Water and Environment Support
in the ENI Southern Neighbourhood region

WES REGIONAL ACTIVITY

MANAGEMENT OF CONSTRUCTION AND DEMOLITION WASTE (C&DW)
ACTIVITY NO: RE-4-REG/ST/P2P

Study Visit & Interactive Workshop
19th – 23rd of September 2022, Marseille, France

The WES project in a nutshell

Mr. Anis Ismail, WES Environment Key Expert

LDK CONSULTANTS
LDK Consultants Global EEIG

This Project is funded by the European Union

WES objectives

Water and Environment Support
in the ENI Southern Neighbourhood region

- WES aims at **protecting the environment and improving the management of scarce water resources in the Mediterranean.**

- WES is assisting **the Partner Countries (PCs) to tackle problems** related to pollution prevention and water use efficiency and create the enabling environment and **enhancing the capacities of stakeholders in developing and implementing the solutions**.

- WES capitalises on previous successful **EU funded regional projects running for more than 10 years (Horizon 2020 CB/MEP; SWIM SM;** SWIM-Horizon 2020 SM).

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WES Identity

Water and Environment Support
in the ENI Southern Neighbourhood region

Facts & Figures	
Partner Countries:	Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Libya*, Palestine and Tunisia
Project value:	9.508.054 Euros
Duration:	May 2019 – November 2023 (54 months)
Project team:	**Team Leader:** Professor Michael Scoullos, scoullos@wes-med.eu **Water Expert:** Ms Suzan Taha, taha@wes-med.eu **Environment Expert:** Mr Anis Ismail, a.ismail@wes-med.eu **Communication & Networking Expert:** Ms Lisa Papadogeorgaki, lpa@ldk.gr **Stakeholder Engagement and Impact Assessment Non-Key Expert:** Dr. Emad Adly, wes.gc@raednetwork.org

Our Consortium

- LDK Consultants Global EEIG (Leader)
- Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE)
- Arab Network for Environment and Development (RAED)
- Association of Cities and Regions for Sustainable Resource Management (ACR+)
- CIHEAM – Mediterranean Agronomic Institute of Bari (CIHEAM Bari)
- Gopa Infra GmbH
- Ramboll Denmark A/S
- Royal HaskoningDHV
- MedWaves, the Regional Activity Centre for Sustainable Consumption and Production of UN Environment Programme/Mediterranean Action Plan (formerly SCP/RAC)

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Projet Structure

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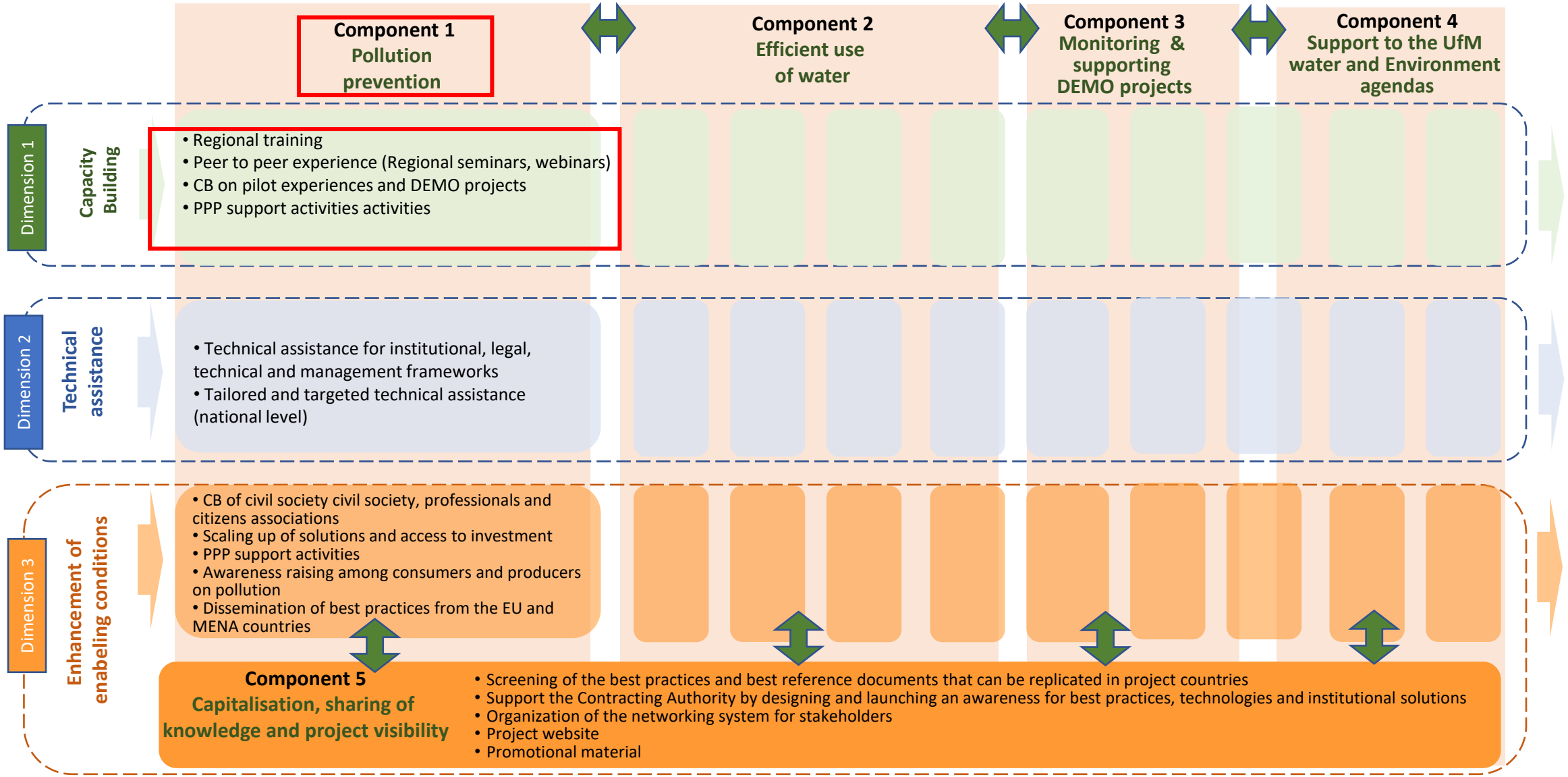

Technical Assistance, Capacity Building, Networking of Stakeholders

Water and Environment Support
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- **Regional level**:

Around **20** regional activities such as **trainings/workshops, study visits** to European and Southern Mediterranean countries, **webinars** and coached **peer-to-peer exchanges.**

- **National Level:**

Around 4 national activities (2 on water and **2 on environment** per partner country). National WES meetings as platforms of collaboration, to assess progress, plan next steps, etc. (tbd due to COVID-19)

Main topics under Component 1: Environment

Topic 1: **Curbing Plastic Pollution and Marine Litter**
Topic 2: **Promotion of Mechanisms and Conditions for shifting to a Circular Economy**
Topic 3: **Prevention and Reduction of Pollution from specific industrial sectors**
Topic 4: **Mainstreaming and implementing Integrated Environmental management**

- **New activities on the reduction of plastic pollution**

3 Regional and 6 or 7 national

Specific Topics

- Successful approaches on **EPR**
- Policy guidance to **ban plastic polymers** that disrupt the sorting and recycling of plastics
- Separate **collection and plastic waste recycling based on good practices**
- Regulatory and technical measures for the **reduction and gradual elimination of SUPs**
- Preparing material **for public awareness campaigns**

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Overall aim of this regional activity on CDW

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- This Regional activity will provide technical assistance and strengthen the capacities of appointed stakeholders from the WES PCs to elaborate and implement effective measures to reduce the environmental impact of CDW and maximize the sustainability of CDW management.

- Specific objectives:

  - sharing knowledge among partners on challenges related to CDW
  - sharing expertise on solutions to manage and reduce CDW
  - boosting south-to-south cooperation
  - building lasting relations and exchanges

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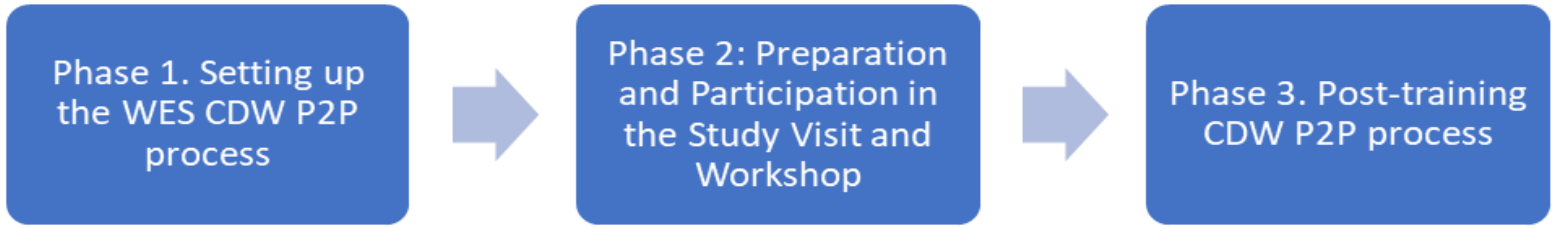
Phases of P2P and SV activity

The activity is composed of three phases:



Phase 1: needs assessment (outlook and challenges of CDW management in Peers countries), knowledge and good practices exchange

