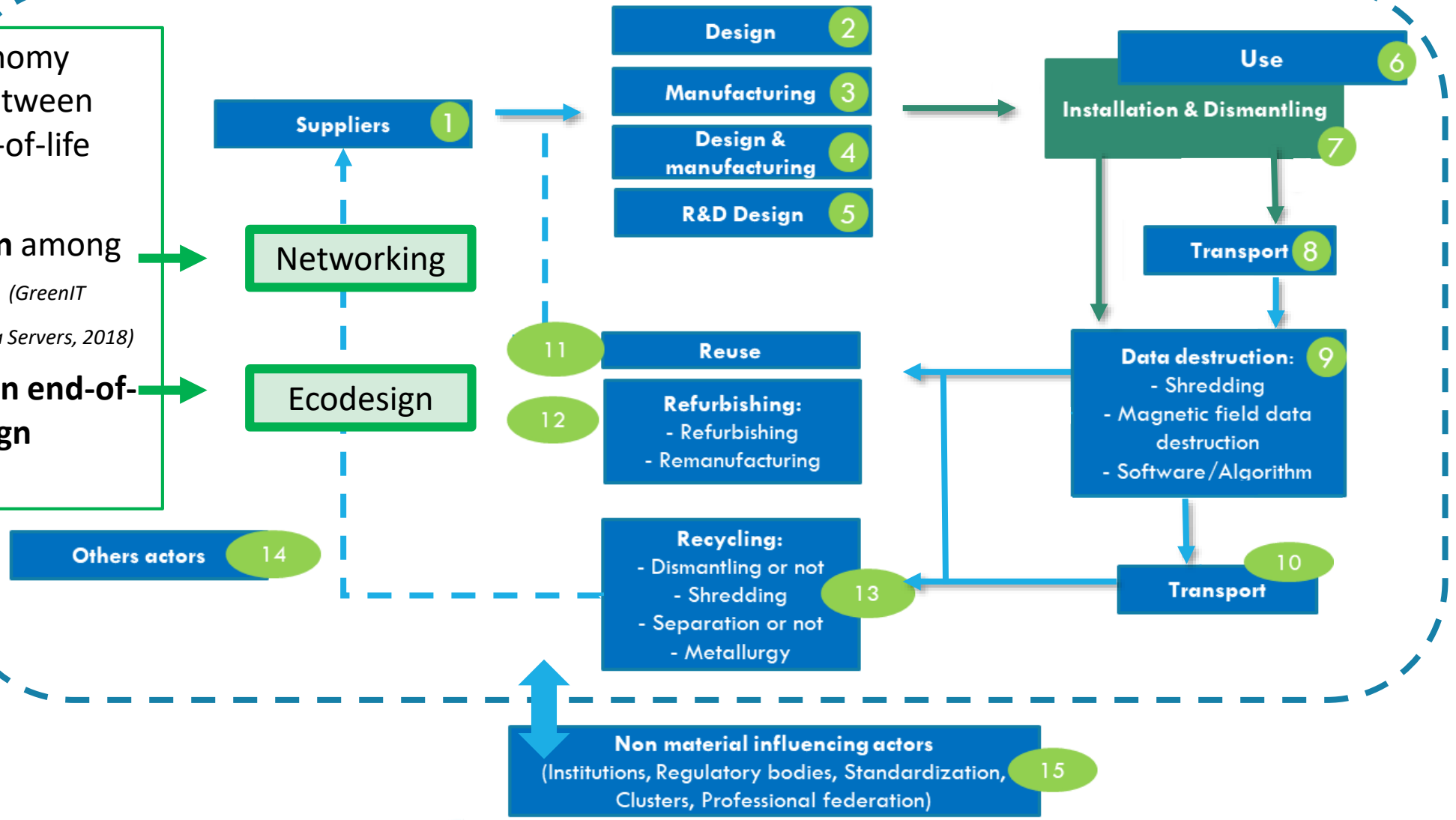
MSP: 30, **19,74%**

C: Colocation DC; E: Enterprise DC; MSP: Managed Service Providers; % Share in Europe

Source: Dodd, N., et al. (2018). Development of the EU Green Public Procurement (GPP) Criteria for Data Centres and Server Rooms Draft third criteria proposals

Data Centre Life Cycle

- Circular economy initiatives between use and end-of-life
- **Not enough collaboration** among stakeholders *(GreenIT Report: Circular Data Servers, 2018)*
- **GAP between end-of-life and design** stakeholders



Equipment composition

- **Batteries, storage equipment and network equipment** need replacement every 3-5 years and **servers** every 3-8…

  …and often earlier!

