Integrating Life Cycle Management for a more Circular Data Centre Industry

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@cedaci_project
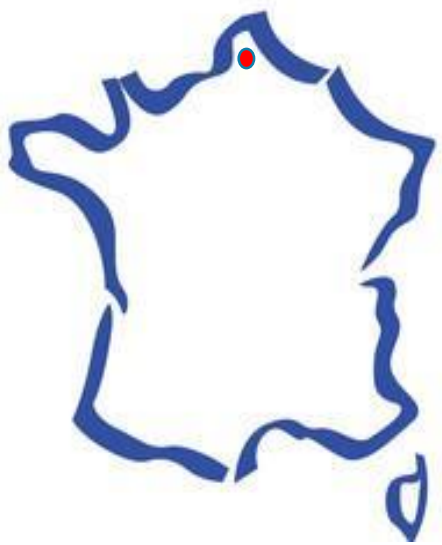
https://www.linkedin.com/company/cedaci-circular-economy-for-the-data-center-industry/

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

LCM Conference Series

www.weloop.org

Contact: info@weloop.org

03 21 13 51 88-9

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

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

Sustainability metrics based on Life Cycle Approaches.

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

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

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
European Regional Development Fund

BEFESA

TND
La recherche des métaux rares

R&D – Innovation

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

HORIZON 2020
LE PROGRAMME DE RECHERCHE ET
D'INNOVATION DE L'UNION EUROPÉENNE

Plastics

Roll-Gom

Interreg
2 Seas Mers Zeeën

Food & retail

COLRUYT
GROUP

Textile

H₂O at Home

Context

Connectivity – very rapid growth at global level

JAN 2018

DIGITAL AROUND THE WORLD IN 2018
KEY STATISTICAL INDICATORS FOR THE WORLD'S INTERNET, MOBILE, AND SOCIAL MEDIA USERS

TOTAL POPULATION	INTERNET USERS	ACTIVE SOCIAL MEDIA USERS	UNIQUE MOBILE USERS	ACTIVE MOBILE SOCIAL USERS
7.593 BILLION	4.021 BILLION	3.196 BILLION	5.135 BILLION	2.958 BILLION
URBANISATION: 55%	PENETRATION: 53%	PENETRATION: 42%	PENETRATION: 68%	PENETRATION: 39%

SOURCES: POPULATION: UNITED NATIONS; U.S. CENSUS BUREAU; INTERNET: INTERNETWORLDSTATS; ITU; EUROSTAT; INTERNETLIVESTATS; CIA WORLD FACTBOOK; MIDEASTMEDIA.ORG; FACEBOOK; GOVERNMENT OFFICIALS; REGULATORY AUTHORITIES; REPUTABLE MEDIA; SOCIAL MEDIA AND MOBILE SOCIAL MEDIA: FACEBOOK; TENCENT; VKONTAKTE; KAKAO; NAVER; DING; TECHRASA; SIMILARWEB; KEPIOS ANALYSIS; MOBILE: GSMA INTELLIGENCE; GOOGLE; ERICSSON; KEPIOS ANALYSIS. NOTE: PENETRATION FIGURES ARE FOR TOTAL POPULATION (ALL AGES).

Hootsuite™   we are social

Context

~ 8.6 million **data centres** globally

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

Predicted growth – 300% by 2025 / 500% by 2030
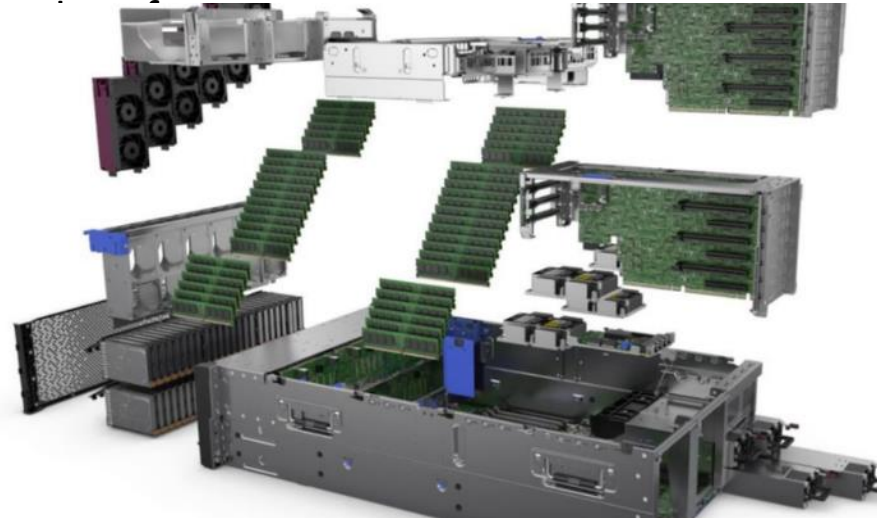
What are data centers?

