CONSTRUCTION AND DEMOLITION WASTE - A CHALLENGE FOR THE EUROPEAN UNION?

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Abstract
In the European Union a large amount of CDW is generated, but there are significant differences between Member States. The paper presents the specific situation corresponding to each Member States and synthesizes the following data: quantity of CDW generated, Quantity of CDW /capita, quantity of CDW recovered, main obstacles to sustainable CDW management and main drivers to sustainable CDW management. The countries that have specific legislation regarding CDW have bigger recycling rates, their experience can be assimilated in the rest of European countries.
Keywords: Construction and demolition waste, prevention, recycling, recovering, waste management

1. INTRODUCTION

Construction and demolition waste consists of materials such as: concrete, bricks, roof tiles and ceramic wares, wood, glass, plastic materials, asphaltic blends, coal tar and tarred products, excavated soil, insulating materials, gypsum, etc. Construction sector has a strategical importance for each country all over the world and its development leads towards the growth in quantity of the construction and demolition waste generated (EC 2016a). The quantity and the composition of the construction and demolition waste is quite variable as it depends on the specificity of the construction works being conducted, more waste being usually generated if a reinforcement/transformation of an old building is being done than in the case of a new building construction. Certain construction materials used in the

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past are considered to be unsafe in the present, as in the case of asbestos, which requires special measures in the demolition process.

Construction and demolition waste is regarded with a great deal of attention at the European level because it represents 25-30% of the total quantity of municipal waste generated, and also due to its great potential for recycling and reutilisation, potential which is not yet fully exploited (EC 1999).

2. MATERIALS AND METHODS

Article 11.2 of Waste Framework Directive (2008/98/EC) stipulates that "Member States shall take the necessary measures designed to achieve that by 2020 a minimum of 70% (by weight) of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in the List of Wastes shall be prepared for re-use, recycled or undergo other material recovery" (including backfilling operations using waste to substitute other materials).

In 2015, the European Commission initiated a study called „Resource Efficient Use of Mixed Waste" which has the following main objectives: to conduct the current state analysis of the construction and demolition waste generated in the European Union member countries; to identify the impediments in recycling and the possible deficiencies which may conduct to the noncompliance with the EU regulations in regarding waste; to elaborate a set of guidelines in order to increase the recycling rate.

In the first stage, each member country produced a report regarding the state of the construction and demolition waste, reports which served as source for the extracted and processed data presented below:

Austria (Deloitte 2015a)

Quantity of CDW generated: 8.3 Mt non-hazardous CDW (2013) - the amount excludes soil, stones and dredging spoil; quantity of excavated material generated: 26.8 Mt

Quantity of CDW /capita: 0.98 t/capita year

Quantity of CDW recovered: 7.2 Mt – 87% of non-hazardous CDW generated (2013) – (without backfilling)

Main obstacles to sustainable CDW management**:** legal barriers**,** heterogeneous quality of recycled materials, lack of economic incentives, End-of-Life status.

Main drivers to sustainable CDW management: advanced practices and a well-established network, legal framework, close collaboration between industry and policy makers, quality norms for recycled materials, enforcement (taxes and high fees are charged by ton).

Belgium (Deloitte 2015b)

Quantity of CDW generated: 6945480 t (2012) the amount excludes soil, stones and dredging spoil (171474 t hazardous CDW)

Quantity of CDW /capita: 0.6 t/capita year

Quantity of CDW recovered: 14542374 t (2012) - without backfilling

Energy recovery: 30782 t (2012)

***Main obstacles to sustainable CDW management*:** differences in legislation among the Belgian regions**,** enforcement of the different regulations perceived as bottleneck, the composite nature of current construction materials, the logistical and economic aspects for recycling small fractions of certain, sorting waste takes time and space, high technical specifications for roads, lack of EoW criteria for recycling aggregates and other recycling materials from CDW in the Walloon Region and Brussels Capital Region (BCR).

Main drivers to sustainable CDW management: existing legal framework in Flanders, especially for the recycling of the stony-fraction of CDW, differentiated landfill taxes and the voluntary TraciMat system, In Wallonia, the legislation obliges to a high recycling rate for CDW and establishes progressive landfill bans of waste, the higher landfilling taxes, price differences between the treatment of sorted and mixed waste, standard specifications for road works in the 3 regions.

Bulgaria (Deloitte 2015c)

Quantity of CDW generated: 1543905 t (2013), the amount includes soil, stones and dredging spoil - (1344.6 Kt soil, 198.5 Kt Non-hazardous CDW, 0.4 Kt hazardous Soils, 0.4 Kt hazardous CDW)

Quantity of CDW /capita: 0.2 t/capita year

Quantity of CDW recovered: 136717 t (2013) – without backfilling

***Main obstacles to sustainable CDW management*:** historic practices including illegal dumping, inconsistency in regulations and lack of implementation tools, lack of coordination of private

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stakeholders towards the implementation of sustainable CDW management, elaboration of Plans for CDW management for new construction is hindered by a lack of guidelines, benchmarks or technical documentation for the quantities of construction waste, difficult to estimate the quantities of CDW in planning phase, lack of benefits and levers to motivate recovery, lack of recycling capacities.

