Expert Facility Activity No: EFH-IL-5

Support for Construction and Demolition (C&D) Waste management

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THE SWIM AND H2020 SUPPORT MECHANISM PROJECT (2016-2019)

The SWIM-H2020 SM is a Regional Technical Support Program that includes the following Partner Countries (PCs): Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, [Syria] and Tunisia. However, in order to ensure the coherence and effectiveness of Union financing or to foster regional co-operation, eligibility of specific actions will be extended to the Western Balkan countries (Albania, Bosnia Herzegovina and Montenegro), Turkey and Mauritania. The Program is funded by the European Neighbourhood Instrument (ENI) South/Environment. It ensures the continuation of EU's regional support to ENP South countries in the fields of water management, marine pollution prevention and adds value to other important EU-funded regional programs in related fields, in particular the SWITCH-Med program, and the Clima South program, as well as to projects under the EU bilateral programming, where environment and water are identified as priority sectors for the EU co-operation. It complements and provides operational partnerships and links with the projects labelled by the Union for the Mediterranean, project preparation facilities in particular MESHIP phase II and with the next phase of the ENPI-SEIS project on environmental information systems, whereas its work plan will be coherent with, and supportive of, the Barcelona Convention and its Mediterranean Action Plan.

The overall objective of the Program is to contribute to reduced marine pollution and a more sustainable use of scarce water resources. The Technical Assistance services are grouped in 6 work packages: WP1. Expert facility, WP2. Peer-to-peer experience sharing and dialogue, WP3. Training activities, WP4. Communication and visibility, WP5. Capitalizing the lessons learnt, good practices and success stories and WP6. Support activities.

Disclaimer:

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ABBREVIATIONS

CO^2	Carbon dioxide
C&D waste	Construction and Demolition Waste
CDW	Construction and Demolition Waste
d	Day
DtD	Door-to-Door
C&D waste	Construction and Demolition Waste
EEA	European Environment Agency
EPR	Extended Producer Responsibility
GPP	Green Public Procurement
NIS	New Israeli Shekels
Inh.	Inhabitants
l	Litre
m	Month
MoEP	Ministry of Environmental Protection
MRF	Materials recovery facility
NIMBY	Not in my backyard
NIS	Shekel
p	person
PRO	Producer Responsibility Organisation
t	Tonne
VAT	Value-added tax
w	Week
WEEE	Waste Electrical and Electronic Equipment

INTRODUCTION AND METHODOLOGY

Israel's waste management policies and regulations have evolved from mainly addressing unregulated waste dumping in the 1980s to a focus on integrated waste management, which promotes reduction at source, reuse, and recovery. The Ministry of Environmental Protection (MoEP) and its Districts are responsible for implementing waste management policy (as well as other national environmental policies). Israel's ultimate objective is a zero-waste policy, aimed at gradually decreasing the amount of non-recyclable waste created, such that within a number of years there will be only one landfill in Israel.

The collection of C&D waste in Israel, unlike the collection of the domestic waste, is not regulated by local authorities, but it is collected by either local authorities or private companies by request. The latter situation makes it difficult to ensure that the C&D waste is disposed of legally. Some 2.5-million tons of construction waste is disposed of in a regulated and orderly way. Another 1.5-million tons is disposed of illegally, often thrown into empty spaces.

The illegal disposal of wastes in open spaces has negative impact on the environment such as air pollution, emission of toxic material into the air caused by the flammable materials in the waste pile, soil and groundwater contamination due to leaking of leachate, etc.

The efforts of MoEP are now focusing on promoting the establishment of authorised sites for the disposal of the C&D waste, on assuring that this waste is transferred to the new sites and on promoting recycling of waste. Recent years have seen a growth in the recycling rate of this waste due to the operation of some dedicated recycling facilities for this waste, but there is still a need to further support this process especially with regard to the enforcement and incentives. Also, local authorities have to be more involved and provided with the tools and capacity to deal with the issue.

This activity aims to assist the MoEP in implementing the forthcoming amendment of the Cleanliness Law of Israel, for better addressing the treatment of Construction and Demolition waste in Local Authorities. It also aims to strengthen the market’s capacity to increase the use of C&D recycled materials by providing assistance in policy tools and work procedures with regards to legislation, enforcement, economic tools, environmental aspects and operational incentives.

The main objectives reached by the EFH-IL-5 activity are:

- Analysis of the main barriers to recycle CDW in Israel;
- Experiences exchange, with the analysis of successful stories;
- Recommendations to develop an effective CDW strategy.

Target groups for this activity were: Ministries/Government Authorities, Local Authorities/Municipal groupings, the private sector including recycling companies, Producer Responsibility Organization (TAMIR).

The Consultant undertook the following tasks:

- Task 1: Training workshop for MoEP staff on methods for management of recycling facilities in urban areas, site visit to two CDW recycling plants in Israel and a round table discussion with local stakeholders;
- Task 2: Organization of a stakeholder workshop and meetings with MoEP representatives (Waste Division, Policy Division and Waste officers of MoEP districts) on how to build up a national strategy and case studies;
- Task 3: Organization of a workshop involving MoEP staff (Waste Division, Planning Division, Waste officers of MoEP districts) with the market build up in the focus.
- Task 4: Organization of workshop involving MoEP staff (Waste Division, EPR Division, Waste officers from MoEP districts, TAMIR-PRO) with the glass recycling in the focus.

Outputs of the aforementioned tasks are:

- Comparative review document of C&DW policies/legislation in various EU Member States;
- Recommendations for Israel on recycling facilities in urban areas;
- Recommendations for implementation of the C&D law in Israel;
- Recommendations on initiatives for the reuse and recycling of C&D materials.

The activity has been developed under the 'Solid Waste Management' thematic of SWIM-H2020 SM and has been designed in complementarity with three other Expert Facility activities taking place in Israel:

- EFH-IL-1: Green and circular public procurement in central and local government in Israel, through policy development and capacity building for manufacturers and procurers;
- EFH-IL-3: Support for the plastic waste management and recycling;
- EFH-IL-4: Support for the glass waste management and recycling.

The activity took place in Israel during 2 missions:

- 2 days from Tuesday, December 4th to Wednesday December 5th, 2018. Expert Francesc Rufe, invited speaker Paolo Marengo. Here below the actions delivered during the mission:
    - Training workshop at the MoEP Headquarter, Jerusalem
    - Site visits at: Rishon Letzion – Municipal recycling plant and Na'an – C&D recycling plant
- 3 days from Tuesday, February 5th to Thursday, February 7th, 2019. Experts Liesbet Van Cauwenberghe and Chris Holcroft, Invited speaker Paolo Marengo. Here below the actions delivered during the mission at the MoEP Headquarter, Jerusalem:
    - Workshop on C&D waste - EU Strategy
    - Workshop on C&D waste – market build up
    - Workshop on glass recycling

THIS DOCUMENT includes the EXPECTED OUTPUT/DELIVERABLES of the Expert Facility Activity EFH-IL-5.

Here below the list:

1. Comparative review document in policies/legislation in various EU Member States
2. Recommendations for Israel on C&DW recycling facilities in urban areas
3. Recommendations for implementation of the C&D law in Israel
4. Policy recommendations for the reuse and recycling of C&D materials in Israel

1 OVERVIEW OF POLICIES/LEGISLATION IN VARIOUS EU MEMBER STATES (MS)

In this document an overview of the C&D waste legislation is reported for 3 EU MS:

- Belgium
- France
- Malta

The overview takes into account the legal framework, the main plans and policy instruments implemented, in order to understand the key elements of the national strategies.

The 3 countries have significant differences in size/scale, so that it is possible to analyse different contexts.

In September 2015, the European Commission, in a project led by Bio by Deloitte, released individual reports on the current CDW management situations in EU Member States, including Belgium, France and Malta. In this document the main updates that have occurred in the three countries are reported.

Furthermore, the main data concerning the C&D waste management are reported, in order to comprehend the main impacts of the strategies.

1.1 BELGIUM

1.1.1 National Legislation concerning CDW

Since in Belgium the Regional Authority is the responsible body for the C&D waste management, the information will be presented in 3 sections, focusing on each of the three regions: the Flemish Region, Brussels Capital Region and Walloon Region (also known as Flanders, the Brussels Region, and Wallonia).

1.1.1.1 Flanders

There are two legislative documents that concern the management of CDW in Flanders:

- The Decree of 2012 on the management of material cycles and waste ("Materialendecreet" or Materials Decree);
- VLAREMA, which is the implementation order of the Decree of 2012, providing provisions on transport and trade of waste, reporting of waste and resources, use of resource, selective collection by enterprises and extended producer responsibility (EPR) (Deloitte, Screening Template for Construction and Demolution Waste management in:Belgium V2 - September 2015, 2015).

Furthermore, there are two additional documents which refer specifically to recycled granulates:

- Demolition management system – aims to guarantee the quality and traceability of recycled aggregates. It focuses on the processing of granulates, transport of recycled aggregates and the effective use.
- The management system resulted in a regulation for ensuring the quality of recycled granulates, entitled the 'eenheidsreglement' that formed the basis for the certification of recycled aggregates.

1.1.1.2 Brussels Capital Region

The CDW management's legislative framework is defined in the following process:

- Before construction, an environmental permit (EP) (Ordonnance du 5 juin 1997 relative aux premise d'environnement) must be obtained
- There is a mandatory recycling of the stony and sandy fraction of CDW[1].
    - The fraction should be processed for use as secondary raw material on different projects.

BRUDALEX (entered into force 23 January 2017) is a new legislative framework that will aim to assist the transition to a circular economy in Brussels. The following aspects refer to CDW:

- The text makes it mandatory for holders of CDW to sort and to have their CDW sorted in a sorting facility.

1.1.1.3 Walloon Region

The basis of the legislation is the waste decree of 27 June 1996. The environment permit in the Walloon region describes conditions for waste management on building sites.[2] The submission of all data gets sent to the Walloon Waste Office (OWD).

1.1.2 Waste management plans (WMP) and Strategies

1.1.2.1 Flanders

MINA plan 4 (effective from 2011-2015) is still being used to provide guidelines for environmental policy, including on waste and material strategies/policy[3]. The other two action programs "Resource conscious construction in cycles" (2014-2020)[4] and "Resource conscious construction 2014-2016"[5] are also still in effect.

Flanders is working on a new Executive Plan on Waste and new indicators in a broader sense. It is still unclear when this report will be released.

[1] 16 MARS 1995. - Arrêté du Gouvernement de la Région de Bruxelles-Capitale relatif au recyclage obligatoire de certains déchets de construction ou de démolition.
[2] 11 mars 1999 - Décret relatif au permis d'environnement
[3] LNE MINA Plan 4
[4] Materiaalbewust Bouwen in Kringlopen
[5] Actieprogramma Materiaalbewust Bouwen

1.1.2.2 Brussels Capital Region

On the 22nd of November 2018 the "Plan de Gestion des Ressources et des Déchets" was adopted. It sets objectives for the 2018-2023 timeframe and the construction sector is in the focus: the plan aims at pursuing the transition of the sector towards a CDW circular management. The main points are: selective demolition, design to disassemble and reuse the materials. In order to reach the objectives, a specific call for tenders will be launched (e.g. "Be Circular").

1.1.2.3 Wallonia

Wallonia published a new "Waste-Resource Management Plan" (Plan Wallon des Déchets-Ressources) in 2015.

Wallonia will develop and/or increase various policies and corresponding tools in order to increase the quality and relative quantity of waste which can be used as a resource. Amongst these are:

- Compulsory source separation of certain waste streams
- Promotion of building deconstruction instead of demolition

Wallonia will study the option of backfilling taxation, at least to ensure a form of monitoring, as it is not considered recycling.

The prevention plan identifies C&D waste among the priority waste streams in which to develop targets and develop actions (detailed on p. 94 in the Plan). Additionally, construction materials are included in the priority streams for which measures to increase re-use should be developed.

1.1.3 Legal framework for sustainable management of CDW

1.1.3.1 Flanders

There is a national/regional sorting obligation for Flanders (on-site and for different materials) for certain CDW from enterprises and households[6]. There is a voluntary green public procurement requirement currently in Belgium. The separate collection of hazardous waste, such as waste containing asbestos, is mandatory.

1.1.3.2 Brussels Capital Region

Currently, there is a national/regional sorting obligation on the reuse of inert waste that has to occur either on-site or by sending it to a sorting centre.[7] Contracting authorities may include environmental clauses in the special specifications for their procurement; however this is not a requirement.[8]

6 VLAREMA, articles 4.3.1 and 4.3.2
7 16 Mars 1995 - Arrêté du Gouvernement de la Région de Bruxelles-Capitale relative au recyclage obligatoire de certains déchets de construction ou de démolition.
8 8 MAI 2014. - Ordonnance relative à l'inclusion de clauses environnementales et éthiques dans les marchés publics

1.1.3.3 Wallonia

There are national/regional sorting obligations for different materials, including metal waste;[9] paper, metal plastic and glass;[10] and for the collection and management of hazardous waste from C&D operations. By 2020, non-hazardous construction and demolition waste (excluding 17054) are subjected to either a preparation for their reuse (recycling, backfilling operations, etc.), all at a competitive minimum of 70% of weight.[11] There are requirements for sustainable purchasing.[12]

1.1.4 Targets

The target is overall coherent with the requirement reported in the EC report[13]. This would be a 70% recovery rate.

