

# CEDaCI

## How to Implement Sustainable Circular Economy in the Data Centre Industry

[www.weloop.org](http://www.weloop.org)

[www.nweurope.eu/cedaci](http://www.nweurope.eu/cedaci)

Carolina SZABLEWSKI

Naeem ADIBI

WeLOOP c.szablewski@weloop.org

WeLOOP n.adibi@weloop.org



@cedaci\_project



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



[www.weloop.org](http://www.weloop.org)

Contact: [info@weloop.org](mailto: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

**JUNIA** Grande école d'ingénieurs

**IMT Lille Douai**  
École Mines-Télécom  
IMT-Université de Lille

**Université de Lille**

**centralelille**  
ÉCOLE CENTRALE DE LILLE



# Our expertise and multi-sectorial experience

## Food



## Building and Construction products



## R&D – Innovation



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



## Plastics



## Electric & Electronic



**CEDaCI**  
Increasing collaboration and communication  
to drive sustainability in the data industry



## Others (textile, paints, etc)



H<sub>2</sub>O at Home



# 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**

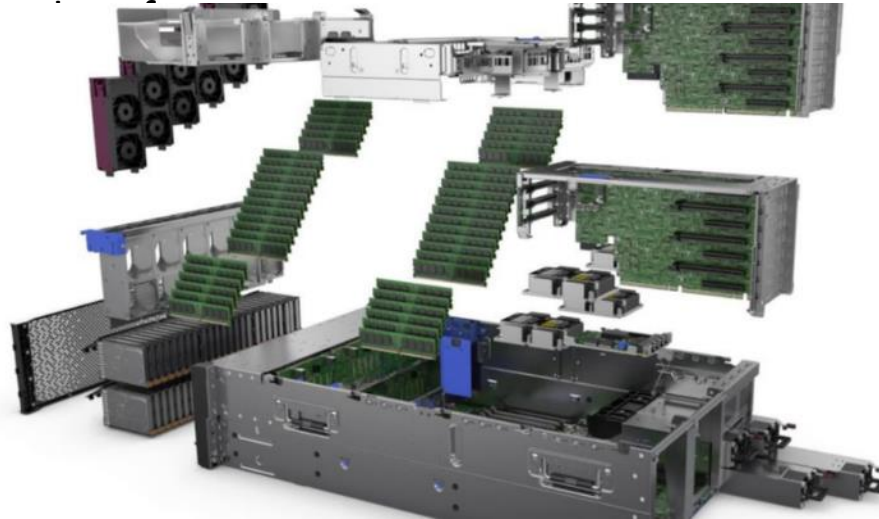
## What are data centers?



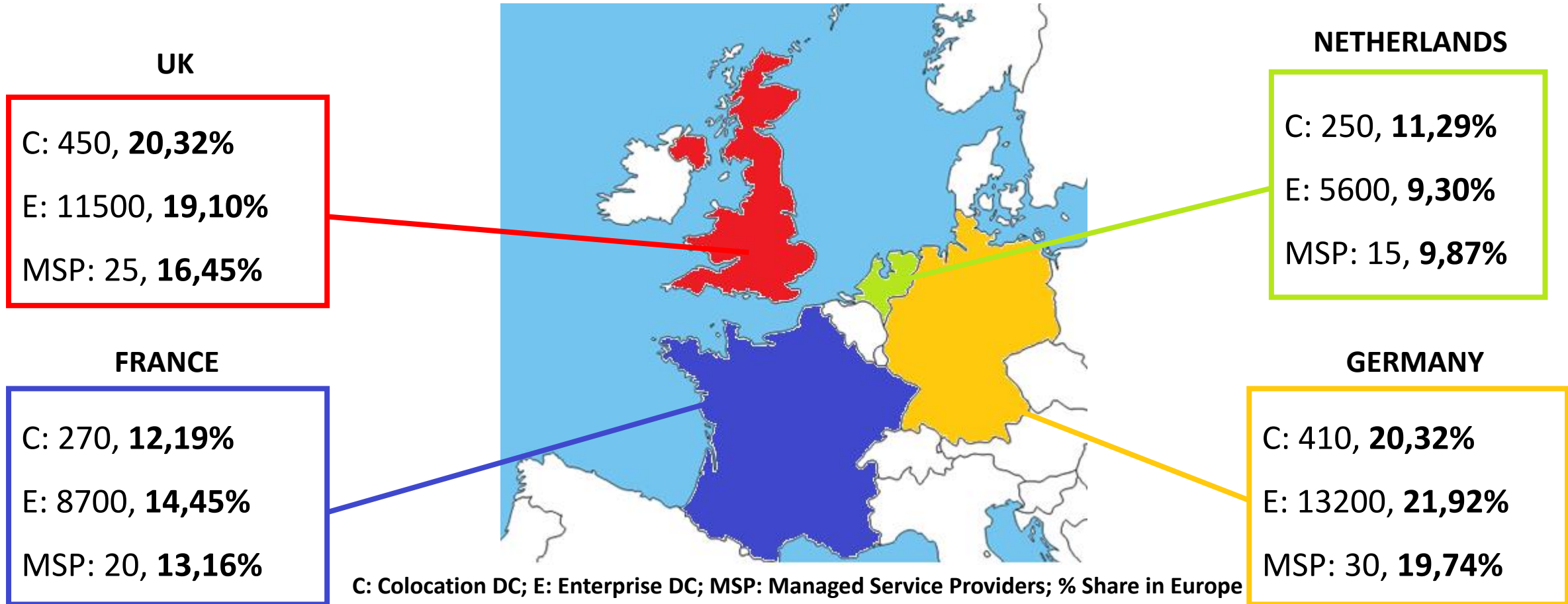
DC industry - emphasis on 24/7 operation & uninterrupted performance  
**reducing operational energy consumption**



