28. UNITED KINGDOM

28.1 Legal Framework – Waste Management Plans and Strategies

28.1.1 National Legislation concerning CDW

Waste legislation in the UK applies to all types of waste. No specific pieces of legislation or regulation are exclusively related to CDW[321]. The UK has transposed the revised EU Waste Framework Directive 2008/98/EC on Waste (WFD 2008/98/EC) [321] into national law [323]-[325] in 2011. A summary of key regulations regarding management of waste in the four regions of the UK (England, Wales, Scotland and Northern Ireland) are given below:

England and Wales

The requirements of WFD 2008/98/EC [321] are applied in England and Wales by the Waste (England and Wales) Regulations 2011 [323] and subsequent amendments [326]-[327] including in Wales, The Waste (Wales) Measure 2010 [328]. They set out the requirements for waste management plans, waste prevention plans, waste hierarchy implementation and carrying of waste/duty of care [321].

Scotland

The requirements of WFD 2008/98/EC [321] are applied in Scotland by The Waste (Scotland) Regulations 2011 [324] and subsequent amendments [329].

Northern Ireland

The requirements of EU WFD 2008/98/EC [321] are applied in Northern Ireland by the Waste Regulations (Northern Ireland) 2011 [325] and subsequent amendments [330]-[331].

Hazardous Waste in UK

The Hazardous Waste (England and Wales) 2005 Regulations [331] and subsequent amendments [332], The Special Waste (Scotland) Regulations 1997 [335] and subsequent amendments [336]- [337] and The Hazardous Waste Regulations (Northern Ireland) 2005 [338] and subsequent amendments [339]-[341] make provisions for the controlled management of hazardous waste from the point of production to the final point of recovery or disposal. They transpose the requirements of the Hazardous Waste Directive 91/689/EC (HWD 91/689/EC)[342] replaced by WFD 2008/98/EC [321] into national law. They provide an effective control system for hazardous wastes and ensure that they are properly managed from their point of production to the final point of recovery or disposal.

Landfill Legislation in UK

The Environmental Permitting (England and Wales) Regulations 2010 [343] and subsequent amendments [344]-[358], The Landfill (Scotland) Regulations 2003 [359] and subsequent amendments [360]- [363] and The Waste Management Licensing Regulations (Northern Ireland) 2003 [364] and subsequent amendments [365]- [371] transpose the current requirements of the Landfill Directive 1999/31/EC (LD 1999/31/EC) [372] into national law. They set out standards for the design and operation of landfills.

European List of Wastes

The List of Wastes (England) Regulations 2005[373] and subsequent amendments[374], The List of Wastes (Wales) Regulations 2005[375], The List of Wastes Regulations (Northern Ireland) 2005 [376] and subsequent amendments [377] and The Special Waste (Scotland) Regulations 1997 [378] and subsequent amendments [379]-[380] transpose the European List of Wastes (Commission Decision 2000/532/EC)[381] into national law. The European List of Wastes [381] is used to classify a material substance either as waste or as hazardous waste.

UK Landfill Tax

The Landfill Tax[382] applies to the disposal of waste in landfills. It was introduced as an environmental tax in 1996 by the UK Government to increase diversion of waste from landfills. The cost for this is currently £84.40/tonne standard rate and £2.65/tonne lower rate. The lower rate is paid on "inactive waste" such as rocks or soil.

UK Aggregates Levy

Aggregates levy [383] is a tax that applies to the commercial exploitation of aggregate (digging, dredging or importing rocks, sand or gravel). It was introduced as an environmental tax in 2002 by the UK Government to encourage the recycling of aggregate. The levy is charged at a flat rate of £2 for every tonne of aggregate extracted. It is also applied at a proportional rate for quantities less than a tonne.

28.1.2 Waste management plans (WMP) and Strategies

In the UK, Waste Management Plans (WMP) have been developed by each of the Government Bodies of England, Wales, Scotland and Northern Ireland. A summary of WMP in the four countries of the UK is given below:

<u>England</u>

Waste Management Plan for England [384] published by the Department for the Environment, Food and Rural Affairs (DEFRA) in 2013, contains a small section which specifically deals with CDW. This highlights the EU target to be reached in 2020 (i.e. at least 70% by weight of CDW

should be subjected to material recovery) and the current performance against it (England and UK are already achieving an estimated recovery rate of 93% at the time of publication in 2013).

