25. SCANDINAVIAN COUNTRIES -DENMARK – FINLAND- SWEDEN

25.1 Legal Framework – Waste Management Plans and Strategies

25.1.1 National Legislation concerning CDW

Sweden

The legislations concerning CDW in Sweden can be found in the Swedish Environmental Code (Miljöbalken) and the Planning and Building Act (Plan och Bygglag). The Miljöbalken makes no special mention of CDW but lays down more generalized requirements about the conditions of the environment indirectly monitoring CDW management as well. The Miljöbalken (in its 2nd and 15th chapters) describes the waste hierarchy (prevention, re-use, recycle, energy recovery and disposal) similar to the European Commission's Waste Framework Directive (2008/98/EC).

The Planning and Building Act of Sweden through the process of granting permission to applications for construction and demolition activities, control the treatment and disposal of waste. According to this law, the application is to be followed by a control plan. Despite a scheduling of the demolition or construction activities, the waste-related aspects within a control plan are limited to a documentation of the safe-handling and sound disposal of hazardous CDW (summarized from Plan och bygglag (2010:900). The control plan is often preceded by an inventory of waste arising from the demolition of the building elements in consideration and its handling. It is foremost the builder's responsibility to draft the control plan and execute construction or demolition in accordance to it.

Denmark

The legislations supervising the recycling of CDW consist of the Environmental Protection Act no. 879 26/06/2010; Statutory Orders on waste, recycling of residual products and soils from building and sorted un-contaminated CDW (Order no. 1309/2012, Order no. 1662/2010). There is in addition a circular on the use of crushed asphalt in road construction [3]. The Waste Order (Affaldsbekendtgørelsen, BEK 1309:2012) stipulates that the builder notify the municipality 14 days before the demolition work is to commence.

Finland

The legislations tied up with CDW in Finland, similar to Denmark comprise acts and decrees. The Waste Act, Land use and building Act, Environmental Protection Act (646/2011, 132/1999, 527/2014). For all the above mentioned acts there are decrees issued by the execution authority. Just like the PBL in Sweden and the Waste Order in Denmark, Landuse and building decree in Finland requires the builder to notify the authorities prior to demolition; also providing details about the amount of waste and how it is going to be handled and so on.

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While making a general comparison about the core ideas or focus points of the legislations for the three countries, it is observed that:

- Sweden focuses more on hazardous waste from demolition waste whereas Denmark is focussed on recycling specially to prevent the leaching from contaminated soils. Finland however seems to be very focussed on the reuse of building elements after demolition.

25.1.2 Waste management plans (WMP) and Strategies

The CDW waste generated in Sweden in voluminous and varied; plans for the management of such waste include high quality recycling and material re-use. This sector also consists of a large percentage of hazardous waste- which was estimated to a share of 10% according to the waste statistics of 2008 [290].

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25.1.3 Legal framework for sustainable management of CDW

The Deloitte waste management study has adopted a few parameters to describe sustainable waste management of CDW. These parameters range from the stages of demolition till waste collection; however a parameter for the green public procurements is included as well. The Table 101 explains the national and regional obligations present in Denmark, Sweden and Finland that relates to the sustainable waste management parameters.

Table 101. National and regional obligations in Denmark, Sweden and Finland

National or regional obligation towards ↓	**Denmark**	**Sweden**	**Finland**
Selective demolition	Selective demolition of buildings owned by the government is carried out according to the guidelines laid down in NMK96. Was established in 1997 during the government's Action Plan for Waste and Recycling 1993-97. In the coming future, the competencies of the demolition companies will be assessed.	During building demolition components in contact with and containing with hazardous materials are dealt with selectively. "Building code (SFS 2010:900) § 6, Paragraph 10: The monitoring plan prepared before demolition must declare how hazardous waste has been surveyed and how it will be managed" [291].	Comprises of the Land Use and Building Act 132/1999 , Land Use and Building Decree 895/199 - Waste Decree 179/2012. The Act 132/1999, oversees the recycling of usable building parts and waste after demolition. The 895/199 decree looks into the ecological footprint of a finished building and the reusability of its components. Permits before construction and demolition form a part of this decree. The Waste decree entails planning for the reclaiming and reusing of waste in an environmentally responsible manner.