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

reducing operational energy consumption

Over 2 gigawatts of renewable energy projects

NEW PROJECTS

61 megawatts	200 megawatts	200 megawatts	225 megawatts	80 megawatts	76 megawatts
Duke Energy U.S.	RES Americas U.S.	EDF Renewable Energy U.S.	Invenergy, LLC U.S.	Acciona Energía CHILE	Eolus Vind SWEDEN

Context

We LOOP

Interreg
EUROPEAN UNION
North-West Europe
CEDaCI
European Regional Development Fund

Embodied impact -building life 60 years

15% -from building and facilities / **85% -from IT equipment**

20 million servers etc = 0.56 million tonnes materials

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

6

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
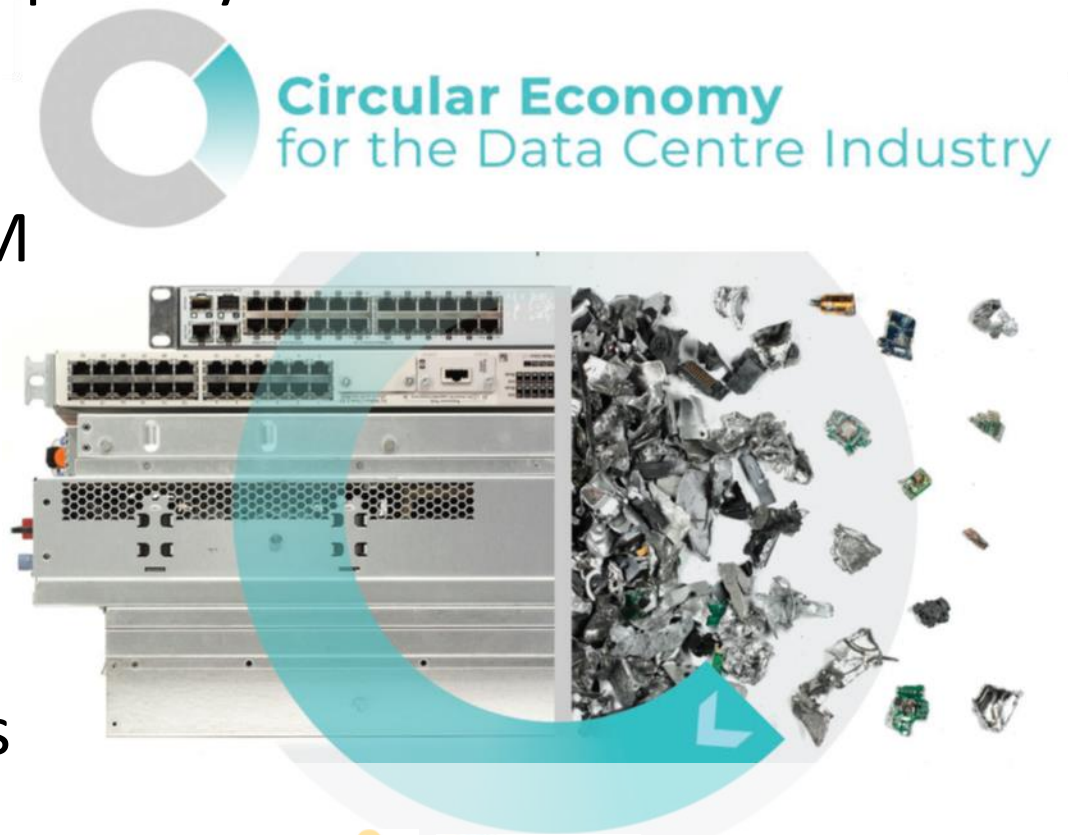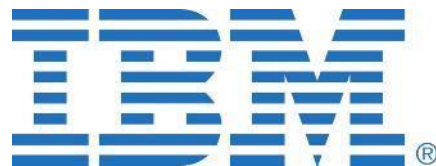
Project steps