Phase 2: participation in the SV and Workshop

Phase 3: follow-up in the post-training period

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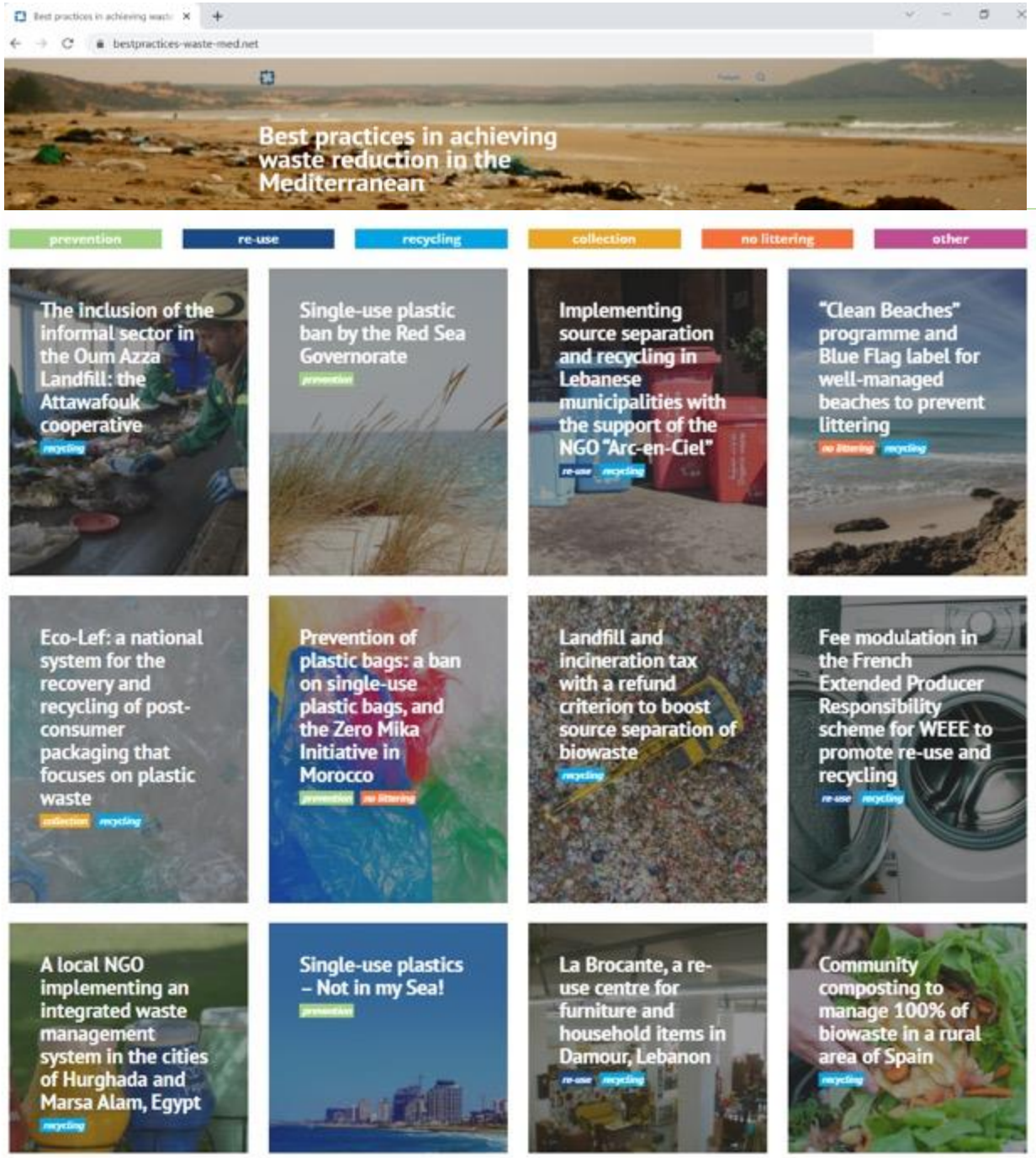

https://bestpractices-waste-med.net promo video

For further information

Water and Environment Support
in the ENI Southern Neighbourhood region

Visit our website: wes-med.eu

info@wes-med.eu

Or follow us on Social media:

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Thank you for your attention!

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Régional activity: Management of Construction and Demolition waste
Study visit & Interactive workshop (RE-4-REG/ST/P2P)

Task 2 – Study visit on demolition and construction waste

Marseille – 19-23 September 2022

EU State of the art

LDK Consultants Global EEIG

Françoise BONNET – ACR+

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Plan

Water and Environment Support
in the ENI Southern Neighbourhood region

- The EU legal and policy framework
- The performances
- The challenges
- The future

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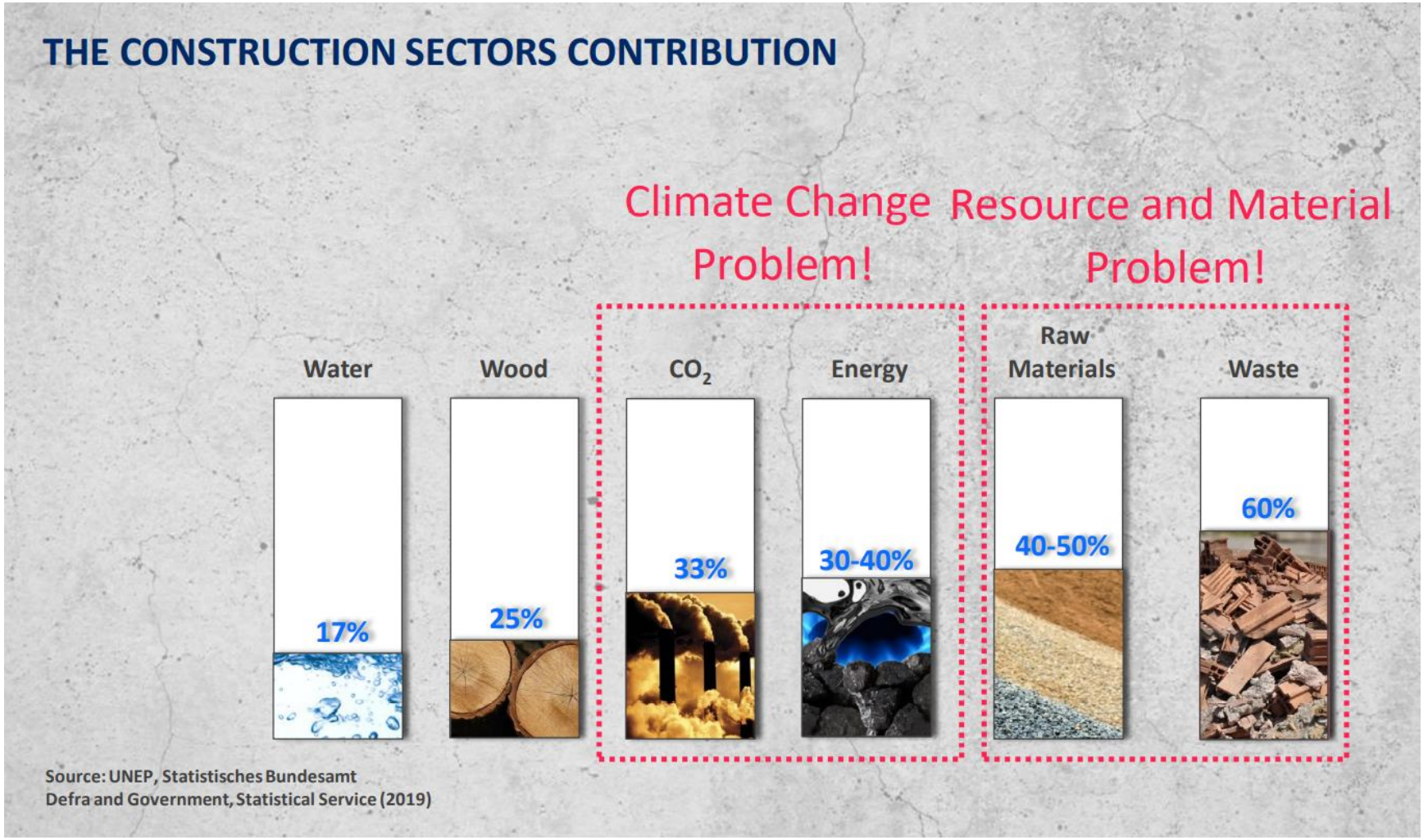
Context….