Main drivers to sustainable CDW management: tailored law for reaching the EU recovery rate, adaptation of stakeholders on different levels towards reaching the goal, development of the national recycling industry.

Croatia (Deloitte 2015d)

Quantity of CDW generated: 682058 t (2012), the amount includes soil, stones and dredging spoil (358916 t soil, 126105.62 t other inert waste, 180052.38 t non-inert non-hazardous CDW, 16984 t hazardous CDW)

Quantity of CDW /capita: 0.16 t/capita year

Quantity of CDW recovered: 192309 t - 32% of non-hazardous CDW generated (2012), backfilling 8645 t -1%

Energy recovery: 7513t (6352t non-hazardous CDW, 1161t hazardous CDW)

***Main obstacles to sustainable CDW management*:** legislation and regulation, treatment facilities and their territorial network, collecting and tracking data about generated and treated CDW, public awareness, public procurement, market conditions.

Main drivers to sustainable CDW management: legislation and regulation, treatment facilities and their territorial network, system monitoring.

Cyprus (Deloitte 2015e)

Quantity of CDW generated: 142200 t (2012), the amount excludes soil, stones and dredging spoil (142200 t non-hazardous CDW). The definition of CDW in Cyprus includes soils and naturally occurring materials which are also counted in the calculation of recovery rates.

Quantity of CDW /capita: 0.12 t/capita year

Quantity of CDW recovered: 83400 t of non-hazardous CDW generated (2012) (from this amount 21000 t were used for backfilling)

***Main obstacles to sustainable CDW management*:** lack of political will, mentality in the construction sector, lack of treatment facilities and low territorial network, lack of incentives for recycling.

Main drivers to sustainable CDW management: existence of a well-articulated legal framework for CDW management including provisions for the sustainable management of CDW, organisation of CDW Management Systems by the actors in the construction sector (obliged by legislation) for the sustainable management of CDW.

Czech Republic (Deloitte 2015f)

Quantity of CDW generated: 13.8 Mt (2012), the amount includes soil (including excavated soil from contaminated sites), stones and dredging spoil.

Quantity of CDW /capita: 1.3 t/capita year

***Quantity of CDW recovered*:** 2.96 Mt recycled and 2.4 Mt used for landscaping (2012)

Main obstacles to sustainable CDW management: availability of recycling facilities, lack of information, non-compliance.

Main drivers to sustainable CDW management: financial incentives, legislation, landfill bans.

Denmark (Deloitte 2015g)

Quantity of CDW generated: 5.57 Mt (2012) the amount includes soil (excluding soil classified as hazardous), stones and dredging spoil (excluding dredging spoils classified as hazardous), (2.69 Mt CDW from buildings, 2.34 Mt soil, 0.0001 Mt dredging spoils, 0.54 Mt hazardous CDW)

Quantity of CDW /capita: 0.99 t/pers an

Quantity of CDW recovered: 86% (2012)

***Main obstacles to sustainable CDW management*:** efforts needed to ensure that recycling of CDW does not cause contamination of the environment and to monitor compliance with legislation, limited demand for reused and recyclable CDW, lacking practice for coordination of demolition activities, lack of knowledge of high-level recycling technologies, missing opportunities for CDW recycling and marketing of recycled products and logistic optimization.

Main drivers to sustainable CDW management: economic and regulatory conditions enhance sustainable CDW management, business opportunities for secondary resources (CDW), reduction of CO2 emissions by recycling of CDW, support for business networks, Resource Efficient Use of

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Mixed Wastes Certification of new buildings, prolonging of the lifetime of constructions and thus reducing CDW generation, cost and resource savings through development of reusable prefabricated elements, improved attention of building owners, architects and consulting engineers to recycling of CDW, exploitation of opportunities for matching demolition and CDW production with supply of material for new buildings and construction.

Estonia (Deloitte 2015h)

Quantity of CDW generated: 1.944 Mt (2013), the amount includes soil, stones and dredging spoil, (0.980 Mt non-hazardous CDW (excl. soils), 0.939 Mt non-hazardous Soils, 0.003 Mt hazardous CDW (excl. soils), 0.022 Mt hazardous soils)

Quantity of CDW /capita: 1.5 t/capita year

Quantity of CDW recovered: 1.867 Mt t (2013) (0.9 Mt non-hazardous CDW (excl. soils), 0.964 Mt non-hazardous soils, 0.0001Mt hazardous CDW (excl. soils), 0.004 Mt hazardous soils)

***Main obstacles to sustainable CDW management*:** delays in developing advanced measures for increasing recycling, mentality in the construction sector (lack of trust in recycled materials, no market/no demand for recycled CDW), overreliance to private sector for waste management, limited treatment options, not full traceability of CDW.

Main drivers to sustainable CDW management: existence of strong national policy governing the principles of sustainable waste management, including CDW, economic incentives, the establishment of the Estonian Recycling Cluster and Recycling Competence Centre.

