Report to DGXI, European Commission

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PRACTICES, AND THEIR ECONOMIC IMPACTS

7. RECORDED QUANTITIES OF CONSTRUCTION AND DEMOLITION WASTE

C&DW arisings

7.1 The best available estimates for C&DW arisings that we have been able to collect are given in Annex 5, together with explanatory notes where relevant. It is anticipated that better data for Germany in particular will be made available during 1999. Figure 7.1 summarises the main figures from Annex 5.

7.2 What we have sought to do in Figure 7.1 is to concentrate attention on 'core' C&DW (as defined in Annex 13), keeping the estimates for soil and road planings separate from the principal waste streams more generally associated with demolition and construction projects. The following brief comments follow the order in which the Member States are listed, which is in declining order of estimated 'core' C&DW arisings.

7.3 The German figures are very much broad order estimates, and pre-date the more recent measures introduced by the government to stimulate the recycling of C&DW (as described in Chapter 8 and Annex 6).

7.4 The UK figure is based on a survey of treatment and disposal facilities in selected areas of the country, and therefore involves some interpretation and estimation, as explained in Annex 5. The recycling rate would have been boosted, perhaps significantly, if estimates of on-site re-use and recycling had also been included in the estimated arisings.

7.5 The French figures are based on a detailed and very recent report ('Guide des Déchets de Chantiers de Bâtiments', see Annex 10, Ref 7.1) from Government and official sources. However this report deals only with building demolition (as opposed to civil engineering structures), and the data provided are therefore an underestimate of the total. It is also understood that the estimate for building demolition waste will be revised upwards by almost 8 million tonnes to 32 million tonnes: an increase of 36%. If this figure was raised by a further 33%-50% (as a broad order estimate for the contribution of civil engineering waste), it would produce a *per capita* figure very similar to those reported in much of the rest of northern Europe (excluding Scandinavia).

7.6 The Italian data come from a recent consultant's report ('Il mercato delle demolizione in Italia' prepared by CRESME for the May 1998 Fiera di Genova, see Annex 10, Ref 9.2). Both this and the French report throw some interesting light onto the subject of *per capita* arisings.

7.7 The French report contains region-by-region *per capita* estimates of building C&DW arisings, which range from 680 kg/person/year in Ile de France (Greater Paris) down to 240 kg/person/year in Haute Normandie and Limousin. Details can be found in Annex 5. A separate report arising from a Brite-EuRam project (see Annex 10, Ref 2.1) notes that 22 of France's roughly 50 fixed C&DW recycling plants are in Ile de France, with the rest located in Nord-Pas de Calais (around Lille), Alsace (around Strasbourg) and Rhône-Alpes (to the south east of Lyon).

7.8 Although the pattern is not entirely consistent, the general finding - for France - is that arisings are highest (or at least more likely to be recorded) in more densely populated urban areas.

7.9 A similar pattern can be seen in Italy, though in this case arisings appear to be more closely correlated with income levels, varying between 500 kg/person/year in Piemonte Val D'Aosta (which includes the city of Torino) and 220 kg/person/year in Sicilia and Campania. The main exception to this 'rule' is the Lazio region (including Roma), where arisings are surprisingly modest, at 260 kg/person/year.

Figure 7.1: Best Estimates for C&DW Arisings (million tonnes)

Country	Year of statistics (or estimate)	Concrete, brick, tiles etc (inert)	Other 'Core' C&DW	Sub-total ('Core' C&DW)	Population - millions (1997)	'Core' C&DW (kg/ person/yr)	Country's 'Core' C&DW as % of EU-15	Cumulative % of EU-15 'Core' C&DW	Soil, stones etc.	Road planings (mainly asphalt)	Total
Germany	1994-96	45.0	14.0	59.0	82.0	720	32.8	32.8	215.0	26.0	300.0
UK	1996	n/a	n/a	30.0	58.9	509	16.7	49.5	29.5	7.5 (**)	67.0
France	1990-92	15.6	8.0	23.6 (***)	58.4	404 (***)	13.2	62.7	n/a	n/a (**)	n/a
Italy	1995-97	n/a	n/a	20.0	57.5	348	11.1	73.8	n/a	n/a	n/a
Spain	1997	n/a	n/a	12.8 (*)	39.3	325	7.1	80.9	n/a	n/a	n/a
Netherlands	1996	10.5	0.7	11.2	15.6	718	6.2	87.1	6.3	2.7 (**)	20.2
Belgium	1990-92	6.4	0.3	6.8	10.2	666	3.8	90.9	27.0	0.9 (**)	34.7
Austria	1997	3.6	1.1	4.7	8.1	580	2.6	93.5	20.0	1.7 (**)	26.4
Portugal	1997	n/a	n/a	3.2 (*)	9.9	325	1.8	95.3	n/a	n/a	n/a
Denmark	1996	1.8	0.8	2.7	5.3	509	1.5	96.8	7.7	0.4 (**)	10.7
Greece	1997	1.8	n/a	1.8	10.5	172	1.0	97.8	n/a	n/a	n/a
Sweden	1996	1.1	0.6	1.7	8.8	193	1.0	98.8	1.5	2.7 (**)	5.9
Finland	1997	0.5	0.8	1.3	5.1	255	0.7	99.5	8.0	0.1 (**)	9.4
Ireland	1995-97	0.4	0.2	0.6	3.7	162	0.3	99.8	1.3	0.0	1.9
Luxembourg	1997	n/a	n/a	0.3 (*)	0.4	700	0.2	100.0	n/a	n/a	n/a
EU-15	-	-	-	179.7	373.7	481	100.0	100.0	-	-	>450