Wales

Towards Zero Waste-One Wales: One Planet Plan [385] published by the Welsh Assembly Government in 2010 is the Overarching Waste Strategy Document for Wales and deals with management and prevention of waste. It contains some information which specifically refers to CDW and suggests that Wales have met their re-use, recycling and recovery target for CDW of at least 85% by 2010. In addition, it sets a new target of at least 90% by weight for reuse/recycling of non-hazardous CDW by 2019/2020.

Construction and Demolition Sector Plan (for Wales) [386] published by the Welsh Assembly Government in 2012 considers both the management and prevention of CDW. It is intended to support the Overarching Waste Strategy Document [385] by detailing outcomes, policies and delivery actions for organisations, companies and individuals involved within the construction and demolition sector in Wales. The document examines both the management and prevention of CDW[321].

Scotland

Scotland's Zero Waste Plan [387] published by the Scottish Government in 2010 sets out the vision for waste policy in Scotland. Although this plan considers CDW, it does not contain a specific section on CDW [321]

Northern Ireland

Delivering Resource Efficiency Plan [388] published by the Department of the Environment (Northern Ireland) in 2013 focuses on both waste management and prevention. The document contains a specific section for CDW which describes the current performance of recycling. It states than in 2009/2010 non-hazardous CDW waste excluding uncontaminated stones and soil accounted for 1.2 million tonnes, of which 70% was diverted from landfill. Finally, it includes the EU recovery rate target of 70% for all non-hazardous CDW by 2020 [321].

28.1.3 Legal framework for sustainable management of CDW

According to the Construction and Demolition Waste Management in United Kingdom Report [321] existing pieces of legislation which promote the sustainable management of CDW are listed as follows:

National/Regional Obligation for Selective Demolition

No specific National/Regional Obligation for Selective Demolition exists.

National/Regional Sorting Obligation (on-site or in sorting facility)

The Waste (England and Wales) Regulations 2011 [323] and subsequent amendments [326]-[327], The Waste (Scotland) Regulations 2011 [324] and subsequent amendments [329] and The Waste Regulations (Northern Ireland) 2011 [325] and subsequent amendments[330]-[331] introduced a duty on organisations that collect waste paper, metal, plastic and glass that from 1 January 2015 this should be done by way of separate collection where it is technically, environmentally and economically practicable (TEEP).

The Environmental Permitting (England and Wales) Regulations 2010 [343], The Landfill (Scotland) Regulations 2003 [360] and The Waste Management Licensing Regulations (Northern Ireland) 2003 [364] set out the regulations covering waste management licenses, permits, exemptions and carriers.

Environment Agency (England) (EAE) and Natural Resources Wales (NRW) Position Statement: Landfilling of gypsum waste including plasterboard [389] (publication withdrawn 6 July 2016), Scottish Environment Protection Agency (SEPA) Technical Guidance Note: The Disposal in Landfill for Non-Hazardous Waste of Gypsum Wastes [390] and Northern Ireland Environment Agency (NIEA) Technical Guidance Note: The Management for Non-Hazardous Waste of Gypsum Wastes [391] state that non-hazardous gypsum-based materials (e.g. plasterboard) must not be landfilled with biodegradable waste. Producers of gypsum waste should separate it for recovery and recycling whenever possible, either on-site or through a licenced waste facility. Where this is not possible and wastes containing gypsum are sent to landfill, they must be deposited in a separate cell in which no biodegradable waste is accepted.

National/Regional Separate Collection Obligation for Different Materials (such as iron and steel, plastic, glass)

The Waste (England and Wales) Regulations 2011 [323] and subsequent amendments [326]-[327], The Waste (Scotland) Regulations 2011 [324] and subsequent amendments [329] and The Waste Regulations (Northern Ireland) 2011 [325] and subsequent amendments [330]-[331] introduced a duty on organisations that collect waste paper, metal, plastic and glass that from 1 January 2015 this should be done by way of separate collection where it is technically, environmentally and economically practicable (TEEP).

Obligation for Separate Collection and Management of Hazardous CDW

The Hazardous Waste (England and Wales) Regulations 2005 [331] and subsequent amendments [332], The Special Waste (Scotland) Regulations 1997[335] and subsequent amendments [336]-[337] and The Hazardous Waste Regulations (Northern Ireland) 2005 [338] and subsequent amendments [339]-[341] make provisions for the controlled management of

hazardous waste from the point of production to the final point of disposal or recovery. These regulations are related to all hazardous waste including CDW.