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



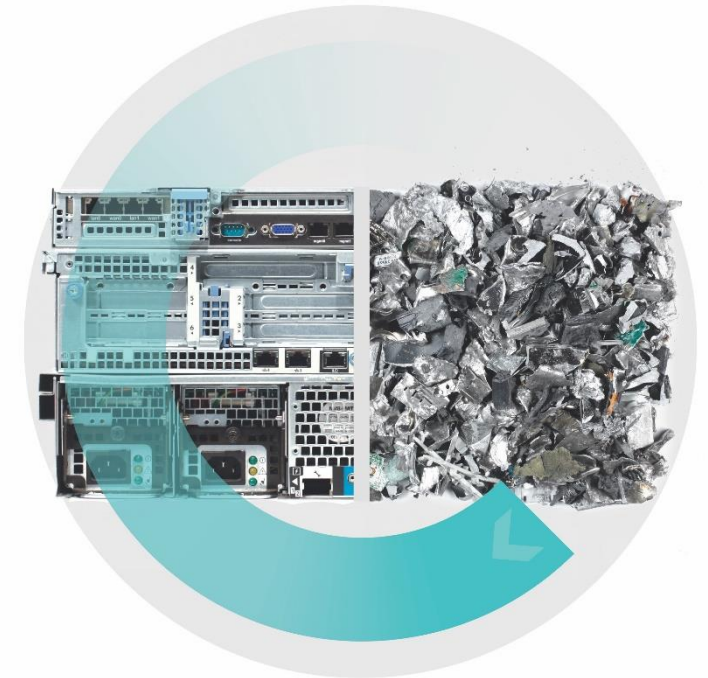
# Data Centres in NWE



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

## CEDaCI – goals

- ✓ 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**



# Map of CEDaCI Pilots

Pilot B Refurbishment/ reuse and business models

Pilot A Ecodesign and manufacture

Pilot C WEEE recycling and reclamation of CRM



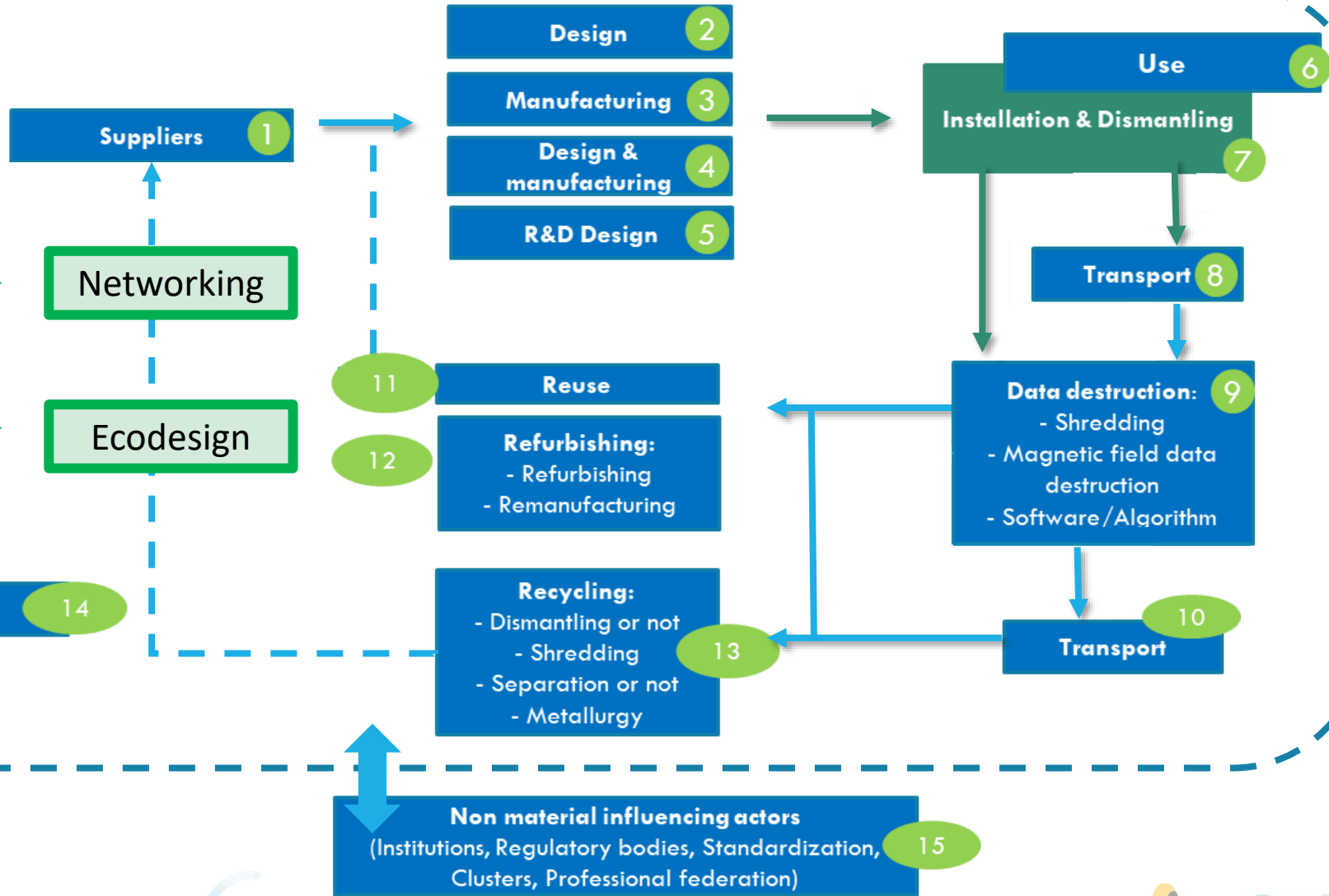
**Wuppertal Institut**

Co-creation



# 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




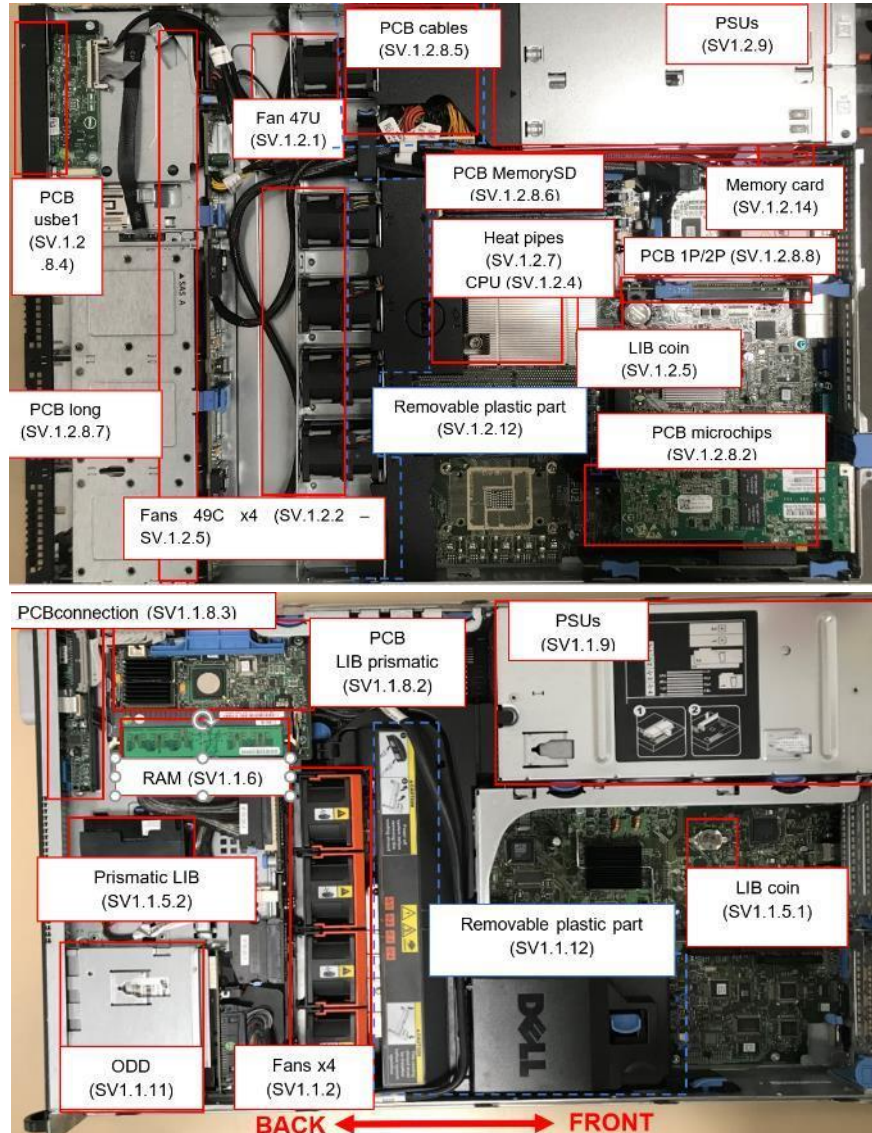