Source: Estimates from Member States, OECD and Study Team. Reference should be made to Annex 5 for full details.

Notes: n/a not available from our main source (in the final column, n/a means not applicable, because estimates for soil, stones etc. - the largest single stream - are not available)

(*) calculated from population x assumed per capita arisings

(**) alternative estimates available from OECD report (page 28) as follows: UK 8.0, France 7.0, Netherlands 3.0, Belgium 0.5, Austria 1.5, Denmark 0.7, Sweden 0.8, Finland 0.2.

(***) it is understood that the figure for total C&DW arisings in France will be corrected to rise by approximately 8 million tonnes to about 32 million tonnes. As a result French *per capita* arisings will rise to about 548kg/year. EU-15 arisings will rise to about 188 million tonnes, and average arisings to 502kg/year.

7.10 The Italian figures are arguably very low at present when compared to historical trends, being almost entirely accounted for by waste from renovation sites. This reflects the downturn in both construction and demolition in Italy in recent years (see Annexes 3-6), this downturn having a strong political component (in that politicians have become increasingly unwilling to authorise public works in response to the corruption scandals and prosecutions of recent years). The French industry has also gone through a period of painful retrenchment since 1990, so the current levels of arisings for both countries may well be lower than their long-term averages.

7.11 This is important as far as the Spanish data are concerned, because in the absence of national data, we have used an estimated average *per capita* arising of 325 kg/person/year to generate a figure of 12.8 million tonnes of 'core' C&DW arisings per year. The figure of 325 kg was obtained by averaging 375 and 275 kg which the Catalan government reckons are the *per capita* arisings of C&DW in urban and rural areas of Catalonia respectively. These figures appear in 'Decret 201/1994' which regulates C&DW in Catalonia.

7.12 Although population densities and construction methods are broadly similar in Spain and France, controls on C&DW disposal are significantly less stringent in Spain, and none of the Spanish cities can rival Paris in terms of size. As mentioned above, French *per capita* arisings are expected to be revised upwards by 36% later in 1998, to 555kg/year.

7.13 When taken together, the estimated arisings from these five Member States account for over 80% of total 'core' C&DW arisings.

7.14 The Dutch figures are derived from relatively reliable surveys and records, and have been widely quoted for several years. By contrast the Belgian data rely heavily on expert opinion and estimates. The Austrian data are very similar to their German counterparts.

7.15 Like Spain, Portugal has no official national estimate for C&DW arisings, and we have used the same *per capita* estimate (325 kg/person/year) as in Spain, and applied it to the Portuguese population. The population data (see Annex 11) are from Eurostat, and refer to 1997. Portugal's construction industry, like Spain's, has been extremely active in recent years, especially in the redevelopment of the more densely populated areas of Lisbon and Porto.

7.16 The Danish data are based on a very reliable survey, albeit one that uses transport notes as its main source, thereby possibly under-recording arisings which are re-used on the original site. The Greek figure comes from official sources.

7.17 The main comment to be made about Sweden and Finland concerns the extremely low levels of *per capita* arisings. The massive difference between Sweden and Finland on the one hand (205 and 255 kg/person/year respectively) and Denmark (519 kg/capita/year) on the other reflects their very different population densities, the relative buoyancy of their construction industries (see Annex 3) and the much greater use of wood in Sweden and Finland.

7.18 Of the final two Member States, the Irish figure (which only amounts to 171kg/person/year) is based on official statistics and best estimates, while the total for Luxembourg has been derived in exactly the same way as the estimates for Spain and Portugal (see above), but using an estimate of 700kg for *per capita* arisings (which is very similar to the German, Dutch and Belgian figures).

7.19 Annex 5 includes information (where this is available) on the types of sites from which the C&DW originates.

Recording of hazardous C&DW and other C&DW suitable for separate collection

7.20 Member State governments were all parties to the recommendations of the 1995 C&DW Priority Waste Streams Project report regarding classification of C&DW waste streams and the need for hazardous components of C&DW to be identified. However, no guidance was given there on the classification of hazardous wastes within C&DW or hazardous C&DW within the general hazardous waste stream, or how these might be recorded.