Finland (Deloitte 2015i)

Quantity of CDW generated: 16 Mt (2012), the amount includes soil, stones and dredging spoil if not used on-site or as aggregate in roads, (cca 1.5-2 Mt non-hazardous CDW from buildings, 14 Mt non-hazardous Soils, 0.15 Mt hazardous CDW)

Quantity of CDW /capita: 2.96 t/capita year

Quantity of CDW recovered: 1.7 Mt (from the amount of 2.2 Mt, excluding soil) (2011)

Energy recovery: 0.25 Mt

***Main obstacles to sustainable CDW management*:** adaptation and simplification of regulations accompanied by reduction of bureaucracy; promotion of development of legislation for waste storage facilities; product standards should take into account special features of recycled material;

consumers' and users' low confidence in recycled products; Environmental Product Declaration does not include recycling; higher costs related to demolition/dismantling, sorting and treatment; costs for quality control, assurance and auditing prior to demolition; the role of public procurement in promoting recycling quite low; big data on site, qualities and quantities of construction materials are missing; product data management and traceability are therefore non-existing.

Main drivers to sustainable CDW management: commitments between main stakeholders to promote sustainable use of CDW; simplification of regulations to promote the recycling of reclaimed concrete; promoting recycling of asphalt on-site; simplification of the permit system for recovered old asphalt granulates. Industrial initiatives to find new solutions for recycling of wood waste as new products; many R&D programmes on recycled materials from CDW and the great support by the Finnish authorities; Nordic initiatives concerning the use of economic instruments to promote recycling and sustainable management of CDW.

France (Deloitte 2015j)

Quantity of CDW generated: 246.7 Mt (2012), the amount includes soil, stones and dredging spoil (180.1 Mt soil, 51.1 Mt other inert waste, 13.1 Mt non-inert non-hazardous CDW, 2.4 Mt hazardous CDW)

Quantity of CDW /capita: 3.88 t/capita year

Quantity of CDW recovered: 153.3 Mt (2012) (40.4 Mt non-hazardous CDW excluding soil, 112.9 Mt soil)

***Main obstacles to sustainable CDW management*: l**ack of political will and legal loopholes, not a priority for the clients, lack of treatment facilities and low territorial network, CDW storage facilities.

Main drivers to sustainable CDW management*:* binding regulation, deterrent storage taxation system, commitment of more resources on legislation enforcement, generalisation of the practice of allotment in call for tenders, robust set of statistics.

Germany (Deloitte 2015k)

Quantity of CDW generated: 201.3 Mt (2012), the amount includes soil, stones and dredging spoil. (113.7 Mt soil - including excavated soil from contaminated sites)

Quantity of CDW /capita: 2.46 t/capita year

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Quantity of CDW recovered: 55.5 Mt recycled and 23 million t other treatment (from 82.2 Mt CDW generated, excluding soil and stones) (2012).

***Main obstacles to sustainable CDW management*:** heterogeneous legislation, lack of economic incentives, lack of enforcement, lack of knowledge.

***Main drivers to sustainable CDW management**:* advanced practices and a well-established network, responsibility of the public sector, universally accepted certificates, public perception and acceptance, norms.

Greece (Deloitte 2015l)

Quantity of CDW generated: 815.3 Kt (2012), the amount excludes soils and naturally occurring materials from excavations. (815.3 Kt non-hazardous CDW and 0.02 Kt hazardous CDW)

Quantity of CDW /capita: 0.08 t/capita year

Quantity of CDW recovered: 2.7 Kt from non-hazardous CDW (including backfilling) (2012).

***Main obstacles to sustainable CDW management*:** lack of political will, mentality in the construction sector, lack of treatment facilities and low territorial network, lack of incentives for recycling.

***Main drivers to sustainable CDW management**:* existence of a well-articulated legal framework for CDW management including provisions for the sustainable management of CDW, existence of a distinct authority (EOAN – Greek Recycling Organisation) for the supervision of the alternative management of CDW (recovery, recycling), organisation of CDW Management Systems by the actors in the construction sector (obliged by legislation) for the sustainable management of CDW, strong community awareness for the creation of preconditions for sustainable CDW.

Hungary (Deloitte 2015m)

Quantity of CDW generated: 3.77 Mt (2013), the amount includes excavated non-hazardous soil.

Quantity of CDW /capita: 0.4 t/capita year

Quantity of CDW recovered: 3.06 Mt (including backfilling) (2013)

Energy recovery: 58 t (2013)

***Main obstacles to sustainable CDW management*:** end of Waste criteria, current guidelines, lack of facilities, environmental awareness, recycled materials, price of recycled CDW materials.

***Main drivers to sustainable CDW management**:* landfill tax, detailed rules for CDW Management.

Ireland (Deloitte 2015n)

Quantity of CDW generated: 3 Mt (2011), the amount includes soils and stones. (1.98 Mt soil, 1.02 Mt other CDW)

Quantity of CDW /capita: 0.64 t/capita year

Quantity of CDW recovered: 2.36 Mt (including backfilling) (2011)

***Main obstacles to sustainable CDW management*:** National Construction and Demolition Waste Council (NCDWC) declined in line with the economic collapse in the construction industry, lack of awareness of different industry stakeholders towards the importance of CDW issues, limited involvement of designers and architects in the CDW management plans, the lack of uptake of green public procurement for construction projects, low interest of C&D industry for CDW prevention and reuse, data anomalies, inconsistencies in the classification of C&D waste and lack of published up-to-date data on CDW generation and management, the emerging issue of hazardous substances& persistent organic pollutants (POPs) in CDW articles.