# DC Equipment lifespan

- **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)
<b>Power generation</b>	Uninterruptible power supply (UPS)	20
	Transformers	20
	Switch gear	20
	Backup generators	20
	Power distribution units (PDUs)	20
	<b>Batteries</b>	<b>3-5</b>
	Power cables	20
<b>IT</b>	<b>Servers</b>	<b>3-8</b>
	<b>Storage equipment</b>	<b>3-5</b>
	<b>Network equipment (switches, routers, etc.)</b>	<b>3-5</b>
	Chassis	20
<b>Cooling system</b>	Network cables	20
	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
<b>Security system</b>	Fire-suppression system	20
	Video-cameras	20
<b>Building structure</b>	Lighting, infrastructure, etc.	20

# Critical Raw Materials

 <b>Critical Raw Materials (CRMs)</b> (European Commission, 2020)			
<b>Antimony</b>	Fluorspar	LREEs	Phosphorus
Baryte	<b>Gallium</b>	<b>Magnesium</b>	Scandium
<b>Beryllium</b>	<b>Germanium</b>	Natural graphite	<b>Silicon metal</b>
Bismuth	Hafnium	Natural rubber	<b>Tantalum</b>
Borate	Helium	Niobium	Tungsten
<b>Cobalt</b>	<b>HREEs</b>	<b>PGMs</b>	Vanadium
Coking coal	Indium	Phosphate rock	<b>Bauxite</b>
<b>Lithium</b>	<b>Titanium</b>	<b>Strontium</b>	



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
Servers	Connectors	Mg
		Sb
		Be
		Co
		12 Pd
		Si