7.21 Of the Member States for which data have been received, only Denmark, Sweden and Finland collect data on hazardous C&DW, though several others (including the Netherlands, Austria and Ireland) identify the volume of asbestos waste.

7.22 Our general conclusions on the issue of C&DW classification have been given above in Chapter 2.

Destinations and uses of C&DW

7.23 In Chapter 2 we identified a wide range of destinations to which C&DW might be sent, and uses to which it might be put. When collecting data on C&DW arisings we also attempted to find out where that C&DW was going next, and for what purpose(s), using the breakdown shown in paragraph 2.29. Although some detailed estimates (notably from the Netherlands, Belgium, Denmark, Sweden and Finland) were provided, we eventually opted to group the destinations/uses under four categories (re-use, recycling, incineration and landfilling). The results which we obtained are also presented in Annex 5.

7.24 Our main reason for simplifying our approach was that there is considerable scope for overlap between our original 10 categories, and confusion over, for example, what constitutes high and low value uses. A case in point would be landscaping: is this recycling or merely disposal? The answer very much depends on the point of view of the person making the distinction, and whether they consider that the landscaping (or noise bunding) is necessary or fortuitous.

7.25 As a general rider it should be made clear that many of the C&DW statistics which are available are approximations and/or estimates. There is often some uncertainty as to what is included in the totals and what is not, and the collection methods vary from Member State to Member State. As reported in Chapter 2, a joint Member State, DGXI and Eurostat statistical expert working group is currently investigating this very topic. Feedback from that working group can be found in Annex 8.

7.26 The five most important shortcomings which we identified relative to the idealised target for breakdown which we set ourselves, and our comments on the significance of those shortcomings, are summarised in Figure 7.2.

Recycling facilities in each Member State

7.27 Figure 7.3 brings together our best available estimates of the numbers of fixed C&DW recycling centres and mobile C&DW crushing and sorting plants. Fixed C&DW recycling centres in this context means places where bulky demolition waste, and particularly concrete waste, is received, crushed, stored and sold. It does not include centres which deal with other individual waste streams such as municipal wastes, or road recycling activities.

7.28 While the available data on crushing plant are not complete, certain wide variations in practice are apparent. Portugal and Greece have virtually no crushers, while the numbers of crushers operating in Spain, Sweden, Finland and Ireland are very limited.

Figure 7.2: Data Shortcomings and Comments on Those Shortcomings		
	Shortcomings	**Comments**
1	There is an almost universal lack of knowledge concerning the breakdown of arisings between different site types.	The lack of distinction between different site types - other than the distinction between building sites and road construction/renovation sites - is not critical. It falls under the heading of information which would be useful to know (because it distinguishes between demolition and renovation waste), but is not essential. The relationships between different site types and the activities involved in demolition and construction are illustrated in Chapter 2, Figure 2.3.
2	There is virtually no information on the uses to which C&DW is put.	This may be very difficult to remedy, because it should not be necessary for a purchaser to declare the use to which he intends to put a product when completing a straightforward commercial transaction. However, this lack of data makes an informed dialogue difficult.
3	Demolition materials which are crushed on site and re-used there may well not be recorded at all.	The lack (in some cases) of data on materials which are crushed and re-used on the original site is of some concern, because this can amount to a significant proportion of the most voluminous single material flow: crushed concrete, bricks, tiles, ceramics and gypsum-based materials. Records based on transport movements or on disposal at licensed landfill sites will tend to under-record this element of C&DW.
4	There are considerable uncertainties over how soil is dealt with in the statistics.	On some sites very large volumes of contaminated soil are moved around with or without some form of treatment. If recorded these volumes can easily distort the overall C&DW figures, so our general rule has been to seek to include contaminated soils which arise directly as a result of construction or demolition activities, but to ignore soils contaminated by industrial (or mining etc.) activities which are being cleaned up as part of a wider urban regeneration process. We also ignore uncontaminated soil and rocks displaced as a result of civil engineering works (such as tunnelling).
5	Very little attention has been paid so far to the collection of statistics on construction waste.	The lack of information on construction (as opposed to demolition) waste is not critical. The waste flows concerned are believed to be small in comparison with demolition wastes, and are susceptible to considerable reductions simply through the application of good site management practices, which have been identified and documented in various instances.