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Sorting (on-site or a separate sorting facility)	Action Plan for Waste and Recycling 1993-97 demands the sorting of CDW on-site or at a registered sorting facility. Requirements for waste sorting are mentioned in the Order nr. 1309, 18/12/2012. CDW from the commercial sector that is recyclable should be sorted at source while residential CDW is deposited at the municipal recycling centre.	The Waste Ordinance SFS 2011:927 (general) and the Building Code (SFS 2010:900) established in 2011 mentions the need for sorting CDW. The Swedish Waste Management Plan from 2012-17 requires that the contractors develop methods for source-sorting and identify solutions for reuse by organizing a common collector or retailer for surplus construction material or CDW.	The Land Use and Building Decree 895/199 states the need to notify the CDW waste generated, sorting methods used and hazardous waste obtained. But the CDW is sorted according to the Waste Decree.
Obligation to separately collect different materials (iron and steel, plastic, glass, hazardous waste etc.,)	The government's Action Plan for Waste and Recycling 1993-97 stipulates the need for the municipality to make arrangements to separately collect different waste fractions.	Combustible waste is to be sorted separately (NFS 2004:4). The Building Code (SFS 2010:900) prescribes the need for a monitoring plan before demolition that declares the surveyed hazardous waste quantities. In the Swedish Ordinance on PCB (SFS 2007:19) looks into the management of PCB contaminated construction products.	The legislations (Waste Act 646/2011, Government Decree on Waste 179/2012), require that hazardous waste be separately collected and managed. The sorting obligation applies to all wastes classified as hazardous (e.g. asbestos, PCB; also solvents, paints, oils).
Green public procurement	-	Is implemented when the municipality is the constructor.	As guidance, 14 procurement areas (with most relating to buildings) have been established in the National Plan for Green Public Procurement (in 2013).

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25.1.4 Targets

Sweden:

- The Swedish Environmental Protection Agency (SEPA) has allocated a milestone target for the construction and demolition waste (within a total 5 milestones) [2] .This milestone target echoes the European Commission's Waste Directive (2008/98/EC) to take measures for the re-use, recycling or material-recovery of at least 70% (by weight) of non-hazardous CDW.
- The preparation for recycling, re-use and material recovery of non-hazardous CDW for at least 70% by weight must be done latest by 2020 (Environmental quality goal).
- The handling of waste and material in the infrastructure sector must have an increased focus on environmental and health concerns (SEPAs goal).
- To adopt a waste-specific approach towards CDW recycling as opposed to the weight-based recycling and recovery targets. The 70% target can be achieved by the recycling of heavier CDW which does not necessarily imply holistic material recovery [5].

Denmark:

- According to the Danish waste management plan for 2013-18, the waste management goals are to obtain CDW of better quality (to reduce contaminants deteriorating the environment) and at the same time maintain a high recycling rate (at least 70%) in Denmark.
- Changes in legislation are under preparation to enable better recycling of asphalt, concrete and brick. The proposed changes will be backed by scientific studies on the recycling of these materials.
- An inter-ministerial report on the mapping of PCB is in Danish buildings has been prepared.
- Studies on the environmental, social and economic dimensions of different CDW have been made such as an LCA (Life Cycle Analysis) study on the reuse of bricks has been published. A socio-economic assessment of bricks is currently being pursued. A feasibility of the recovery and recycling of concrete has been reported.
- The pros and cons of recycling impregnated wood and the potential for recycling wind turbine blades and district heating pipes is being studied.

Finland:

The waste management study document by Deloitte states that there are none of the national goals or targets set for the recovery of CDW in Finland. The target of recycling a minimum of 70% CDW has been stipulated by the National Decree on Waste (179/2012) echoing the EC Waste Directive. There are recommendations towards adopting a waste-

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specific approach towards recycling and recovery contrary to the weight-based approach. Additionally, it has been recommended that backfilling not be recognized as a recovery operation [292].

25.1.5 End of Waste (EoW) status

There are no national EoW criteria set for any types of waste so far nor is there any preparatory work going on in Denmark, Sweden or Finland [291][293][294].

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

The Deloitte report [291][293][294] describes the non-legislative instruments in every European country on the basis of instruments such as landfill tax, sustainability standards covering CDW for private and public sector, extended producer responsibility with relation to CDW. A description of such instruments for Denmark, Sweden and Finland is provided in the Table 102.