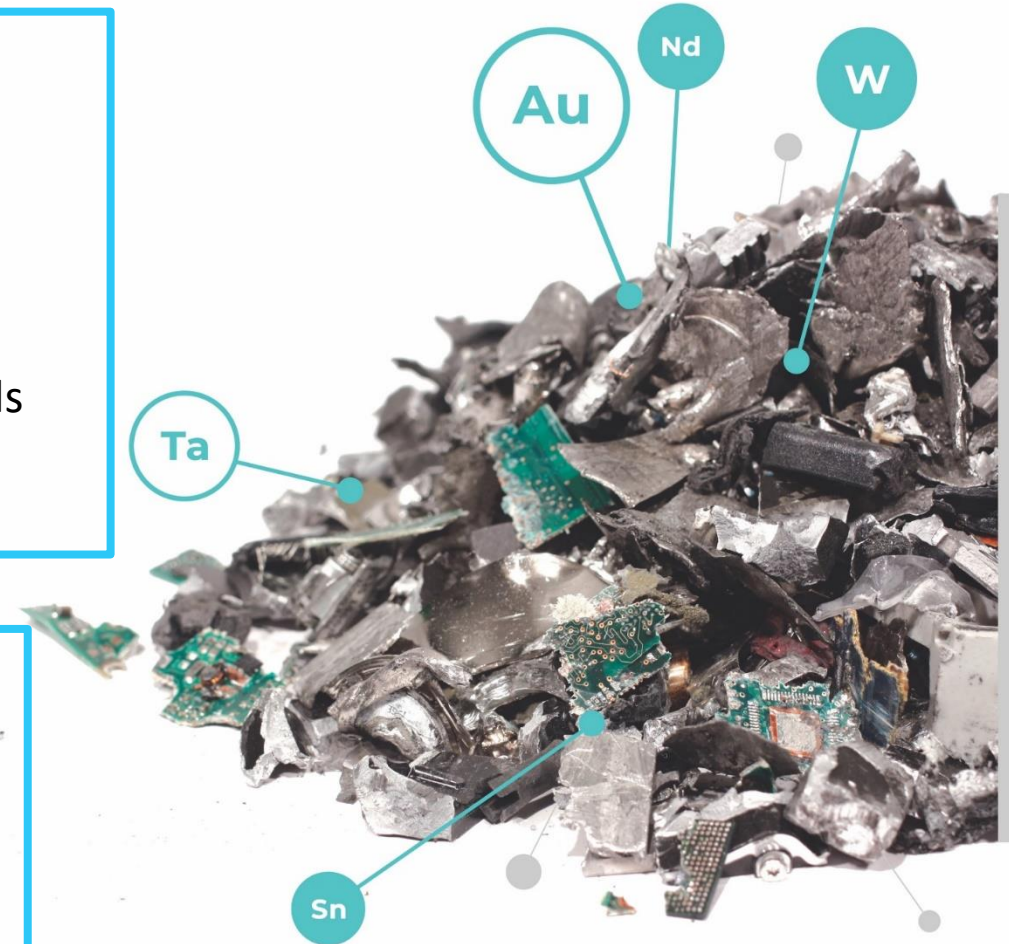
# Recycling of CRM

## 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 in Data Centre

**NWE**

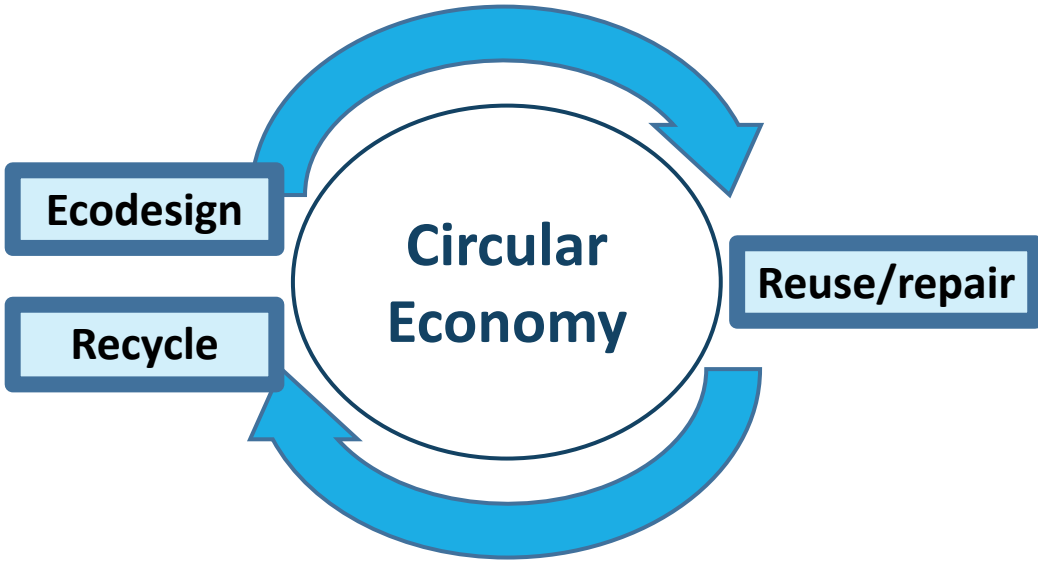
High economic importance

Large market

**DC Equipment**

High replacement rates

High value



Extend life of products:  
Economic and environmental benefits

**WEEE**

High toxicity

Low recycling rates

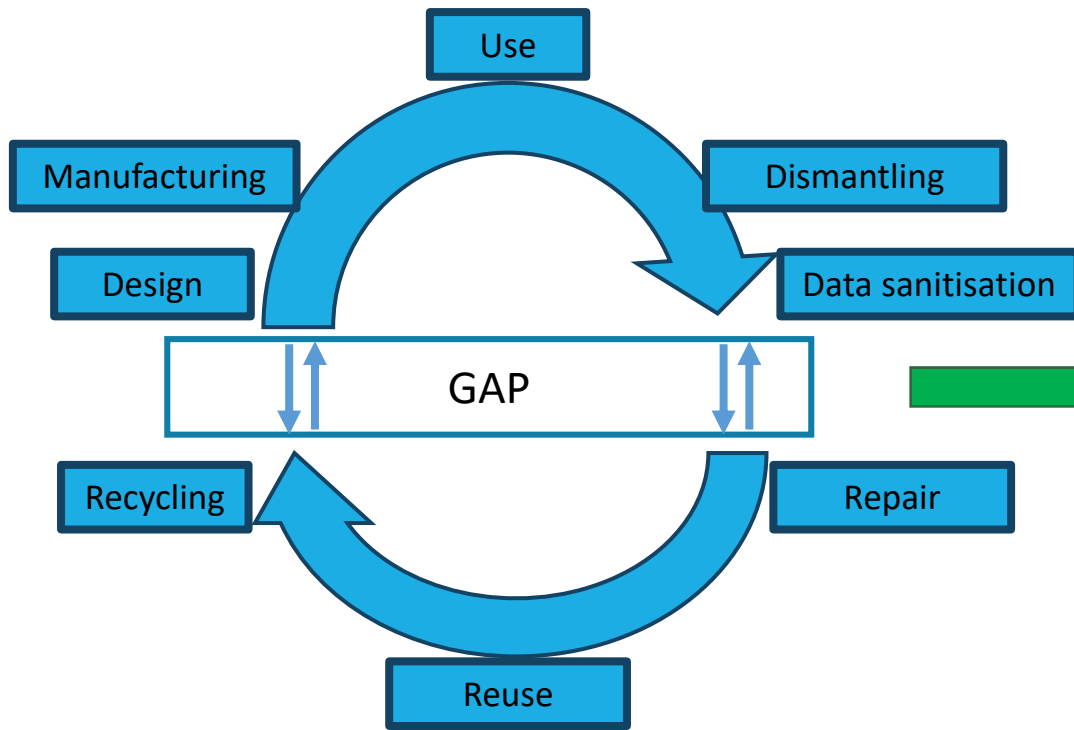
Societal and environmental impacts

**Materials**

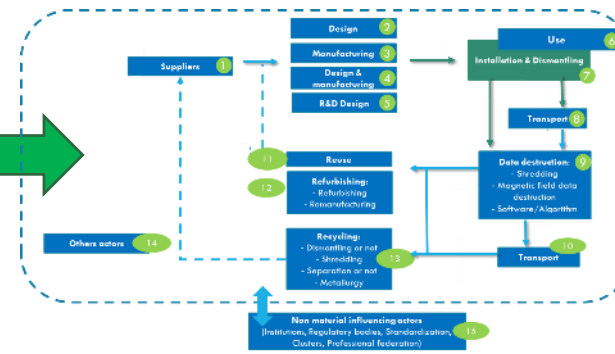
High amount of  
Critical Raw Materials

Need of secure supply chain

Very low recovery rates



## 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**

# 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**



# CRM in Data Centres

CPU    RAM    PCBs

Equipment ID	SV.1.1.4	SV.1.1.6	SV.1.1.8.1	SV.1.1.8.2	SV.1.1.8.3	SV.1.1.8.4	SV.1.1.8.5	SV.1.1.8.6	SV.1.1.8.7	SV.1.1.9.1 .5	SV.1.1.9.2 .5	SV.1.1.11
Total mass (kg)												
Metals	wt % (server = 100%)											
Ag	0,0000	0,0001	0,0028	0,0004	0,0001	0,0000	0,0000	0,0000	0,0000	0,0009	0,0008	0,0000
Au	0,0000	0,0001	0,0004	0,0002	0,0000	0,0000	0,0000	0,0001	0,0001	0,0000	0,0000	0,0000
Ba	0,0007	0,0006	0,0304	0,0018	0,0002	0,0011	0,0044	0,0060	0,0020	0,0041	0,0146	0,0002
Co	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0001	0,0000	0,0003	0,0006	0,0000