(Figure 7.3 follows on the next page)

Figure 7.3: Fixed and Mobile C&DW Crushing & Sorting Plants		
Member State	**Total no. (est)**	**Comments**
Germany	Up to 1,000	Better data expected in 1999. This estimate (from the Bundesverband der Deutschen Recycling-Baustoff-Industrie) appears high. The quantity of C&DW recycled is estimated at $8x10^6$ t/year, but the Brite-EuRam report estimates a typical crushing plant to have a capacity of about 120,000 t/year but an actual throughput of only 40,000 t/year.
UK	Perhaps 50-100	This estimate is the study team's own. A total of >360 crushers are licensed, but this includes all quarry crushers. On this basis, typical C&DW crushers have a throughput of 40-80,000 t/year.
France	About 50	50 refers to fixed centres. The total capacity is estimated at $5x10^6$ t/year, producing an average of 100,000 t/year per crusher.
Italy	Probably 60-110	The number of specialist C&DW recyclers with fixed plants is estimated not to exceed 10. The other 50-100 are small mobile crushers.
Spain	About 6	These are mobile crushers at fixed sites. Capacity not known.
Netherlands	120	Roughly 20 are on construction sites with the other 100 on fixed C&DW recycling centres. Total capacity $16.25x10^6$ t/year (i.e. average capacity around 135,000 t/year).
Belgium	92	80 crushers/recyclers with a capacity of $5x10^6$ t/year & 40 sorting facilities in Flanders. None in Brussels. 12 recycling plants in Wallonia with a capacity of $0.9x10^6$ t/year.
Austria	150	Total capacity $5x10^6$ t/year, typical throughput 20,000 t/year, so plants are operating at around 60% capacity. Crushers roughly 2:1 fixed:mobile.
Portugal	n/a	Few if any crushers.
Denmark	About 30	Total crushing capacity estimated at about $3x10^6$ t/year, with a typical throughput of 100,000 t/year. Crushers roughly 1:1 fixed:mobile.
Greece	n/a	Almost certainly no crushers.
Sweden	10	8 mobile, 2 fixed - capacity not known, but typical throughput about 25,000 t/year.
Finland	10	Refers to concrete/masonry collection facilities, number of fixed/mobile crushers not known.
Ireland	<8	<6 mobile, 2 fixed in preparation.
Luxembourg	n/a	No data were received from Luxembourg.
EU-15	About 1,500	Typical capacity 100,000 t/year per crusher, but most machines operating well below this level.

Source: Estimates from Member States, study team and Brite-EuRam report (see Annex 10, Ref 2.1).
See also Annex 6.

Note: n/a = not available

8. MEASURES USED TO PROMOTE RE-USE AND RECYCLING OF CONSTRUCTION AND DEMOLITION WASTE

The range of measures

8.1 The report of the C&DW Priority Waste Streams Project recommended (in its recommendation number 11) that:

"Member States and their 'competent authorities' for waste management planning should consider the following options when assessing the measures necessary to improve the management of construction and demolition wastes. The measures adopted should avoid distorting the market and lead to demonstrable environmental benefit. The options available include, for example:

- *selective restrictions or bans on the disposal of recoverable materials;*
- *total bans on the disposal of certain materials;*
- *the mono-landfill of certain materials for possible future recovery;*
- *tightening environmental and planning controls on disposal;*
- *the imposition of local, regional or national taxes or levies on the disposal of recoverable materials."*

8.2 We have sought to identify all significant initiatives undertaken by the various Member States (and, where possible, other bodies) to promote the re-use and recovery of C&DW. We used the following headings, which cover both positive incentives as well as restrictions:

(i) restrictions or bans on the disposal of any elements of C&DW;

(ii) the use of mono landfills for any fractions of C&DW (including storage to permit future treatment and recovery);

(iii) the use of other environmental or planning controls;

(iv) the use of 'punitive' fiscal measures (such as landfill or quarrying taxes);

(v) the use of 'positive' fiscal measures (subsidies);

(vi) the use of positive waste management planning measures;

(vii) financial support to research and development projects;

(viii) financial support to pilot and demonstration schemes;

(ix) the use of Voluntary Agreements (for example between demolition waste contractors and national administrations);

(x) the provision of education and training support geared specifically to C&DW;

(xi) the availability of advisory services geared to C&DW;

(xii) the existence of 'waste exchanges' (particularly Internet-based schemes);

(xiii) the availability of standards and norms applicable to recycled materials;

(xiv) the availability of C&DW recycling facilities (our findings on this topic were reported at the end of the previous Chapter) and any public sector initiatives to provide them;

(xv) any other measures not covered by the above.

8.3 Figure 8.1 (which extends to four pages, and can be found at the end of this Chapter) provides a summary of our key findings regarding the mechanisms employed by Member State governments, agencies and local authorities. Annex 6 provides a Member State-by-Member State commentary on the contents of Figure 8.1.

8.4 Inevitably there is some overlap between the categories set out in paragraph 8.2, and we have attempted to avoid repetition in the way our findings are reported in both Figure 8.1 and Annex 6. We have also attempted to summarise which of the various measures are considered by the Member States to have been most effective.

The effectiveness of the measures

8.5 Although no formal assessment has been made by any Member State government on the cost-effectiveness of the various measures, some themes do emerge on the subject of their more general relative effectiveness.