Table 102. Non legislative instruments in Denmark, Sweden and Finland

Non-legislative instruments characterized as: ↓	Denmark	Sweden	Finland
Landfill tax	The tax was established in 1987 and currently amounts to DKK 475/tonne (EUR 64/tonne). The tax is larger than the landfill fee for recyclable waste, DKK 366 /tonne (EUR 49 /tonne). . Landfill of hazardous waste was formerly excluded from the tax but has since 2010 been integrated in the taxing system; and the taxation fee is the same. The taxation has promoted the development of recycling technologies and decreased the amounts to be landfilled.	Law on landfill tax SFS 1999:673 exempts certain waste categories such as excavated soil that is deposited on landfill sites for inert waste. Reclaimed asphalt as well as construction and demolition waste is subject to the tax. A refund is granted for waste that is not disposed and subsequently removed, e.g. for recycling.	Was introduced in Finland as a legislative measure in 1996.
Sustainability standards covering CDW	DGNB (Danish Green Building Council) from 2011, in its sustainability certification of buildings oversees the	The Swedish version of BREEAM adopted in 2013 recognizes CDW management and its reuse. Points are	The most used sustainability assessment schemes include PromisE (developed in Finland), BREEAM and LEED. BREEAM

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	entire life cycle including the recovery, recycling options for CDW.	awarded for on-site waste management, the re-use of recycled mineral fractions and the re-use of façade, load bearing elements. The LEED certification provides points for the use of recycled materials in construction. "Miljöbyggnad" (an environmental certification system for buildings), managed by Sweden Green Building Council for Swedish conditions proposes to reward CDW recycling.	was established in 1990 and LEED in 1998.
Sustainability standards covering the public sector	There is no official Danish sustainability standard for buildings for the public sector. However, the Energy Agency in 2015 launched a free-of-charge Life Cycle Assessment (LCA) tool for buildings, including end-of-life. Furthermore, the Energy Agency has issued the publication "Bæredygtigt byggeri" –which includes guidance on the importance of including the whole life cycle of the building, including the CDW and considerations about		

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	resources and recycling.		
Extended producer responsibility	Extended producer responsibility programs are operated by Rockfon A/E for rock wool material.	-	-

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25.3 CDW management performance – CDW data

25.3.1 CDW generation data

Figures **Chyba! Nenalezen zdroj odkazů.**,Figure 20Figure 21 have been collected from the Deloitte waste management document [291][293][294] for Denmark, Sweden and Finland respectively.

The Danish CDW waste statistics are collected every year by the Danish EPA through a system called National Waste Data system (ADS). The ADS system (updated from the earlier ISAG) requires that along with waste handling facilities, all other actors coming in contact with CDW must report the quantities of the waste handled.

Table 103. CDW generation data, Demark (Danish ISAG system). Source: Construction and Demolition Waste Management in Denmark [293].

CDW generation data	2007		2008		2009	
	tonnes	% (w/w)	tonnes	% (w/w)	tonnes	% (w/w)
Non-suitable for incineration	123 949	2	105 866	2	89 237	2
Concrete waste	1 568 950	27	1 451 830	24	1 283 870	26
Bricks	331 858	6	220 562	4	203 867	4
Other CDW	481 704	8	734 057	12	619 626	12
Asphalt	781 217	14	883 570	15	948 585	19
Soil and stone	1 725 739	30	1 961 028	33	1 391 549	28
Other recyclable CDW	400 562	7	229 636	4	89 686	2
Other fractions	352 747	6	422 242	7	343 339	7
TOTAL	**5 766 726**		**6 008 791**		**4 969 758**	

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Year	2010			2012		
Waste type	Generated	Source separated for material recycling*,	Off-site sorted for material recycling*	Generated	Source separated for material recycling*	Off-site sorted for material recycling*
06.1 Metal waste, ferrous	50 000	50 000	37 176	33 000	33 000	29 762
06.2 Metal waste, non-ferrous			4 766	28 000	28 000	4 904
06.3 Metal waste, mixed	22 500	22 500	1 717	79 000	79 000	771
07.1 Glass waste	5 000	5 000	12	2 000	2 000	181
07.4 Plastic waste	150	150	111	200	200	540
07.4 Wood waste	125 000			300 000	0	
12. Mineral waste from construction (excluding 12.4 and 12.6)	900 000	608 659		700 000	428 381	
12.1 CDW, other sectors	14 283			144 770		
12.8 Mineral waste from waste treatment	101 900		(included in 608 659 tonnes)			47 562
(10.2 Mixed waste, not specified)				25 000	0	0
TOTAL	1 218 833	686 309	43 782	1 311 970	570 581	83 720

Figure 20. Amounts of CDW generated in 2010 and 2012 included in the definition of CDW according to the WStatR. Source: Construction and Demolition Waste Management in Sweden [291]

The Swedish EPA (Naturvårdsverket) is responsible for reporting the waste statistics, the collection of which is done by a consortium called SMED (Svenska MiljöEmissionsData). The waste data is collected using methods such as waste factors (kg/m^2 of a certain type of waste), estimated by the turnover of construction and demolition companies and CDW data from environmental reports of companies.