***Main drivers to sustainable CDW management**:* legislation regarding recycling targets, experience in regional non-hazardous waste management planning, creation of NCDWC, the implementation of a landfill levy on CDW, increasing of the landfill tax, legal requirements for CDW management planning in the case of large construction projects, the production of a number of very useful guidance documents on C & D Waste management best practice, all of which are available on NCDWC (www.ncdwc.ie).

Italy (Deloitte 2015o)

Quantity of CDW generated: 39.6 Mt (2012), the amount excludes soils and stones (38.79 Mt non hazardous CDW, 0.85 Mt hazardous CDW) and 12 Mt soil

Quantity of CDW /capita: 0.65 t/capita year

Quantity of CDW recovered: 29.9 Mt (from which 160290 t backfilling) (2012)

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***Main obstacles to sustainable CDW management*:** lack of confidence for the products derived from waste, lack of knowledge of the technical characteristics of recycled aggregates, materials specifications in call for tenders do not support the development of a demand for recycled aggregates, the lack of on-site sorting as well as selective demolition practices, recycled aggregates are also not always competitive compare to aggregates from virgin materials, due to the lack of taxes on mining activities, low level of landfill tax.

***Main drivers to sustainable CDW management**:* enforcement of green procurement law, the development of end of waste criteria, new and more stringent rules for selective demolition practices would greatly increase CDW sustainable management.

Latvia (Deloitte 2015p)

Quantity of CDW generated: 396 955 t (2012), the amount includes soil, stones and dredging spoil.

Quantity of CDW /capita: 0.2 t/capita year

Quantity of CDW recovered: 155 323 t (without backfilling) (2012)

***Main obstacles to sustainable CDW management*:** absence of C&D Legislation, poor of national data transparency and reporting, lack of national resources for CDW development, lack of deterrents aimed at landfilling, underdeveloped market for recycled CDW (aggregates), lack of communication on CDW management practices, communication to all actors, B2B and B2C lacks attention, widespread awareness about good practices on the local, regional, and national level could help bring about change.

***Main drivers to sustainable CDW management**:* EU-funding for CDW projects, tighter enforcement on illegal dumping and the introduction of stricter landfill costs, better communication on CDW management practices, incentives towards favourable use of recycled aggregates.

Lithuania (Deloitte 2015q)

Quantity of CDW generated: 564.8 Kt (2012), the amount excludes naturally occurring materials (soil) (564.286 Kt non hazardous waste, 0.56 Kt hazardous waste)

Quantity of CDW /capita: 0.18 t/capita year

Quantity of CDW recovered: 74% re-use, recycling, recovering and 14.5% backfilling (2012)

***Main obstacles to sustainable CDW management*:** inefficient sorting of CDW on site, insufficient processing capacity throughout the country, there are no possibilities for further use of recycled of CDW.

***Main drivers to sustainable CDW management**:* legislation, waste management plans and strategies, sustainability standards that cover CDW.

Luxembourg (Deloitte 2015r)

Quantity of CDW generated: 585 542 t (2012) the amount excludes soils and naturally occurring materials (6506223 t soil)

Quantity of CDW /capita: 1.17 t/capita year

Quantity of CDW recovered: 517 516 t (without backfilling) (2012)

***Main obstacles to sustainable CDW management*:** lack of training and awareness of workers in the construction sector, end-market issues for some recyclable materials, quantity of excavated soils and especially contaminated excavated soils: financial burden of depollution is on the owner, not on the polluter.

***Main drivers to sustainable CDW management**:* binding regulatory framework, centrally planned and supervised infrastructure of inert waste treatment facilities, market conditions serving as incentives to sorting at source.

Malta (Deloitte 2015s)

Quantity of CDW generated: 529332 t (2012), the amount excludes soils and naturally occurring materials (528 564 t non-hazardous CDW (excl. soils), 758 t hazardous CDW (excl. soils))

Quantity of CDW /capita: 1.3 t/capita year

Quantity of CDW recovered: 532643 t (2012), (139181 t recycled, 393462 t backfilled)

***Main obstacles to sustainable CDW management*:** lack of clear legislative framework and roles of actors in CDW management, no market for recycled CDW, limited treatment options – no standards for recycled CDW, CDW reporting issues.

Main drivers to sustainable CDW management: adequate network of facilities for receiving CDW (for recovery/backfilling), consisting mainly of spent or operating quarries belonging to private entities, economic incentives (lower tax) for restoration of old buildings instead of demolition, obligation prior to construction permitting for setting up a Waste Management Plan concerning the construction project, by the contractor.

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Netherlands (Deloitte 2015t)

Quantity of CDW generated: 25.71 Mt (2012), the amount excludes dredging spoils and the vast majority of soil (24.22 M t non-hazardous CDW, 1.48 Mt hazardous CDW)

Quantity of CDW /capita: 1.54 t/capita year

Quantity of CDW recovered: 24253 Kt (2012) (24249 Kt recycling – from which 23062 Kt non hazardous waste and 3.27 kt other recovery (includes backfilling)- from which 2.54 kt non hazardous waste)

Energy recovery: 0.944 Mt (2012)

***Main obstacles to sustainable CDW management*:** Market conditions, bureaucracy, lack of maturity of initiatives, culture and mentality

Main drivers to sustainable CDW management: market conditions, cost reduction as driver for CDW management, legislation

Poland (Deloitte 2015u)

Quantity of CDW generated: 3510000 t (2012), the amount includes soil (including excavated soil from contaminated sites) (29215 t non hazardous waste, 3481085 hazardous waste).