8.6 The main theme to emerge is that no single measure can work in isolation (and the fact that most Member States have several measures operating in parallel makes it effectively impossible for us - or them - to estimate or measure the cost-effectiveness of any single measure).

8.7 Before C&DW recycling can be expected to reach significant levels there appear to be four conditions which must be met, as follows:

(i) landfills must be well managed, and 'fly tipping' of waste must be uncommon and subject to sanctions;

(ii) the holder of the C&DW must face a significant financial cost for landfilling waste, with hazardous or mixed waste facing significantly higher costs (to avoid contamination and to discourage mixing);

(iii) the opportunity must exist for the main bulky inert fraction of the C&DW to be treated (crushed and sorted) prior to re-use or recycling;

(iv) there must be at least a tacit acceptance (by users, specifiers and other similarly interested 'actors') that suitably prepared C&DW-derived aggregates may be used to displace primary aggregates. Positive action to draw up technical standards is not essential, but C&DW-derived aggregates should not be discriminated against on the basis of their origins alone.

8.8 We conclude that if any of these four conditions is not met, then that Member State or region will find it effectively impossible to progress beyond the simplest level of recycling of inert C&DW, because even basic crushing and sorting technology will be hard to justify in parts of the territory concerned. More complex technology capable of dealing with mixed and contaminated C&DW is likely to follow as soon as all four conditions are met.

8.9 However, we believe that widespread and consistently high levels of recycling (by which we mean 75% or above of 'core' C&DW being recycled in most regions) is likely to be achieved only if some form of ban on landfilling C&DW is imposed and enforced, or if a requirement is put in place that all C&DW must be separated with each stream being directed to some form of re-use or recovery operation. Doing this would effectively remove the second condition from the list in paragraph 8.7 above.

8.10 By contrast, we believe that relying on a mechanism such as a tax on landfill or a tax on primary aggregates would not on its own achieve high recycling rates under all circumstances, because the tax would have to be set at politically unacceptable levels before it changed the behaviour of engineers and demolition contractors in areas with easy access to landfills (or quarries). Varying the tax rate to match local conditions would create considerable distortions to trade, and would therefore probably be equally unacceptable.

8.11 It is clear that the financial costs of landfilling can exert considerable influence on the choice whether or not to recycle C&DW. How these costs are expressed, whether by access charges

alone or by charges supplemented by taxes, is not particularly important. What matters is that demolition contractors receive clear price signals that encourage them to separate the different waste streams, and then to recycle as many fractions as possible. It appears highly unlikely to us that those Member States with a less well-established tradition of technical waste management would succeed in boosting recycling rates simply by raising landfill charges significantly. This would be more likely to divert waste away from managed disposal towards totally unregulated 'fly tipping'.

8.12 Those Member States which have achieved most by way of C&DW recycling have also run extensive research, pilot and demonstration projects in the past. It is not so obvious that (with the possible exception of demonstration projects) other Member States need to repeat this process, because the accumulated experience is extensive and overlapping. Exceptions to this statement would include research into:

(i) selective demolition and processing of those construction materials (such as glass and plastics) which are becoming significantly more widely used; and

(ii) designing for deconstruction, and finding alternatives to materials and techniques (such as the widespread use of bonding agents) which are economically driven at the manufacturing and construction stages, but which create problems at the point of demolition where direct re-use is not an option.

8.13 This latter point is also an area in which the use of highly specific Voluntary Agreements (VAs) to phase out particular materials or techniques may offer an effective means of tackling otherwise intractable problems.

8.14 A study for DGIII and DGXI in 1995 (see Annex 10, Ref 2.4) found that, in general, the Netherlands, the Scandinavian countries, Germany and Austria have made the greatest use of VAs. Where complying with a code of good practice (or similar) involves the companies concerned in additional costs, most other Member States have found that problems with 'free riders' have undermined the VAs, and they have often opted for conventional legislation instead. Exceptions to this rule, where VAs have worked even in Member States where there is no great tradition of such measures, are where there is a clear objective, a few companies of a similar size, and a forum to encourage compliance (such as a fully representative and motivated trade association).

8.15 Germany, the Netherlands, Austria, Denmark and Sweden have also done most to require separation of C&DW streams and to discourage 'inappropriate' landfilling. All have done so by 'command and control' regulations rather than by using price signals alone, though their landfill charges (including landfill taxes where they apply) are generally higher than in other Member States. Actual numbers to illustrate this point can be found in Chapter 9.

8.16 One relatively simple administrative measure that appears to have positive impacts and few (if any) negative side effects is a requirement for demolition and C&DW management plans. If developers are required to provide a demolition plan with an associated C&DW management plan to the local authority before they are given permission to demolish a building or structure, they have to weigh up the cost and benefit factors associated with re-use and recycling of C&DW before committing to a timetable in which the need for speed precludes any serious attempt at selective demolition. Because circumstances vary so much from place to place, we believe that any requirement for such plans should be administered locally rather than nationally, though within a national policy framework which acknowledges the value of such plans.