1.1.5 End of Waste (EoW) status

1.1.5.1 Flanders

The EoW criteria established in the Materials Decree of 2012 are still effective. This falls under the national legislation.

1.1.5.2 Brussels Region

The EoW criteria established in Article 9 of the 'Ordonnance relative aux déchets du 14 juin 2012' are still in effect.

1.1.5.3 Wallonia

New legislation is under development but has not been released yet. When the legislation will be in place, Federations will try to create EoW criteria for recycled aggregates and for excavated soil (Deloitte, Screening Template for Construction and Demolution Waste management in:Belgium V2 - September 2015, 2015).

9 Article 2, 5 MARS 2015. – Arrêté du Gouvernement wallon instaurant une obligation de tri de certains déchets
10 Article 16. 10 mai 2012 Décret transposant la Directive 2008/98/CE du Parlement européen et du Conseil du 19 novembre 2008 relative aux déchets et abrogeant certaines directives
11 Article 16. 10 mai 2012 Décret transposant la Directive 2008/98/CE du Parlement européen et du Conseil du 19 novembre 2008 relative aux déchets et abrogeant certaines directives
12 28 NOVEMBRE 2013. – Circulaire relative à la mise en place d'une politique d'achat durable pour les pouvoir
13 Screening template for Construction and Demolition Waste management in Belgium: V2 – September 2015, Bio by Deloitte, p. 21

1.1.6 CDW generation data

Eurostat has published (database accessed on the 7th February of 2019) the following data for construction waste. The table depicts the waste split into different categories.

Table 1-1: Generation of waste by waste category

Generation of waste by waste category (Construction)	2016	2014	2012	2010	2008
Total Waste	19.573.150	18,347,257	17,132,768	16,852,673	15,441,861
Chemical and medical wastes (subtotal)	45,548	31,632	104,936	90,663	8,990
Recyclable wastes (subtotal, W06+W07 except W077)	864,74	866,872	713,934	1,025,225	1,134,699
Equipment (subtotal, W077+W08A+W081+W0841)	3,853	10,559	2,209	2,209	2,847
Animal and vegetal wastes (subtotal, W091+W092+W093)	261,740	266,864	193,709	69,368	107,293
Mixed ordinary wastes (subtotal, W101+W102+W103)	845,788	862,516	912,881	1,725,627	566,214
Common sludges	2,31	674	3,762	11,323	626
Mineral and solidified	17,549,171	16,500,446	15,201,355	13,928,258	13,621,193

As can be seen from the table, a large part of the construction waste is composed of recyclable wastes. Additionally, the mixed ordinary waste could also possibly be reused/recycled.

1.1.7 CDW treatment data

1.1.7.1 Brussels Capital Region

Construction and demolition waste (CDW) produced in the BCR: estimates of recycling and/or sorting expressed in ton and as percentage, on the basis of four different studies

Sources: studies commissioned by Environment Brussels: see (1), (2), (3) and (4)

	2011 (1)	May 2012 (2)	May 2012 (3)	Dec. 2013 (4)
Quantity of CDW generated per year	~650000 T (waste stream)	**~650000 T**	600000 T (collected)	~700000 T (waste stream)
recyled *not recycled* *neither recycled nor reused*	*552500 T* *~100000 T*		*500000 T* *100000 T*	
% recycled	~85%			
% sorted		**77%**		75%
% not recycled	~15%			
Sorted quantity per year:		**~500000 T**		525000 T
sorted on the construction site		*~400000 T*		
Quantity of unsorted CDW per year:		**~150000 T**		150000 T
mixed CDW that is sorted at sorting centres		**~75000 T**		

(1) Environment Brussels, 2011. *Technisch verslag - Voorbeeldgebouwen : Het beheer van bouwafval : Fiche 4.3, Info-fiche voor professionelen*, page 4

(2) CERAA-ROTOR, May 2012 *Etude sur l'analyse du gisement, des flux et des pratiques de prévention et de gestion des déchets de construction et de démolition en RBC*, page 158

(3) PWC, May 2012 *Analyse des emplois existants et potentiels dans le secteur des déchets en Région de Bruxelles-Capitale*, diagram on page 55

(4) Environment Brussels, *Nieuwsbrief voor ondernemingen*, no. 23, Dec. 2013, page 3

[14]

The CDW generation has been relatively consistent over the last few years, including the percentage that is increased. Unfortunately, there is no further information available after 2013.

1.1.7.2 Flanders

There was a report released by Flanders that reported treatment data. The data collection is valid up till 2012. There is no backfilling in Flanders, so there were zero values reported for this section. Furthermore, internal recycling is not included in the reported data.

1.1.7.3 Walloon Region

The region had a valorisation rate of 85% in 2008[15].

1.1.8 CDW exports/imports data

For the majority of Belgium, there is no data available on CDW exports/imports. The only data from 2011, concerns the import/export between the different legislative regions (Flanders, Brussels, Walloon Region). There is, however, a limited amount of exports to the Netherlands for tar asphalt for thermal cleaning.

14 http://www.environment.brussels/state-environment/summary-report-2011-2012/waste/construction-and-demolition-waste
15 Plan déchets horizon 2010: http://environnement.wallonie.be/rapports/owd/pwd/catflux1.pdf

1.1.9 CDW treatment facilities data

1.1.9.1 Flanders

In 2014, there were 197 fixed locations that dealt with the sorting of mixed CDW, crushing of rubble and the mixing of lean concrete. There were also 50 mobile installations working under the COPRO-certification in Flanders. There are four landfills for inert waste (category 3) located in Flanders (2013 data).

1.1.9.2 Brussels Capital Region

In 2016, there were only three sorting facilities in Brussels. CDW was being exported to other regions and this still seems to be the case in 2017.

1.1.9.3 Walloon Region

In 2016, there were 5 landfills for inert waste in Wallonia. 99% of the waste that is being landfill is soil (OWD data) (Deloitte, Screening Template for Construction and Demolution Waste management in:Belgium V2 - September 2015, 2015). There are 242 centres authorized to perform the sorting/recycling of inert construction waste and demolition. Out of these, 150 are building contractors.

1.1.10 CDW management initiatives

1.1.10.1 Flanders

A report of the European Environment Agency (EEA, 2016) stated that the Materials Programme of Flanders is looking for a profitable system to collect windowpanes (flat glass) in order to produce new glass. Furthermore, a ‘materials methodology for building components is being developed as a measurement tool’ to help stakeholders make conscious material choices. The materials methodology is being ‘tested in a series of innovative construction projects’ in addition to ‘pilot projects on flexible construction in social housing’ (EEA, 2016).

TRACIMAT is another promising initiative. It is a non-profit construction and demolition waste (CDW) management organisation, founded by the H2020 HISER partners - the Flemish Construction Confederation (VCB), together with the Federation of Producers of Recycling Granulates (FPRG), the Belgian Demolition Association (CASO) and the Organisation representing the engineering and consultancy companies (ORI), that aims at providing a traceability system to boost the selective collection of CDW.

1.1.10.2 Wallonia

There is a concentration on the construction sector, especially concerning flat glass. This can be seen by some of the projects that were initiated by GREENWIN (https://www.greenwin.be/). GREENWIN is a Wallonia industry cluster aiming at innovation in green chemistry and durable materials (including their applications in zero or near zero energy buildings). With the financial support of the Walloon Region, GREENWIN intends to promote all companies having local activities that deal with materials, either their production or their application, and that share a concern about their environmental impact. All projects are

evaluated on their market potential as well as their favourable impact on the life cycle environmental costs and benefits of the end products.

Other projects include the Reverse Metallurgy project. The Reverse Metallurgy project brings together different industrial and academic Walloon partners in order to allow the development of techniques that better recycle metals and to develop measures focusing on smart steels or new surfaces. The ambition of the Reverse Metallurgy project is to recycle metals so that they can again be used as raw materials (http://www.gre-liege.be/reversemetallurgy/).

1.1.11 Drivers / barriers to increase CDW recycling

As mentioned in the EEA report (EEA, 2016), one of the main barriers to the increase in CDW recycling is the difference in legislation amongst the Belgian regions and the lack of cooperation between the regions. Facilitating this would significantly increase the possibilities for CDW recycling.

At the moment, 'collaboration agreements' are created between the relevant political entities. The Coordination Committee for International Environment Policy (CCIM/CCPIE) created through such an agreement created a subgroup on material resource efficiency policy through which CDW would be discussed.

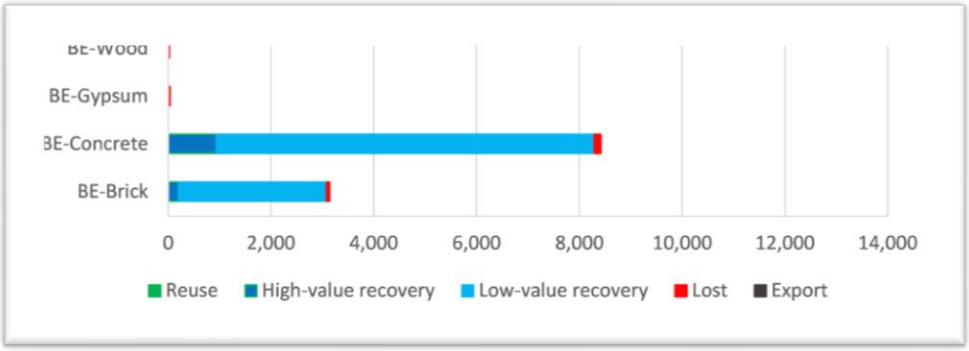
1.1.12 CDW materials (concrete, bricks, tiles and ceramic, asphalt, wood, gypsum)

1.1.12.1 Recovery techniques

The graph below shows some statistics taken by the H2020 HISER project for Belgium.

As shown, only concrete and brick has some level of high-value recovery in Belgium. Wood and gypsum are largely lost in CDW, whereas a large level of low-value recovery occurs for concrete and brick.

Figure 1-1: C&D waste main destinations in Belgium[16]



16 http://www.hiserproject.eu/index.php/news/80-news/158-mass-flow-of-bricks-concrete-gypsum-and-wood-in-belgium-the-netherlands-spain-and-finland

1.1.12.2 Environmental and economic impacts of CDW waste management

There is currently very little information about the impact of CDW waste on the environment and economic situation in Belgium.

1.1.12.3 Drivers / barriers to increase recycling

Flanders

There are several drivers for the increase in CDW recycling, including the:

- Adoption of several sectorial implementation plans
- Taxes on landfilling
- Stony-fraction recycling rate was increased to 95% with the stimulation of both practical and technical solutions and economic benefits (landfill taxes).

In contrast, the barriers are:

- The different legislations in the Belgium region remains an issue for smoother recycling.
- Modern construction material is more complex and this provides a hindrance to the recycling of waste, resulting in a larger landfill amount.
- Logistical aspects can also prove to be a challenge

Brussels Capital Region

There are several drivers for the increase in CDW recycling, including the:

- The cost of treatment of mixed waste can be 3-10 times higher than the cost of treatment for sorted waste.
- There is legal text that requires the government to provide subsidies to non-profit or social organizations that are active in the area of reuse and preparation for reuse.

In contrast, the barriers are:

- Certain legal aspects can be time consuming, such as waiting for the approval to sort containers on public roads.
- The soil ordinance does not encourage the recovery in soils.
- It seems to be fairly expensive to try to fulfil different sorting, storage and recycling suggestions (Deloitte, Screening Template for Construction and Demolution Waste management in:Belgium V2 - September 2015, 2015).

Walloon Region

There are several drivers for the increase in CDW recycling, including:

- Similarly to Brussels, the treatment costs for sorted waste is less expensive than for mixed waste.
- Legislation is strict and obliges a high recycling rate for CDW.

In contrast, the barriers are very similar to the barriers of the Brussels region, including the too strict legislations for certain fractions. Additionally, there is no EoW criteria for recycling aggregates.

1.1.13 Recycled materials from CDW

An estimated 90% of the recycled aggregates are used as sub base and base layers in road construction. 10% are used in road-like applications on construction sites. Less than 1% of the recycled aggregate is used in high-grade application.

1.2 FRANCE

France has a powerful legal and regulatory framework with pre-audits on demolition sites, national and regional waste management plans including CDW amongst others, benefiting CDW management. However, according to the stakeholders contacted by BIO by Deloitte for their study, more significant financial and human resources need to be allocated to CDW legislation enforcement. Furthermore, the study highlighted insufficient regulation of backfilling and ground raisings.

1.2.1 National Legislation concerning CDW

Law 2009-967 of 3 August 2009, known as "*Grenelle I*" law, and **Law 2010-788** of 12 July 2010, known as "*Grenelle II*" law, make **pre-audits compulsory on demolition sites** (Articles 46 and 190, respectively). This measure is made compulsory for certain categories of buildings by **Decree n°2011-610** of 31 May 2011, which created articles R. 111-43 to R. 111-48 of the French Construction and Housing Code, and is supplemented by the Ministerial Order of 19 December 2011. The pre-audits, named "diagnosis on waste arising from demolition works", aim to characterize the materials present on site and plan the CDW management.