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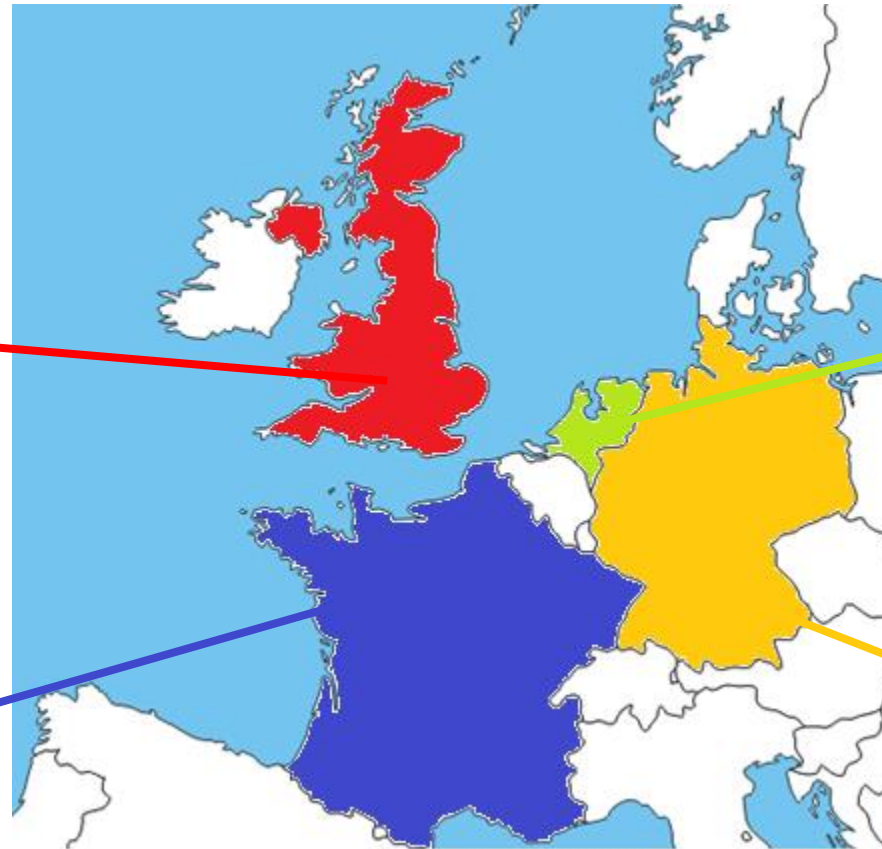
E: 11500, **19,10%**