THE CONSTRUCTION SECTORS CONTRIBUTION
Climate Change Problem!
Resource and Material Problem!
Water
Wood
CO_2
Energy
Raw Materials
Waste
17%
25%
33%
30-40%
40-50%
60%
Source: UNEP, Statistisches Bundesamt
Defra and Government, Statistical Service (2019)

The EU legal and policy framework

- 2014: communication on Resource efficiency opportunities in the building sector
- → to improve design, construction, demolition, and recycling of construction products as well as simplify data in the use of resources to reduce waste

- 2015: the Circular economy package (and the Construction 2020 Strategy)
- → concrete and ambitious programme of actions and measures covering the whole cycle, from production and consumption to waste management and the market for secondary raw materials

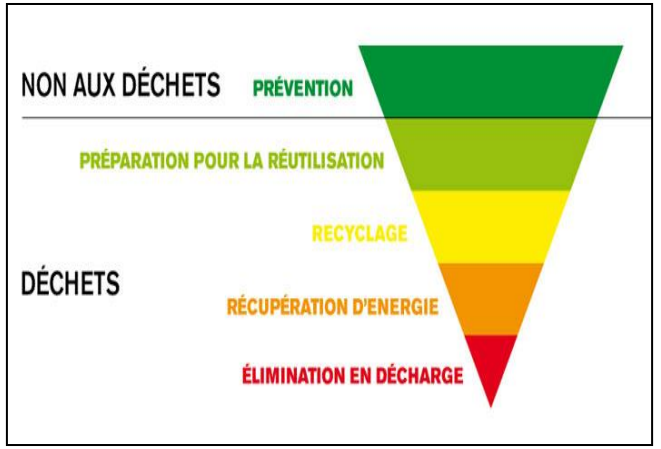
The EU legal and policy framework

- The Construction 2020 Strategy included in the CE package
- Recycling of CDW encouraged by mandatory targets (cfr Waste framework directive 2008/98/EC)
- EU CDW Management protocol
    - Pre-demolition assessment guidelines
    - Voluntary industry-wide recycling protocol for construction and demolition waste
    - Core indicators for the assessment of the LC environmental performance of a building + incentives for their use
- Building design improvements
- Design for Deconstruction

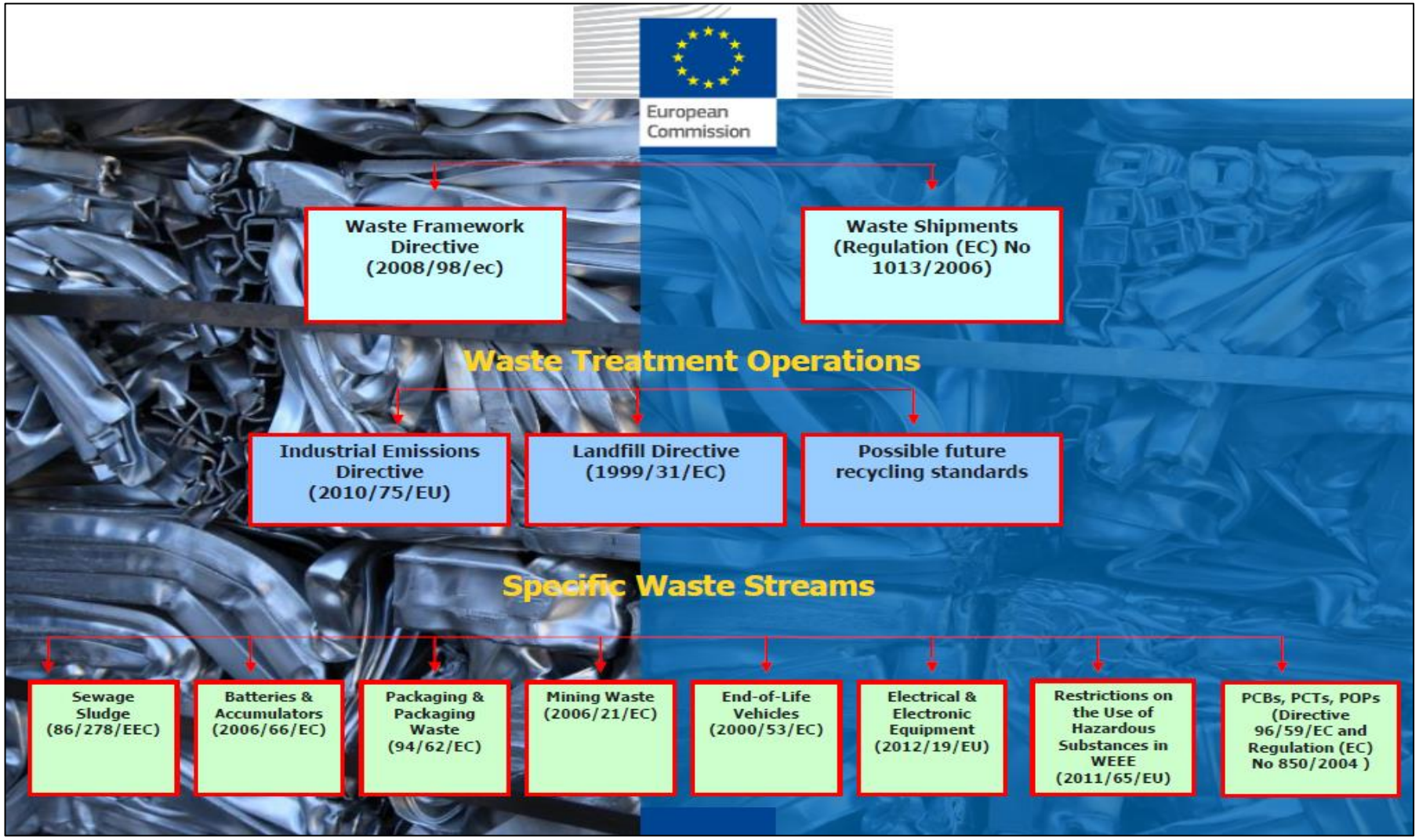
The EU legal and policy framework

The lansink scale applied to the building sector:

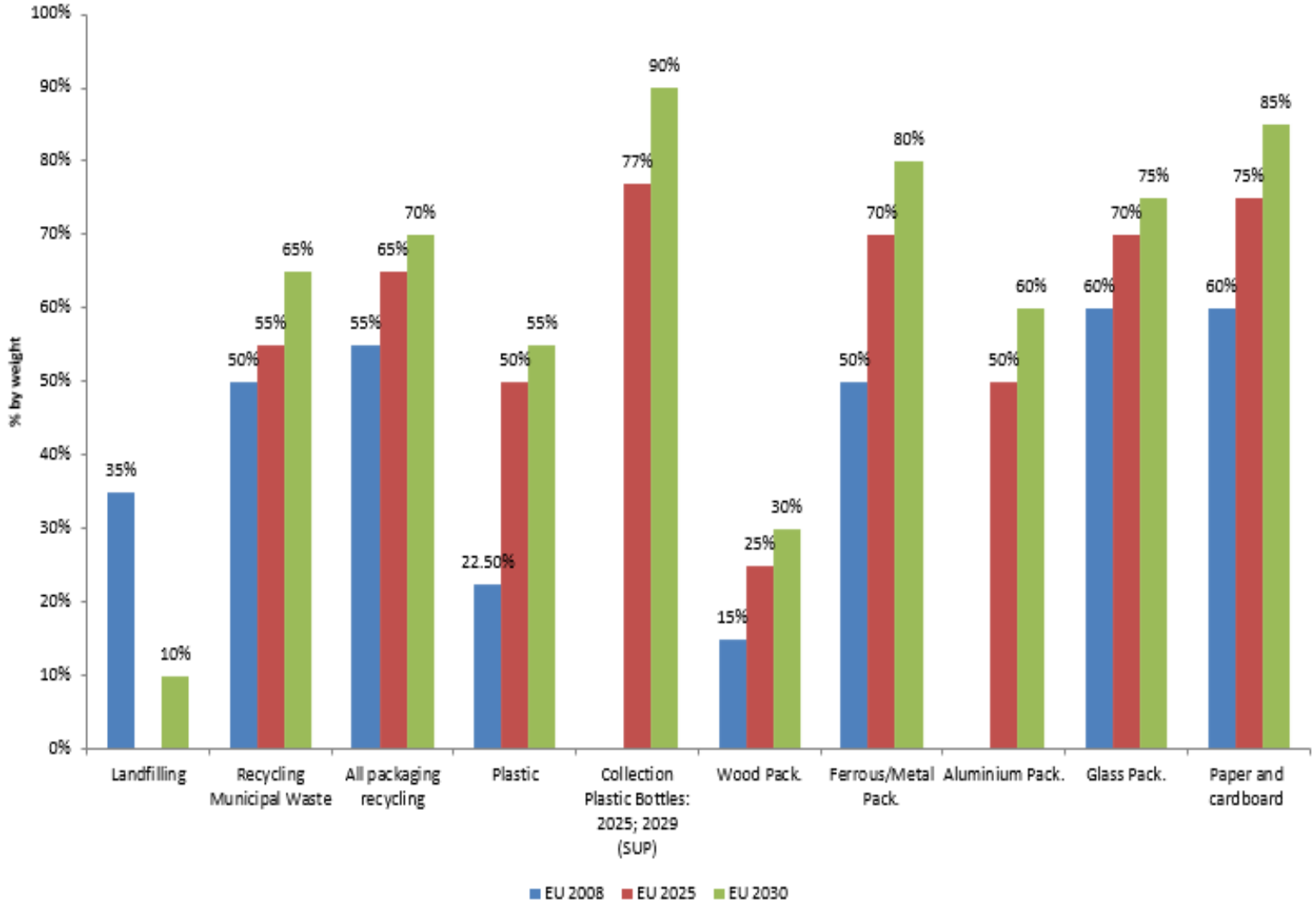
Prevention : design, choice of materials et technics
Preparation for Reuse : material preservation and reuse on-site and out of site
Recycling : on site sorting of recyclables (>80% ; inerts (debris and ciments), metals, woods, plastics, packaging, …)
Energetic valorisation : waste to energy (WtE) valorisation of non recyclable wastes
Landfilling : landfilling of non valorisable wastes (<1 % ; mainly asbestos, flyashes from WtE and low grade gypsum).