Order n°2010-1579 of 17 December 2010 amends the Environment Code to transpose the legislative part of the Waste Framework Directive 2008/98/EC (abbreviated WFD) into French law. It specifies the definition of waste, introduces the hierarchy in treatment operations, enforces waste prevention and sets the obligation to have a national waste prevention plan. **Decree n°2011-828** of 11 July 2011 then finalized the transposition of the WFD (regulatory part). It reformed waste territorial planning, set a limit on incineration and landfilling, and imposed separate collection for recovery on large bio-waste producers. The **Environment Code** also impacts CDW by specifying the responsibility of waste producers and through its definition of waste prevention. Additionally, **waste traceability** is compulsory in France following **Decree n°2011-828** of 11 July 2011 and a couple of accompanying Ministerial Orders from 2012.

Since the 2010 Order, all companies are supposed to implement **source separation and collection** of waste. **Five waste streams** are targeted: paper, metal, plastic, glass, and wood. However this particular measure was not applied until the **Decree n°2016-288** of 10 March 2016, which sets the regulatory grounds for implementing source separation and collection of these five waste streams by companies in Article 3, hence its nickname: the 5-stream Decree ("*Décret 5 flux*" in French). Large producers of waste must do so for all five waste streams whereas small companies will gradually have to sort only paper. This piece of legislation specifies that several producers situated on a common site with the same waste management operator count as one larger producer. Furthermore, Article 5 of this Decree sets the legal framework for measures relative to the **recovery of construction material, product and equipment waste**. Indeed, distributors whose distribution unit is at least 400 m² and whose annual turnover is at least 1 M€ must organise the recovery of waste from the same type of construction materials, products and equipment as they distribute, within a radius of ten kilometers. Waste professionals hope this Article, which entered into force on 1 January 2017, will help reduce illegal dumping (Barrault, 2016). This Article 5 of the 5-stream

Decree is a direct implementation of Article 93 of the **Law 2015-992** of 17 August 2015, related to energy transition for a green growth. The energy transition law (abbreviated "*LTECV*") also includes various other measures regarding CDW:

- Article 70 sets numerical targets for CDW prevention and recovery
- Article 78 prohibits inert waste disposal on agricultural lands
- Article 94 states that if waste destined for development, rehabilitation, or construction works is received by someone on a land they own, this person cannot receive financial compensation for using said waste
- Article 96 was the precursor to Article 3 of the 5-stream Decree, and further forbids and sanctions discriminations against recycled or reused materials offering the same performance level.

Decree n°2014-1501 of 12 December 2014 modified the classification of facilities for environmental protection (ICPE in French, facilities classified for environmental protection). Following this Decree, inert waste landfills, known as ISDI, short for inert waste storage facilities in French, were submitted to ICPE legislation from 1 January 2015 with the objective of improving consistency in the status of landfills and facilitating penalisation of illegal landfills.

Transport of CDW is also regulated as **non-inert waste transport** and must be registered with local authorities, the "*Préfecture*", if quantities exceed 100 kg of hazardous waste or 500 kg of non-hazardous waste. **CDW regulation infringement** such as illegal dumping or incineration on site is punishable by law, with sanctions of up to 2 years imprisonment and a fine of 76 000 €.

Although not specific to CDW, France has 18 extended producer responsibility (EPR) schemes, some of which impact a small fraction of the waste which can arise on a construction, renovation, or demolition site: waste electric and electronic equipment, tyres, furniture, gas bottles, batteries and accumulators, and light bulbs.

1.2.2 Waste management plans (WMP) and Strategies

1.2.2.1 National level

The first national waste prevention plan was adopted in February 2004, followed by the 2009-2012 Waste action plan in September 2009, which covered both prevention and management. In 2012, to meet the requirements of the Waste Framework Directive, waste prevention and management were separated to have distinct plans.

The **2014-2020 National waste prevention programme** was drawn up in 2012 and approved by Ministerial order in August 2014. Waste streams were classified into 3 levels of priority, with CDW identified as a priority 1 stream due to the huge amounts generated. Therefore one of the key objectives of the national waste prevention programme is to at least stabilise CDW generation by 2020 (260 Mt). The following actions are foreseen to meet this objective:

- Implement specific awareness-raising for building owners / construction developers, and other stakeholders from the buildings and public works sector
- Develop voluntary commitment charters for the building and public works sector to encourage waste prevention
- Identify and use incentive levers to develop construction material re-use
- Review the regulation relative to demolition audits and improve it if necessary.

The **waste reduction and recovery plan 2016-2025** was published in January 2017 in a document acting jointly as the basis for the "national strategy of transition towards a circular economy". It summarises work carried out so far and objectives linked to the energy transition law. The energy transition law set objectives to increase material recovery to 55% in weight of non-hazardous, non-inert waste by 2020 (65% by 2025) and 70% recovery of CDW by 2020. By 2025 the amount of waste sent to disposal (landfill of incineration without energy recovery) must be reduced by half.

Furthermore, this same law aims to reinforce public procurement for a circular economy via its Article 79. Indeed, regarding CDW, public authorities must ensure that their tenders for construction or road works include a requirement to give priority to reuse or recycled materials. They must ensure that 50% of materials used for road works come from reuse or recycling of CDW in 2017, increasing to 60% in 2020. Additionally, amongst these materials, from 2017 onwards at least 10% of materials used in surface layers and at least 20% of those used in foundation layers must come from reuse or recycling. From 2020 onwards this must reach 20% for surface layers and 30% for foundation layers.

The waste plan also highlights the need to bring framework regulation up to date regarding waste status (end-of-waste, by-product status, for example). Indeed, the government will continue ongoing work on the clarification of regulation and will prepare modifications if necessary to facilitate waste recovery whilst maintaining the same insurances regarding environmentally-sound waste treatment.

1.2.2.2 Local level

France is divided in Regions, which are, in turn, subdivided into Departments. The Ministerial Circular of 15 February 2000 established the Departmental CDW prevention and management plans. The Grenelle II law then made these plans mandatory and under the responsibility of the Departmental Councils (Regional Council in the Paris Region).

However, Article 8 of **Law n°2015-991** of 7 August 2015 on the New Territorial Organisation of the French Republic, known as the "***NOTRe***" law, has transferred this responsibility to the Regions of France (which have also been redefined). Furthermore, the **regional waste prevention and management plan** (abbreviated "*PRPGD*" in French) will act as a **unique framework** for all types of waste, whereas until now departments had to develop plans for three separate streams: hazardous, non-hazardous, and C&D waste.

The modalities of this new regional plan are specified in **Decree n°2016-811** of 17 June 2016. The regional plan must include:

- A state of play of waste prevention and management
- A six- and twelve-year forecast of the trends of waste quantities produced in the territory

- Waste prevention, recycling and recovery targets setting out the national targets adapted to regional specificities, and relevant indicators
- A six- and twelve-year waste prevention planning and waste management planning
- A regional action plan for circular economy

Certain waste streams will be covered by specific planning within the regional plan, amongst which is construction and demolition waste, for which the plan must include:

- A summary of actions related to the deployment of waste recovery
- A qualitative and quantitative identification of secondary mineral resource available at a regional scale.

The regional CDW prevention and management plan for the Paris Region (*Région Île-de-France* in French), known as PREDEC, was adopted in June 2015 (Conseil régional d'Île-de-France, 2015). In other regions, current departmental waste prevention and management plans will apply until the publication of a new regional plan.

1.2.3 Legal framework for sustainable management of CDW

The report drafted by BIO by Deloitte (2015) identifies specific national or regional legislation which can create good conditions for a sustainable management of CDW.

Table 1-2: Legal framework for sustainable management of CDW

Description	Occurrence (Yes/No), Key scope or exemptions	Policy reference & year
Obligation for selective demolition	No – mandatory pre-demolition audit for certain categories of buildings before demolition work, but no obligation for selective demolition	Law 2009-967 (Grenelle I) of 3 August 2009 – Article 46 Law 2010-788 (Grenelle 2) of 12 July 2010 – Article 190 Obligation from March 2012 for specific types of buildings
Sorting obligation (on-site or in sorting facility)	No – though it is prohibited to mix hazardous waste with other waste	Environment Code Article L. 541-7-2
Separate collection obligation for different materials	Yes – source separation & collection for paper, metal, plastic, glass, and wood is compulsory for companies, not specific to C&D operations	Decree n°2016-288 of 10 March 2016 – Article 3 Smaller companies will gradually have to sort paper only
Obligation for separate collection and management of hazardous waste from C&D operations	No	
Related Green public procurement requirements	No – though in 2017, 50% of materials used for road works should come from CDW reuse or recycling, 60% in 2020	Law 2015-992 (LTECV) of 17 August 2015 – Article 79

1.2.4 Targets

As mentioned in previous sections, several targets have been defined in existing policy and regulation:

- **Stabilise the generation of CDW by 2020** at the level reached in 2010 (260 Mt), an objective set by the 2014-2020 Waste prevention plan
- **70% CDW recovery and recycling by 2020**, an objective set by the WFD present in Article 19 of the bill on energy transition for a green growth and reiterated in the Waste reduction and recovery plan 2016-2025. However, this has not yet been transposed into French law, and the wording excludes neither hazardous CDW nor naturally occurring material, contrary to the WFD target.
- **30% reduction in the amount of non-hazardous, non-inert waste sent to disposal** (landfill or incineration without energy recovery) by 2020 compared to 2010, and 50% reduction by 2025, an objective set by the same Article 19 of the energy transition bill.
- Public authorities will have to ensure that **50% of materials used in road works** originate **from reuse or recycling of CDW in 2017**; 60% in 2020, according to Article 79 of the bill on energy transition for a green growth and reiterated in the Waste reduction and recovery plan 2016-2025.

1.2.5 End of Waste (EoW) status

The Environment Code describes the principles of end of waste status in Article L.541-4-3, created by Order 2010-1579. This was supplemented by Decree 2012-602 of 30 April 2012, which specified the terms according to which the EoW criteria are adopted and the related procedure.

Only two types of materials are currently covered by EoW criteria. European regulation adopted in 2011 covers recycled metal. In France, Order of 29 July 2014 states that shredded wood packaging waste shall no longer to be considered waste when it is used as a biofuel in boilers. EoW criteria for steel industry slag for use in road and public works are currently under discussion.

Decree 2016-1890 of 27 December 2016 brings various adaptation and simplification measures in the field of waste prevention and management. Article 6 specifies the composition and operation of the advisory board on EoW.

Finally, French jurisprudence recognised that it is possible to end the waste status in an implicit way, without requiring specific regulatory criteria. This is only possible for production processes which use waste instead of raw materials, in part or completely. The resulting product is not considered waste, though it must be similar to the products which would have resulted from the process had only raw materials been used. The "implicit" end of waste status in production processes is explained in a notice published in the Official Journal of 13 January 2016[17].

[17] The notice in the Official Journal of 13 January 2016 is available at the following link : https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000031825201

1.2.6 Non-legislative instruments (best practices, guidelines, recommendations…)

Non-legislative instruments include best practices, guidelines, recommendations, and the like. They are an essential part of CDW management and they can create conditions for a sustainable management of this type of waste. See section 1.1.10 CDW management initiatives, as many initiatives received national funding and/or issued recommendations.

The key instruments in France are:

- **Landfill tax** ("*TGAP*" in French for general tax on polluting activities): this tax from 2009 raises the cost of polluting activities so as to divert economic actors away from them;
- **Incentives and budget lines dedicated to waste prevention and management**: various funding possibilities are available in France, for stakeholders ranging from companies to local communities. One of the better known funding bodies is the French Environment and Energy Management Agency, ADEME, though others include European funds, Caisse des Dépôts et Consignations, etc.;
- **Environment Agency**: founded in 1991, the French Environment and Energy Management Agency, **ADEME** provides full support to individuals, companies, and local communities regarding waste prevention and management, in the form of information, technical assistance, or funding;
- **Sustainable Construction Methodological Guidebook**: Edited by the Saine-Saint-Denis General Council in 2009;
- **Building certification standards covering CDW**: HQE (2005), BREEAM (1990) and LEED (1998) exist in France;
- **Industry sustainability standard covering CDW**: the Quarries Environment Charter (2004) is a global environment voluntary commitment, and the Clean Building Approach (2005) aims to improve working methods and quality of life on building sites;
- **Public sector sustainability standard covering CDW**: the Green Site and Clean Site charters were initiated by ADEME and consist in an approach that covers all environmental aspects of a site;
- **Environment Assurance Plan**: this contractual obligation is an operational document drafted by the environment coordinator or the client. Each company which will work on the construction site must fill it in before starting the work, indicating which provisions they will take to limit and monitor the nuisances and impacts of their operation on the environment;
- **Sustainable Building Plan**: it was launched in 2009 with the aim at involving the stakeholders towards energy and environmental goals. On the 29th January 2019, the updated report on the Plan has been released (Plan Bâtiment Durable, 2019).

Furthermore, various guidance and tools have been developed to improve CDW management regionally and nationally in France. These include guidebooks written by ADEME or the French Building Federation (FFB), smartphone applications, and a website called OPTIGEDE which acts as an online information sharing platform. A comprehensive table of such guidance and tools is available in BIO by Deloitte (2015). New instruments arise regularly, such as the guide on the environmental acceptability of recycled aggregates from CDW in road works published by CEREMA in January 2016, for example, which aims to encourage the use of recycled aggregates (CEREMA, 2016).