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

NETHERLANDS

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

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

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

FRANCE

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

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

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

GERMANY

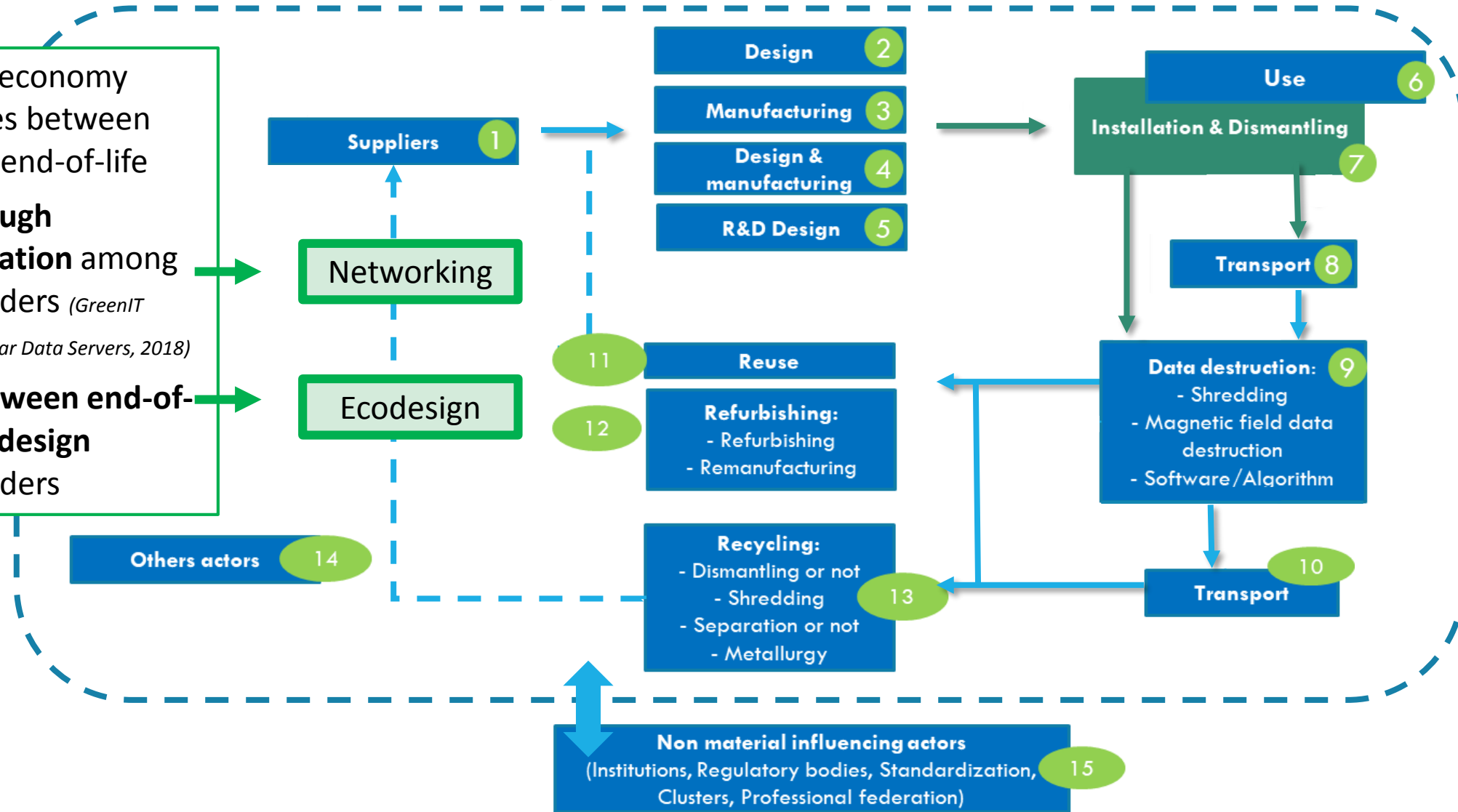C: 410, **20,32%**

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

Networking

Ecodesign

Suppliers 1	

Design 2
Manufacturing 3
Design & manufacturing 4
R&D Design 5

Use 6
Installation & Dismantling 7
Transport 8

11 Reuse
12 Refurbishing:
- Refurbishing
- Remanufacturing

Data destruction: 9
- Shredding
- Magnetic field data destruction
- Software/Algorithm

Recycling: 13
- Dismantling or not
- Shredding
- Separation or not
- Metallurgy

Transport 10

Others actors 14

Non material influencing actors 15
(Institutions, Regulatory bodies, Standardization, Clusters, Professional federation)