In	0,0004	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Li	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Mg	0,0001	0,0001	0,0107	0,0022	0,0001	0,0001	0,0004	0,0012	0,0002	0,0052	0,0147	0,0003
Sb	0,0000	0,0000	0,0005	0,0004	0,0000	0,0003	0,0012	0,0000	0,0013	0,0000	0,0000	0,0000
Sn	0,0001	0,0005	0,1323	0,0179	0,0008	0,0011	0,0052	0,0049	0,0030	0,0266	0,0566	0,0012
Sr	0,0000	0,0000	0,0027	0,0001	0,0000	0,0000	0,0003	0,0006	0,0001	0,0000	0,0000	0,0000
Ta	0,0000	0,0000	0,0139	0,0073	0,0000	0,0000	0,0000	0,0022	0,0000	0,0000	0,0000	0,0000
Ti	0,0002	0,0002	0,0153	0,0028	0,0006	0,0005	0,0013	0,0027	0,0005	0,0021	0,0065	0,0001
W	0,0003	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

SV.1.1
19,6720864

wt %
0,0051
0,0010
0,0662
0,0011
0,0004
0,0000
0,0352
0,0038
0,2502
0,0039
0,0234
0,0329
0,0003

Low  
 High criticality  
 Very high criticality

The 100% reference is the server total weight



### Circular Data Centre Compass (CDCC)

Increasing collaboration and communication to drive sustainability in the data industry

#### About CDCC

Co-financed by the European Regional Development Fund, the CEDaCI Project is developing the circularity solutions to decrease the environmental impact of the IT equipment used by the Data Centre industry.

The Circular Data Centre Compass is designed to guide the Data Centre Industry (DCI) to choose more circular options during the procurement, refurbishment and the disposal of servers and to assess the environmental, social and economic impacts.