8.17 A number of Member States are using EU funding to encourage wider provision of C&DW processing and recycling centres, and to operate demonstration projects. This is likely to continue to be a valuable method of encouraging best practice in Member States with little or no tradition of C&DW recycling.

Figure 8.1 (page 1 of 4): Summary of Measures Used to Influence the Management of C&DW in the EU-15 as a Whole, and in Germany, the UK and France

Measure	EU-15	Germany	UK	France
1. Restrictions or bans on disposal	Restrictions on the disposal of mixed C&DW increasing.	Mixed or recoverable C&DW may not be landfilled.	None specific to C&DW.	No C&DW specific restriction or bans From 1st July 2002, installations for the elimination of wastes by storage will not be authorised to receive other than ultimate wastes.
2. Mono landfill (for possible future recovery)	Very limited.	Some, for inert waste and/or soils.	None specific to C&DW.	No requirements for C&DW.
3. Other environmental or planning controls	No common theme. Landfill Directive will raise disposal costs and encourage re-use and recycling.	Disposal sites tightly controlled, re-use sites less so. Destination of C&DW has to be documented from 1.1.1999. System differs for inert/hazardous wastes.	Disposal sites tightly controlled, re-use sites less so. Conditions can be attached to planning consents. C&DW crushers need licences or process authorisations	None relating to C&DW.
4. Taxes (landfill and others)	Landfill taxes becoming more widely used.	No federal tax or levy. 5 Länder tried to impose levies on waste incineration and disposal generally but this power was overturned in the courts. There are different prices for landfilling according to the hazardousness of the waste.	Landfill tax since 10/96. Lower rate for inert wastes. Volume landfilled has declined. An aggregates tax is presently being considered by the government.	Non-inert wastes are taxed (ADEME tax) on disposal.
5. Subsidies	Few direct subsidies.	No direct subsidies.	Regional assistance grants can be used towards the purchase of C&DW crushers.	None.
6. Positive waste planning measures	Waste management planning widespread, targets for increasing re-use and recycling and reducing disposal increasingly common.	There is an obligation to draw up waste management plans. The 1996 Closed Cycle & Waste Act requires recycling where possible and economic.	General waste management planning is required. National Government encourages local authorities to take a positive stance.	National guidance and encouragement is becoming more evident.
7. R&D support	Widely used.	Various programmes for contaminated soils, use of recycled materials and selective demolition.	Various R&D programmes.	Extensive R&D programmes.
8. Pilot and demonstration schemes	Much accumulated knowledge available.	Some projects including selective demolition projects.	A few specific projects.	Mainly restricted to road construction, but some housing.
9. Voluntary Agreements	Patchy use.	National and local VAs to encourage separation, re-use and recycling.	None.	None.
10. Education and training	Widely provided, but generally not specific to C&DW.	Part of VA.	Part of general waste management training. Handbook of best practice available. Handbook encouraging re-use and recycling in construction imminent	Training for contractors and individuals available.
11. Advisory services	Patchy availability.	Part of VA.	Part of the trial Aggregates Advisory Service. Information only.	Commercial and not-for-profit services.
12. Waste exchanges	Limited at present but increasing in use - particularly Internet-based systems.	National and regional Internet-based exchange schemes for inert materials.	National Internet-based exchange.	None.
13. Other measures	Few identified.	Return systems for PVC products.	Policy advocacy. Some local authorities give preference to recycled C&DW.	None.
Most effective measure(s)	Combination of measures, particularly restrictions on disposal and high disposal costs.	Combination of measures.	Combination of measures, but landfill tax most significant.	

Figure 8.1 (page 2 of 4): Summary of Measures used to Influence the Management of C&DW in Italy, Spain, the Netherlands and Belgium