Quantity of CDW /capita: 0.09 t/capita year

Quantity of CDW recovered: 2778966 t (2012) (2043436 t recycling, 733703 t backfilling)

Energy recovery: 2749 t (2012)

***Main obstacles to sustainable CDW management*:** not a priority for construction companies, low awareness of the construction sector regarding CDW issues, regulatory obligations, law enforcement and monitoring.

Main drivers to sustainable CDW management: increasing of resources for legislation enforcement, binding regulatory framework, standards as incentives for sorting on site, enhance awareness raising among stakeholders, demand for some materials.

Portugal (Deloitte 2015v)

Quantity of CDW generated: 1746652 t (2013), the amount excludes uncontaminated soil and other naturally occurring material excavated

Quantity of CDW /capita: 0.16 t/capita year

Quantity of CDW recovered: 845930 t (2013) –without backfilling

Energy recovery: 1951 t (2013)

***Main obstacles to sustainable CDW management*:** economy slowdown in the country, non-compliance with legal framework, lack of enforcement, limited permission to use recycled CDW, high management cost associated to proper CDW management, low landfill tax and non-existent disposal fee tax under the environmental rehabilitation of quarries, inexistent legal and technical specifications for selective demolition, inexistent End of Waste (EoW) criteria for inert CDW, non-competitive pricing of recycled materials, lack of coordination and synergy between stakeholders, lack of data cross checking and verification of CDW generation for small and medium construction companies, lack of environmental awareness.

Main drivers to sustainable CDW management: existence of a specific legal framework and technical guides, existence of facilities for sorting and recycling (although the heterogeneity of geographical distribution), obligation to report data.

Romania (Deloitte 2015w)

Quantity of CDW generated: 1330069 t (2012), the amount includes soil (including excavated soil from contaminated sites), stones and dredging spoil.

Quantity of CDW /capita: 0.07 t/capita year

Quantity of CDW recovered: 253550 t (2011) – without backfilling

***Main obstacles to sustainable CDW management*:** lack of infrastructure and facilities, low landfill taxes, poor market conditions for recycled aggregates, lack of C&D legislation, poor reporting and statistical data.

Main drivers to sustainable CDW management: National Waste Management Strategy (2014-2020), introduction of waste management requirements in the construction and demolition authorisations, the acquisition of mobile installations and onsite installations for mechanical treatment of inert waste.

Slovakia (Deloitte 2015x)

Quantity of CDW generated: 806184 t – data from Eurostat, 1612998t – data from MoE (2012), the amount includes soil (including excavated soil from contaminated sites), stones and dredging spoil.

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Quantity of CDW /capita: 0.15 t/capita year

Quantity of CDW recovered: 600688 t (2012) – without backfilling

***Main obstacles to sustainable CDW management*:** lack of EoW criteria for CDW, insufficient capacity of CDW recycling facilities.

Main drivers to sustainable CDW management: existing legislative drivers, upcoming legislation, targets to achieve.

Slovenia (Deloitte 2015y)

Quantity of CDW generated: 535154 t (2012) the amount includes soil (103354 t soil, 36304 t other inert waste, 391296t non-inert non-hazardous waste, 4200 t hazardous waste).

Quantity of CDW /capita: 0.25 t/capita year

Quantity of CDW recovered: 1557675 t (2012) (1039736 t backfilling, 14711t covering landfill sites, 418900 t recovered)

***Main obstacles to sustainable CDW management*:** status of EoW, legislation and regulation, statistics, green procurement , Waste Management Strategy, interest in CDW regulations.

Main drivers to sustainable CDW management: green procurement, EoW status, legislation and regulation, statistics, interest for CDW regulations.

Spain (Deloitte 2015z)

Quantity of CDW generated: 27703854 t (2012) the amount includes uncontaminated soil and other naturally occurring material excavated (27637698 t inert waste, 66156 t hazardous waste)

Quantity of CDW /capita: 0.6 t/capita year

Quantity of CDW recovered: 23340023t (2012) (19011024 t reuse, recycling and 4328999 t backfilling)

***Main obstacles to sustainable CDW management*:** economy slowdown in the country, lack of regulations (pre-demolition audits), market conditions for recycled aggregates, lack of awareness of the advantages of recycled aggregates, availability of landfills and low landfill cost, absence of GPP, lack of awareness B2B & B2C, statistical methodology inconsistencies.

Main drivers to sustainable CDW management: leverage record low CDW levels to focus on other initiatives, promote regulations (pre-demolition audits), jump start the creation market

conditions for recycled aggregates, increase availability of landfills and address low landfill cost issue, increase awareness B2B & B2C.