Waste category	2010, Mtonnes	2012, Mtonnes
Non-hazardous CDW		
CDW from buildings	1.24	1.20
Soils	4.00	3.50
Dredging spoils	3.50	2.07
Hazardous waste		
CDW from buildings	0.19	0.17
Soils	0.45	0.72
Dredging spoils	0	0
Total (non-haz. and haz. CDW)	**9.38**	**7.67**

Figure 21. Generated hazardous and non-hazardous waste in Finland by VAHTI. Source: Construction and Demolition Waste Management in Finland [293]

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25.3.2 CDW treatment data

Denmark has already achieved the 70% target of CDW recycling and recovery. The largest fraction of CDW is concrete waste- 90% of which is recycled as un-bound road subbase roads replacing natural gravel.

Year	2008	2009	2010	2011	2012	2013
Generated CDW (tonnes)	n/a	n/a	1 218 833	n/a	1 311 970	n/a
Recycled CDW (tonnes)	n/a	n/a	121 432	n/a	178 358	n/a
Backfilled CDW (tonnes)	n/a	n/a	608 659	n/a	475 943	n/a
Landfilled CDW (tonnes)	n/a	n/a	21 476	n/a	14 755	n/a
Energy recovery if any (tonnes)	n/a	n/a	240 746	n/a	413 924	n/a
Unknown treatment (tonnes)	n/a	n/a	226 520	n/a	228 990	n/a
Recycling rate (%)	n/a	n/a	59.9	n/a	49.9	n/a

Figure 22. CDW generation and recovery (prepared by SEPA). Source: Construction and Demolition Waste Management in Sweden [291]

From Figure 22 it can be seen that a large portion of the CDW from 2010 and 2012 fall into the unknown treatment category, this can be interpreted as the un-reported statistics from waste facilities. These numbers could also represent internal recycling operations within industries.

Statistics Finland released a notice on the treatment of wastes from housing construction in 2011 where 1.7 million tons of waste generated in housing construction were used or transported to pre-processing for utilization. The mineral waste used or treated for utilization amounted to 1.3 million tons and metal waste to 100 000 tons. Energy production used 250 000 tons of wood waste from construction. Around 250 000 tons of construction waste ended up at landfill sites. In 2011, the total amount of construction waste was 2.2 million tons. The figures do not include soil waste or dredging spoils generated in construction. Onsite recovery or internal recycling is not reported according to the WStatRegulation. However, on-site incineration is reported as disposal or energy recovery if existing. When the waste is received at a treatment facility, the origin of the waste is determined on a rough activity level. Wastes from construction activities are classified in their own category. As a result there is no problem in the traceability of CDW in Finland. There is no information on temporary storage, but this is not so significant because temporarily stored material is recorded as soon as it reaches a treatment

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facility. In most areas the following construction and demolition wastes are collected separately and treated: wood waste, metal, gypsum, mixed waste, brick and concrete, soil and gravel

25.3.3 CDW exports/imports data

The Danish EPA reports that import of CDW consist of metals from Sweden and the export consists of metals to Germany and the UK. ADS reported that in 2013, Denmark exported 84,006 tons and imported 16,060 tons of CDW.

In Sweden, the county administrative boards are the responsible authorities for the operative control of transboundary waste shipments to and from Sweden; the SEPA is however the main authority who approves the import or export. In 2013, 23,362 tons of CDW was imported to Sweden from Denmark, Switzerland, Estonia and Germany. The main waste types imported were glass, plastic and wood containing or contaminated with dangerous substances (17 02 04*), and wood (17 02 01). In the same year, 2,484 tons of CDW was exported to Germany, Denmark and Norway, the main waste types being cables containing oil, coal tar and other dangerous substances (17 04 10*), and soil and stones (17 05 04). In 2014, in total 23 362 tons were imported and 2 485 tons were exported. The data on exported/imported amounts are mainly based on information from building and demolition companies and information from environmental reports from waste management facilities. Regarding wood (17 02 01), it is unsure whether the wood waste really emanates exclusively from the building and demolition sector. Contrary to Denmark, Sweden seems to import more waste than export; the waste composed of impregnated wood, plastic is maybe required as fuel for the waste incinerators.