Measure	Italy	Spain	Netherlands	Belgium
1. Restrictions or bans on disposal	Few restrictions on any wastes. Much C&DW is 'fly tipped'.	None specific to C&DW. Much C&DW goes to small, unregulated landfills.	National ban on landfilling of reusable C&DW since 1/97.	In Brussels, only contaminated C&DW may be landfilled (but there are no landfills in Brussels). In Flanders a ban on mixed waste landfilling started in 07/98. In Wallonia restrictions are less.
2. Mono landfill (for possible future recovery)	No requirements for C&DW.	No requirements for C&DW.	No requirements regarding C&DW but contaminated sludge must go to mono landfill.	No requirements for C&DW.
3. Other environmental or planning controls	Controls are exercised by the Regional, Provincial and Municipal authorities.	Controls are exercised by the Regional, Provincial and Municipal authorities. Much selective demolition and C&DW recycling is informal.	Demolition contractors need licences and are required to separate C&DW streams.	None relating to C&DW.
4. Taxes (landfill and others)	There is a landfill tax of 20 Lire/kg (approximately ECU10/tonne).	None.	Levies vary by region rather than by material.	Landfill taxes higher in Flanders (9.5 ECU/t) than in Wallonia (3.75 ECU/t). In Flanders a lower rate can apply to residual fractions of processed C&DW.
5. Subsidies	None.	The EU's LIFE programme has been used to susidise initiatives on C&DW recycling.	Public projects offer bonuses for using C&DW-derived aggregates.	Walloon government has invested in public/private C&DW recycling centres.
6. Positive waste planning measures	Some municipalities have started to take positive initiatives to encourage C&DW recycling.	Waste planning is a Regional responsibility. Catalonia, Madrid and the Basque Country have taken steps to develop C&DW planning.	National Government encourages recycling schemes and provides guidance for local policy makers and regulators on best practice.	Regional plans with quantified targets are in place.
7. R&D support	Some limited R&D programmes have been mounted.	R&D has been mainly concerned with road (re)construction. CEDEX is the key organization.	Various R&D programmes.	Various R&D projects.
8. Pilot and demonstration schemes	[To be checked]	A few road projects. Madrid's C&DW recycling centre will be a demonstration project.	Several substantial projects.	Several substantial projects over an extended period.
9. Voluntary Agreements	None.	There are no national VA's relating to C&DW.	National VAs involve demolition contractors, aluminium and glass industries.	Regional VAs in Flanders and Wallonia involve contractors and recyclers.
10. Education and training	None specific to C&DW.	None specific to C&DW.	No national programmes specific to C&DW.	All regions run educational programmes.
11. Advisory services	To be checked.	None.	Many non-government services.	A public/private service ran from 1994-97. A road recycling advisory service is still active.
12. Waste exchanges	To be checked.	None.	None.	Internet-based service in Flanders and national (non-Internet) service - both for general wastes, not C&DW specific.
13. Other measures	None.	None.	None.	None.
Most effective measure(s)	-	-	Ban on disposal of reusable C&DW.	Encouragement and concensus.

Figure 8.1 (page 3 of 4): Summary of Measures used to Influence the Management of C&DW in Austria, Portugal, Denmark and Greece

Measure	Austria	Portugal	Denmark	Greece
1. Restrictions or bans on disposal	There is an obligation to sort and recycle C&DW above specified thresholds.	Few restrictions on any wastes. Much C&DW is 'fly tipped'.	No explicit ban, but municipalities are obliged by law to assign C&DW which cannot be recycled, but which can be burned, to incineration.	None.
2. Mono landfill (for possible future recovery)	Some C&DW-specific landfills.	No mono landfills available to C&DW.	For limited waste streams.	No mono landfills available to C&DW.
3. Other environmental or planning controls	Disposal sites tightly controlled, re-use sites less so.	Effectively none. Any C&DW recycling that takes place is unregulated.	C&DW centres need licences.	Few, if any.
4. Taxes (landfill and others)	No tax, but rates for disposal of C&DW fixed nationally.	None.	Landfill and incineration tax since 1987. Lower rates for incineration. The extraction of gravel is taxed.	None.
5. Subsidies	None.	None.	No direct subsidies.	None.
6. Positive waste planning measures	National waste plan is periodically updated.	No specific planning for C&DW has been developed so far.	National targets must be acted on by local authorities. Municipalities are responsible for ensuring that sufficient treatment capacity is available.	Only preliminary plans have so far been developed for C&DW.
7. R&D support	Some R&D projects.	Research under way to establish levels of C&DW arisings. Technical R&D has included road (re)construction using secondary aggregates, excluding C&DW.	Large number of projects.	Not known.
8. Pilot and demonstration schemes	Some projects.	A demonstration project to recycle concrete on the Expo'98 site was proposed, but was abandoned due to concerns about its hazardous content.	Several substantial projects.	Not known.
9. Voluntary Agreements	National VA to increase recovery of C&DW.	None.	National VA on selective demolition involving demolition contractors.	None.
10. Education and training	Training schemes available.	None specific to C&DW.	Specific C&DW management training courses are offered.	Not known.
11. Advisory services	Recycling Federation provides advisory service.	None.	Two main national private sector services.	Not known.
12. Waste exchanges	National Internet-based scheme recently established.	None.	Conventional market for C&DW products.	Limited conventional market for C&DW.
13. Other measures	None.	None.	Some local authorities give preference to recycled C&DW.	None known.
Most effective measure(s)	Combination of measures.	-	Combination of measures, but landfill/ incineration tax most significant.	-

Figure 8.1 (page 4 of 4): Summary of Measures used to Influence the Management of C&D Waste in Sweden, Finland, Ireland and Luxembourg