Related Green Public Procurement Requirements

Greening Government Commitment targets (UK) [392] (Published 8 August 2014) sets out the targets that Central Government Departments and their Agencies must meet by 2015. This includes reducing greenhouse gas emissions, reducing the amount of generated waste and ensuring Government buys more sustainable and efficient products and engages with its suppliers to understand and reduce the impacts of its supply chain.

Wales procurement policy statement 2012 [393] contains 9 policy principles for the Welsh Public Sector. One of these is related to economic, social, environmental impact. This states that value for money should be considered as the optimum combination of whole-of-life costs in terms of generating efficiency savings, good quality outcomes for the organization and also benefits society and the economy, whilst minimizing damage to the environment.

Scottish Sustainable Procurement Action Plan [394] (Published 28 October 2009) sets out 10 key steps and associated actions to sustainable procurement. It outlines an approach to successful sustainable procurement which means identifying more sustainable ways of meeting requirements and designing appropriate sustainable procurement specifications. The approach should address the social, economic and environmental implications of product and service choices. It should embrace whole life costing and address how aspects such as design, manufacturing materials, operating costs, energy consumption, waste and recycling options support a more sustainable approach.

Northern Ireland Public Procurement Policy 2014 [395] outlines 12 guiding principles to govern the administration of public procurement in Northern Ireland which reflect the statutory obligations related to equality of opportunity and sustainable development.

28.1.4 Targets

CDW targets vary across the four countries (England, Wales, Scotland and Northern Ireland) of the UK with different targets being adopted [396].

England

In England a target of 70% is set for re-use, recycling and recovery of CDW by 2020 in accordance with WFD 2008/98/EC [321], [396]. In addition, a joint Industry/Government target was set to halve CDW to landfill by 2012 based on a 2008 baseline[321].

Wales

In Wales a target of 90% is set for re-use, recycling and recovery of CDW by 2019/20. In addition, a proposed annual target of 1.4% reduction in CDW generation throughout the time period leading to 2050 is set [396].

Scotland

In Scotland a target of 70% is set for re-use, recycling and recovery of CDW by 2020 in accordance with WFD 2008/98/EC [396].

Northern Ireland

In Northern Ireland a target of 70% is set for recovery of CDW by 2020 in accordance with WFD 2008/98/EC[396]. In addition, a target of 85% resource efficiency for the Northern Irish economy by 2025 has been set by the Sustainable Development Strategy for Northern Ireland [397]. This includes the progressive reduction of quantities of biodegradable waste going to landfill and a general waste reduction in all sectors, encourage and motivate businesses regarding resource efficiency and waste minimisation and promote materials re-use, recycling and recovery through initiatives such as the Waste and Resources Action Programme (WRAP).

Industry targets across the UK

In addition to the above targets set by the Government Bodies of the four countries of the UK, construction companies as well as high profile construction projects (London Olympics 2012, Crossrail etc.) have set their own targets for diverting CDW from landfill [321]. More specifically, UK Contractors Group has set targets for their members which include:

a) Divert at least 90% of CDW from landfill with the ambition of achieving zero non-hazardous CDW to landfill by 2020.
b) 50% Reduction in construction waste by 2020 based on a 2010 baseline.

The National Federation of Demolition Contractors on the other hand, has tasked its members to achieve a reduction of CDW sent to landfill. This led to an audited result of 94% achieved in 2014 [321].

Building Research Establishment Environmental Assessment Method (BREEAM) schemes for assessing, rating and certifying the sustainability of buildings award credit points for minimizing waste (which are measured by m^3 or tonnes/100 m^2 floor area and diversion of waste from landfill) [321].

28.1.5 End of Waste (EoW) status

End of Waste (EoW) criteria have been established in the UK since 2011 [321]. The waste producer has to check whether its waste derived product meets the requirements of EU EoW Regulations for iron, steel and aluminium scrap [398], glass cullet [399] or copper scrap [400]. If

no EU EoW Regulation is relevant to the waste derived product, then waste producers must undertake an EoW Test. An EoW Test is met by either complying with a Quality Protocol (England, Wales and Northern Ireland) or carrying out an EoW Test Assessment.