Finland exports a small amount of mixed CDW to Estonia for sorting and recycling. A very small amount of PCB-containing demolition waste is imported to Finland for disposal.

25.3.4 CDW treatment facilities data

According to the Danish Waste Association (Dansk Affaldsforening) has reported 39 landfills in Denmark with a capacity between 10,000 tons- 12.3 million tons. It is expected that the lack of landfill capacity could lead to transporting waste over longer distances thus increasing the disposal costs.
In Sweden there are 30 landfills for inert CDW. The remaining capacity is 636,000 tons as of January 2014; the landfill capacity is expected to decrease as no new are planned. 405,000 tons CDW were used for covering and rehabilitation on the existing landfills, was reported recovered. 200,000 tons are reported as input to sorting plants for mixed CDW. The number of treatment facilities only dedicated to CDW is unknown as CDW is mixed with waste from other sectors in these treatment facilities (landfills, sorting facilities, material recycling facilities, incineration facilities, etc.), but the number of so-called A-, B- and C-classified facilities which to some extent receive and treat CDW in Sweden is estimated to be around 1,250. However, mostly stationary recycling facilities are used for asphalt recycling, but no recycled asphalt is included in the statistics today as Eurostat does not ask for information on internal recycling. A

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rough estimation of what amounts of asphalt which are not directly processed on-site, and subject to internal recycling, is from 800,000 to 1 Mtons annually. There is, however, an on-going discussion between SEPA and the industry on the issue. For the time being, there is insufficient capacity for the use of more advanced separation technologies that can handle CDW. Thus, to maintain and increase the recycling of CDW the Swedish system depends to a large extent on the sorting of wastes at source.

Several different sized treatment facilities are extensively located across Finland and treat mixed CDW containing concrete, plastics, bricks, wood and metals. The combined capacity of eight large-scale facilities based on their environmental permits is around 680,000 tons. In addition, these facilities also treat other types of wastes. The possibility of pre-treatment creates an opportunity to accept larger quantities of waste. In addition to the mixed CDW treatment facilities, Finland has a number of other recycling facilities operated both by private companies and by some municipalities that can treat also source separated waste fractions such as mineral waste (e.g. over 100,000 tons). However, more detailed information of their capacity regarding source separated CDW has not been compiled in available reports. Considering the amount of CDW generated, there is sufficient treatment capacity in place in Finland. Specific inert CDW landfills are not reported. As for general inert landfills, 4 landfills with a capacity of 496,000 tonnes are operating in Finland. Figure 23 shows the distribution of landfills for hazardous, non-hazardous and inert waste.

	Landfill for hazardous waste	Landfill for non-hazardous waste	Landfill for inert waste
Total number of existing landfills	22	90	4
Number of these landfills complying with the directive	20	88	4
Number of landfills closed (no more depositing) between January 2010 and 31 December 2012	3	10	0
Number of landfills re-equipped		11	
Rest capacity (tonnes)	18 060 728	48 667 821	496 000

Figure 23. Total landfill distribution in Finland (Source: Finnish Environment Institute)

25.3.5 Future projections of CDW generation and treatment

A 2015 Danish report prepared by the EPA on waste projection, has forecasted the generation and treatment of waste, required to evaluate the future treatment capacities and the fulfilment of policy targets. The projection model is applied for two scenarios; a business as usual scenario (BAU) where no new waste policies are implemented, and a scenario where targets in the Danish Government's resource strategy 'Denmark without waste' from October 2013 are fulfilled. The activity within the building and construction sector is expected to increase by 45% from 2012 to 2030 (more than GDP), and the amount of waste is expected to increase to year 2030 with 43% calculated from the baseline for year 2012 in the BAU scenario and respectively 47% in the scenario with resource strategy fulfilled. According to the report, it is concluded that

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capacities for recycling of materials from building and construction appear sufficient for a very long period.
There are no studies so far projecting the future of CDW in Sweden and Finland.