1.2.7 CDW management performance – CDW data

The French Ministry of the Environment, Energy, and the Sea launched a survey on C&D waste produced in 2014, conducted by Observation and Statistics department (SOeS). The description of the survey was published on 27/1/15[18] and the data and final report were released in 2017 (ADEME, Dechetes du Batiment, 2017). The previous official national data on CDW dates back to a survey from 2008 (SOeS, 2010).The 2008 survey has served as a benchmark for biennial estimates sent to Eurostat and for national publications by ADEME. As all this data relies on a survey on 2008 statistics, which is therefore almost a decade old, a certain amount of caution should be applied when interpreting the data.

Raw materials consumed in France in 2013 add up to 784 Mt (either from France or imported), of which half (**391 Mt**) were construction materials. This amount is obtained by adding raw materials extracted from the territory or imported and subtracting material exports. Construction material apparent consumption in France in 1990 was 12% higher than that in 2013 (ADEME, 2016).

1.2.8 CDW generation data

In this paragraph, the waste generation data are showed, according to the EUROSTAT database (Eurostat, 2017).Total waste production in France was 324 Mt in 2016 (325 Mt in 2014), of which 224 Mt were from the construction sector (228 Mt in 2014). The breakdown of total waste generation and that of CDW is shown in Table 1-3 (Eurostat, 2017).

From 2006 to 2010, waste generation grew, but in 2012 the trend was reversed with a 2.8% reduction. This is mostly due to a slowing construction sector, for which waste generation dropped by 5% (ADEME, 2016).

Table 1-3: Waste generation in France, total (left) and from the construction sector (right) (Eurostat, 2017)

Type of waste	2012 (Mt)	2014 (Mt)	2016 (Mt)
Non-hazardous	333.43	313.68	312.46
Hazardous	11.30	10.78	11.01
Total waste generated	**344.73**	**324.46**	**323.47**

Type of CDW	2012 (Mt)	2014 (Mt)	2016 (Mt)
Non-hazardous	244.33	229.16	221.58
Hazardous	2.38	2.81	2.78
Total waste generated	**246.70**	**227.61**	**224.36**

Construction waste in 2016 was made up of **222 Mt** of **non-hazardous** waste, covering 216.49 Mt inert waste and 12.67 Mt non-inert waste, and **2.78 Mt** of **hazardous** waste, adding up to a total of 224 Mt (Eurostat, 2017).

[18] SOeS "Survey on waste and excavated materials produced by the construction and public works sector in 2014" description, from 27/01/2015: http://www.statistiques.developpement-durable.gouv.fr/sources-methodes/enquete-nomenclature/1542/0/enquete-dechets-deblais-produits-lactivite-btp-2014-edd.html

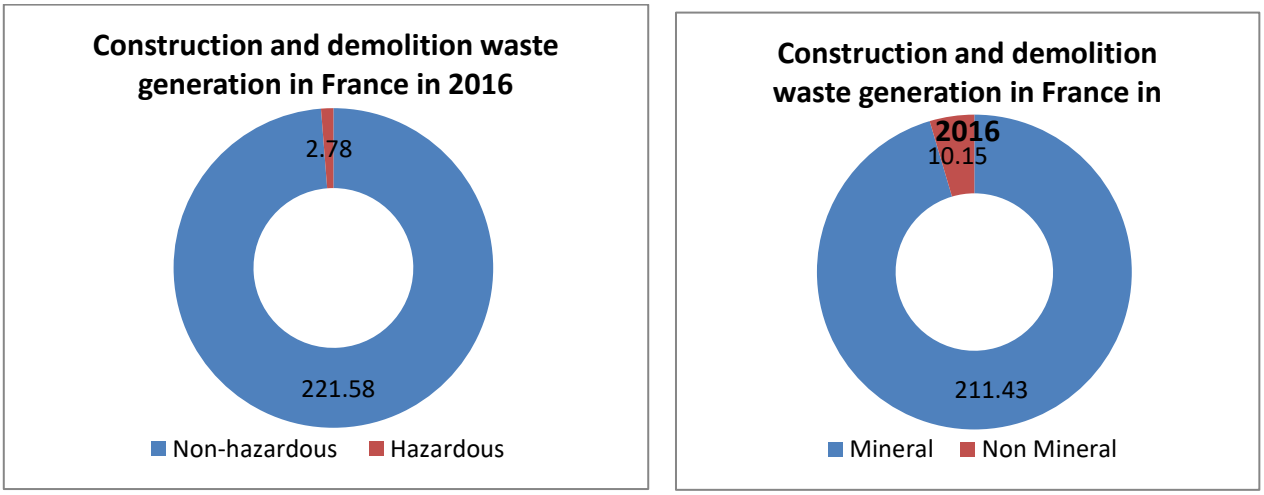


Figure 1-2: CDW generation in France in 2016, total (left) and breakdown of non-hazardous waste generation (right) (Eurostat, 2017)

In France, CDW is divided into two main sectors: building and public works. The 2008 SOeS survey gives the breakdown of waste generated per sector, with building works further divided into structural and finishing works, as shown in the following table:

Table 1-4: Waste generation in France, total (left) and from the construction sector (right) (Eurostat, 2017)

Sector	Amount generated (Mt) - 2008*	Amount generated (Mt) - 2014**
Building works	38	42
Structural works	*28*	*31*
Finishing works	*10*	*11*
Public works	216	185
Total	**254**	**227**

In a Q&A document on construction and demolition waste for construction professionals, the French Building Federation (FFB) also mentions waste generation per type of building works: 90% of the 38.2 Mt generated originate from renovation or demolition sites. 65% comes from demolition, 28% from renovation, and 7% from new construction (FFB, 2014).

According to the survey delivered by ADEME (ADEME, Dechetes du Batiment, 2017), in 2014 the total CDW generation of 228 Mt was composed by 42 Mt from the building sector and 186 Mt from the public works stream. The main streams of the CDW generated through the building sector are reported below:

- inert: 31.5 Mt

- non-hazardous and non-inert waste: 9.7 Mt

- hazardous waste: 1.1 Mt

1.2.9 CDW treatment data

In the Table below the breakdown of the main CDW destination rates is reported (SOeS, 2017).

Table 1-5: Breakdown of the CDW main destinations rate (%) in 2014, (SOeS, 2017)

Destination	Building sector	Public works sector
Reuse	14%	26%
Road backfilling	*10%*	*16%*
Civic amenity site	*21%*	*11%*
Recycling	22%	21%
Collection company	**25%**	**8%**
Socking site for inert CDW	**6%**	**14%**
Other	2%	4%

Although it is chemically inert and therefore does not require specific treatment, inert waste poses a definite challenge, both regarding transport and storage, due to its sheer amount. It can be used for quarry filling, or crushed into aggregates for road works, landscaping, or to make concrete. The remaining waste which is not recycled is then sent to specialised landfills.

Of the 241 Mt of inert waste produced in 2012 (231.3 Mt of it being CDW), almost half (49%) was recycled and 17% was used in road works or backfilling. The remaining 34% were landfilled (ADEME, 2016). It is worth noting that landfills are called storage facilities in France, hence many documents talk of storage rather than landfill. Furthermore, backfilling performed in the framework of an inert waste landfill is recorded as landfilling, but this is not the case if it is performed at a non-inert waste landfill, which introduces a certain bias in statistics.

The SNED indicates that the average recovery of deconstruction waste is around 90% for inert waste and 45% for non-hazardous waste (SNED, 2016).

1.2.10 CDW exports/imports data

In 2013, reported imports of waste reached 2.5 Mt, among which 1.6 Mt of uncontaminated soil and stones were imported from Switzerland and Luxemburg to be recycled.

In 2013, reported exports of waste reached 1.6 Mt (SOeS, 2016).

1.2.11 CDW treatment facilities data

CDW landfill data is relatively simple to obtain in France. However, it is much more difficult to obtain precise information on CDW recycling facilities.

ADEME reported a total of 228 non-hazardous landfills in France, 16 for hazardous waste, and 657 for inert waste by end 2014 (ADEME, 2016). However, this only includes landfills with a prefectural authorization.

Indeed, BIO by Deloitte cites data from 2013 that is double that amount for inert waste landfills, as there were some awaiting regularization, and close to 500 illegal ones (BIO by Deloitte, 2015).

1.2.12 Future projections of CDW generation and treatment

The only indication on future CDW generation is the objective set by the 2014-2020 Waste prevention plan to stabilise the generation of CDW by 2020 at the level reached in 2010 (260 Mt).

1.2.13 Methodology for CDW statistics

The 2008 survey was conducted by the French Environment Ministry (at the time, its name was Ministry for Ecology, Energy, Sustainable Development and the Sea, though this changes regularly after elections). 7 000 establishments were surveyed by post between November 2009 and March 2010. The survey reports waste amounts based on the latest destination known by the producer, not the final one, as they are not always aware of the final destination of their waste. Asbestos removal companies are not classified as construction companies in French nomenclature but they were surveyed nonetheless to include this data into the survey.

The description of the methodology for the new survey, on 2014 data and due to be published in spring 2017, is available from the SOeS website: http://www.statistiques.developpement-durable.gouv.fr/sources-methodes/enquete-nomenclature/1542/0/enquete-dechets-deblais-produits-lactivite-btp-2014-edd.html.

1.2.14 Construction and demolition waste management in practice

1.2.14.1 CDW management initiatives

Various initiatives currently exist in France. Four interesting cases are highlighted in the following pages:

- **Paprec/Raboni partnership**, allowing construction SMEs to deposit their construction waste and pick up new materials on the same site
- **RECYBETON project**, a national R&D programme, which aims to find solutions to recycle each cubic metre of deconstructed concrete as a component of new concrete.
- **DEMODULOR project**, which approached construction waste prevention from the disassembly angle
- **DEMOCLES project**, on recycling of waste from **finishing works** on demolition/rehabilitation sites.

Of course, many other initiatives exist. For example, the National Syndicate of Demolition Companies (SNED) and the French Building Federation (FFB) launched a joint initiative in May 2016: **Imaterio**, a free **construction waste and material database** (www.imaterio.fr). It connects owners of inert waste and reuse materials with potential users. Although intended for professionals, Imaterio can also be used by individuals who might wish to respond to an advertisement. In March 2015, the SNED and FFB launched a **waste**

traceability software called **Investigo** (www.investigo.fr), free for use by members of the SNED (SNED, 2016).

Name	Paprec/Raboni partnership
Description	The Paprec Group is a company specialised in recycling and recovery whereas Raboni is a distributor of construction/renovation materials. Faced with the observation that building industry tradesmen struggle to find solutions for their **building site waste**, and therefore end up sending it to landfills instead of recycling, Paprec and Raboni decided to set up a partnership to counter this issue. Construction SMEs can **deposit their waste and pick up new construction materials on the same site**. The waste is then directed to Paprec recovery/recycling facilities.
Scope	Raboni has 12 recycling centres, with one full-time Paprec employee per site. 4 sites have fluvial access: collection is therefore done by a barge with a capacity of 360 tonnes of waste per rotation (equivalent to 60 waste collection vehicles). Paprec has 2 recycling centres dedicated exclusively to CDW in the region.
Year established	2004, renewed in 2014 for 5 years
Geographical coverage	Paris Region (Île-de-France)
Leadership	Industry-led
Tonnes recycled	Approximately 70 000 m^3 collected per year, with a recycling rate close to 80%

A new pilot operation initiated by the Syndicate for **PVC pipes and fittings**, STR-PVC was launched in October 2016 to increase collection and recycling of plastic pipes and fittings in France. PUM Plastiques, a distributor, and Paprec Plastiques, the plastics recycling branch of the Paprec Group, partnered up to capture this stream from tradesmen and to offer new services for their clients, to anticipate landfill bans, and to encourage sustainable practices. At the launch of the pilot, Paprec containers were placed in PUM Plastiques agencies in two cities initially, Rennes and Limay, with more locations planned in coming months. Customers can bring their waste pipes and fittings for recycling.

Name	RECYBETON
Description	RECYBETON (complete recycling of concrete) is a national R&D programme which aims to **increase reuse** of materials from **deconstructed concrete** as constituents of new concrete or hydraulic binders, including fine particles.
Scope	Collaborative research project on deconstructed concrete, involving 47 partners for 5 years with a budget of 5 M€
Year established	2012
Geographical coverage	National
Leadership	Public-private partnership

Part of the scientific programme of RECYBETON is covered by the ECOREB project, funded by the National Research Agency (ANR) for 4 years, from end 2012. As part of the RECYBETON project, ECOREB addresses scientific issues associated with the use of crushed concrete aggregate as a constituent of new concrete.