- Technology changes through the time

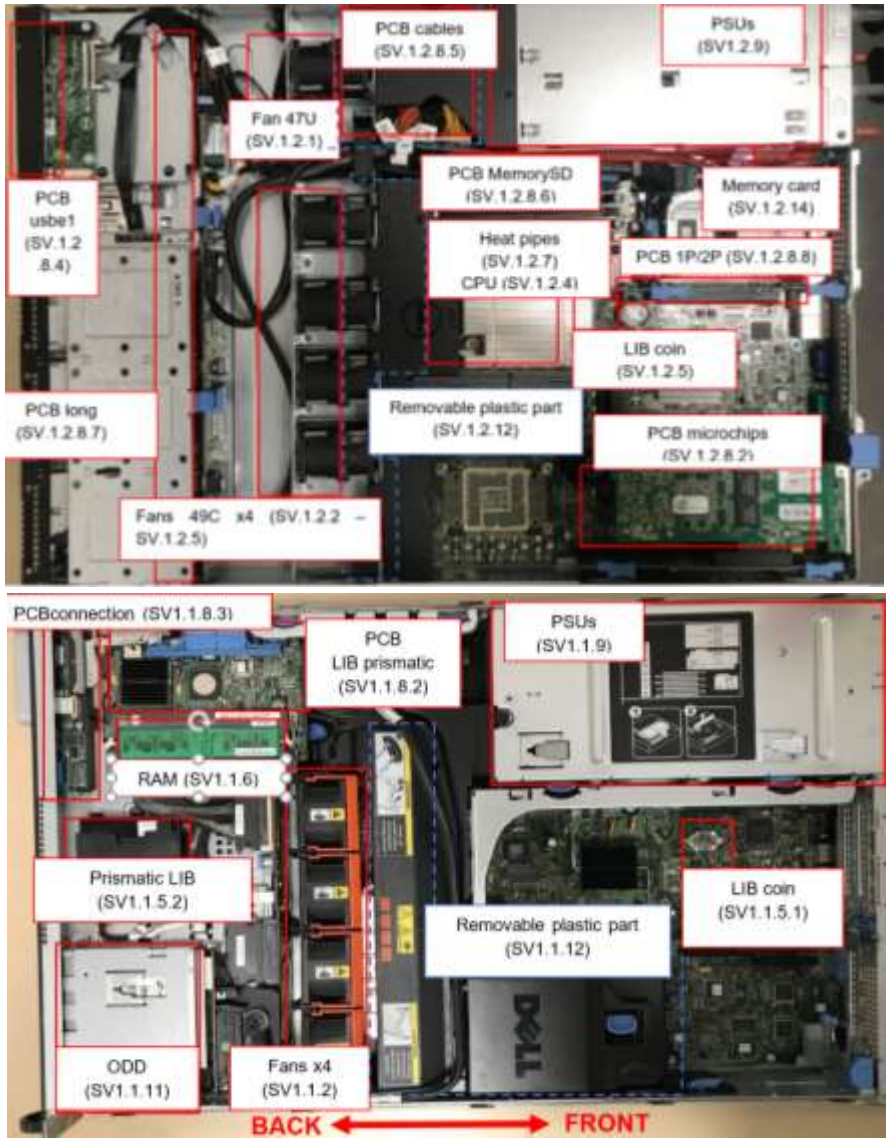
	Data centre equipment	Lifespan (years)
Power generation	Uninterruptible power supply (UPS)	20
	Transformers	20
	Switch gear	20
	Backup generators	20
	Power distribution units (PDUs)	20
	Batteries	**3-5**
	Power cables	20
IT	**Servers**	**3-8**
	Storage equipment	**3-5**
	Network equipment (switches, routers, etc.)	**3-5**
	Chassis	20
	Network cables	20
Cooling system	Chillers	20
	Computer room air conditioning units (CRACs)	20
	Direct expansion air handler	20
	Pumps	20
	Cooling towers	20
	Heat exchange systems	20
	Reservoir storages for collecting rain water	20
Security system	Fire-suppression system	20
	Video-cameras	20
Building structure	Lighting, infrastructure, etc.	20