25.3.6 Methodology for CDW statistics

The Swedish and Finnish methods follow the Eurostat guidelines however as per a statutory order in Denmark, a system called ADS (Waste data system) has the duty to report waste statistics.
The Danish EPA is in charge of collection of statistical data of data. All waste producers, receivers, exporters and importers in Denmark are, according to the Statutory Order on Waste data system no 1306/2012, obliged to give information of waste amounts, waste origin, planned treatment and waste receiver. The waste is classified according to the LoW codes and the waste producer is classified according to industry or NACE code. The statistics are based on total reports from every waste operator in Denmark. The report includes information about waste producer, recipient, waste type, and treatment, weight in metric tons. The report includes all types of waste including CDW. The statistics are published yearly, and raw data are available to the public on the system's website (https://www.ads.mst.dk). The quality of waste data is checked through checking with earlier data- and own control systems at the Danish EPA. In case of uncertainty, direct contacts are taken to the stakeholder in order to ensure correct raw data.
In Sweden, the methodology used for gathering data on CDW generation and treatment follows the Eurostat guidelines by SEPA. The same methodology has been used for 2010, 2012 and now 2014. Compared to other sectors, the uncertainties in the current method are rather high, and potential methodologies have been assessed. In 2016, the method for data collection of treated CDW amounts underwent change where waste management facilities (A- and B-classified) were under obligation to report the received CDW and corresponding treatment method. SEPA is also considering implementing increased reporting requirement for C-classified facilities but no decision has been made yet.
In Finland, the methodology used for gathering data on CDW generation and treatment follows Eurostat guidelines, when reporting is under WStat regulation requirements.

25.4 C&D waste management in practice

To fulfill the recycling target by 2020 it is basically required that the re-use and recovery of CDW increase with a subsequent decrease in energy recovery. High quality recycling requires homogeneous waste fractions that could be implemented when waste material is sorted at source during and after building demolition. To ensure lesser contamination from PCBs, PCAH and so on, an inventory assessment prior demolition is to be taken. However as the current guidelines for waste-handling during demolition concentrates on the reduction of hazardous CDW and waste prevention, focus should be laid on preparation for recycling as well. It is advised that the demolition plan pay heed to the recycling of mineral fractions such as concrete, bricks and stones.

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CDW sorting

Denmark: According to the Statutory Order no. 1309/2012 (Affaldsbekendtgørelsen) on waste, CDW is to be sorted on site into 10 waste fractions (concrete being one of the fractions). Sorting on-site can be neglected if the waste arising from the construction and demolition operation is less than 1 tonne; if for a certain reason sorting is impossible on the site then sorting takes place in a stationary facility approved by the municipality.

Finland: The Finnish Government Decree 179/2012 on waste requires the CDW holder to organize separate collection of waste to ensure a significant amount of waste can be reused, recycled or recovered. Separate collection of waste is obligatory for a few waste types which include a mineral and ceramic waste group containing concrete, brick and tiles.

Sweden: Sorting guidelines are given by the Swedish Construction Federation (Sveriges Byggindustrier) [295] for on-site sorting obligatory for 9 waste types. The sorting aspects are subjected to change depending on the material type, hazardous composition and desirable method of disposal in the site vicinity. The ordinance on Landfilling of Waste (2001:512) prohibits the disposal of unsorted combustible waste at a landfill site. Exceptions were made in 2005 regarding the organic waste. The exception for landfilling of organic and combustible waste is given in SEPA regulations and guidelines on the handling of combustible and organic waste. Combustible CDW need not be sorted at source if circumstances are such that sorting on-site is not possible.

Denmark	Finland	Sweden (Acc. To Sverigesbyggindustrier)
Natural stone, e.g. granite and flint	Concrete, brick, mineral tile and ceramic waste	Products and materials for re-use
Non-glazed tiles (Brick and roof tiles)	Gypsum-base waste	Hazardous waste
Concrete	Non-impregnated wood waste	Electronic waste
Mixtures of stone materials, and non-glazed tiles and concrete	Metal	Wood
Iron and metal	Glass	Plastic for recycling
Gypsum	Plastic	Combustible
Stone-wool	Paper and cardboard	Scrap and metal
Soil	Soil and waste rock material	Fill material
Asphalt		Waste to be landfilled
Mixture of concrete and asphalt		

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25.4.1 CDW management initiatives

Most of the CDW management initiatives for Sweden, Denmark and Finland are acquired from the Waste studies reports prepared by Deloitte for the European Commission [291][293][294].