Name	DEMODULOR
Description	DEMODULOR demonstrated the technical, environmental, and economic feasibility of **disassembly** in renovation or deconstruction for simplified recovery and recycling of materials and products. The project was led by the Materials and Equipment for a Sustainable Construction (MECD) alliance, gathering the network of technical and industrial centres in the construction sector. Its aim was to develop constructive waste prevention solutions using a systemic approach of disassembly (dismountable structures).
Scope	The project focused on bearing elements (walls and floors) as well as the building envelope (roof and walls).
Year established	2012-2015
Geographical coverage	National
Leadership	Industry-led, supported by ADEME

Name	DEMOCLES
Description	The DEMOCLES project aimed to increase recycling of elements from **finishing works** on demolition/rehabilitation sites. DEMOCLES followed a collaborative and operational approach, integrating actors from all across the value chain – over 40 partners were involved. Thanks to 6 pilot sites and technical working groups, the project successfully: • Identified operational and economic challenges linked to sorting waste on-site and downstream treatment • Defined a common and reliable framework for on-site sorting to ensure an adapted recycling stream, at limited costs • Formulated concrete and operational recommendations on waste management for both the client and the contractor
Scope	Waste from finishing works, which represents about 10 million tonnes, or 30% of all waste produced by the construction sector
Year established	2014-2016
Geographical coverage	National, with six test building sites in Île-de-France and Rhône-Alpes
Leadership	Public-private partnership

1.2.15 Drivers / barriers to increase CDW recycling

Drivers and barriers to increase CDW recycling were presented in a clear and concise fashion in the factsheet of the Resource Efficient Use of Mixed Wastes study (BIO by Deloitte, 2015). Most of these are listed in the following table.

A more recent study analyzed drivers and barriers to the reuse of construction products and materials (RDC Environment, éco BTP, & I Care & Consult, 2016).

Category	Drivers	Barriers
Legislation & regulation	• CDW management plan implementation (national and departmental, though soon regional) • Compulsory pre-demolition audits • Objective of stabilising CDW production by 2020 at 2010 level • EoW status and criteria defined by law	• Delay in entry into force of departmental CDW management plans • Insufficient support through public procurement of the use of recycled materials from CDW • Requirement for contractors to demonstrate technical feasibility of use of construction materials from recycling • Insufficient regulation of backfilling and ground raisings in the Town planning Code
Allocation of resources	• ADEME has a large intervention budget on waste & circular economy – 191 M€ in 2017	• Insufficient resource allocation (financial, human) to the enforcement of CDW legislation • Sanctions are too low and rarely applied
Reuse		• Uncertainty in EU Construction Products Regulation as to the obligations of EC marking for reclamation products
Sorting & recycling	• Large number of innovative companies and R&D programmes • Guidance from the road works sector could benefit building works	• Very limited number of mechanised sorting lines in France • Demolished buildings not designed for easy deconstruction and recycling • Lack of space on building sites
Treatment facilities		• Insufficient number of treatment installations, therefore too distant from sites, which encourages illegal dumping • Apparent reluctance of local authorities to authorise new facilities
Market conditions	• Landfill tax (TGAP) as a tool to improve recycling	• The landfill tax is low compared to other EU Member States • Operating costs of CDW sorting, recovery, and recycling are declared as being too high by most construction companies
Definitions & statistical data	• Separate targets for inert waste and non-inert non-hazardous waste	• Difficulty to assess CDW sources and streams precisely • Inconsistencies with backfilling reporting and definition
Contracts for building & public works		• Waste management is often neglected in contracts • Lack of traceability and control of the recycling rate to check commitment in tenders

1.2.16 CDW sector characterization

1.2.16.1 CDW materials

The 2014 survey gives more detailed information on waste generation in the French construction sector. Inert waste is by far the predominant type of waste generated, with 80% of CDW. The recovery percentage for the inert stream is 61%, significantly higher comparing the value registered in 2008 (49%).

Table 1-6: Inert waste generation in 2014 (SOeS, 2017)

Type of inert waste	Amount generated (Mt)
Concrete	19.1
Bricks, tiles, ceramic, and slate	4.2
Glass	0.2
Tar-free bituminous mixtures	11.2
Unpolluted soil and stones	139.8
Other materials from road demolition	12.5
Non-polluted track ballast	2.2
Non-polluted dredging spoil	2.8
Other inert waste	1.1
Mixed inert waste	18.1
Total inert waste	211.2

Table 1-7: Non-hazardous, non-inert waste generation in 2014, (SOeS, 2017)

Type of non-hazardous, non-inert waste	Amount generated (Mt)
Wood untreated or treated with non-hazardous substances (palettes…)	1.6
Plastic materials (incl. flexible floor coverings)	0.6
Ferrous or non-ferrous metals	2.8
Insulation materials: fibreglass, stone wool	2.4
Plaster	0.4
Plant material	0.6
Waste tyres (m^3 not shredded)	0.0
Other types of non-hazardous, non-inert waste	1.5
Mixed non-hazardous, non-inert waste	2.0
Mixed inert waste and non-hazardous, non-inert waste (Ordinary Industrial Waste[19])	1.3
Total non-hazardous waste	13.2

1.2.17 Recycled materials from CDW

Inert materials such as concrete and rubble are widely used in road works. Recycled aggregates are thus the main construction and demolition waste product. Plaster and wood are two other waste streams for which recycling is already operational. The DEMODULOR project gathered data indicating the destination of certain materials (Réseau CTI, CERIB, FCBA, CTMNC & CTICM, 2015):

- Steel: 98% recycling/reuse, 2% landfill
- Concrete: 67% recycling/reuse, 33% landfill
- Wood: 57.2% recycling/reuse, 17.3% landfill, 25.5% energy recovery
- Terracotta: 39% recycling/reuse, 6% landfill, 55% material recovery

[19] Ordinary industrial waste is known as DIB in France, for "*déchets industriels banals*"

In France, 35 million m³ of ready-to-use concrete were produced in 2015, by 516 companies, and consumption per capita is 0.54 m³ per year. This ranks France as the second producer and fifth consumer of concrete in Europe (UNICEM, 2017). Yet despite this, concrete recycling into concrete is still rare in building works. The National Research Agency funded the ECOREB project aiming to change this tendency by removing scientific barriers associated with the used of crushed concrete aggregates as a constituent of new concrete.

There are two main barriers to the use of recycled materials from CDW in public procurement. The first is the requirement for contractors to demonstrate that it is technically possible to use construction materials from recycling. The second is linked to the price of recycled materials. They may be more expensive than raw materials, particularly if they are located further away and therefore lead to increased transport costs. As price is unfortunately the main criterion in public procurement, this can make recycled materials less competitive and therefore limits their increased use.

1.2.18 Market conditions / costs and benefits

Costs linked to legal management of the CDW represent 2-4% of the total revenues in the building sector, or 1.2-2.4 billion Euro, depending on if waste is sorted or not, according to data from 1998 (FFB, 2014).

There is a General Tax on Polluting Activities (TGAP) in France, which must be paid by companies whose activities or products are considered polluting: waste, pollutant emission, oils, detergents, extracted materials, etc. The amount of the tax depends on the category of activity or product and is modified every year. It is based on the weight in tonnes of waste received in an installation to which it applies. The rate is also slightly higher in continental France and Corsica than it is in Guadeloupe, Martinique, and Reunion Island. The 2017 rates for continental France are listed in Table 3-7 (French Government, 2017). These rates apply from 1 January 2017 to 31 December 2017.

Table 1-8: General Tax on Polluting Activities (TGAP) rates for waste in 2016 (French Government, 2017)

Type of waste treatment facility			Tax rate in €/tonne
Non-hazardous waste landfill	Unauthorised landfill		150
	Authorised landfill	A. EMAS registered or ISO 14001 certified	32
		B. With biogas recovery >75%	23
		C. Bioreactor landfill (biogas capture and leachate reinjection, biogas recovery)	32
		D. Meeting both previous criteria	15
		E. Other	40
Non-hazardous waste incineration plant	A. EMAS registered or ISO 14001 certified		12
	B. With high energy performance		12
	C. With NO_x emissions <80 mg/Nm³		12
	D. Meeting both A and B		9
	E. Meeting both A and C		6
	F. Meeting both B and C		5
	G. Meeting A, B, and C		3
	H. Other		15
Hazardous waste	Landfill		25.57
	Incineration plant or other treatment		12.78

The French Building Federation (FFB) gathered information on the costs of waste management which entrepreneurs should consider. These include:

- Labour for sorting or dismantling prior to the removal of waste from the building site
- Specific installations required on-site (storage area, skips, etc.)
- Scale effect linked directly to the amount of waste to remove
- Waste transport (linked to distance from treatment facilities)
- Waste treatment (grouping or sorting centre, treatment centre, recycling, incineration, landfill).

The estimated costs per destination of the waste (excluding transport and skip costs), are listed in Table 1-9.

Table 1-9: General Tax on Polluting Activities (TGAP) rates for waste in 2016 (French Government, 2017) Estimate CDW management costs per destination of the waste (FFB, 2014)

Destination	Estimated cost (excluding transport and skip rental)
Inert waste recycling plant	a few euro per tonne
Non-hazardous recycling plant	variable, can be zero (metal by-back)
Inert waste landfill	1-8 €/tonne
Non-hazardous waste landfill	80-120 €/tonne
Hazardous waste landfill	200-500 €/tonne
Incineration plant	60-110 €/tonne
Hazardous waste specific treatment	200-1200 €/tonne

Waste management adds up to 10-25% of deconstruction costs (SNED, 2016).

Finally, the National Syndicate for General Contractors in Building and Public Works, EGF.BTP, estimated the cost of waste removal per type of material and treatment for 2009, as shown in table 1-10.

Table 1-10: Estimate CDW management cost per material and type of treatment (EGF.BTP, 2010)

Waste	Treatment	Cost excl. taxes, incl. transport
Inert	Recycling	10-19 €/tonne
	Landfill	10-31 €/tonne
Wood	Recycling	0-91 €/tonne
	Incineration, energy recovery	19-183 €/tonne
Plaster	Recycling	58 €/tonne
	Landfill	106 €/tonne
Mixed waste	Incineration	122 €/tonne
	Landfill	122-290 €/tonne
Hazardous waste	Treatment then landfill	230 €/tonne and over
	Directly to hazardous waste landfill	230-350 €/tonne

All these sources therefore highlight the importance of sorting CDW – if not from an environmental perspective, then at least to reduce costs.

1.3 MALTA

1.3.1 National Legislation concerning CDW

The Waste Regulations (L.N. 184 of 2011), which implement the EU Waste Framework Directive (2008/98/EC) in Maltese Law is still in effect. Everything included in this directive is valid for Malta and provides the legal foundation for CDW management.

Further applicable laws include:

- Legal Notice 168 of 2002 focusing on Waste Management (Landfill) Regulations
- Legal Notice 382 of 2009 focusing on Deposit of Waste and Rubble (Fees) (Amendment) Regulations
- Legal Notice 344 of 2005 focusing on Abandonment, Dumping and Disposal of Waste in Streets, and Public Places or Areas Regulations
- Legal Notice 295 of 2007 focusing on Environmental Management Construction Site Regulations
- Approved Supplementary Planning Guidance concerning inert waste disposal in quarries

1.3.2 Waste management plans (WMP) and Strategies

The Waste Management Plan (WMP) is still in place for the Maltese Islands (2014-2020), which takes a resource management approach. There is a separate section for CDW which analyses the current situation and sets future targets. A Waste Prevention Plan (WPP) was also created, with an extensive section concerning the prevention of CDW.

A strategic document specifically targeting CDW released by the Maltese government is 'Recycling of Construction and Demolition Waste in Malta – Strategy for short-term implementation', consisting of the theoretical basis and analysis of the potential of recycling CDW in Malta.

1.3.3 Legal framework for sustainable management of CDW

At the moment, there are few legal frameworks concerning the sustainable management of CDW. There is, however, an obligation for the separate collection and management of hazardous waste from C&D operations outlined in LN 184 of 2011. This is a national obligation.

1.3.4 Targets

The WMP aims to:

- Minimise CDW through reuse activities and to promote the recycling and recovery thus minimising the impacts on raw materials.
- Recover 70% of CDW by 2020

The WMP suggested that the possibility of shifting from recovery to recycling and prevention should be assessed.

1.3.5 End of Waste (EoW) status

The Council Regulation (EU) No 333/2011 on EoW of scrap metal and Commission Regulation (EU) No 715/2013 on EoW of copper scrap are relevant to Malta. These regulations are relevant for CDW, though they do not refer specifically to CDW materials.

Currently, no EoW criteria has been created for Malta. The decision would have to be made case by case as designated by regulation 6 of S.L. 504.37, Waste Regulations 2011.

1.3.6 Non legislative instruments (best practices, guidelines, recommendations…)

According to a news article, there are currently construction and tunnel projects underway that would result in a sizable amount of CDW, which would 'increase the political pressure for land reclamation projects like the ones being proposed in Portomaso in St Julian's and Jerma in Marsascala'. It is possible that this kind of solution will be more popular in the coming years, having been suggested in 2006 during a similar construction boom as the one that is happening in Malta currently.

1.3.7 CDW management performance – CDW data

The last published information on CDW management was taken from 2004-2011. The table can be seen below. Currently, CDW is considered the largest share of waste that is generated by the Maltese islands.