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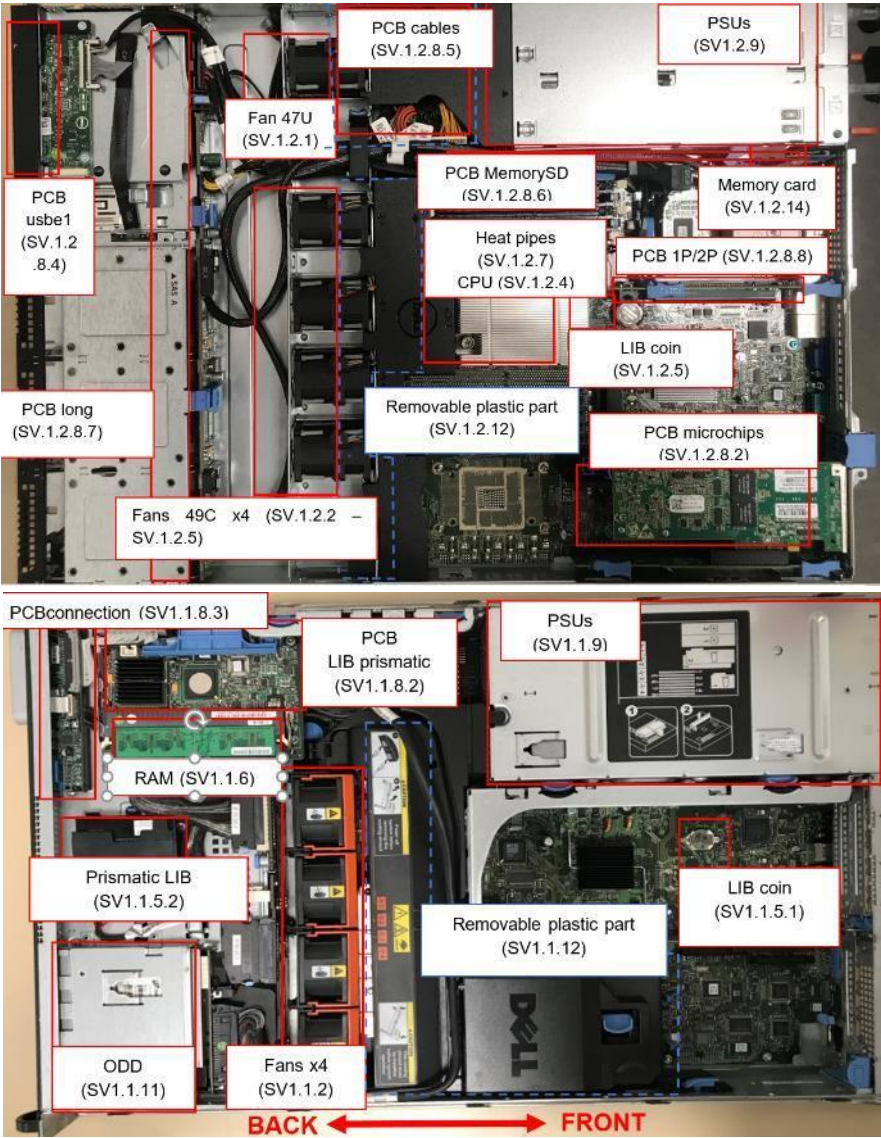
Equipment	Component	CRM
Power generation	Lithium Ion Batteries	Co
Storage equipment	HDD	Dy
		Nd
		Pr
		Tb
		Si
	SSD	(CRM found in PCB)
Servers, storage equipment (SSD), Network equipment	PCB	PGM
		Sb
		Si
		Ga
		Ta
		Ge
		Co
		Mg
Servers	Connectors	Sb
		Be
		Co
		Pd
		Si

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CRM in Europe

Supply Risk

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

Critical Raw Materials (CRM)