#### How CDCC works

Co-financed by the European Regional Development Fund, the CEDaCI Project is developing the circularity solutions to decrease the environmental impact of the IT equipment used by the Data Centre industry.

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[Start Compass](#)

[A guide to using the CDCC](#)

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Dell PowerEdge R320  
Select a server

Dell PowerEdge R320  
Select a server

6	2012	China
Generation	Year	Manufacturer Country
UK	iNet Group	1
Provider Country	Provider Company	Chasis
10480	1	1
Weight	Processor	Heat Pipe
2	2	2
RAM	PSU	Battery
4	10	12
System Cable	PCB	Plastic
18	5	648*433*43
Screw	Fan	Dimensions(mm)

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Intel® Xeon® L5630 Processor  
SSD Drive Bay  
PC3L-10600R Memory  
Qualcomm NC362i NIC

Save Reset

Intel® Xeon® L5630 Processor  
SSD Drive Bay  
PC3L-10600R Memory  
Qualcomm NC362i NIC

Save Reset

# Thank you for listening – any questions?

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

- Dr. Naeem ADIBI [n.adibi@weloop.org](mailto:n.adibi@weloop.org)
- Dr. Carolina SZABLEWSKI [c.szablewski@weloop.org](mailto:c.szablewski@weloop.org)



@cedaci\_project



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

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# Waste Electrical and Electronic Equipment (WEEE)