JRC. (2015). *Environmental Footprint and Material Efficiency Support for product policy, analysis of material efficiency requirements of enterprise servers*

Critical Raw Materials (CRM) in DCs

Critical Raw Materials (CRMs) (European Commission, 2017)

Antimony	Fluorspar	LREEs	Phosphorus
Baryte	**Gallium**	**Magnesium**	Scandium
Beryllium	**Germanium**	Natural graphite	**Silicon metal**
Bismuth	Hafnium	Natural rubber	**Tantalum**
Borate	Helium	Niobium	Tungsten
Cobalt	**HREEs**	**PGMs**	Vanadium
Coking coal	Indium	Phosphate rock	

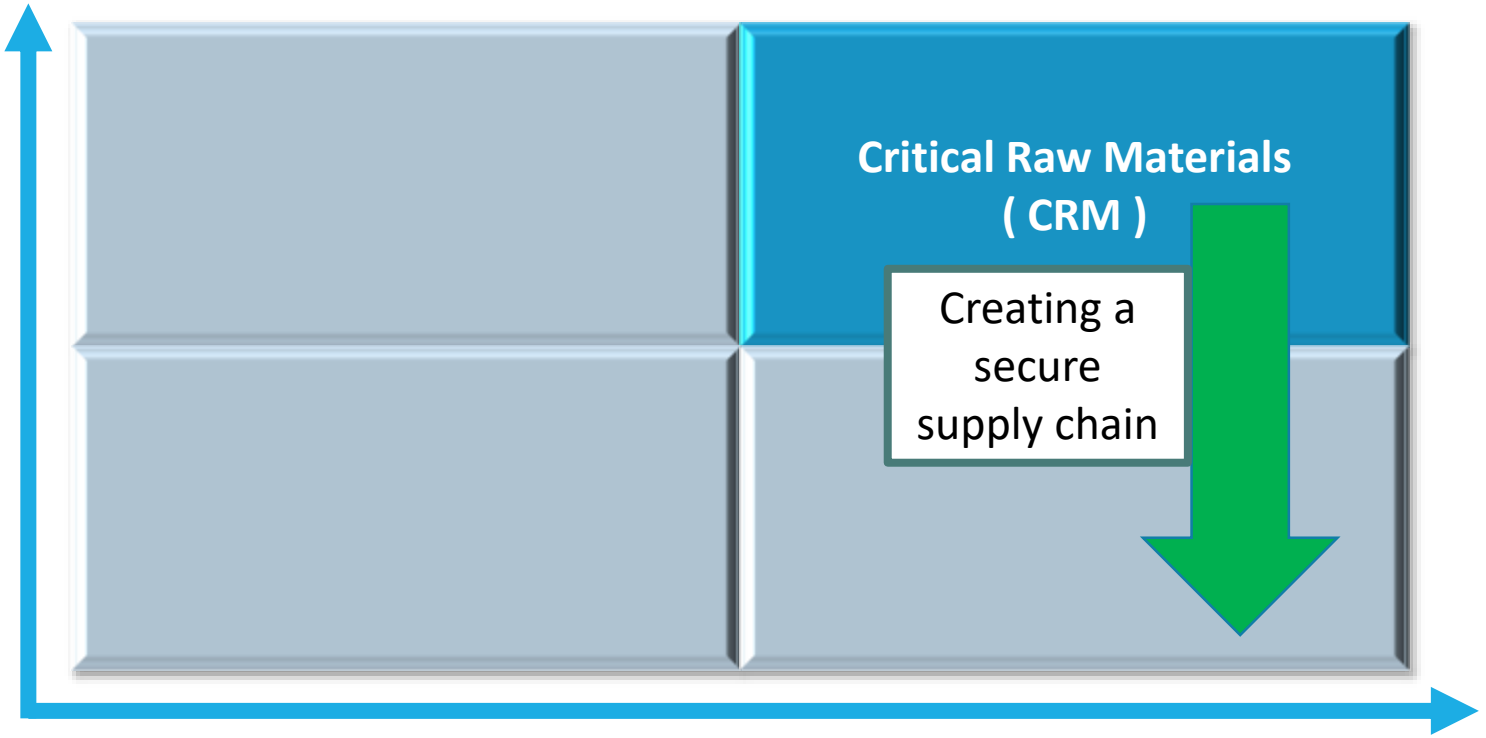


Equipment	Component	CRM
Power generation	Lithium Ion Batteries	**Co**
Storage equipment	HDD	**Dy**
		Nd
		Pr
		Tb
	SSD	**Si**
		(CRM found in PCB)
Servers, storage equipment (SSD), Network equipment	PCB	**PGM**
		Sb
		Si
		Ga
		Ta
		Ge
		Co
		Mg
Servers	Connectors	**Sb**
		Be
		Co
		Pd
		Si

CRM in Europe

Supply Risk

- **Import reliance**
- **Geopolitical** situation of providers
- **Number of countries** (providers)
- **Recycling rate**
- **Substitution index**



- Link to **industry supply chains**
- **Modern technology**
- **Environmental applications**

http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_fr

CRM in data servers

"Basic building brick" server			
Material	**Quantity in server (g)**	**Material**	**Quantity in server (g)**
Sb	4,44	**Si metal**	11,22
Be	0,03	**REEs**	
Co	9,27	**Nd**	14,63
Mg	0,004	**Dy**	3,60
Pd	0,40	**Pr**	3,60
		Tb	0,75

NETHERLANDS

(GreenIT Report: Circular Data Servers, 2018)

- **184.000 scrapped sever units per year**, only in Amsterdam
- **11% refurbished**
- **24% recycled** with 81% of its mass recovered, 15% valorised and 4% lost in the process

These values depend on the technology and age of the equipment

Need to characterise different equipment to set strategies

Every year in NWE

~ 250 t

CRM are scrapped

CEDaCI project. WeLOOP

- Environmental Footprint and Material Efficiency Support for product policy, analysis of material efficiency requirements of enterprise servers, 2015