Table 1-11: C&D waste management over the period 2004 to 2011 (Ministry for Sustainable Development, 2014)

	Recycled	Recovered	Landfilled	Disposed at sea	Others	Total
2004	19,916		2,580,454	210,404		2,810,774
2005	15,332		1,970,883	357,942		2,344,157
2006	101,756		2,061,340	329,426		2,492,522
2007	243,818		2,110,641	146,205		2,500,664
2008	173,982		1,522,000	300,360		1,996,342
2009	63,463		462,584	74,370		600,417
2010	114,149		688,061	290,120		1,092,330
2011	139,144	3,611	422,057	149,120	2,125	716,057

Landfilling is still the preferred option of management, although a percentage of that which is landfilled in understood as backfilling (permitted as inert landfills). This percentage was then moved to 'recovered' in 2011. The intension is for 'backfilling spent quarries, together with recycling recyclable C&D waste [to] aid Malta [in achieving] its 2020 target of recovering 70% inert [CDW] (Ministry for Sustainable Development, 2014).

1.3.8 CDW generation data

There seems to be an increase in construction projects currently taking place in Malta, possibly resulting in an estimated 2 million cubic metres of construction waste from the Paceville mega-projects alone[20]. This means that there will be more discussion on CDW in the coming year, including a possible redirection of the waste to either recycling or dumping.

In the following Tables some of the main data concerning CDW are reported, according to the National Statistics Office – Malta (NSO).

Table 1-12: C&D waste management over the period 2004 to 2011 (Ministry for Sustainable Development, 2014)

CDW generation (tonnes)	2010	2011	2012	2013	2014
Mineral waste from construction & demolition (NHAZ)	746,666	643,412	500,883	541,909	145,531
Mineral waste from construction & demolition (HAZ)	0	0	5	0	0

The data show a significant decreasing trend in mineral waste from construction and demolition concerning non-hazardous waste. According to the report, it is unclear why exactly this decrease in generation is occurring, however the economic market and consequently the demand could have something to do with this.

Eurostat released information for Malta for the construction sector (data according to the database accessed on the 7th of February 2019).

Table 1-13: C&D generation by waste category

Total Waste	1,698,659	988,070	1,044,089	1,241,079	1,354,892
Chemical and medical wastes (subtotal)	0	0	0	0	0
Recyclable wastes (subtotal, W06+W07 except W077)	31,176	28,957	27,994	36,487	27,811
Equipment (subtotal, W077+W08A+W081+W0841)	0	0	0	0	0
Animal and vegetal wastes (subtotal, W091+W092+W093)	0	0	536	472	287
Mixed ordinary wastes (subtotal, W101+W102+W103)	0	0	3,816	2,721	4,783
Common sludges	0	0	15	28	0
Mineral and solidified	1,667,483	959,114	1,011,727	1,201,371	1,322,011

The total waste generated from construction has stayed largely the same, with a large portion coming from mineral and solidified waste.

1.3.9 CDW treatment data

The following table shows the Eurostat data (data according to the database accessed on the 7th of February 2019) for the treatment of the mineral waste generated from construction and demolition activities. As seen from the previous table, mineral and solidified waste is the largest portion of waste

[20]http://www.maltatoday.com.mt/environment/environment/70252/paceville_megaprojects_will_generate_2_million_cubic_metres_of_construction_waste#.WFqSBEYw2Qk

derived from construction and demolition, therefore the treatment for this fraction is more readily available.

Table 1-14: Treatment of the mineral waste generated from construction and demolition activities (EUROSTAT)

Total waste treatment	1,161,055	1,068,245	507,563	491,912
Disposal - landfill	260	1,325	1,536	128,280
Land treatment and release into water bodies		0	0	0
Incineration / disposal (D10)		0	0	0
Incineration / energy recovery (R1)		0	0	0
Recovery other than energy recovery - backfilling	882,690	548,290	392,945	534
Recovery other than energy recovery – except backfilling	278,105	518,629	113,082	119,412

Currently, the majority of the mineral waste is being used for backfilling operations or recovery activities other than backfilling. The last category more likely refers to the export of CDW to other countries with better facilities to process them.

A certain percentage of the mineral waste from CDW is landfilled, although there is discussion in the news on the need for stricter checks in consideration of the amount of illegal landfilling that was and is occurring in Malta. The illegal landfilling criterion includes the ban on landfilling clean inert CDW within Malta[21]. However, it is still unclear why CDW is being sent to landfill instead of for other treatment options mentioned below.

1.3.10 CDW exports/imports data

According to the Deloitte report (Deloitte, 2015), the last available data for CDW was taken in 2012, showing 26.891 tonnes for CDW exported for recovery or disposal (this consisted mainly of recyclable materials for which there are no recycling options available in Malta) (Deloitte, Construction and Demolition Waste management in Malta - V2 - September 2015, 2015). The majority of CDW generated in Malta is exported for recycling or other uses as Malta does not have a lot of the facilities needed to process the CDW.

[21] https://www.wasteservmalta.com/constructionwaste

1.3.11 CDW treatment facilities data

In the table below there is a list of inert mineral waste streams, characterized by stones, concrete, bricks, tiles and ceramics from construction & demolition. It also includes clean geological material from excavation work which should be kept in mind.

Table 1-15: Mineral waste streams (Malta, 2016)

tonnes

Waste category		Final treatment	2010	2011	2012	2013	2014
EWC-Stat code	Description						
10.2	Mixed and undifferentiated materials	Disposal at sea	353	0	0	0	0
12.1	Mineral waste from construction and demolition	Disposal in quarries	634,500	393,112	0	0	0
12.1	Mineral waste from construction and demolition	Recycling	119,412	136,329	113,082	83,892	20,158
12.1	Mineral waste from construction and demolition	Backfilling in quarries	0	0	392,945	173,800	97,782
12.2, 12.3, 12.5	Other mineral wastes	Disposal at sea	34,120	8,800	0	0	0
12.2, 12.3, 12.5	Other mineral wastes	Backfilling in quarries	0	0	0	622,732	73,789
12.2, 12.3, 12.5	Other mineral wastes	Recycling	0	0	0	282,466	397,327
12.7	Dredging spoils	Disposal at sea	256,000	140,320	1,037,680	663,940	433,017
Total			**1,044,385**	**678,561**	**1,543,707**	**1,826,831**	**1,022,074**

Notes:
1. Disposal at sea of mixed and undifferentiated materials refers to maize.
2. Dredging spoils data for 2013 was revised.
3. All waste categories included in this table are non-hazardous.

Source: MEPA

Disposal at sea of materials was completely stopped by 2012, although dredging spoils are still disposed at sea at a large scale. The final treatment of the mineral waste from CDW shifted from disposal in quarries to recycling and backfilling in quarries. There has been less generation of CDW which has caused the above numbers to fall as well, however there is a heavy lean towards backfilling in quarries. This could be due to two reasons: there is no mandatory recycling scheme in place in Malta and the financial incentive to recycling may not be attractive enough to cause a shift in treatment.

1.3.12 Future projections of CDW generation and treatment

Similar to what was stated in the Deloitte document (Deloitte, 2015) on Malta, there is currently no publication of future projections, though there is a plan to start this in the current WMP (valid till 2020).

1.3.13 CDW management initiatives

For the rehabilitation of buildings instead of new constructions, there were two initiatives reported by the Deloitte report:

- ‘Economic incentives in the form of lower tax rates for first time buyers purchasing old property, so as to promote the restoration and rehabilitation of such properties instead of demolition’ (2014), and
- ‘Incentives for the rehabilitation of village cores and protected buildings’ (2012) (Deloitte, Construction and Demolition Waste management in Malta - V2 - September 2015, 2015).

There was also a ban on landfilling of clean inert CDW initiated in 2003. By 2016, 2 million tonnes/year had been diverted to backfilling.

1.3.14 Drivers / barriers to increase CDW recycling

There have been cases of illegal dumping of CDW, which has been found not to be uncommon. A trial was just completed in Malta. The biggest barrier would still be the lack of implementation of the existing legal framework, though there seems to be a greater effort to combat the illegal dumping.

Similarly to many European countries, there is no established market for recycled CDW and as raw materials are still cheaper, there is no financial incentive. However, there is an economic incentive consisting of lower taxes for the restoration of old buildings in order to discourage demolition.

There is a lack of treatment facilities in Malta, causing an increase in illegal dumping sites. However, there is an adequate network of facilities for receiving CDW intended for recovery or backfilling.

1.3.15 CDW materials (concrete, bricks, tiles and ceramic, asphalt, wood, gypsum)

Both the public and the private sector are involved in the management of CDW in Malta. The market forces are led by the private sector; however there are definitions and obligations that emanate from national legislation for the collection, sorting, transport, treatment and final disposal of CDW (Deloitte, Construction and Demolition Waste management in Malta - V2 - September 2015, 2015).

The performance of CDW recovery is high and Malta has reached the target of the Waste Framework Directive, but the quality of recycling is considered low and the products are largely used as backfilling material. A large percentage is used for screed and concrete production.

There are no specific numbers for the different CDW materials at the moment from Malta. However, there are numbers from one of the main waste treatment plants on the final treatments of the total waste output, including many CDW materials. We have included this table here in order to give an idea as to the treatment of the materials.

Table 1-16: Sant'Antnin Waste Treatment plant output (Malta, 2016)

tonnes

Waste category		Final treatment	2010	2011	2012	2013	2014
EWC-Stat code	Description						
6.1	Metallic wastes, ferrous	Exports for recycling	0	1,324	1,162	1,319	994
6.2	Metallic wastes, non-ferrous	Exports for recycling	0	82	83	85	62
6.3	Metallic wastes, mixed	Exports for recycling	2,192	232	210	348	150
7.1	Glass wastes	Exports for recycling	333	0	1,308	2,846	3,155
7.2	Paper and cardboard wastes	Exports for recycling	7,376	8,357	6,043	6,193	6,557
7.2	Paper and cardboard wastes	Incineration	0	21	0	0	0
7.4	Plastic wastes	Exports for recycling	1,936	2,104	1,829	1,713	1,727
7.5	Wood wastes	Landfill	1	0	0	0	0
8 (excl. 8.1, 8.41)	Discarded equipment	Exports for recycling	0	0	0	18	18
9.2	Vegetal wastes	Landfill	2,456	0	0	0	0
10.2	Mixed and undifferentiated materials	Exports for recycling	324	0	0	0	0
10.3	Sorting residues*	Landfill	8,481	35,551	41,955	40,228	34,093
10.3	Sorting residues*	Anaerobic digestion plant	0	9,192	9,989	12,092	8,672
10.3	Sorting residues*	Exports for energy recovery	0	1,367	1,029	0	0
10.3	Sorting residues*	Exports for recycling	0	1,188	0	645	837
Total			**23,099**	**59,418**	**63,609**	**65,486**	**56,266**

* waste which is generated from waste treatment operations (secondary waste).
Note: All waste treated at Sant' Antnin Waste Treatment Plant is non-hazardous.
Source: WasteServ Malta Ltd.

The majority of the waste in terms of materials (metals, paper and cardboard, plastics, etc.) is exported for recycling.

There is some specific information on limestone from Malta - Guidance on the excavation of limestone with a view to reduce construction and demolition waste is planned, as are discussions between all relevant stakeholders during the revision of local plans to limit unnecessary waste. There is an emphasis on promoting the value of limestone resources at the excavation stage and on harnessing the potential of technology to make the process more resource efficient (Deloitte, Workshop "Improving management of construction and demolition waste", 2016). For more information, see: http://www.eea.europa.eu/publications/waste-prevention-in-europe-2015 (p. 38).

1.3.15.1 Product description and applications

The mineral CDW recycling sector does exist in Malta, with the waste being crushed and generally used as screed or for concrete production.

Other CDW is used for backfilling and Maltese stone is being reused as it is considered a high-quality material and with cultural significance.

1.3.15.2 Recovery techniques

There is an increasing recognition that Maltese stone is a finite resource and actions are being encouraged to reuse this stone as much as possible. This is further helped by the recognition that Maltese stone is considered a high quality material.

1.3.15.3 Environmental and economic impacts of CDW waste management

The economic crisis has had a significant negative impact on construction in Malta.

1.3.16 Drivers / barriers to increase recycling

There is a recycling sector for mineral CDW in Malta; however, there is no sector for non-mineral CDW. The materials that can be recovered are all exported for recycling. However, the lack of market for CDW recycling and the lack of financial incentives are the greatest barriers to the increase of recycling. Additionally, the need to export all CDW for recycling does not simplify the process.

1.3.17 Recycled materials from CDW

At the moment there is no recycling sector of non-mineral CDW materials. Specific materials that can be salvaged from construction sites are exported. The mineral CDW recycling sector does exist in Malta, with the waste being crushed and generally used as screed or for concrete production.

There are also reuse practices in place that are enforced via the development planning permissions. This specifically relates to the reuse of old/weathered stone for the maintenance of old buildings and also for the construction in Urban Conservation Areas (UCA's) (Deloitte, Construction and Demolition Waste management in Malta - V2 - September 2015, 2015).

1.3.18 Market conditions / costs and benefits

The waste management sector is considered an emerging market, expected to grow in case resource scarcity becomes a larger issue (Deloitte, Construction and Demolition Waste management in Malta -

V2 - September 2015, 2015). However, as CDW does not have a financial gain involved, it is difficult to motivate the private construction sector to change established habits at the moment. Additionally, there is no strict legislation in place regarding CDW treatment, perhaps causing a concern for market equality in case certain companies wish to participate/initiate voluntary schemes.