The EU legal and policy framework: a set of obligations and targets



The EU legal and policy framework: a set of obligations and targets



The EU legal and policy framework: a set of obligations and targets

…by 2020, the preparing for re-use, recycling and other material recovery of non-hazardous construction and demolition waste shall be increased to a minimum of 70 % by weight

The EU legal and policy framework: a set of obligations and targets

Article 11 of the waste framework directive:

Member States shall take measures to promote preparing for re-use activities, notably by encouraging the establishment of and support for preparing for re-use and repair networks, by facilitating, where compatible with proper waste management, their access to waste held by collection schemes or facilities that can be prepared for re-use but is not destined for preparing for re-use by those schemes or facilities, and by promoting the use of economic instruments, procurement criteria, quantitative objectives or other measures.
Member States shall take measures to promote high-quality recycling and, to this end, subject to Article 10(2) and (3), shall set up separate collection of waste.
Subject to Article 10(2) and (3), Member States shall set up separate collection at least for paper, metal, plastic and glass, and, by 1 January 2025, for textiles.

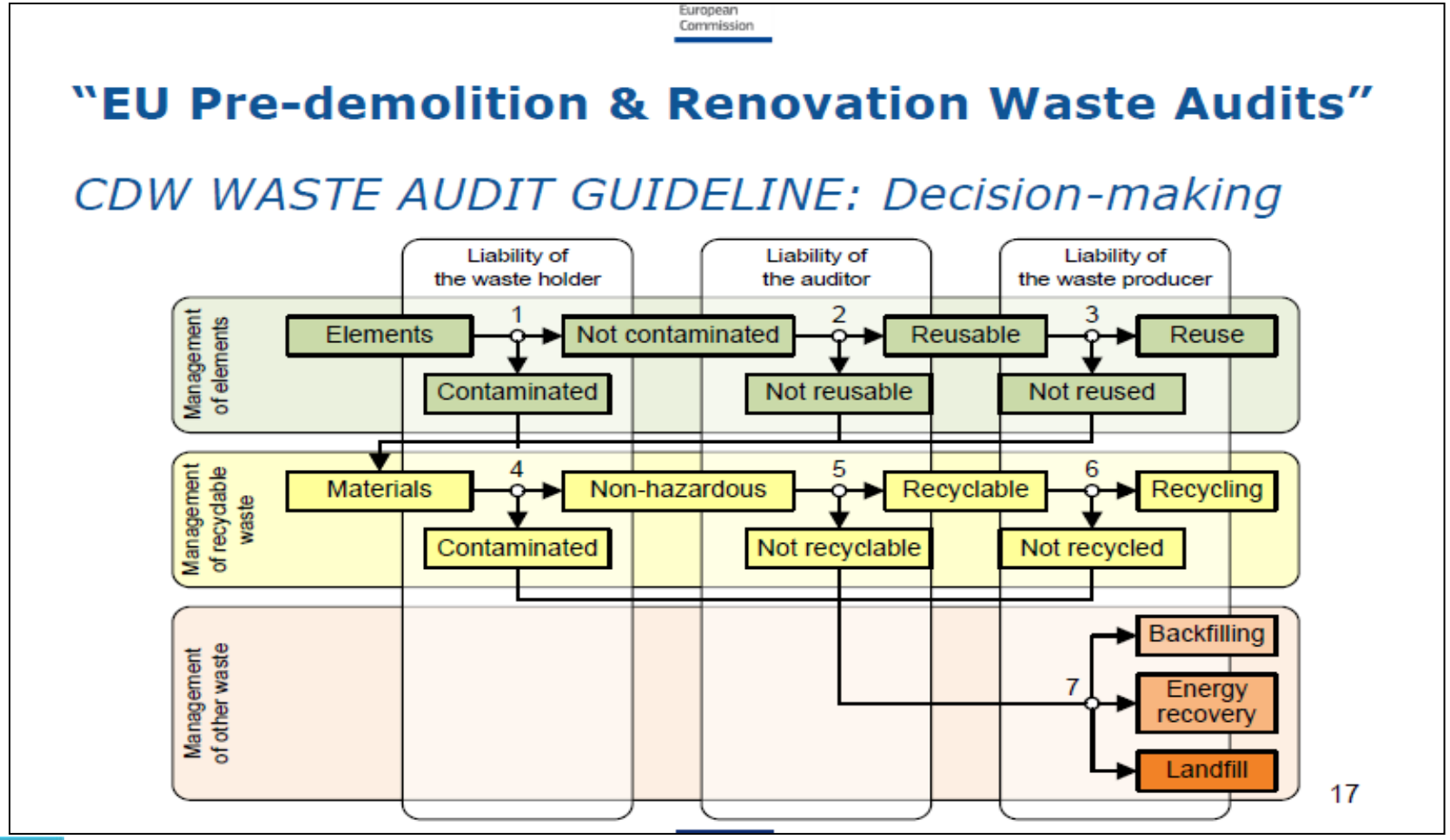
Member States shall take measures to promote selective demolition in order to enable removal and safe handling of hazardous substances and facilitate re-use and high-quality recycling by selective removal of materials, and to ensure the establishment of sorting systems for construction and demolition waste at least for wood, mineral fractions (concrete, bricks, tiles and ceramics, stones), metal, glass, plastic and plaster.';

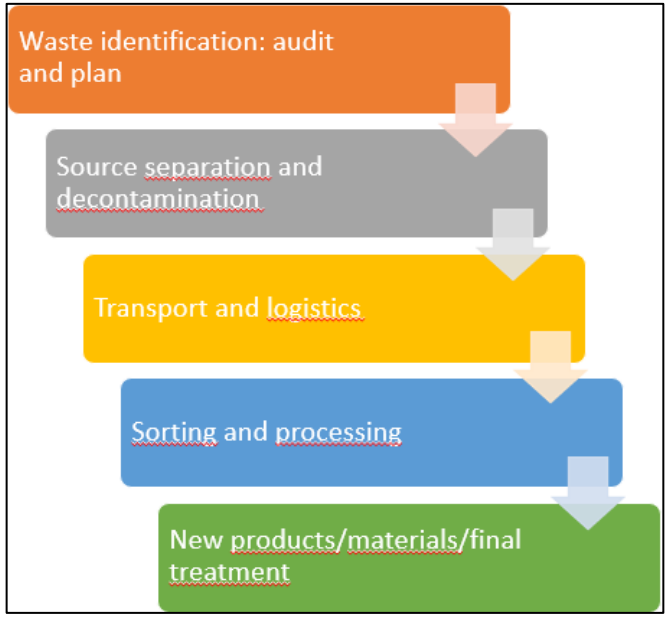
European Waste legislation : a set of obligations and targets

Transposition of those obligations and targets into national / regional law:

- landfill tax (cfr 180 € / T. in “Région Sud”);
- Landfill ban for all recyclables;
- Sorting at source (“in situ”) obligation;
- Mandatory dismantling audit;
- …

The EU legal and policy framework: Guidelines





The EU legal and policy framework: Guidelines

The EU CDW Management protocol (non-binding guidelines on how to properly handle this waste stream) recommends the following :

- Improved **waste identification**, **source separation** and collection
- Improved waste **logistics**
- Improved waste **processing**
- **Quality** management
- Appropriate policy and framework conditions

This Protocol has the following **target groups of stakeholders**:

- Industry practitioners - construction sector (including renovation companies and demolition contractors), construction product manufacturers, waste treatment, transport and logistics as well as recycling companies
- Public authorities at local, regional, national and EU levels
- Quality certification bodies for buildings and infrastructure
- Clients of C&D recycled materials

.

The EU legal and policy framework

European standards for aggregates: introduced in 2004, withdrawn in 2013 to allow some changes, reviewed in 2016.

EN 12620 provides standards fo the physical and chemical properties of recycled aggregates from construction and demolition waste.