Creating a secure supply chain
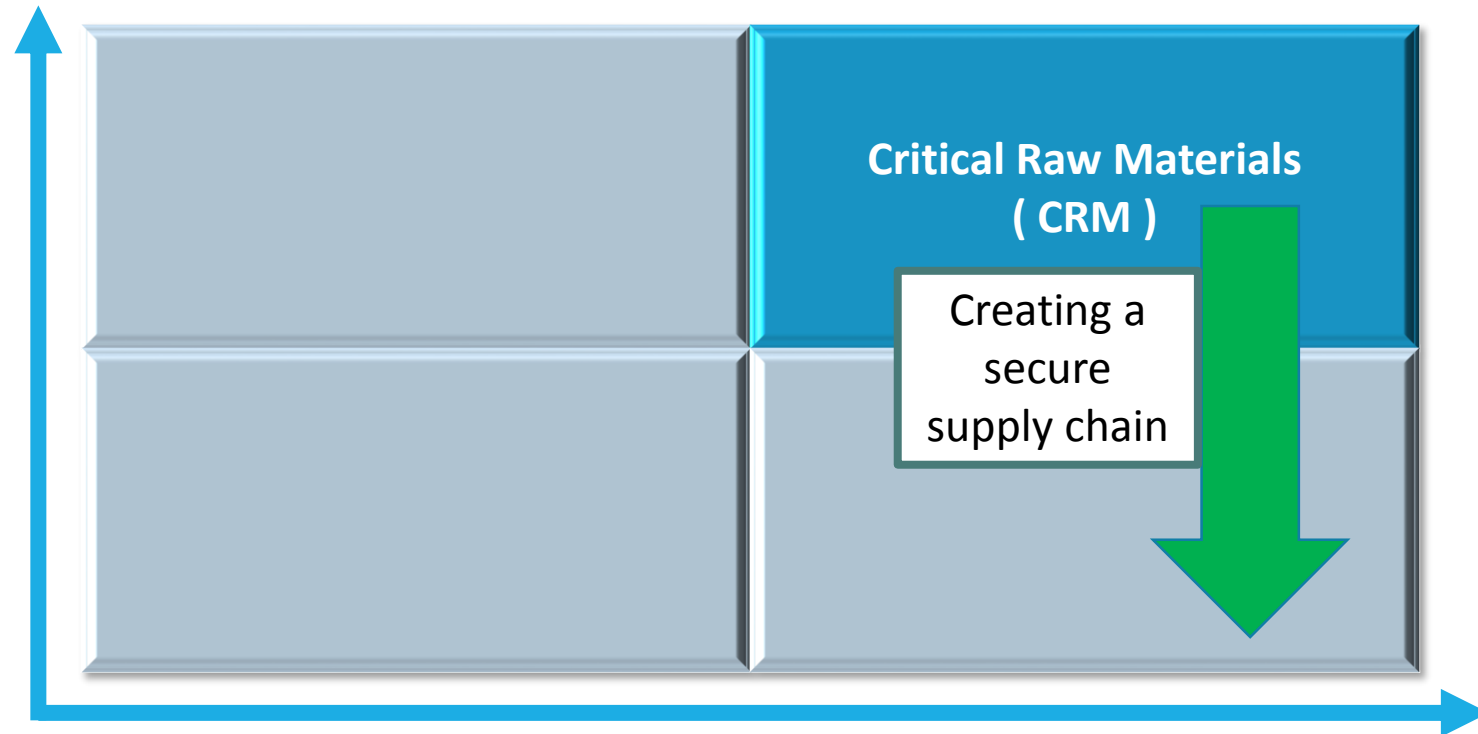
Economic importance

- 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

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

CRM Recovery, 2014

➢ **Improve the design**
➢ **Research & Development** in recycling
➢ **Extend lifetime by reusing and refurbishing**
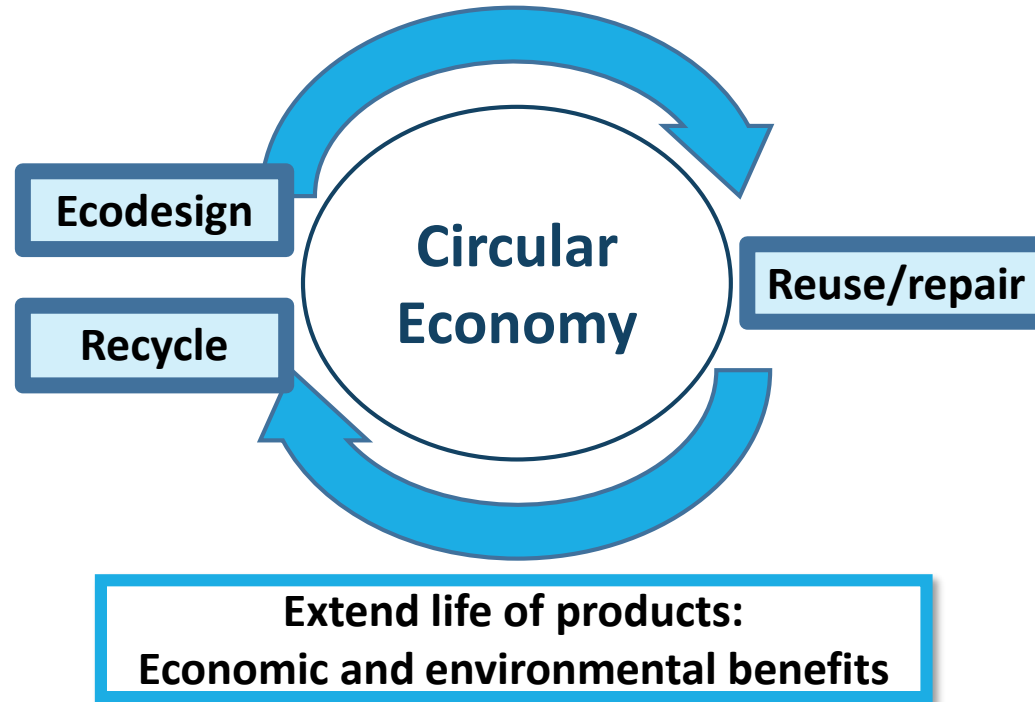
Circular Economy/LCM in DCI