-Ecodesign Technical Assistance Study on Standards for Lot 9 Enterprise Servers and Enterprise Data Storage, Intertek

Waste Electrical and Electronic Equipment (WEEE)

- Toxic materials: need special treatment
- ***WEEE Directive 2012/19/EU***
  - Obligation to dismantle hazardous components
    - Printed Circuit Boards
    - Batteries
    - External cables
    - Capacitors with PCBs

    Ready for:
    Reuse
    Refurbish
    Recycling
  - Objectives:
    - Reduce amount of waste (Reuse, Refurbish)
    - Avoid landfilling
    - Proper treatment, managing toxic materials
    - Avoid illegal exports to less developed countries (Asia, Africa)

Source image: stephenleahy.net

- Human health impacts
- Environmental Impacts
- Losses of resources (Economic impact)

Data centre equipment recycling

Component with CRM	Industrial recycling process
Lithium Ion Batteries	Yes
HDD	No
SSD	No
PCB	Yes
Connectors	Yes

CEDaCI project. WeLOOP

High recovery

Co
Platinum Group metals

Low recycling rates: low collection, lost in the process

Precious metals
Iron
Aluminium
Plastics (incineration)
Copper
Lead

Materials with best recovery rates from electronic products

Very low recovery

Ta
Rare Earths
Be
Ge
Ga
Si

- Not economically viable processes
- Small concentrations
- Lost in the recycling process

Recycling of CRM

CRM in data servers	EU Import reliance Primary material (European Comissmion, 2018)	Recycling rate from end-users (European Commission, 2018)	Use in servers	Comments
Sb	100%	28%	Flame retardant in PCBs	**Not from PCBs!**
Be	100%	0%	Contacts as alloying element in Cu alloys	**Lost in the process**
Co	32%	35%	Cathode in LIB (PSU and PCB)	**Rates are supposed to incraese with EV development**
Mg	100%	13%	Alloying element for Al alloys	**Recycled as an alloy element with aluminium**
PGM	100%	11%	Found in capacitors, HDD and coatings to enhance conductivity	**Lots of losses!**
REE	100%	6-7%	Nd and Dy in magnets of HDD	**Not from old scrap!**
Si metal	64%	0%	Connectors and Transistors NAND memories, SDD and PCBs	**Not from old scrap!**
Ta	100%	1%	Capacitors from PCBs	**Not from old scrap!**