The EU legal and policy framework: the KEY elements

- **Policy and framework conditions**:

→ an appropriate regulatory framework

→ a real enforcement of the law

→ public procurement as a way to move forward

→ awareness, public perception and acceptance

The EU legal and policy framework

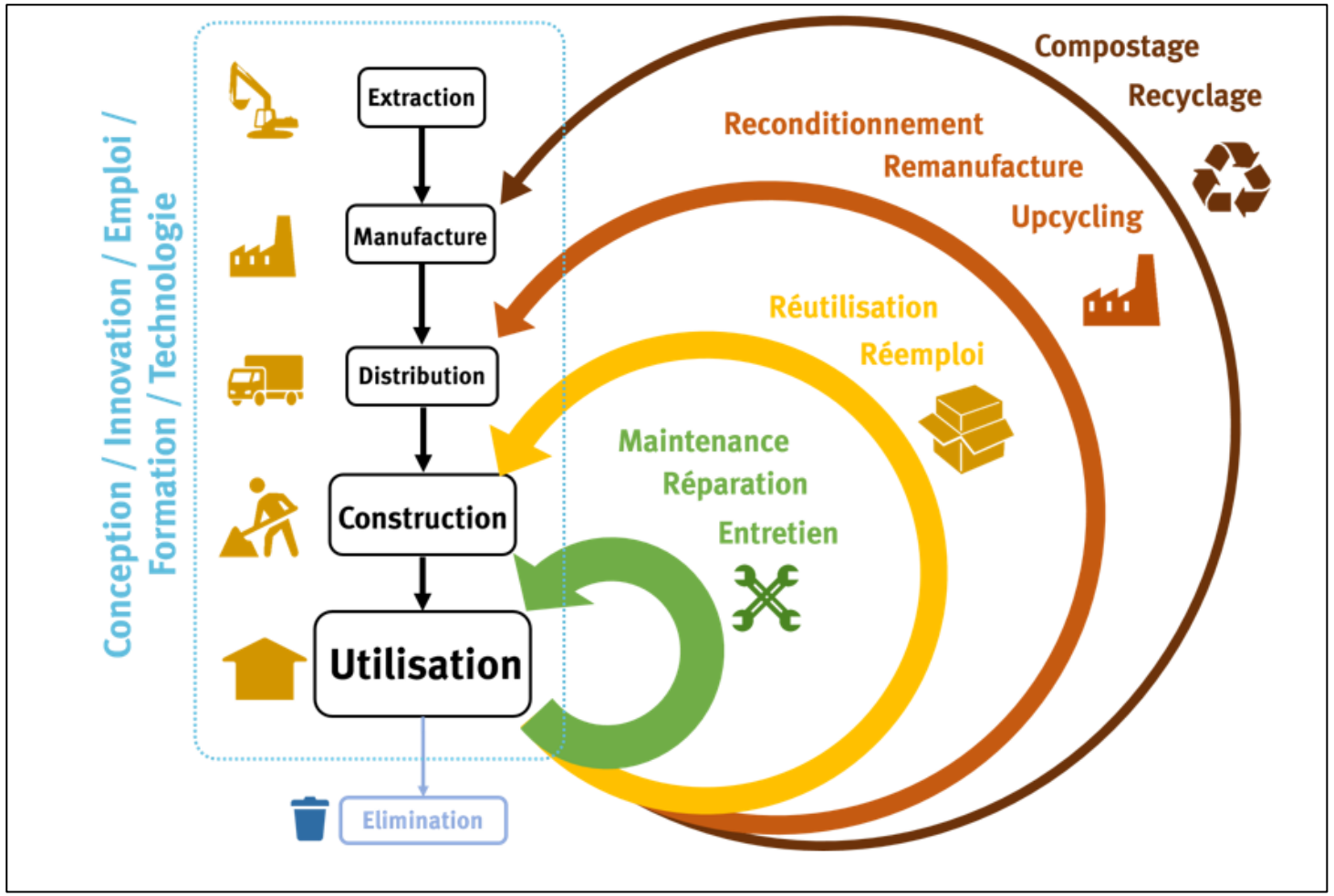
- For more information:

- EU Construction and Demolition Waste management Protocol (July 2017- http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8985)
- EC Sustainable Buildings Communication (2014)
- the EU 2020 Construction Strategy

Challenges and answers…

Lack of competitiveness of recycling and of secondary raw materials	Economic instruments: taxes on disposal, green taxes, green public procurements… AND Combining product and waste activities in an industrial approach/industrial symbiosis
Lack of credibility of secondary raw material	National standards…AND R&D activities
Lack of awareness of different key players on circular construction	Centralised, pro-active communication, cooperation with external stakeholders and within public administrations
Lack of commitment of the different players towards circular practices	Ambitious CDW management strategies with targets on re-use and recycling

The future


Extraction
Manufacture
Distribution
Construction
Utilisation
Elimination
Conception / Innovation / Emploi / Formation / Technologie
Compostage
Recyclage
Reconditionnement
Remanufacture
Upcycling
Réutilisation
Réemploi
Maintenance
Réparation
Entretien

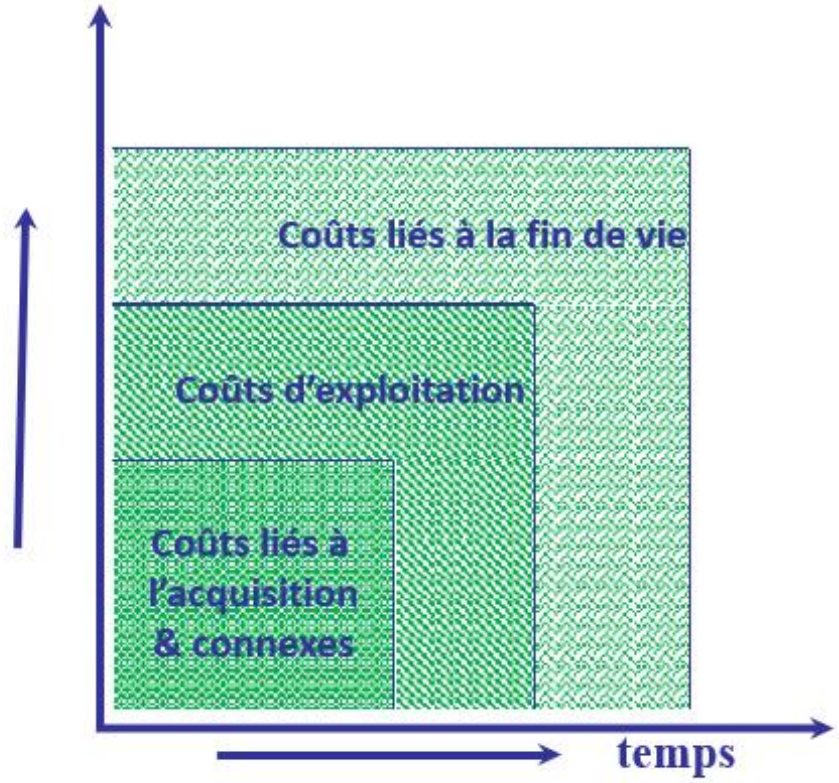
The future: towards circular building

LCA and “cradle to cradle” approach

Dismantling, elimination

Energy, repair, spare parts, maintenance

Purchase, delivery, installation, start-up



Advantages: greater cost awareness, greater transparency of future costs and therefore better prediction and planning, especially for future expenses

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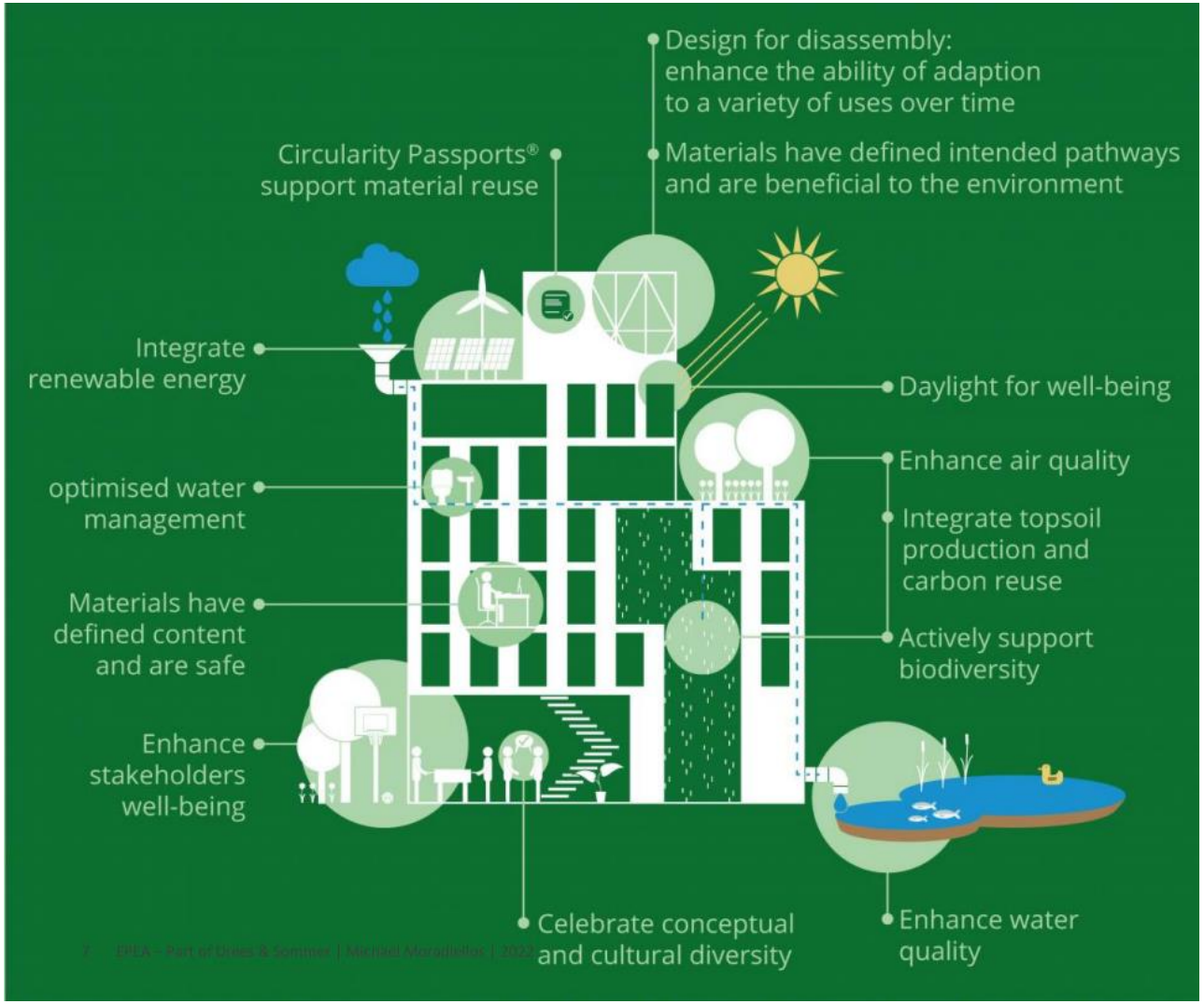
The future