Sweden (Deloitte 2015za)

Quantity of CDW generated: 7.67 Mt (2012), the amount includes soil, stones and dredging spoil (1.20 Mt non hazardous from buildings, 3.5 Mt non hazardous soils, 2.07 Mt non hazardous dredging spoils, 0.17 Mt hazardous from buildings, 0.72 hazardous soils)

Quantity of CDW /capita: 0.81 t/capita year

Quantity of CDW recovered: 0.66 Mt considering 1.31 Mt the total generated quantity of CDW (2012), (0.18 Mt recycled, 0.48 Mt backfilled)

Energy recovery: 0.41Mt (2012)

***Main obstacles to sustainable CDW management*:** the EU recovery target favors recycling of high-density waste types, there is no distinction between backfilling and other more resource efficient recovery operations, existence of an abundant resource of high-quality rock, transport distances of CDW.

***Main drivers to sustainable CDW management*:** cost savings through improved logistics in CDW management, improved and better controlled quality of CDW opens new possibilities for recycling, landfill taxes and ban on landfilling of combustible waste fractions promotes sorting of waste.

UK (Deloitte 2016)

Quantity of CDW generated: 100.23 Mt (2012 the amount includes soil, stones and dredging spoil (54.39 Mt excavation waste, 44.79 Mt non-hazardous CDW, 1.06 Mt hazardous CDW)

Quantity of CDW /capita: 1.6 t/capita year

Quantity of CDW recovered: 38.8 Mt (2012) from amount of non-hazardous CDW (44.79 Mt)

***Main obstacles to sustainable CDW management*:** environmental permitting and exemptions**,** legacy issues/difficult wastes, infrastructure/markets/transport costs, site based constraints to segregate.

Main drivers to sustainable CDW management*:* government programmes and schemes, quality Protoco, recycled content, leadership and verification, landfill tax, reliability of data.

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3. RESULTS AND DISCUSSIONS

The quantity of the construction and demolition waste generated in EU exceeds 700 million tonnes per year. The largest declared quantities of waste are generated in those countries which have the largest population, France and Germany being notable examples (Figure 1). Moreover, the generated quantity of waste generated by any of the two mentioned countries is larger than the total quantity generated by all the other EU countries together, without UK.

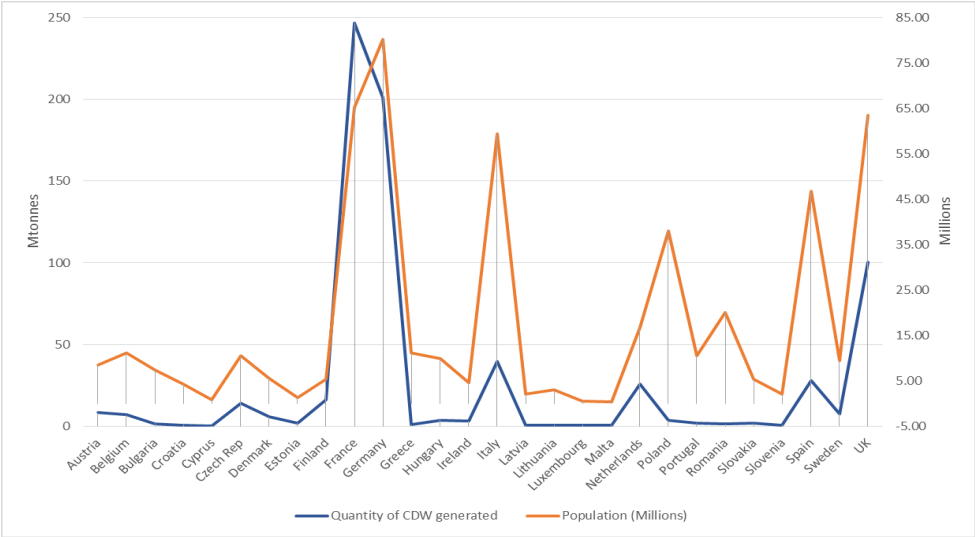

FIGURE 1 - THE QUANTITY OF CDW GENERATED IN EU COUNTRIES (ACCORDING TO THE VALUES REPORTED IN THE FACTSHEETS BY EACH EU MEMBER COUNTRY MOSTLY FOR THE YEAR 2012) AND POPULATION OF EU COUNTRIES