A Quality Protocol sets out EoW criteria for the production and use of a product from a specific type of waste. Compliance with these criteria is considered sufficient to ensure that the fully recovered product may be used without undermining the effectiveness of EU WFD 2008/98/EC [321] and therefore without the need for waste management controls. More specifically, a Quality Protocol indicates how compliance should be achieved and points towards good practice for the storage, transportation and handling of the fully recovered product. In addition, the Quality Protocol aims to provide increased market confidence in the quality of products made from waste and hence encourage greater rates of recovery and recycling.

Quality Protocols which are relevant for CDW include: aggregates from inert waste [401], flat glass [402], lubricating oils [403], waste plasterboard[404] and non-packing plastics [405].

It should be noted that producers and users are not obliged to comply with the above Quality Protocols. If they do not, then the material will be considered to be waste (unless on a case-by-case basis can be demonstrated otherwise) and waste management controls will apply to its handling, transportation and use[401]- [405].

In addition, the above protocols do not affect the obligation of producers to hold an environmental permit (including an exemption) and to comply with its conditions when storing and processing waste [401]- [405]

In Scotland, SEPA does not automatically recognise the validity of the above protocols. In some cases, regulatory position statements are issued (for example when it comes to recycled gypsum from plasterboard [406]). In other cases the Quality protocol is valid (for example when it comes to recycled aggregate from inert waste [401]).

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

Non legislative instruments in the UK dealing with CDW include:

- Building Research Establishment Environmental Assessment Method (BREEAM) (last updated in 2014). It has specific topics related to CDW which include requirements to have a waste management plan, set waste reduction targets and divert waste from landfill [407].
- Code for Sustainable Homes (last updated in 2010). It has specific issues related to CDW waste which include requirements to have a waste management plan, set waste reduction targets and divert waste from landfill [408].

- Building Research Establishment (BRE) Home Quality Mark (HQM) (introduced in 2015). This is a standard for new homes. It includes measures and practices for improving efficiency by effectively managing and reusing waste materials [409].
- Royal Institution of Chartered Surveyors (RICS) SKA rating. This is an environmental assessment method, benchmark and standard for the fit-out of non-domestic buildings. It includes measures for reducing waste sent to landfill, designing out waste, increase recycling of CDW and preparing a site waste management plan [410].
- CEEQUAL international evidence-based sustainability assessment, rating and awards scheme for Civil Engineering, infrastructure, landscaping and public realm projects (last updated in 2012). It was established following work promoted by the Institution of Civil Engineers (ICE) UK and operated with a group of 14 industry shareholders. CEEQUAL contains a section on the use and management of physical resources which covers topics such as minimising material use and waste, responsible sourcing of materials, using re-used and/or recycled materials, durability and maintenance, future de-construction or disassembly, design for waste minimisation, waste from site preparation, policies and targets for resource efficiency and on-site waste management [411].
- The Construction Waste Measurement Protocol published by the European Network of Construction Companies for Research and Development (ENCORD) in 2013. This document is a guide for measuring and reporting waste from construction activities [412].
- Northern Ireland Government Construction Clients Sustainability Action Plan (2012-2015) (introduced in 2012). It has a number of topics related to CDW including where projects should report and measure their performance and set percentage waste to landfill reduction target for each year to achieve at least 75% recycling or re-use of Construction, Demolition and Excavation Waste (CDEW) by 2020 using a 1998 baseline [413].
- Guidance Note 4: Bulk Inert Materials/Aggregates-Re-use and Recycling published by the Department of Finance and Personnel, Government of Northern Ireland (published in 2006 and amended in 2009). The aim of this guide is to promote the re-use and recycling of bulk inert materials in construction in order to reduce consumption of natural resources, energy, transport costs and waste going to landfill [414].
- Guidance Note 6: Demolition, Dismantling, Recovery and Re-use published by the Department of Finance and Personnel, Government of Northern Ireland (published in 2007 and amended in 2012). The aim of this guide is to minimise the amount of waste sent to landfills from the demolition and dismantling of buildings and structures [415].
- ICE Demolition Protocol is a national protocol first published by ICE in 2003 and updated in 2008. It provides a framework for delivering on sustainable construction. More

specifically, it shows how the production of demolition material can be linked to its specification and procurement as a high value material in new construction. In addition, it shows how resource efficiency can be driven through the planning process [416].