Source: Drees & Sommer

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The future

Water and Environment Support
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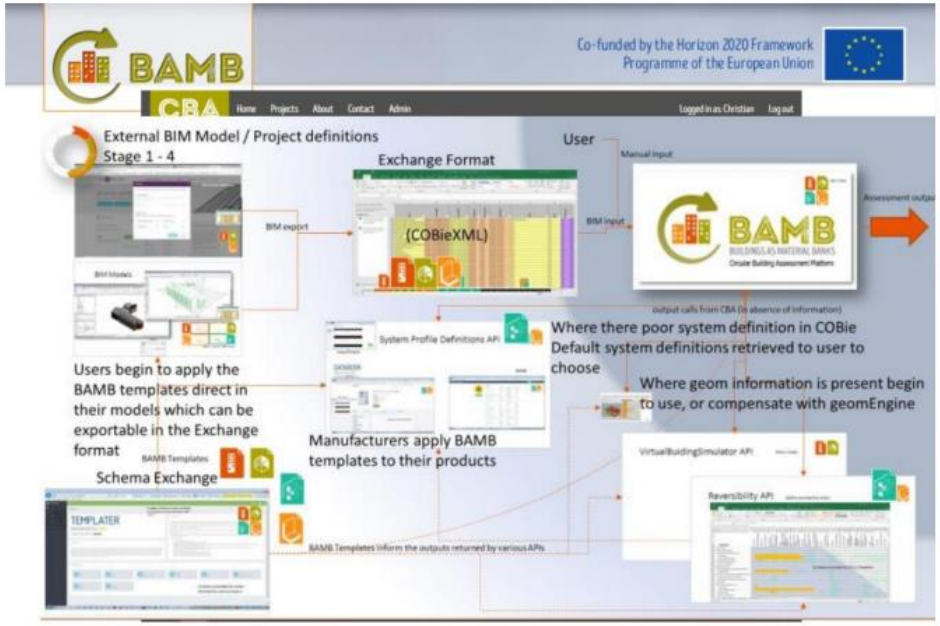
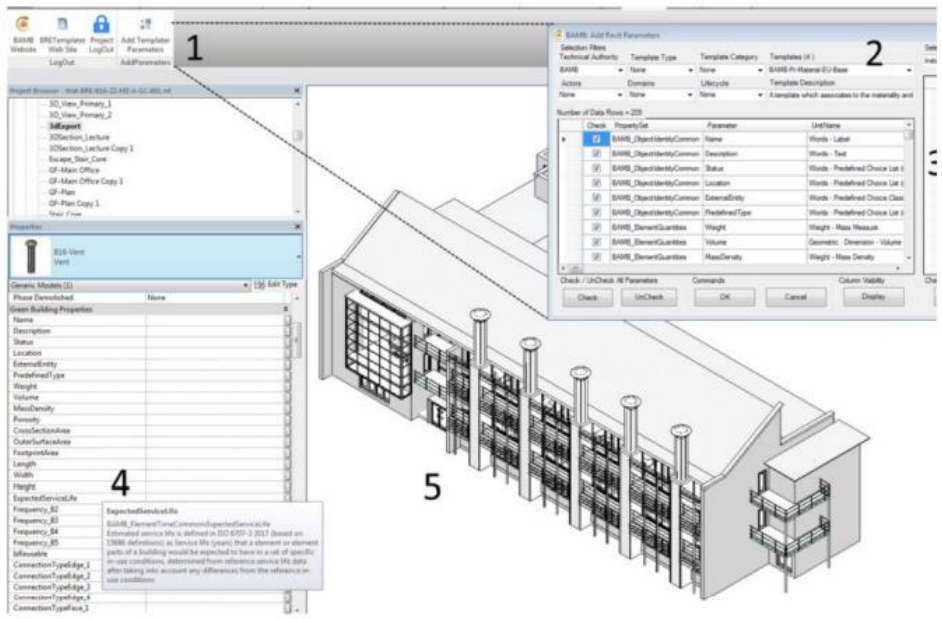
BUILDING AS MATERIAL BANKS (BAMB H2020)

The EU project for circular buildings

BAMB
BUILDINGS AS MATERIAL BANKS





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Regional Activity on Management of C&DW

WES RE-4-REG CDW P2P Study Visit & Workshop
2022 September 20-21-22

CDW management practices in the Southern Mediterranean

Special insight into the case of Tunisia

Presented by: Ahmed Jelidi, WES expert
Eng. Dr. Prof. Civil Engineering
Consultant in Engineering and Sustainability of Construction Materials

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Situation of CDW management

- In general, in the Southern Mediterranean countries, the management of CDWs is not yet well established as it is in the Northern Mediterranean countries,
- Despite the realization throughout the last twenty years of several studies, projects, programs : inventory, diagnosis, proposition of solutions, pilot actions, guides, scientific research, etc. , the finding is :
  - **Lack of sorting of CDW on construction sites**;
  - **Illegal dumps ;**
  - **Insufficient number and capacity of controlled public landfills** ;
  - **Non-existence of a sorting and treatment center for CDW**, with the exception of just one private small unit installed , but which find difficulty to sell their Inert CDW Product processed .
  - **Almost total absence of use of recycled CDWs**, except for the some reuse of road "millings" or the implementation of the first pilot project using Inert CDW Product processed in road backfilling (Re-Med project).

CDW Quantities generated

- **Cumulative quantities of untreated CDW scattered anarchically**

8 to 15 millions m3 (around 12 to 20 million tones)

Illegal dumps : **82%** and clogged municipal landfills : **18%**

(FR : 11% and 89%)

- **Annually CDW quantities generated**

2021 : 1,6 million m3 / year (about 2,5 million tone / year)

2040 : 5 million m3 / year (about 7,8 million tone / year)

- **Ratio of CDW quantities generated**

2021 : 0,14 m3 / capita / year (about 200 kg / capita / year)

2040 : 0,36 m3 / capita / year (about 540 kg / capita / year)

Source : Programme Tadaeem - USAID - Ministère de l'environnement - Tunisie - 2020

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CDW Quantities generated

- Ratio of CDW quantities generated

0,14 m3 / capita / year (about 200 kg / capita / year)

Pays	CDW m3/hab./an	CDW t/hab./an
France	1,92	3,45
Finlande	1,5	2,70
Allemagne	1,42	2,56
Belgique	1,39	2,51
Royaume Uni	1,02	1,84

European benchmark on construction waste management Synthesis

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CDW Sources

- Demolition : 2,2 à 2,5 m3 / m2

25% to 35% (65% FR)

- Renovation : 0,5 à 0,7 m3 / m2

45% to 50% (28% FR)

- New construction : 0,1 m3 / m2

12% to 15% (7% FR)

- Road: 0,2 à 0,4 m3 / m2
- Underground networks : 1,4 m3/ml

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CDW Removal Solutions

1. **Removal of Unsorted CDW**: Landfilling / Backfilling in an abandoned quarry
2. **Collection** (Unsorted and sorted CDW)
3. **Storage** for processing purposes (Unsorted and sorted CDW)
4. **Processing** (primary sorting and/or secondary sorting followed by various processing operations) to obtain a new construction material (alternative material)
4. **Marketing** of a new construction material (alternative material)
5. **Utilization** of a new construction material (alternative material)

Substantially : CDW inert product processed mostly for **Road Backfilling**

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Pilot operation of removal-transport-sorting-crushing of CDW from the authorized landfill (former CAT quarry)

EL Ouardia Municipality - Ben Arous Governorate - March 2018

Removal and transport of **CDW**

Manual Sorting:

80% IW + 18% NINDW + 1% HW

Crushing + Screening :

Source : Research study – DGC – ENIT - Tunisie - 2018

New construction material (alternative material) 71%

Pilot operation of removal-transport-sorting-crushing of CDW from the Illegal dumps

Mnihla Municipality – Ariana Governorate - August 2019

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

Pilot operation of removal-transport-sorting-crushing of CDW from the Illegal wdumps

Mnihla Municipality – Ariana Governorate - August 2019

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

Pilot operation of removal-transport-sorting-crushing of CDW from the Illegal dumps

Mnihla Municipality – Ariana Governorate - August 2019

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

Manual sorting procedures for CDWs on site

In order to succeed in the manual sorting operation of CDW, it is necessary to create favorable conditions (healthy and security) for sorting on site:

Workers with ppe : special clothing, helmet, gloves, shoes, breathing mask, etc.

Remark :

- The unit time for manual sorting is around **2 to 2.5 m3 / hour / worker.**
- For a construction site that produces 5 m3 of CDW per week, it is sufficient to devote approximately **2 to 3 hours per week to manual sorting by a single worker**.
- In the case of a rehabilitation and heavy transformation site, which produces 15 m3 of CDW per week, the time to be devoted would not exceed **1 day / week of manual sorting by a single worker**.