2 C&DW RECYCLING PLANTS IN ISRAEL

The site visits that took place on the 5th of December 2018, as well as of the round table discussion with the local stakeholders, are reported in the following paragraphs.

2.1 SITE VISIT 1 - RESHON LETZION – MUNICIPAL RECYCLING PLANT

The plant is characterized by significantly high capital costs (20% financed by the MoEP) composed by 3 main sections: cracking, separation and washing. In order to sell the recycled material it is necessary to treat it until a 0-25 mm size (otherwise it is impossible to place the material on the market). The potential buyers of the recycled material are worried about the release of fake documents during the value chain. An ongoing pilot study in Tel Aviv is addressed to tackle this issue.

Figure 2-1: Site visit to the recycling plant Reshon Letzion

2.2 SITE VISIT 2 - NA'AN – C&D RECYCLING PLANT (NEDGEV MUNICIPALITY)

The facility contributes to part of the transport cost in order to encourage people to deliver the material to the authorized facility.

Natural aggregates are 30% more expensive than recycled.

The managers of the facility are interested in a law that makes obligatory a minimum rate of recycled aggregates in new constructions.

All CDW is processed until it reaches 0-25mm (material with higher size doesn't have a market).

Figure 2-2: Site visit to the recycling plant – Nedgev Municipality

2.3 ROUND TABLE DISCUSSION

The local stakeholders, together with MoEP representatives and the NKE Francesc Rufe, that joined the roundtable discussion are listed below:

Table **2-1**: Round table discussion participants

Participant	Role	Institution
Elad Reich	Project Manager	Shapir
Hanni Cohen	Section Manager	Maskal
Kornit Golwasser	Environmental Consultant	Federation of Local Authorities in Israel
Ronen Kat	Building officer	Mashcal
Hamutd Ben-Jakob	Engineer	ACB Contractor Organization
Ami Kaplan	Solid Waste Management	Municipality of Jerusalem

Participant	Role	Institution
	Division	
Mariana Garov	Waste management officer	Aannemers Municipality
Livnat Goldberg,	Waste Division officer	MoEP
Francesc Rufe	SWIM CDW NK Expert	Catalan Waste Agency
Nunit Merov	Environmental Planner	Netanya Municipality
Tamar Sterzer	Environmental Project Coordinator	Forum IS
Eran Shriker	Waste and recycling officer	MoEP

Here below the main themes discussed:

- Municipalities would like to improve the documentation check process, to ensure the reliability of the certificates realised by the recycling facilities. They aims at increasing the confidence about the quality of the recycled material.

- Contractor representatives are worried with the quality of recycled materials (CE mark) and about responsibility: if an infrastructure realized with recycled aggregate presents some damages after few years, the Ministry would support them? How? (Make a law with the uses for recycled aggregates).
- Contractors are interested in the relevant international standards (ISO, CEN) in the C&D sector.
- How to ensure the correct management of the C&DW from the first stage (e.g. audit, selective collection, etc.)?
- Explanation of Catalonian recycled aggregates (RA) subsidy
- Landfill tax for CDW used to fund RA subsidy and studies/guidelines

Municipalities ask for an update of the formula that relates m^2 of construction Vs m^3 of CDW. It seems to be calculated at the lower range so it results in less estimation of CDW production than the real one. This causes illegal dumping of the surplus material.

2.4 RECOMMENDATIONS

Illegal dumping of C&DW is causing significant environmental issues.

The creation of a local market for the recycled materials is the key to make sustainable the operation of the recycling facilities, that nowadays are facing the issue to have a lot material stored as output of the recycling processes, without the chance to sell it (regardless of the quality). Green Public Procurement can be an effective instrument to boost the use of recycling materials in the construction market.

The inclusion of minimum recycled contents in the technical specifications of the Public Procurement tenders can help developing a local market. For example, the Italian Ministry of the Environment and Protection of Land and Sea of Italy sets the use of at least the 30% of recycled materials in new constructions (Moretti et al., 2017).

Another effective instrument can be subsidies. The case of the Catalunya Region can be useful to analyze the Israel case. Catalunya Region, as well as Israel, have a great potential of natural aggregates production (high supply). It results in a low recycled aggregates demand (basically due to natural price Vs recycled price). In Catalunya, the subsidies are financed by the C&DW tax (3 €/ton destined to final disposal treatment). The target of the initiative was the promotion of recycled aggregates with CE mark certification in works executed by municipal entities. Local Authorities are key actors of the model, because of their knowledge about the needs and opportunities for the local communities. The Catalan Waste Agency started subsidies for recycled aggregates in 2009, increasing recycled aggregates demand and also giving more confidence in the construction sector actors (companies, engineers, etc). Furthermore, there is currently a Law proposal to set a minimum of 5% use of recycled aggregates in public and private construction works. The initiative has been reinforced through the signature of an Agreement between Aggregates Sector – Waste Managers Association – Catalan Waste Agency.

The recycling facilities need to rely on the quality of the input material that has to be maximized through pre-audit inventory (before demolition, construction or renovation) and selective collection.

A deposit system could be an effective instrument to improve the recycling process: the release of a permit for starting a demolition/renovation/construction site can be subordinated to a binding deposit (paid in advance by the owner or the contractor). The deposit should be proportional to the estimated quantity and quality of the C&DW, calculated through a standardized methodology and cross checked by the public authority. For instance, in Catalunya – Spain, the Deposit for the C&D waste is currently (2019) equal to 3 €/ton with a minimum of 150 € (the scheme is implemented by the local Waste Agency and it was presented during the workshop that took place in Israel on the 4th of December at the MoEP premises in Jerusalem).The deposit will be returned as soon as the owner or the contractor shows the documentation certifying the complying stream of the C&DW (site – recycling facilities). This scheme could guarantee the reduction of the illegal dumpsites, even if it is important to develop a market for the recycled materials to avoid the output material is piled up outside the recycling facilities (without revenues by selling the materials). In order to run such a scheme a funding from the public sector has to be put in place. The landfill tax for the C&DW could be one of the sources to trigger the

process. Once the scheme will be consolidated, the market of the recycled materials could increase the economic sustainability of the recycling facilities.

The inclusion of minimum recycled contents and quality certifications in the technical specifications of the Public Procurement tenders can help developing a local market.
Transportation is another barrier to deliver the C&DW materials to the authorized recycling facilities.
The realization of transfer stations can increase the efficiency of the operational activities.

The transport distance and the value of the avoided impacts would determine the friendliness of the management option. Therefore, transportation patterns are analyzed through Life Cycle Assessment.

There are several researches investigating the topic, that is quite complex to adapt to specific local contexts. Ortiz et al. (2010) pointed out that the best management for stony materials lies within on-site recycling to replace natural gravel. The study of Mah et al. (2017), who compared the greenhouse gas emissions produced in the CDW management, showed a roughly 10% reduction when the mobile plant was within a 3 km radius from the construction site. Penteado and Rosado (2016) stated that, for a medium-sized city in Brazil, the convenience of CDW recycling over landfilling was limited by 30 km distance between the construction site and the recycling plant.

Since recycled aggregates are aimed at replacing natural aggregates, another trade-off balance is established between the production life cycle of both materials.

The modulation of the recycling facility gate fee according to the quality of the delivered material could improve the economic sustainability of the recycling facilities. The system should certify the C&DW process (from the demolition/renovation/construction site to the recycling facility gate) has been delivered thorough specific steps: for instance implementing pre-audit inventory and selective collection operations (in paragraph 1.2.18 the unitary fees for different kind of C&DW treatments are reported). A similar scheme (the Flemish scheme called TRACIMAT) has been presented during the workshop held on the 5th of February at the MoEP premises in Jerusalem. In the paragraph 1.10.1.1 a description of TRACIMAT is reported.

Finally, here below, a list of the European and International Committees working on the elaboration of Standards in the Construction and Demolition Sector. They can be suitable references to analyze the local challenges.

Table **2-2**: List of the European and International Committees working on the elaboration of Standards in **the Construction and Demolition Sector**

Cements	CEN/TC 51 "Cement and building lime"
	ISO/TC 74 " Cement and lime"
Concrete	CEN/TC 104 "Concrete and related products"
	CEN/TC 177 "Prefabricated reinforced components of autoclaved aerated concrete or light-weight aggregate concrete with open structure"
	ISO/TC 71 "Concrete, reinforced concrete and pre-stressed concrete"
Ceramics	CEN/TC 67 "Ceramic tiles"
	ISO/TC 189 "Ceramic tile"
Aggregates	CEN/TC 154 "Aggregates"
Plastics	CEN/TC 249 "Plastics"
	ISO/TC 61 "Plastics"
End-of life-Tyres	CEN/TC 266 "Materials obtained from End-of-Life Tyres (ELT)
Natural stones	CEN/TC 246 "Natural stones"
Aluminium	CEN/TC 132 "Aluminium and aluminium alloys"
	ISO/TC 79 "Light metals and their alloys"
Sustainability of construction works	CEN/TC 350 "Sustainability of construction works"
	ISO/TC 59/SC 17 "Sustainability in buildings and civil engineering works"
	ISO/TC 207/SC3 "Environmental labelling"
	ISO/TC 207/SC4 "Environmental performance evaluation"
	ISO/TC 207/SC5 "Life cycle assessment"
Dangerous substances	CEN/TC 351 "Construction products Assessment of release of dangerous substances"
Characterization of waste	CEN/TC 292 "Characterization of waste"

3 RECOMMENDATIONS ON THE C&DW LAW

The Israel legislative framework can be effectively implemented to achieve positive impact in the C&DW management. Currently, there is not a significant rate of material recovery in Israel and the illegal dumpsites are negatively affecting the environment. This is caused by several factors (also described in the paragraph 4.2), explained in the previous chapters, not only linked to the Law in place.

The C&DW Law should address the main following points, in order to achieve positive results:

- Appropriate policy and legal framework conditions
- Improved waste identification, source separation and collection
- Improved waste logistics
- Improved waste processing and quality management
- Recycling target

- Appropriate policy and legal framework conditions

The integration of the C&DW management in a wider circular economy strategy can be a significant driver to trigger virtuous processes towards circularity. Specific targets for the recycling rate can create the conditions to achieve positive results, even if all the targets have to be followed by instruments allowing a proper implementation. At this stage, it is important to clarify the difference between recovery, recycling and backfilling, in order to avoid wrong or speculative interpretations.

- Improved waste identification, source separation and collection

In Israel, the current confidence about the quality of the C&DW recycled materials is generally low, and this is one of the barriers to develop a local market.

The identification of the different materials (for instance through audit), the source separation and the selective collection can be effective instruments to guarantee the quality of the different steams produced.

The law could introduce regulations for pre-demolition and renovation audits, to forecast the C&DW streams will be produced. This kind of enforcement could be mandatory for determined size of working site (e.g. In France the pre-audit for demolition and renovation operations is mandatory for sites over 1,000 m^2 of surface. In Austria if the produced C&DW is larger than 750 tonnes and an external auditor is required for building over 3,500 m^3).

The « Guidelines for the waste audits before demolition and renovation works of buildings" prepared by the European Commission (May 2018), can be a source of inspiration to set up the rules.

The audit can be directly linked to the permit needed to run the operations, to make it as effective as possible.

- Improved waste logistics

Transport is an important topic, frequently affecting the sustainability of the recovery operations. Furthermore, In Israel there are a lot of illegal dumping, also caused by the costs to transport the C&DW to the treatment plants.

It is important to keep the distances between the CDW producer and the sorting/recycling plant as short as possible, maybe through a transfer Station or directly operating on site. The development of permits oriented to guarantee where possible the treatment on site, through mobile station, can be a promising practice. The study published on the European Commission website "*Development and implementation of initiatives fostering investment and innovation in construction and demolition waste recycling infrastructure*" is a compelling collection of recommendations and examples on recycling facilities.

- Improved waste processing and quality management

The technology to process the C&DW is already in place in Israel in some of the C&DW operational recycling plants (e.g. Reshon Letzion recycling plant, see the site visit description paragraph 2.1). The effort should be addressed to guarantee, monitor and effectively communicate the quality of the output material. This can be a driver for the architects, engineers and designers to deploy the materials. The economic factor is of course an issue, but according to the discussion with the MoEP officers and local stakeholders (see round table discussion description paragraph 2.3), the main barrier is the perception and acceptance about the recycled materials that often are perceived as low quality products. Standards and Certifications can help rising acceptance as well as quality insurance instruments

4 CHALLENGES FOR THE REUSE AND RECYCLING OF C&D WASTE

During the workshop that took place on the 6th of February at the MoEP in Jerusalem, many topics concerning the key factors to build up a market for the recycled materials from the C&D waste stream were discussed.