- Waste and Permitting Guidance published by the National Federation of Demolition Contractors (NFDC) in 2012. It provides guidance to UK NFDC members on environmental permitting [417].
- Technical Memorandum 56 (TM56): Resource Efficiency of Building Services (introduced in 2014) is a national guidance produced by both Chartered Institute of Building Services Engineers (CIBSE) and WRAP. It aims to help Engineers and Consultants to better understand the principles and importance of resource efficiency [418].
- Scottish Ecological Design Association (SEDA) Design for Deconstruction is a regional (Scotland) guide for how to apply design for deconstruction (published in 2005). It aims to minimise construction waste, CO_2 emissions and construction costs through the use of reclaimed materials [419].
- SMARTWaste is a national online reporting platform managed and owned by BRE (introduced in 2008). It is a web based tool for companies designed to monitor and measure CDW as well as other environmental impacts [420].
- measuRE is a national Built Environment reporting tool which allows users to monitor resource efficiency (introduced in 2014). It replaced the Waste Landfill Reporting Portal and covers use from construction activities and corporate operations [421].
- Net Waste Tool is a national online resource managed and owned by WRAP (Waste & Resources Action Programme) (introduced in 2008). It is a wed based tool for companies designed to forecast construction waste arisings, develop site waste management plans, reduce the costs of construction waste, optimise waste disposal strategy, measure reductions in waste to landfill (including carbon impact) and increase re-use and recycling of CDW [422].
- BREMAP is a national online map for finding the nearest CDW facility by postcode (introduced in 2008). It is managed and owned by BRE [423].
- Recycled and Secondary Aggregates Suppliers Map is a regional map (Scotland) system for aggregate producers who have complied with the Quality Protocol: Aggregates from inert waste[401]. It was developed in 2014 [424].
- Environment Agency Carbon Calculator is a regional (England and Wales) online calculator (excel spreadsheet) developed by Environment Agency (England and Wales) in 2014. It is used for construction projects including material and waste management routes [425].
- Considerate Constructors Scheme (CCS). This is scheme in which construction companies and suppliers voluntarily register and agree to abide by the Code of Considerate Practice, designed to encourage best practice beyond statutory

requirements. The main areas of concern are: the general public, the workforce and the environment including CDW management [426].

28.3 CDW management performance – CDW data

28.3.1 CDW generation data

CDW data in the UK is collected on an annual basis. The data is collected through the Environment Agency (England), Natural Resources (Wales), Northern Ireland Environment Agency (NIEA) and Scotland Environment Protection Agency (SEPA) using waste management data from licensed waste management facilities. In addition, data from other sources such as the recycled aggregates industry is used. Finally, the above data is occasionaly supplemented by surveys on CDW or CDEW arisings conducted on either England, Wales or Northern Ireland [427]- [429].

Table 123 based on DEFRA's Diggests of Waste and Resource Statistics (2015) [430] and (2016) [431] provides information regarding generation of CDW (excludes excavation waste) in UK for years 2010 and 2012.

Table 123. Generation of Non-Hazardous and Hazardous CDW and Recovery Rate for Non-Hazardous CDW in UK (Years 2010 and 2012).

Year	Non-Hazardous CDW (tonnes)	Non-Hazardous CDW Recovery (tonnes)	Non-Hazardous CDW Recovery Rate (%)	Hazardous CDW* (tonnes)
2010	45419000	39129000	86.2	1018000
2012	44786000	38759000	86.5	1057000

*includes dredging

The above data shows that in 2010 and 2012 the UK achieved Non-Hazardous CDW recovery rates of 86.2% and 86.5%, respectively. These rates are above the 70% target which the UK must meet by 2020.

28.3.2 CDW treatment data

UK estimates on recovery rate of Non-Hazardous CDW were calculated in accordance with WFD 2008/98/EC [321]. However, the methodology used for calculating data is not identical across all UK countries. Although absolute values of CDW are subject to a relatively high level of uncertainty, sensitivity analysis suggests no significant impact on the final recovery rates 1]. It is estimated that the majority of CDW in the UK is turned into an End-of-Waste aggregate product under exemption. Finally, there is no available data regarding storage of CDW.

28.3.3 CDW exports/imports data

Some waste materials have an export/import market. In 2013 the UK has exported 13.2 million tonnes of scrap metal worth more than £4.3 billion, while importing 0.5 million tonnes. Part of this metal originated from CDW [321]. Wood waste is also exported mainly for use as biomass in Germany and Sweden. According to Wood Recyclers' Association (WRA) over 600000 tonnes of wood waste were exported in 2014. Some of this wood may have come from CDW [432]. In addition, 1.8 million tonnes of Refuse Derived Fuel (RDF) were exported from England and Wales in 2013. Some of this may have been derived from CDW 1]. Finally, approximately 50% of packaging waste in 2011 was exported with a small quantity coming from CDW [433].