Initiative	Details
Sweden	
Guidelines on the hazard classification of asphalt by the Swedish EP	Established in 2013, a national initiative
Guidance on waste prevention	Skåne (southern province in Sweden) has prepared 2 reports of the reduction of CDW.
Guidance for the reduction of CDW and aspects included in public procurement	Established by Swedish association of Local authorities and regions
Project Constructivate	Convened by Mistra Closing the Loop, this project aims to determine the path for the effective recycling of CDW. The project focusses on rules and regulations, design of logistics and business models. The project works on the traceability of materials during the time of demolition and the economic motivation for contractors to demolish properly.
Denmark	
Quality of CDW, Initiatives for CDW management – Prepared by Danish EPA	The quality of CDW was determined by the level of contamination by PCB. More stringent regulations on demolition have been proposed to get a better idea about the material recovery potential. Better possibilities for the recycling of concrete and new methods for handling impregnated wood, masonry [7].
Finland	
ReUse-project financed by the Finnish Ministry of the Environment	Reuse of structural elements: obstacles and opportunities. Established in 2014.
Rudus/Betoroc; Mixture of concret eand bricks	Recycling of reclaimed concrete in earth construction that was established in 1996.
Zenrobotics Recyclers (Finnish SME)	Development of robotic recycling system (ZRR) which picks raw materials (wood, plastics, metal, stone, concrete etc) from construction and demolition waste.

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	Waste material spread on a conveyor belt and the ZRR system will autonomously sort the waste. Established first in 2007.
HISER-project "Holistic Innovative Solutions for an Efficient Recycling and Recovery of Valuable Raw Materials from Complex Construction and Demolition Waste" (2015-2019)	HISER's main goal is to develop and demonstrate novel cost-effective technological and non-technological holistic solutions for a higher recovery of raw materials from ever more complex construction and demolition waste due to the variety of materials used. The solutions obtained will be validated in demolition work and five case studies throughout Europe. The environmental and economic impact of the solutions obtained in the HISER project will be quantified from a life cycle perspective (LCA/LCC). Recommendations will also be put forward to define new European policies and standardization standards to implement the best solutions in the construction sector.
Project on wood recycling financed by the Finnish Ministry of the Environment	Development of new recycling concepts and new products from wood waste.
European Regional Development Fund project on recycling of gypsum and felt roof waste	Study on collection systems and treatment processes of gypsum and felt roof waste – analysis of barriers & economics

25.4.2 Drivers / barriers to increase CDW recycling

Barriers to increase recycling

The table below is a brief description of the barriers Sweden and Finland faces at fulfilling vital features attributive to high recycling rates in a given recycling chain. These points are primarily derived from Deloitte's study [291][293].

	Sweden	Finland
Legislation	The EU WFD targets for recovery: As the target is weight-based it promotes foremost the recovery of mineral waste fractions but does not target the fractions causing larger environmental impacts. The target does lay focus on high-quality recycling instead considers backfilling	Legislations relating to health and safety impede the progress in recycling. Lack of EoW criteria for CDW. The recycling targets are not country-specific especially to factors like climate, material availability, housing

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	as a recovery measure. The definitions of recycling and recovery are very fitting for the building scenario but does not emphasize on the recycling of asphalt and track ballast (from infrastructure operations) that have a high recycling rate.	types etc.
Economics	SEPA has surveyed in 2015 that waste sorting increases treatment costs when compared to waste combustion. The long transportation distances to cover during waste treatment and recycling is not feasible on the long run.	Good availability of natural sands and aggregates reduces the demand for recycled alternatives. The market for recycled materials is thus lacking.
Sorting and recycling process techniques	On-site sorting is better than off-site sorting as automated sorting is not available in all the facilities.	As there is a lacking market for recycled materials, there is no motivation to establish standards or guidelines for waste sorting.
Quality	The presence of hazardous waste and contamination in CDW negatively influences quality. There is no standardization/ certification (CE marking) for secondary raw materials in construction.	There is a difference in the quality of recycling resulting in the utilizing of CDW in low-grade applications.
Work contracts	Several stakeholders' involvement does not help in waste prevention.	

The barriers for vital features in the recycling chain in Denmark are:

- Market conditions are not very well developed for CDW as it is not economically feasible because of the cost intensive recycling process, transportation. At the same time it is hard to ensure regular supply and a good quality secondary material.
- Recycling process and techniques: high-grade use of recycled CDW requires advanced sorting techniques. The supply of CDW has to match the demands, this requires intensive planning.
- Quality: The lack in clarity while interpreting PCB related criteria leads to larger contamination leading further to large and avoidable costs.

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Benefits to increase recycling

	Sweden	Finland
Legislation		Material specific recycling targets: 70 % of construction and demolition waste must be recycled as material by 2020. Government Decree 591/2006 promotes the utilization of crushed concrete.
Economics	The landfill tax and the large transportation distances have reduced the landfilling of CDW.	Reduced landfilling owing to landfill tax.
Sorting and recycling process techniques	Landfill taxes and ban of landfilling of combustible waste fractions promote sorting of waste and improves quality of CDW..	Benefits the environment.
Quality		Use of efficient selective dismantling enables the separation of unwanted fractions from CDW and improves quality.
Work contracts	Several stakeholders' presence in the planning stage will ensure a uniform improvement in the recycling rates.	