Only **1% of CRM** recovery from **WEEE**

CRM Recovery, 2014

Work Package 6
(October 2019 – March 2021)
Recycling pilot case

Recycling of CRM

Economically non-viable (yet) for all the CRM

- Very **small concentrations of CRM** in products
- Composition of equipment is unknown
- Destruction of data (Data sanitation) and it's influence on recycling
- Electronic products are complex: **costly** dismantling operations of the components (PCBs, drives, capacitors, etc.) and separation of materials

CRM Recovery, 2014

- Complex processes are required (high CAPEX)
- **Volatile prices** of CRM

- **Improve the design**
- **Research & Development** in recycling
- **Extend lifetime by reusing and refurbishing**

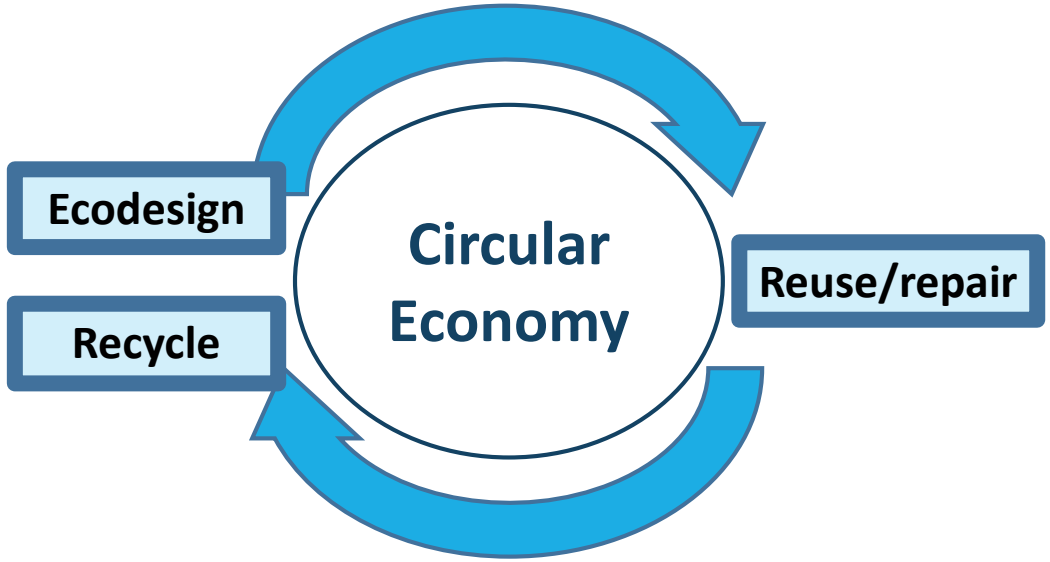
Circular Economy/LCM in DCI

NWE

- High economic importance
- Large market

DC Equipment

- High replacement rates
- High value



Extend life of products:
Economic and environmental benefits

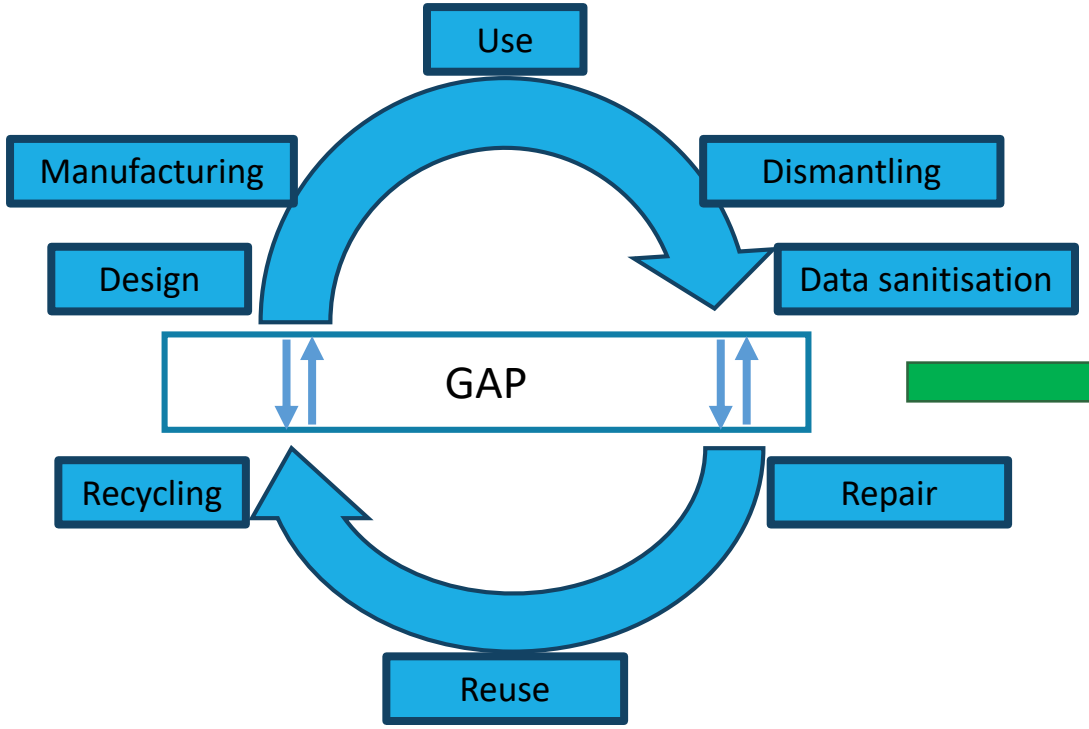
WEEE

- High toxicity
- Low recycling rates
- Societal and environmental impacts

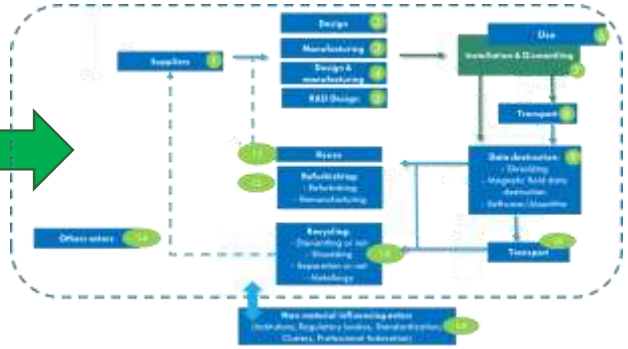
Materials

- High amount of Critical Raw Materials
- Need of secure supply chain
- Very low recovery rates

Conclusion and perspectives



Networking



Ecodesign

1. **Improve communication** among stakeholders
2. **Increase efficiency** of end-of-life strategies
3. **Increase awareness** about CRM
4. **Create secure supply chain**

Map of CEDaCI Pilots

Pilot B Refurbishment/ reuse and business models

Pilot A Ecodesign and manufacture

Pilot C WEEE recycling and reclamation of CRM

Co-creation

Application to join CEDaCI network

Application via Online Survey: https://fr.surveymonkey.com/r/CEDaCI

Join the multi-professional network

- ✓ Receive innovative insights towards circularity solutions
- ✓ Share ideas within a multi-professional network, e.g. designers, manufacturers, business actors related to refurbishing, remanufacturing, and recycling, DCI operators & users, public authorities, scientists from several disciplines, policy and communication experts
- ✓ Test, develop and use a circular business model
- ✓ Enlarge your national and European business network

More information: www.cedaci.org and info@cedaci.org

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Level of integration

- Working Group France
- Working Group UK
- Working Group Netherlands
- Working Group Germany
- Broader network

Key topics

- Eco-design
- Refurbishing
- Recycling
- Socio-economic impact

Life Cycle (LC) stages (selection)

- Supplier
- Design
- Manufacturing
- R&D Design
- Installation & Dismantling
- Transport
- Data destruction
- Reuse
- Refurbishing
- Recycling

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We Loop

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Thank you for listening – any questions?

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