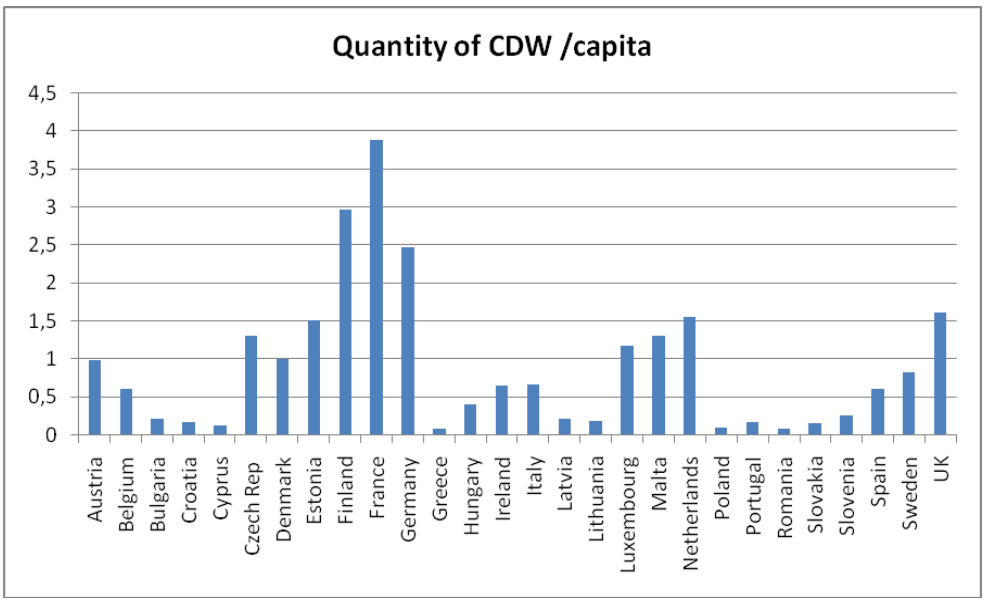

FIGURE 2 - THE QUANTITY OF CDW/CAPITA GENERATED (T/PERS YEAR) ACCORDING TO THE VALUES REPORTED IN THE FACTSHEETS BY EACH EU MEMBER COUNTRY MOSTLY FOR THE YEAR 2012

The quantity of generated CDW varies significantly from a member country to another (from 3.8 tonnes/capita per year in France to 0.07 tonnes/capita per year in Romania) (Figure 2). The construction and demolition waste is differently defined in EU countries, not always including the excavated soil (uncontaminated soil and other naturally occurring material excavated), resulting in great differences in the reported values between countries.

Analysing the data provided by the member countries revealed the following problems: in many countries there are issues regarding the accuracy and completeness of the collected and summarized data, different data reported (with or without excavated soil, which include/not-include hazardous waste), the available data are old, a share of the construction and demolition waste is illegally disposed and is not therefore accounted etc.

There exist differences between data from the countries reports and data reported by Eurostat, mainly due to the fact that excavated soil quantities are included or not (Figure 3).

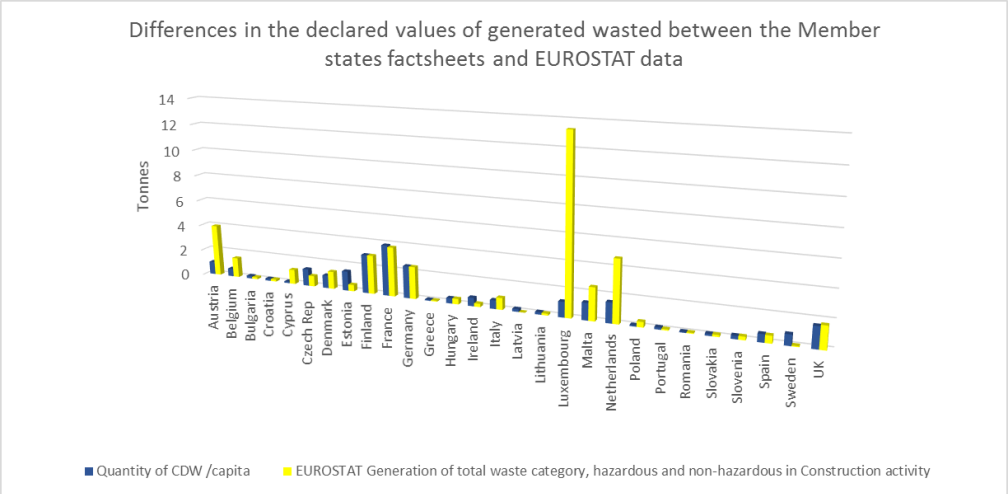

FIGURE 3 - DIFFERENCES IN THE DECLARED VALUES OF GENERATED WASTED BETWEEN THE MEMBER STATES FACTSHEETS AND EUROSTAT DATA (SOURCE: HTTP://EC.EUROPA.EU/EUROSTAT/WEB/PRODUCTS-DATASETS/-/ENV_WASGEN)

On the other side, the differences between the quantities of the construction and demolition waste generated in the EU member countries are determined by the economic activities in the construction sector, or by the geological and seismic characteristics of the soil, or by the various technologies and the building traditions which are used in the construction field (the use of concrete, wood or bricks as the principal material of construction) (BIO Intelligence Service (2011), Iacoboaea & Sercaianu (2010), Iacoboaea et al. (2010), Iacoboaea & Aldea (2016)).

In most of the countries the quantity of the construction and demolition waste decreased in the last years due to the economic crisis, but also because of the measures undertaken in order to diminish the

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amount of waste generated. Nevertheless, this quantity increased in several countries due to the increase of the construction sector activity and, at the same time, due to the changes regarding the way data collection is performed.

The recycling rate of the non-hazardous construction and demolition waste varies a lot between the EU member countries. Most of them recycle concrete, bricks and asphalts, and also an important share of soil, ballast or gravel. Sometimes the term "backfilling" has numerous interpretations depending on each member country, as in the case of Poland where the term is even used instead of recycling.