28.3.4 CDW treatment facilities data

CDW treatment data in the UK is collected on an annual basis. DEFRA is responsible for collecting and combining data from treatment facilities authorised by mandatory permit or license from the environment agencies (EAE, NRW, SEPA and NIEA) of all four UK regions. The permit or license defines the capacity limit of the facility with the exception of some small scale incinerators for which the permit or license does not set a limit (some CDW such as insulation foams and plastics may be sent for incineration). Table 124 adopted from Construction and Demolition Waste Management in UK Report 1] and shown below provides information on the number of treatment facilities in the UK and their capacities (UK and England only).

Table 124. Number and capacity of treatment facilities in UK that accept CDW.

Facility Type	Measure	UK	England	Wales	Scotland	Northern Ireland
Energy recovery	Number of facilities	27	13	3	8	3
	Capacity (tonnes/year)	2893000	2111000			
Incineration	Number of facilities	87	65	1	15	6
	Capacity (tonnes/year)	8385000	7992000			
Recovery other than energy recovery (includes backfilling)		3542	1895			
Deposit onto or into	Number of facilities	594	478	25	71	20

Facility Type	Measure	UK	England	Wales	Scotland	Northern Ireland
land (landfill)	Rest (remaining) capacity (m^3)	633203000	505438000			

*Energy recovery refers to facilities where the main purpose is generation of energy or formal R1 accreditation has been awarded.

28.3.5 Future projections of CDW generation and treatment

No future projections of CDW generation and treatment are available at national level 1]. When it comes to regional level, the Welsh Government Construction and Demolition Sector Plan [386] provides information on the development of CDW treatment capabilities (such as allowing businesses to use household recycling centres).

28.3.6 Methodology for CDW statistics

The CDW recovery rates given in Section 28.3.1 were submitted to the Statistical Office of the European Union (EUROSTAT). However, the estimation methodology was not able to use accurate data regarding aggregate production or identify specific European Waste Classification for Statistics (EWC-STAT) codes in generation and treatment of CDW. DEFRA is aware of the above limitations and is currently aiming to address them in conjunction with the industry in time for the 2016 Data submission.

28.4 C&D waste management in practice

28.4.1 CDW management initiatives

- Carpet Recycling UK is a national initiative established in 2008. Since then, it helped to divert 567000 tonnes of carpet waste from landfill to recycling or energy recovery [434].
- Envirowise (now part of WRAP) is a UK Government-funded programme established in 1994 that provides free advice and practical guidance to help businesses of all sizes and sectors boost resource efficiency and ultimately save money [435].
- Enabling Zero Waste is a regional (Constructing Excellence in Wales) initiative designed to work with the construction industry. It was established in 2013 in order to provide practical, positive and active intervention via professional waste management solutions for achieving zero waste send to landfill [436].
- **Demolition and Refurbishment Information Datasheets (DRIDS)** provide informative and practical guidance around the materials and products found on modern demolition sites. It was established in 2013 by the NFDC[437].

- WASTE is a regional (England) action plan for halving construction, demolition and excavation waste to landfill. It was published in 2011 by the Strategic Forum for Construction [438].
- BRE Dealing With Difficult Demolition Wastes Guide provides practical guidance for improving the recovery of certain types of waste arising from demolition that are difficult to reuse, recycle or recover (such as carpet underlays, insulated concrete formworks, industrial batteries, structural insulated panels and smoke alarms). It was published in 2013 [439].
- UK Contractors Group (UKCG) supports its members in practising effective waste management by reducing waste production and diverting waste from landfill. UKCG members have agreed to report data through the WRAP. In 2012 UKCG members diverted 91% of all construction and demolition waste away from landfill [440].

28.4.2 Drivers / barriers to increase CDW recycling

Factors which act as drivers for increased CDW recycling include schemes such as BREEAM, Government sponsored programmes such as WRAP and the Landfill Tax. More specifically:

- BREEAM awards credits to projects that meet targets for diverting CDW from landfills. This has led to an increase in recycling with construction contractors demanding better performance from their waste management subcontractors [321].
- WRAP has developed a number of projects aiming to increase recycling of CDW. Working together with the government and the construction industry they provide assistance to companies in diverting CDW from landfills. In addition, they provide assistance in financing recycling plants [321].
- The increase of the Landfill Tax has been a major driver for increased CDW recycling. It made the option of landfilling certain types of CDW more expensive compared to recycling. This generated more investment to the waste management industry [321].