The benefits for vital features in the recycling chain in Denmark are:

- Market conditions: The availability of economic support (by means of loans) while pursuing CDW recycling is an advantage. The cooperation between the stakeholders of industry and waste-management are advantageous as well.
- Economic: The taxation on non-reusable CDW and a tax on natural resources ensure an increase in the recycling rate.
- Recycling process and techniques: substituting natural resources with recycled- reduced exploitation.
- Quality: Implementing selective demolition on a larger level and the practice of on-site sorting.

25.5 CDW sector characterization

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The CDW sector characterization for Denmark, Sweden and Finland are similar to each other with respect to the operations involved right from the stages of demolition, waste sorting and treatment.

The sector for Denmark and Sweden consists of the following actors (as is explained in [291][293][294]):

Sweden	Denmark
Building companies	Building owners
Demolition companies	Architects and consulting engineers
Waste transport companies	General contractors
Waste sorting or treatment companies	Specialized demolition contractors
End-users (incl. waste incinerators, landfill companies)	Waste handling companies and recyclers
Authorities (permitting, monitoring)	Transport companies
	Municipal authorities

The CDW sector in Finland consists of construction and demolition companies as waste producers. It is the municipalities that monitor and control the sorting and treatment procedures of CDW, often giving guidelines based on national legislation. The guidelines are mainly about separating the hazardous components from the non-hazardous and sending the waste to the respective treatment facility. The sorting is done on-site by the demolition contractors.

The waste-treatment, logistics and demolition operations are mainly carried out by private contractor companies.

25.5.1 CDW materials (CONCRETE, BRICKS, TILES AND CERAMIC, ASPHALT, WOOD, GYPSUM)

Product description and applications, recycled new products and recovery techniques

CDW material	Application
CONCRETE	Concrete waste in Denmark, Sweden and Finland is used mainly as filling in the unbound road layers. The rate of concrete recycling however varies across the countries with Denmark achieving nearly 90%. In a few isolated cases across all three countries, aggregates are reclaimed from waste concrete and used to produce new concrete. Technical specifications for the use of reclaimed aggregates for the unbound use in road filling, is given by the Swedish Transportation Administration.
BRICKS	Similar to concrete waste, bricks are used as filling materials in roads, landfill covers in all 3 countries. Where selective demolition is possible, bricks are re-used in new construction.

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TILES and CERAMIC	
ASPHALT	The most important criteria for asphalt recycling established by the Swedish EPA are the carcinogenic PAH-16 or PAH-7 are below 300 and 100 mg/kg respectively. In Denmark, technical guidelines on the use of reclaimed asphalt in unbound application have been published by the Danish Road Directorate.
WOOD	It is very common in Finland to produce chipboard from waste wood after the removal of nails. This is achieved by crushing plywood, chipboards and lumber by several actors. The recycling of wood is prevalent in Sweden whereas, the energy recovery from combustion of waste wood is also common.
GYPSUM	In Finland the gypsum recovered from waste plasterboards are recovered for use in the production of new plasterboards. The same is common in Sweden where according to recycling companies, the recycling of gypsum into new plasterboards is cheaper than landfilling.

Product description and applications

See section25.5.1

Quantitative analysis

See section25.5.1

Recovery techniques

See section25.5.1

Environmental and economic impacts of CDW waste management

See section25.5.1

Drivers / barriers to increase recycling

See section25.4.2

25.5.2 Recycled materials from CDW

See section25.5.1

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25.5.3 Market conditions / costs and benefits

The following is the quality control process during the receipt of crushed concrete and alternative material for use in unbound layers for roads (as given by the Swedish Transportation Administration):

The crushed concrete that is to be used in road construction should have its properties declared and receipt controlled. Where the product is not certified then the monitoring during receipt is done by conducting a few tests, the delivery of material is accompanied by a demolition certificate.

If the crushed concrete product is not certified the producer must show a declaration of control conducted by the producer for certain properties like purity, strength and abrasion resistance. The declaration containing the details on the properties cannot be more than a year old.

The market in Sweden for recycled aggregates for road filling is dominated by demolition, waste-management companies, quarries and construction companies. These are sold as material alternative to natural gravel for purposes such as road-filling, landscaping, landfill covers and so on.

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