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

# DC Equipment recycling

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

High recovery  
Co  
Platinum Group metals

Precious metals  
Iron  
Aluminium  
Plastics (incineration)  
Copper  
Lead

Very low recovery

Ta  
Rare Earths  
Be  
Ge  
Ga  
Si

Low recycling rates: low collection, lost in the process

Materials with best recovery rates from electronic products

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

CEDaCI project. WeLOOP

# CRM recycling

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

**Only 1% of CRM recovery from WEEE**  
*CRM Recovery, 2014*

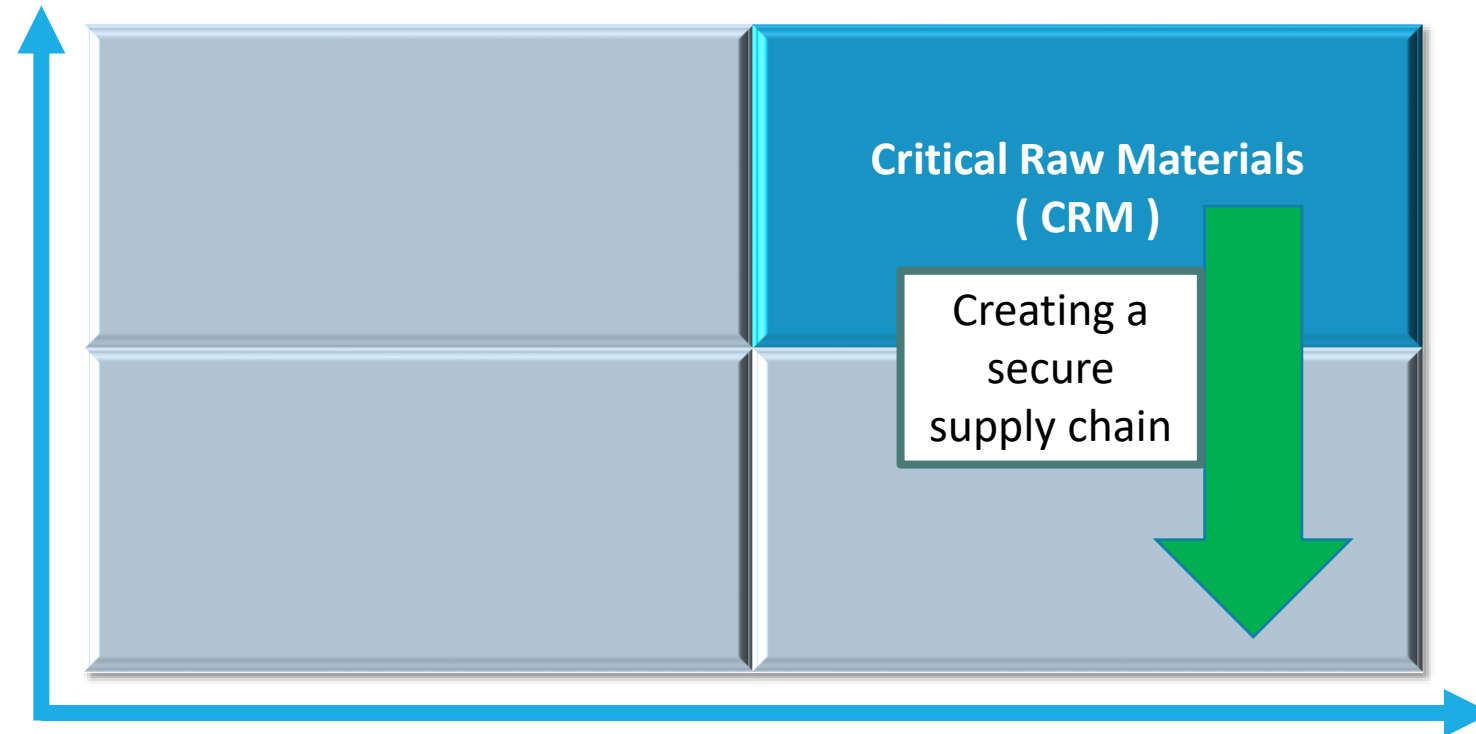
**Work Package 6**  
**(October 2019 – March 2021)**  
**Recycling pilot case**





## Supply Risk

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



## Economic importance

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

[http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical\\_fr](http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_fr)