Factors which act as barriers to increase CDW recycling include environmental permitting and exemptions, health and safety concerns, transport costs, on-site separation constraints of CDW and aggregates levy. More specifically:

- Environmental permitting and exemptions can be restrictive to recycling CDW since they tend to apply to relatively small quantities. Although the environmental permitting process has been simplified over the recent years, it still acts as a deterrent for medium scale recycling of CDW. This is particularly the case when it comes to on-site recycling [321].
- Commonly used products and materials for buildings and structures may become hazardous waste over time raising health and safety concerns. Although such wastes

should be dealt with via the appropriate hazardous waste route, there are problems in clearly identifying non-recyclable hazardous from recyclable non-hazardous materials. In addition, there are CDW products and materials which may become hazardous during reprocessing. Hence, there is a tendency for all of them to be treated as non-recyclable [321].

- Transportation of CDW over long distances to appropriate recycling centres increases costs and CO_2 emissions and acts as a barrier for increasing recycling rates [321].
- Time and space are the main constraints when it comes to onsite separation of CDW [1].
- The Government assumed that the Aggregate Levy would increase the market price of aggregates used in construction by an amount in line with the levy and hence provide recycled aggregate producers with a margin to cover the costs of making recycled aggregate from CDW. However, buyers (i.e. construction companies) of aggregates were well aware that the levy was not applied to the recycled aggregates and therefore expected their price to be lower than that of primary aggregates. In addition, the levy was applied to the producer at the point of production, and not on the purchaser at the point of sale. This gave the opportunity to the primary aggregate producers to view the levy as an operational overhead and decide on how it would be allocated across their product range. Consequently, the market price of primary aggregates used for concrete or asphalt (which face low levels of competition from recycled aggregates) increased at a higher rate than the levy. On the other hand, the market price of primary aggregates used as sub-base course in highway construction (which face high levels of competition from recycled aggregates) increased at a lower rate than the levy [321].

Factors which act both as drivers and barriers for increasing CDW recycling include demonstration of technical performance, leadership and verification, market conditions, waste infrastructure and reliability of data.

- Over the last decade, there was a significant increase in the amount of guidance and information available to the construction and demolition industries for improving their CDW recycling performance. However, construction companies are reluctant to use recycled products without certification of tested performance. This practically excludes the use of materials derived from CDW for structural applications [321].
- Many construction companies have set zero waste to landfill targets for the CDW they produce. However, these targets are quite difficult to achieve onsite. In addition, recycling performance is highly dependent on the CDW receiving facility [321].
- In many cases, the Landfill Tax made it cheaper to recycle and recover CDW rather than sending it to landfills. However, the price volatility of certain markets such as plastics can profoundly influence their recycling future [321].

- Over the last decade, there was a significant investment increase in waste infrastructure. However, there is still space for improvement especially when it comes to rural areas [321].
- Over the last decade, there was a significant improvement on accurate CDW data at site, company, regional and national levels. However, there is still limited high quality detailed information when it comes to different types of CDW materials (especially at national level) [321].

28.5 CDW sector characterization

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

Product description and applications

The main CDW product in the UK is recycled aggregate which is mainly used as unbound recycled aggregate for pipe bedding, sub-base and base courses in highway pavement construction. However, research conducted in Northwest England over the last ten years [441]-[444] demonstrated the potential for using recycled aggregate as a replacement for virgin aggregate in a number of different precast concrete products (i.e. concrete building blocks, paving blocks and flags). Replacement levels of both fine and coarse virgin aggregate by either Recycled Concrete Aggregate (RCA) and Recycled Masonry Aggregate (RMA) were recommended. In addition, BS 8500-2:2015+A1:2016[445], the complementary British Standard to BS EN 206:2013+A1:2016 [446] sets out the requirements for the use of either Crushed Concrete Aggregate (CCA) (previously described as Recycled Concrete Aggregate) or Recycled Aggregate (RA) in structural and non-structural concrete.