Interreg
North-West Europe
EUROPEAN UNION
CEDaCI
European Regional Development Fund

NWE

High economic importance

Large market

DC Equipment

High replacement rates

High value

Ecodesign

Recycle

Circular Economy

Reuse/repair

Extend life of products:
Economic and environmental benefits

WEEE

High toxicity

Low recycling rates

Societal and environmental

impacts

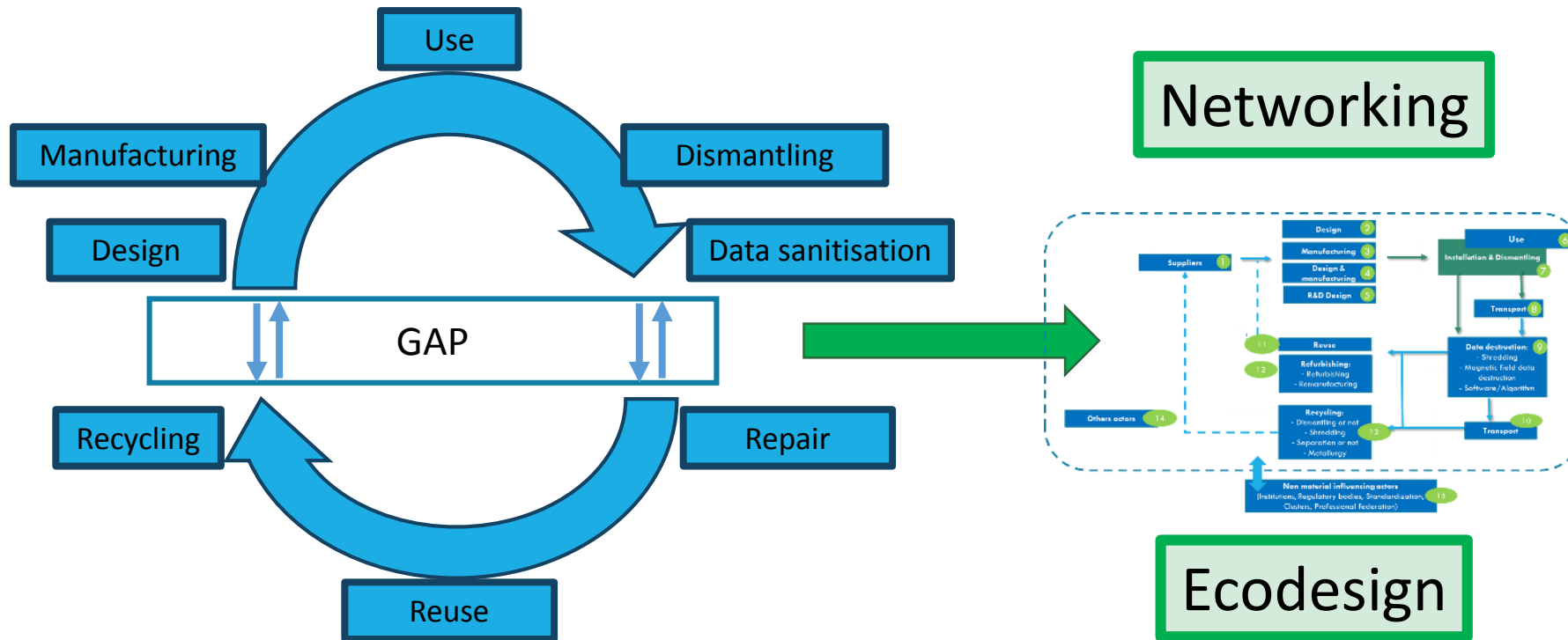### Materials

High amount of

Critical Raw Materials

Need of secure supply chain

Very low recovery rates

Conclusion and perspectives

Networking

Ecodesign

GAP

Use — Dismantling — Data sanitisation — Repair — Reuse — Recycling — Design — Manufacturing

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

Thank you for listening – any questions?

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