Here below the main points raised during the workshop are listed:

- How to create the needed confidence to develop a market for the recycled materials from C&DW

- Action at the source (demolition/construction site) is a key point: pre-audit, selective collections are some of the key measures/activities that need to be established to guarantee quality and confidence- Industrial Symbiosis, as a driver to develop the market of recycling materials

Figure 4-1: Example of handelo eco-industrial park, Norrkoping, Sweden (source: http://www.industriellekologi.se/symbiosis/norrkoping.html)

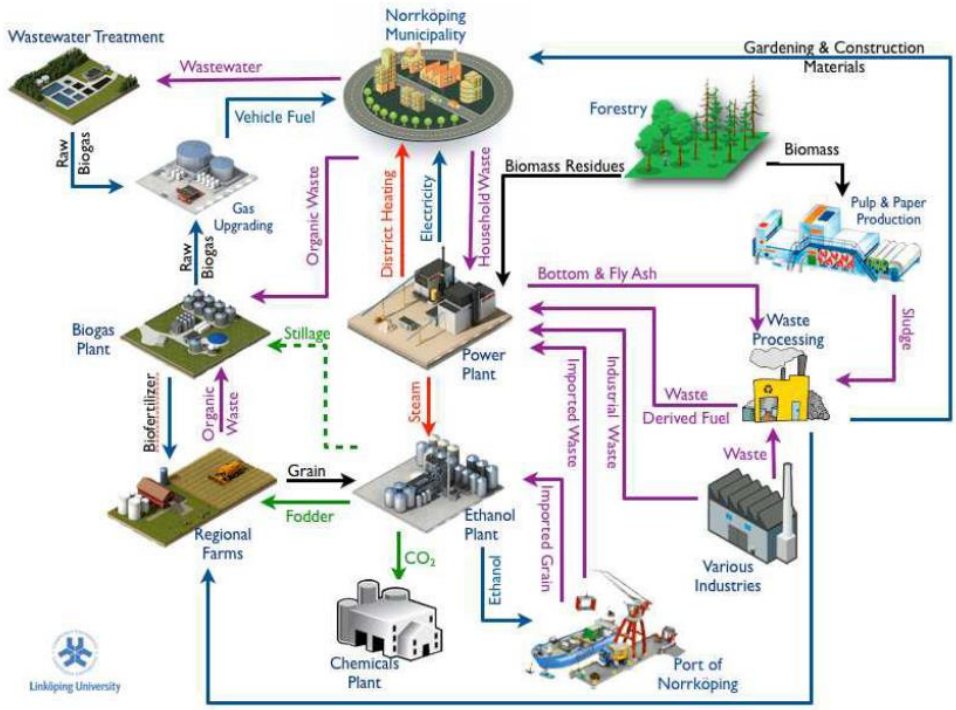
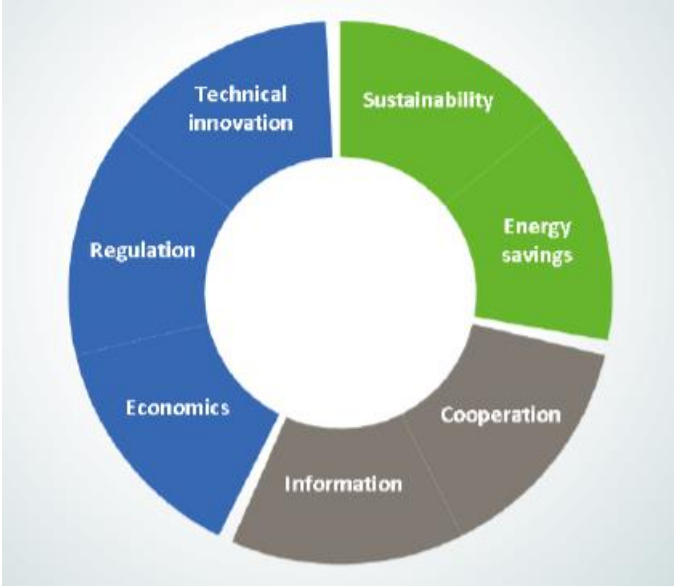


Figure 4-2: Main drivers for Industrial Symbiosis



- Barriers: community engagement, lack of information, technical, regulatory

- NIMBY is an important phenomenon for new recycling facilities proposed across Europe and Israel

- Barrier in Israel: limited community engagement, absence of recycling target fixed by law, low commitment from architects, designers and engineers to increase the use of recycled materials from C&DW, Low EoW criteria qualification of the recycled materials from C&D W.

In the EU, there is a target of 70% recovery by 2020 set in the Waste Framework Directive (Directive 2008/98/EC). There is a huge disparity in recovery rates between Member States, with some over 90% (Netherlands, Luxemburg, Italy, Slovenia, Austria, and Latvia) and others under 10% (Finland, Greece and Cyprus). Current recovery rates may seem high, but most of the EU Member States include “backfilling” in them, although it is a low-value application. Backfilling is a recovery operation where waste is used as a substitute for non-waste materials to reclaim excavated areas or for engineering purposes in landscaping. If backfilling is not taken into account, not a single Member State reaches the 70% target. There are many other challenges, such as varying definitions of CDW between countries, the large number of actors resulting in difficult coordination, and discrepancies in data collection methodologies.

In the DIRECTIVE (EU) 2018/851 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 amending Directive 2008/98/EC on waste requires the introduction of a definition of material recovery to cover forms of recovery other than energy recovery and other than the reprocessing of waste into materials used as fuels or other means to generate energy. It includes preparing for re-use, recycling and backfilling and other forms of material recovery such as the reprocessing of waste into

secondary raw materials for engineering purposes in construction of roads or other infrastructure. Depending on the specific factual circumstances, such reprocessing can fulfil the definition of recycling if the use of materials is based on proper quality control and meets all relevant standards, norms, specifications and environmental and health protection requirements for the specific use. By 31 December 2024, the Commission shall consider the setting of preparing for re-use and recycling targets for construction and demolition waste and its material-specific fractions, textile waste, commercial waste, non-hazardous industrial waste.

- Source separation stage is a key aspect in the overall process

- Drivers: Public authority's commitment and leadership at National and Local level

- Israel main applications for recycling material from CDW: backfilling

- Main Drivers to develop a market:

- Time: a proper timeline with planned actions and goals is needed to succeed.
- Tools: the development of tools can help practitioners to replicate the good practices in an efficient way
- Trust: cooperation towards common goals creates the conditions to start trusting in new opportunities
- Dissemination: organizing workshops and conferences involving all the stakeholders, is an effective way to co-working to develop a new process
- R&D: involvement of technology providers and R&D is an essential element in the successful matchmaking between supply and demand.
- Trials: without trials, it would be difficult to reach a commercially acceptable process or product. In general, many technical problems have to be solved before reaching a mainstream product or process
- Data and indicators: data collection and indicator analysis are key aspects to be consistent in the introduction of new opportunities
- Stability: long-term plans and clear vision are needed to create good conditions
- Taxes: high cost for landfilling would help to develop environmental friendly alternatives
- Regulation: a clear legislative framework is needed to allow the private sector reacting in the right direction.

4.1 NEW ECO-CEMENTS

In this paragraph two kinds of Ecocements developed within the H2020 FISSAC project are briefly described:

- Calcium Sulpho-Aluminate (CSA - Belite-yeelemite based cements) cement
- Blended cement.

This paragraph has the purpose to provide some concrete results coming from H2020 projects, focusing on interesting local replication opportunities.

Calcium Sulpho-Aluminate (CSA) cement is produced by using aluminum saline slags, glass waste, ceramic waste and ladle furnace slag within the raw meal. When comparing CSA cement to ordinary Portland cement (OPC), CSA cement has the following advantages:

- lower CO_2 footprint
- lower embodied energy
- reduction in consumption of natural resources by substituting a variety of industrial by-products
- high resistance to sulphate attack.

The main conclusions obtained from the evaluation of CSA cements are:

- CSA cement is produced by using Secondary Raw Materials (SRM): aluminium saline slag, glass waste, ceramic waste and ladle furnace slag;

- According to experimental studies, secondary raw materials have been used for producing CSA cement clinker instead of natural raw materials. An amount of SRM in CSA raw meal has been arranged according to CSA cement clinker properties.

- Different CSA cement clinker raw meal recipes have been prepared for experimental studies.

Blended cements are produced by using ladle furnace slag, glass and ceramic waste materials as mineral additives to the ordinary Portland cement. The main advantage of this route is lowering the clinker content in the blended cement thus reducing the environmental impacts.

The main conclusions obtained from the evaluation of Blended cements are:

- Blended cements are produced by using Secondary Raw Materials (SRM); glass waste, ceramic waste and ladle furnace slag; with eco-design methodology.

- According to experimental studies, secondary raw materials are used for producing blended cement instead of natural additives. Amount of SRM in blended cement recipe has been arranged according to three criteria, utilizing all waste, maximizing the waste amount and strength class based on EN 197-1 standard[22].

4.2 MAIN LOCAL BARRIERS

In Israel there is a law mentioning that every quarry can (not must) have a crusher facility to treat the C&DW delivered by the construction and demolition sector companies.

Quarry owners are not the same as the crusher owners: this is a key barrier in Israel, generating a competition issue between virgin and recycled materials. If the quarry owners were also the managers of the C&DW treatment plant, they would be interesting to sell the recycling material to generate revenues and to increase the lifespan of the quarry.

It is very important to provide tenders with a minimum requirement of recycled materials in the Public Procurement process (see for instance the case of Italy and Catalunya Region – Spain in paragraph

[22] This European Standard has been prepared by Technical Committee CEN/TC 51 "Cement and building limes", the secretariat of which is held by IBN. This European Standard replaces ENV 197-1:1992. This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2000, and conflicting national standards shall be withdrawn at the latest by December 2000.

2). This could encourage the use of the recycled materials, that are not sold at the moment although they are available (just stocked outside the recycling plants).

There was a proposal in Israel for an EPR scheme for CDW, but it failed mainly because the lack of a strong commitment of the construction and demolition sector.

Here below some of the main barriers along 4 categories: Organizational and Political, Economic, Social and cultural, Environmental.

Table **4-1**: Barriers to reuse and recycle CDW

Category	Barriers
Organizational and Political	Government policy is not driving recycling; Environmental regulations are working against recycling; Material specification and certification in buildings are not encouraging recycling; Lack of compliance with legislation, weak implementation; Absence of specific legislation concerning C&D waste; Lack of markets/lack of demand for the recycled materials; Lack of recovery facilities for recycling; Inconvenience of location of recycling facilities or need to take materials to many different places; Design for deconstruction has not yet been incorporated into the building process; Selective deconstruction techniques are already designed but are not implemented because too costly; No End of Waste criteria.
Economic	Availability and low cost of raw materials; Cost of recycling processes making products more expensive than those from virgin materials; Alternatives to recycling are less costly – landfill gate prices are too low; Low value products/low volume products are being landfilled rather than stored for recycling because it is uneconomic to stockpile; Lack of subsidies or other economic incentives that could drive the use of secondary materials.
Social and Cultural (knowledge and education)	C&D waste material is not considered as a potential resource (except metal); Misconception of the quality of recycled products compared to new materials; Lack of technical information about recycled content materials; Lack of knowledge about what can be recycled, or about recycling opportunities in the region; Lack of knowledge across the industry and requirement for training; Lack of good quality data concerning C&D waste; Difficulty in assessing/forecasting precisely C&D waste sources and streams; Authorities are often reluctant to authorize the installation of new treatment facilities.
Environmental	Contamination of recyclables due to lack of separation or lack of space for separation.

4.3 POLICY RECOMMENDATIONS[23]

Here below are some policy recommendations that can allow pulling the market of C&D recycled materials:

[23] These recommendations must take into account also the other outputs of the overall EFH-IL-5 activity, such as the "Comparative review document of C&DW policies/legislation in various EU Member States"

- Regulatory framework:
  - make sorting at source (the demolition or building site) mandatory;
  - make a traceability system of the C&DW mandatory in electronic form;
  - set specific target for C&DW recycling, clarifying the difference between recycling and backfilling in the legislation;
  - make mandatory a minimum content of recycling materials in new infrastructures/building;
  - set EoW criteria entailing a comprehensive set of tests before recycled products are placed on the market;
  - impose landfill bans for recyclable C&DW fractions;
  - recognize selective demolition in GPP.

- Voluntary tools (Certificates, Standards)
  - promote certificates of selective demolition;
  - develop standards for reusable and recycled products/elements;
  - promote use of Building Information Modelling (BIM[24]) to facilitate future demolition-related activities;
  - encourage R&D initiatives for the development of technologies to demonstrate equivalency among recycled and virgin materials;
  - apply qualitative waste prevention plans, including objective to eliminate hazardous substances in new construction works;
  - provide specific instructions and schemes for pre-demolition audits.

- Monitoring
  - implement stricter control of landfilling and illegal disposal activities;
  - ensure that traceability systems provide complete information about the waste track;
  - set a standardized procedure for data collection about the content and leaching of contaminants;
  - simplify paperwork burden.

- Economic instruments
  - create economic incentives to increase use of recycled materials (e.g. through taxation the price of raw material);
  - vary the extraction taxes in place to reflect also the ecological impact and the extent of environmental damage;

[24] BIM, short for Building Information Modelling, is a digital tool disrupting the construction industry as a platform for central integrated design, modelling, asset planning running and cooperation. It provides all stakeholders with a digital representation of a building's characteristics in its whole life-cycle and thereby holds out the promise of large efficiency gains.

- progressively increase C&DW landfill taxes (see for instance the France, Belgium and Malta examples in part 1, as well as the Catalunya case in part 2), supported by appropriate enforcement and control and by a network of alternative treatment plants;
- favour design for modularity, deconstruction and reuse with incentives on the supply side;
- reduce corporate tax rates for companies using recycled materials.

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