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPAD - Tunisie - 2020

Pilot operation of removal-transport-sorting-crushing of CDW from the Illegal wdumps

Mnihla Municipality – Ariana Governorate - August 2019

Removal and transport of **CDW**

Manual Sorting:

91% IW + 8% NINDW + 1% HW

Crushing + Screening :

New construction material (alternative material) 71%

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

Sort of CDW

- Inert Waste

80% à 91% (FR 55% à 60%)

- Non-Inert, Non-Hazardous Waste

8% à 18% (FR 35 à 40%)

- Hazardous Waste
- **1% à 2%** (FR 3% à 5%)

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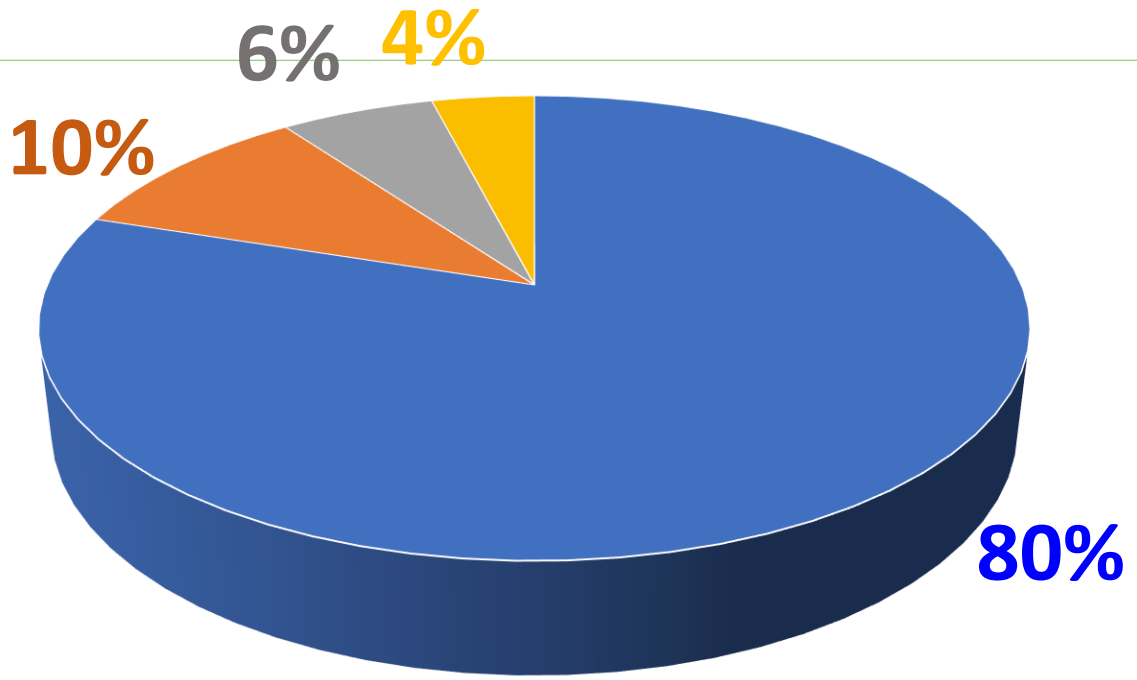
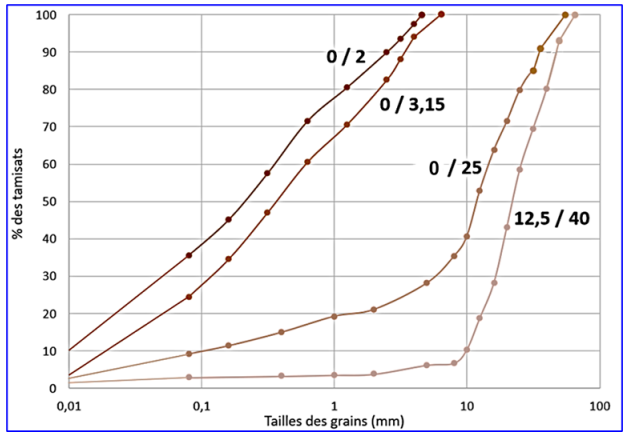
Distribution of materials in a construction



- Matériaux Minéraux (Béton, Céramique, Marbre, Plâtre, Verre)
- Matériaux Métaliques (Acier, Aluminium , Cuivre)
- Matériaux Organiques polymères (Plastiques, Bitumes, Composites)
- Matériaux Organiques naturels (Bois, fibres végétales)

Source : Research study – DGC – ENIT - Tunisie - 2018

Analyses physico-chimiques et mécaniques des CDW après tri et concassage



Source : Research study – DGC – ENIT - Tunisie 2018

Propriétés physico-chimiques et mécaniques	Norme de l'essai	Valeur normative	Sable 0 / 3,15	Tout-venant 0 / 25	Gros gravier 12,5 / 40
Module de finesse MF	NF P18- 560	1,8 ≤ MF ≤ 3,2	2,1	-	-
Masse volumique apparente ρ (t/m³)	EN 1097-3	> 1,5	1,45	1,45	1,15
Masse volumique absolue γ (t/m³)	EN 1097-7	> 2,5	2,51	2,17	2,2
Absorption d'eau Ab (%)	EN 1097-6	< 5,5	-	6,86	5,95
Limite de liquidité LL	NF P 94-051	-	29	-	-
Limite de plasticité LP	NF P 94-051	-	18	-	-
Indice de plasticité Ip (%)	NF P 94-051	< 15	11	-	-
Fines argileuses VBS (g/100g fines)	EN 933-9	< 0,2	0,85	-	-
Optimum Proctor Wopt (%)	NF P 94-003	-	10	-	-
Optimum Proctor ρd (t/m³)	NF P 94-003	> 1,5	1,9		
CBR à sec (à 95%)	NF P 94-078	-	53,51	-	-
CBR imbibé (à 95%)	NF P 94-078	> 10	36,12	-	-
Résistance à l'attrition LA (%)	EN 1097-2	< 40	-	59,2	60
Résistance à l'usure MDE (%)	EN 1097-1	< 50	-	49	48
%Matières Organiques	NF P 94-055	< 2	8,69	8,69	6,52
Teneur en silice % SiO_2	Méthode interne	-	-	-	25,50
Teneur en sulfates % SO_3	Méthode interne	< 3,5	0,82	0,82	0,51
Teneur en calcite % $CaCO_3$	Méthode interne	-	39,22	39,22	46,07
Teneur en chaux libre% CaO	Méthode interne	-	21,96	21,96	25,80

➔ **Analyses physico-chimiques :**

- **Minéralogie et composition chimique,**
- **Faisabilité en tant que Remblai pour la réalisation de couches de base de chaussée**

➔ **Nature des DI concassés obtenus à partir des CDW :**

➔ **Matériau silico-calcaire avec des fines sablo-limoneuses peu plastiques à faible argilosité.**

➔ **Leurs caractéristiques sont globalement conformes aux valeurs normatives exigées pour leur utilisation dans les remblais ordinaires.**

Analyses Géotechniques des granulats obtenus à partir du traitement (tri + concassage + criblage) des Déchets Inertes des CDW cumulés

Aptitude à l'utilisation pour les sous-couches de chaussées et les remblais

هيدرو صول للأسس HYDROSOL FONDATIONS	ESSAIS DE LABORATOIRE	HF19045
		le 06/11/2019

Echantillon			A1	A2	B1	B2
Identification	W(%)		2	5	4	3
	Equivalent de sable (%)	ES	65	52	57	64
	Granulométrie et sédimentométrie	> 5mm	63	57	64	63
		>2mm	75	66	76	76
		>0,42mm	83	76	85	82
		<0,08mm	9	13	8	11
		<2µ	1	2	1	1
	Poids volumiques	γ_{abs}	2.27	2.22	2.30	2.00
		γ_s	2.65	2.67	2.66	2.65
		γ_{app}	1.28	1.33	1.36	1.31
	Coef d'absorption (%)	A_B	6.30	4.02	3.7	5.09
Micro-Deval		MDS	23	25	27	23
		MDE	54	59	60	56
Los Angeles		LA	37	37	38	39
Analyses chimiques		VB(%)	0.14	0.20	0.15	0.15
Essais de compactage	Proctor modifié	Wopt (%)	11	9	10	8
		γ_{dmax} (g/cm3)	1.96	2.03	2.02	1.99
	CBR immédiat à l'optimum Proctor à 100%	I CBR-S	111	136	141	120
	CBR après immersion à l'optimum Proctor à 100%	I CBR -I	51	62	69	55
	CBR immédiat à l'optimum Proctor à 95%	I CBR-S	49	59	65	50
	CBR après immersion à l'optimum Proctor à 95%	I CBR -I	24	27	30	26
	CBR immédiat à l'optimum Proctor à 90%	I CBR-S	20	25	28	21
	CBR après immersion à l'optimum Proctor à 90%	I CBR -I	11	12	13	12

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

Analyses Minéralogiques des granulats robtenus à partir du traitement (tri + concassage + criblage) des Déchets Inertes des CDW cumulés

Une constitution essentiellement silico-calcaire avec des fines sablo-limoneuses peu plastiques à faible argilosité.