The recycling rate was difficult to compute because of the lack in data homogeneity declared within the countries reports. In principle, the recycling rate was computed from the quantity of non-hazardous CDW (in those cases where data were available), and by including backfilling (in those cases where data were available) (Figure 4). There are 3 countries that have recycling rates more than 100%, but the causes are not clear.

The countries which have specific regulations regarding the construction and demolition waste have greater recycling rates, exceeding 80% of the generated quantity (Figure 4). The main measures undertaken by these countries consist in imposing higher taxes for landfilling, which for the mixed waste can be even 10 times higher than for the sorted waste, imposing taxes over the use of natural aggregates, providing financial and fiscal incentives regarding sorting and recycling construction and demolition waste, or regarding the production and use of recycled aggregates.

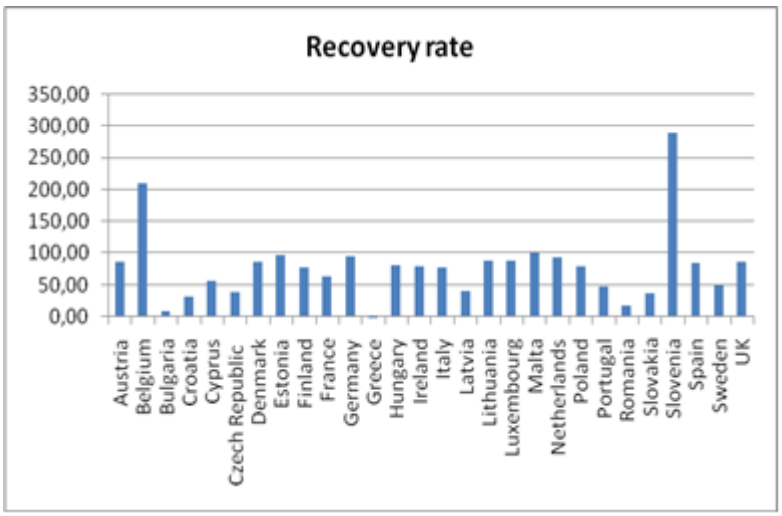

FIGURE 4 - THE RECOVERY RATE CALCULATED FROM THE VALUES DECLARED IN THE EU COUNTRIES FACTSHEETS MOSTLY FOR THE YEAR 2012 (FOR FINLAND, GERMANY, SWEDEN, UK THE RATES WERE COMPUTED FROM THE DECLARED AMOUNT INSTEAD OF THE TOTAL AMOUNT)

The countries without specific concerns in recycling the construction and demolition waste have low recycling rates (for example Greece, Bulgaria, Romania) (Figure 4). The small rate of recycling for these countries can be also explained by the presence of the natural aggregates at a low price.

The main obstacle regarding the recycling and reuse of the C&D waste was identified and mentioned in the EU Construction & Demolition Waste Management Protocol (EC 2016b) as "the lack of confidence in the quality of C&D recycled materials", with certain concerns expressed regarding the "potential health risk for workers using recycled C&D materials".

Certain countries have large rates of recycling, but these rates are generated mostly by the backfilling process and less by recycling the other types of waste. A better way of expressing the recycling rate would be to limit the rate of the backfilling at a maximum level and the rate of recycling the other types of the construction and demolition waste at a minimum level which would also help in achieving the goal of recycling in the future.

There are a couple of measures which can be adopted so that the amount of construction and demolition waste would decrease and these are indicated below:

- The replacement of certain concepts used in the design process of a building (standardising, avoiding changes in the final stage of design, presenting detailed designs etc.)
- The selection of certain construction materials and methods (the use of low waste technologies "LWT" for construction – the use of precast structural elements, metallic formworks etc.) (Lennon 2005, Duran et al. (2006), Rodriguez et al. (2007)).

The re-use of the construction and demolition waste on the construction sites represents an important method of reducing the amount of waste.

The measures adopted by the successful EU countries in increasing the amount of recycled construction and demolition waste include some of the following:

- Specific regulations for the construction and demolition waste domain
- The issuing of the building/demolishing permits conditioned by the existence of a pre-demolition audit and a construction and demolition waste management plan
- Waste sorting
- Standards for the use of recycled aggregates in constructions

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- Banning/very high taxation for the disposal in landfills of the construction and demolition waste which can be recycled
- Fiscal and financial incentives for recycling the construction and demolition waste
- Facilitate material content traceability etc

4. CONCLUSIONS

There are big differences between the quantities of CDW among the member states. These differences take place because inclusion/non-inclusion of excavated soil (uncontaminated soil and other naturally occurring material excavated), of hazardous waste, but also because of the accuracy of the registered data, and as well as the evolution of the construction sector and of the used technologies and so on.

At the same time, there exists big differences between the quantities of recycled CDW in the member states that are generated by the specific legislation in each country, standards as incentives for sorting on site, by the interest for the recycled materials, standards for the use of recycled materials, by the taxes used for landfilling, fiscal and financial incentives for recycling the construction and demolition waste etc.

In order to achieve the objectives established by the Waste Framework Directive 2008/98/CE a share of the EU member countries should put in some considerable efforts. Some of the solutions assumed by the countries with greater recycling rates could be helpful to adopt in the rest of the countries. However, transferring certain solutions from a country successful in achieving the recycling target to another country is not necessary as successful, and is not an easy task.

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