Other CDW products include wood waste which is used for animal bedding or panel-board manufacture and gypsum plasterboard which is used in the manufacture of new plasterboard.

Quantitative analysis

According to the Minerals Production Association (MPA) 29% (61 out of 210 milliontonnes) of aggregates used in the UK in 2014 came from recycled or secondary sources [447].

Recovery techniques

Recovery techniques are described by Quality Protocols. For CDW the following Quality Protocols exist: aggregates from inert waste [401], flat glass [402], lubricating oils [403], waste plasterboard [404] and non-packing plastics [405] (Please refer to Section 28.1.5).

Environmental and economic impacts of CDW waste management

During the first five years of the Quality Protocol: Aggregates from Inert Waste [401] being in operation an estimated reduction of 1.9 million tonnes of waste sent to landfill was achieved. A

corresponding saving to the construction industry of approximately £1 billion through the avoidance of disposal fees and landfill tax was also achieved. The net benefit is estimated to exceed £3 billion by 2020[448].

WRAP case studies suggest significant net savings by achieving good practice waste reduction and recovery. As an example, cost savings of approximately £309 K can be made during the construction of a new £13.5 million Integrated Waste Facility (IWF). The additional costs required to achieve the above savings are estimated to be £21 K yielding a net cost saving of £288 K. This represents a reduction of 2.12% on the overall construction cost. In addition, CO_2 savings of 431 tonnes are projected [449].

DEFRA has compiled an extensive list of emission factors for material consumption and waste including those associated with CDW. This data can be used to estimate CO_2 equivalent savings through reuse, recycling and recovery onsite and at company, regional and national level [450].

Drivers / barriers to increase recycling

Please refer to Section28.4.2.

28.5.2 Recycled materials from CDW

The main CDW product in the UK is recycled aggregate which is mainly used as unbound recycled aggregate for pipe bedding, sub-base and base courses in highway pavement construction. The Aggregates Levy [383] has significantly increased the use of recycled aggregates. According to Minerals Production Association (MPA) 28% (55 out of 198 million tonnes) of aggregates used in the UK in 2013 came from recycled or secondary sources [451]. However, use of recycled aggregate in concrete products is still very limited. Although a lot of research has been carried out over the last 20 years in the UK [441]- [444] and [452]- [456] and specifications exist for its use in concrete (BS 8500-2:2015+A1:2016 [445]) ready-mix and precast concrete manufacturers are reluctant to use it. This is mainly due to concerns regarding contamination levels of harmful substances (i.e. chloride content, gypsum plaster, bitumen, glass, metals, plastics and wood).

28.5.3 Market conditions / costs and benefits

Market conditions

The Landfill Tax [382] has encouraged separation of inert waste (which is subjected to a lower rate), recycling and recovery of CDW. An exemption applies when it comes to inactive waste (mainly CDW) used for filling quarries. Landfill Site Operators (LSO) can contribute money to the Landfill Communities Fund (LCF) which finances local community projects. LSO contributing to the LCF are able to claim a credit (4.2% in 2016/17) against their landfill tax liability. The percentage is called the diversion rate and is set each year by Government. The credit LSO are

entitled to is 90% of their contribution to LCF. They then either bear the remaining 10% themselves or can ask an independent third party to make up the difference [457].

The Aggregates Levy [383] enabled more investment in recycling infrastructure and allowed recycled aggregate producers to have a higher unit of production cost and still compete against primary aggregate producers. However, the Government's expectation for recycled aggregates to be cheaper because of the levy does not seem to be the case [321].

Costs and benefits

Costs (perceived/actual) and benefits of recycling and recovery of CDW are listed below.

- Capital investment and time are required to set up and operate recycling and recovery facilities. However, this leads to reduced material and disposal costs [321].
- Capital investment and time are required to train staff and change its mentality regarding on-site recycling. However, this leads to market differentiation by aligning with the client's corporate social responsibility objectives [321].
- Capital investment and training are needed for meeting the requirements of quality protocols, environmental permitting and/or exemptions from permitting. However, this leads to reduced CO_2 emissions [321].
- Capital investment and time are needed for developing and maintaining site waste management plans, other plans and pre-demolition audits. However, this fulfills the requirements set by planning authorities [321].
- Capital investment and time are required for measuring and monitoring CDW arisings and their recycling/recovery management. However, this contributes towards achievement of sustainability standards. In addition, it meets legal requirements. Finally, it improves site management and staff engagement and development [321].