AGQ Labs

RAPPORT D'ANALYSE

ilac-MRA IAS ACCREDITED Testing Laboratory TL-475

Référence:	MN-19/009878	Type d'échantillon:	MINERAL
Déscription:	ECHANTILLON A2	Date de la fin:	04/11/2019

RESULTATS ANALITIQUES

Paramètre	Résultat	Unités	Incertitude	CMA
Metales Fusión Alcalina ICP-OES				
* Aluminio	17.842	mg/kg	-	
Calcium	204.619	mg/kg	-	
Fer	12.066	%	-	
* Magnésium	4.414	mg/kg	-	
* Manganèse	247	mg/kg	-	
* Phosphore	310	mg/kg	-	
* Potassium	4.514	mg/kg	-	
* Silicio	17,6	%	-	
* Sodium	1.759	mg/kg	-	
* Titanio	1.205	mg/kg	-	

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

Analyses des Lixiviats des granulats recyclés obtenus à partir du traitement (tri + concassage + criblage) des Déchets Inertes des CDW cumulés

➔ **Conformité aux exigences réglementaires environnementales**

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

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Version : 20191101-R1456-TDM **Date de réception :** 25/09/2019

RAPPORT D'ANALYSES R1456

Essais	Date d'exécution	A_2 Fin	Arrêté du 26 Mars 2018[a]	Conformité[b]
pH	04/10/2019	7,7 à 22,6 °C	6,5 < pH < 9	C
DCO (mg O_2/l)	07/10/2019	< 30[c]	1000	C
Chlorures (mg/l)	05/10/2019	8,0	700	C
Nitrates (mg NO_3/l)	07/10/2019	6,38	90	C
Nitrites (mgNO_2/l)	05/10/2019	0,092	10	C
Sulfates (mg/l)	07/10/2019	230	500	C
Sulfure (mg/l)	07/10/2019	< 0,05[c]	3	C
Fluorures (mg/l)	08/10/2019	0,227	3	C
Indice de phénol (mg/l)	08/10/2019	< 0,05[c]	1	C
Chrome VI (mg/l)	08/10/2019	< 0,040[c]	0,5	C
Aluminium (mg/l)	09/10/2019	< 0,045[c]	-	-
Cadmium (mg/l)	09/10/2019	< 0,004[c]	0,1	C
Cobalt (mg/l)	09/10/2019	< 0,021[c]	0,5	C
Cuivre (mg/l)	09/10/2019	< 0,026[c]	2	C
Fer (mg/l)	09/10/2019	< 0,056[c]	-	-
Plomb (mg/l)	09/10/2019	<0,019[c]	1	C
Manganèse (mg/l)	09/10/2019	0,055	1	C
Nickel (mg/l)	09/10/2019	< 0,019[c]	1	C
Zinc (mg/l)	09/10/2019	< 0,064[c]	5	C
Chrome (mg/l)	09/10/2019	< 0,041[c]	-	C
Arsenic (mg/l)	10/10/2019	< 0,005[c]	0,1	C
Sélénium (mg/l)	10/10/2019	< 0,005[c]	1	C
Antimoine (mg/l)	10/10/2019	< 0,005[c]	0,2	C
Etain (mg/l)	10/10/2019	< 0,005[c]	2	C
Argent (mg/l)	10/10/2019	< 0,005[c]	0,1	C
Baryum (mg/l)	10/10/2019	< 0,005[c]	10	C
Strontium (mg/l)	10/10/2019	< 0,005[c]	-	-
Molybdène (mg/l)	10/10/2019	< 0,005[c]	-	-
Titane (mg/l)	10/10/2019	< 0,005[c]	2	C
Vanadium (mg/l)	10/10/2019	< 0,005[c]	-	-
Lithium (mg/l)	10/10/2019	< 0,005[c]	-	-
Mercure (mg/l)	10/10/2019	< 0,0002[c]	0,01	C
Silice (mg/l)	09/10/2019	20,7	-	-
Calcium (mg/l)	10/10/2019	172,0	-	-
Magnésium (mg/l)	10/10/2019	< 8,792[c]	300	C
Sodium (mg/l)	10/10/2019	15,99	1000	C
Potassium (mg/l)	10/10/2019	14,36	50	C

Analyses des Lixiviats des granulats obtenus à partir du traitement (tri + concassage + criblage) des Déchets Inertes des CDW cumulés

➔ **Aptitude aux utilisations dans le BTP en tant que granulats recyclés, sans impact notable sur l'environnement par d'éventuels effets contaminants des sols et sous-sols en place ou avec la nappe phréatique par contact ou par lixiviation**

Source : Programme Tadaeem - USAID - Ministère de l'environnement - IPAPD - Tunisie - 2020

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RAPPORT D'ANALYSES R1456

COT (mg/l)	10/10/2019	< 0,5[c]	-	-
Solvants chlorés (mg/l)	10/10/2019	< 0,5[c]	-	-
Sulfite (mg/l)	26/10/2019	< 0,5[c]	-	-
Indice d'hydrocarbure C10-C20 (mg/l)		< 0,1[c]	-	-
Indice d'hydrocarbure C10-C40 (mg/l)		< 0,1[c]	-	-
HAP :				
Acenaphthylene (mg/l)	10/10/2019	< 0,1[c]	-	-
Fluorene (mg/l)	10/10/2019	< 0,1[c]	-	-
Phenanthrene (mg/l)	10/10/2019	< 0,1[c]	-	-
Anthracene (mg/l)	10/10/2019	< 0,1[c]	-	-
Pyrene (mg/l)	10/10/2019	< 0,1[c]	-	-
Benzo(a) anthracene (mg/l)	10/10/2019	< 0,1[c]	-	-
Chrysene (mg/l)	10/10/2019	< 0,1[c]	-	-
Benzo(b) fluoranthene (mg/l)	10/10/2019	< 0,1[c]	-	-
Benzo(k) fluoranthene (mg/l)	10/10/2019	< 0,1[c]	-	-
Benzo(a) pyrene (mg/l)	10/10/2019	< 0,1[c]	-	-
Indeno(1.2.3-cd)pyrene (mg/l)	10/10/2019	< 0,1[c]	-	-
Dibenzo(a.h)anthracene(mg/l)	10/10/2019	< 0,1[c]	-	-
Benzo(g.h.i)peyrlene(mg/l)	10/10/2019	< 0,1[c]	-	-
PCB :				
PCB 28 (2,4,4'-Trichlorobiphenyl) (µg/l)	10/10/2019	< 1[c]	-	-
PCB 52 (2,2',5,5'-Tetrachlorobiphenyl) (µg/l)	10/10/2019	< 1[c]	-	-
PCB 101 (2,2',4,5,5'-Pentachlorobiphenyl) (µg/l)	10/10/2019	< 1[c]	-	-
PCB 153 (2,2',4,4',5,5'-Hexachlorobiphenyl) (µg/l)	10/10/2019	< 1[c]	-	-
PCB 118 (2,3',4,4',5-Pentachlorobiphenyl) (µg/l)	10/10/2019	< 1[c]	-	-
PCB 118 (2,2',3,4,4',5'-Hexachlorobiphenyl) (µg/l)	10/10/2019	< 1[c]	-	-
PCB 180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl) (µg/l)	10/10/2019	< 1[c]	-	-

CDW Removal Cost

- **Removal cost** to abandoned quarry or storage center or processing center

of Cumulative quantities of CDW scattered anarchically

12 TND / m3 (3,6 € / m3)

96 to 168 millions TND (29 to 51 millions €)

0,3 % to 0,4 % of state budget 40,8 billion TND / year (13 billion € / year)

10% to 17% of Environment ministry budget 1 billion TND / year (300 million € / year)

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CDW Removal Cost (annually)

Water and Environment Support
in the ENI Southern Neighbourhood region

- **Estimate Annually removal cost** to abandoned quarry or storage center or processing center of CDW quantities annually generated
  - **12 TND / m3 (3,6 € / m3)**

19,2 millions TND / year (5,8 million € / year)

- **Estimate Ratio of removal cost** to abandoned quarry or storage center or processing center of CDW quantities annually generated

1,6 TND / capita / year (0,5 € / capita / year)

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Inert CDW product processed Cost

- **collection stream** (sorted or unsorted CDW)
  - Transport from building site to Storage center or Processing center or abandoned Quarry : **12 TND / m3** (3,6 € / m3)
- **On-site CDW Sorting stream**
  - Investment : Container (15 m3) : (5 000 € / unit : 16 500 TND / unit)
  - 10-year amortization : **0,3 TND / m3** (0,1 € / m3)
- **Processing stream**
  - Investment : Processing center (60 000 to 270 000 m3/ year) : 2,5 million TND / center to 6,2 million TND / center (750 000 € to 1,8 Million €)
  - 10-year amortization : **2,3 TND / m3 to 4,2 TND/m3** (0,7 € / m3 to 1,3 € / m3)

➔ **Total cost of Inert CDW Product processed (alternative material) :**

- 12 + 0,3 + (2,3 to 4,2) = **14,6 to 16,5 TND/m3** (3,6 + 0,1 + 1,3 = 5 € / m3)

- **Sales price (from quarry) of natural gravel : 10 to 12 TND/m3** (3,3 to 3,6 € / m3)

This Project is funded by the European Union

Merci pour votre attention

Thank you for your attention