Measure	Sweden	Finland	Ireland	Luxembourg
1. Restrictions or bans on disposal	Combustible wastes will be banned from landfills from 2002, and organic wastes from 2005.	None specific to C&DW.	Generally the same as other wastes. However, landfills may only accept C&DW if their licence specifies it as an allowable waste stream.	Not known.
2. Mono landfill (for possible future recovery)	Yes.	None specific to C&DW. Emphasis on waste soils.	There are no mono landfills available to C&DW in Ireland.	Not known.
3. Other environmental or planning controls	A demolition plan must be lodged before buildings are demolished. This must address hazardous waste streams in particular. Demolition must be supervised by a suitably qualified person. Counties and Municipalities issue waste plans.	All landfills, recycling centres and transporters are licensed and checked. Many local authorities set charges specifically to encourage recycling.	Disposal sites are increasingly tightly controlled.	Not known.
4. Taxes (landfill and others)	A tax on aggregates (gravel) already exists. A landfill tax is expected to be introduced in 1999.	Since 01/98 C&DW landfilled with municipal waste is subject to a tax of 90 FIM/tonne + VAT (ECU19/t).	None.	Not known.
5. Subsidies	None.	None.	The EU's ERDF is being used to support Ireland's first two C&DW recycling centres at Ballyeally and Ballyfermot.	Not known.
6. Positive waste planning measures	The National Road Authority has a target of 90% for recycling road materials by 2000.	Since 01/98 C&DW is supposed to be sorted. National plan (with targets) and regional plans exist. Landfills and treatment centres are getting larger.	Local Authority waste plans are required to consider C&DW recycling. Dublin has already done so.	Not known.
7. R&D support	A large number of projects.	A large number of projects.	See "Subsidies" above.	Not known.
8. Pilot and demonstration schemes	Several substantial projects.	Several projects, notably since 1996.	A 1996 pilot project at Ballyeally (see above) demonstrated that C&DW-derived aggregates can meet National Road Specifications.	Not known.
9. Voluntary Agreements	National VA covers better practice, reduced landfilling, certification of C&DW specialists.	No C&DW-specific VA, but packaging VA includes construction materials packaging.	None.	Not known.
10. Education and training	Specific C&DW-related courses are widely available.	Emphasis is on construction site management and general waste management.	A training scheme including C&DW has recently been launched (June 1998).	Not known.
11. Advisory services	Two services available.	Public and private services available.	None.	Not known.
12. Waste exchanges	Internet-based exchange available. Local Authorities will advise on upcoming demolition projects.	Conventional market for C&DW, particularly wood and metals.	None.	Not known.
13. Other measures	Some producers operate return systems.	None.	None.	Not known.
Most effective measure(s)	Combination of measures.	Combination of measures.	Demonstration.	-

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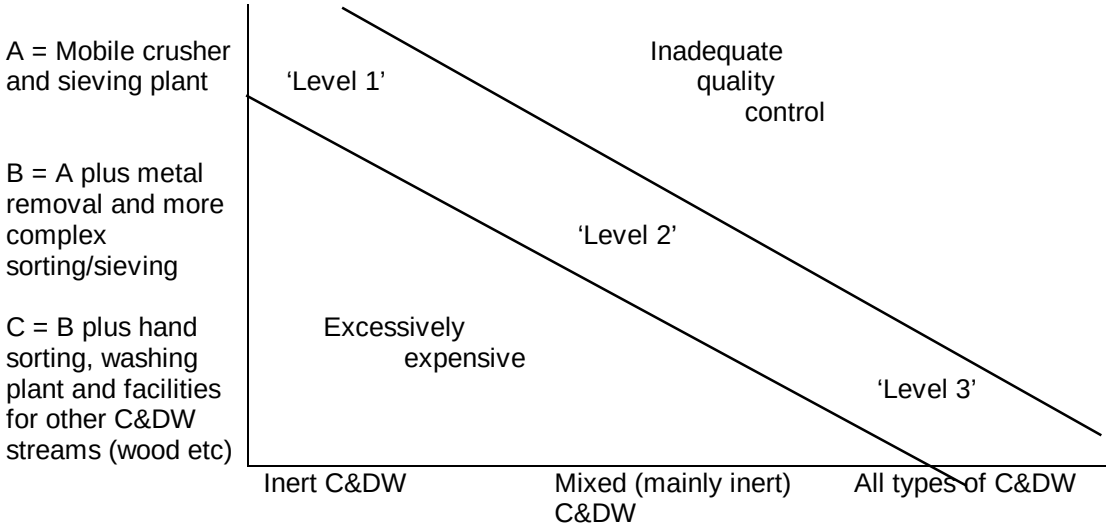
9. ECONOMICS OF THE RE-USE AND RECYCLING OF CONSTRUCTION AND DEMOLITION WASTE: PRACTICAL CONSIDERATIONS

Introductory remarks

9.1 There is a wide range of possible technical solutions which can be applied to C&DW recycling, from simple mobile crushers for the inert fraction of C&DW right through to fully integrated fixed C&DW recycling centres capable of dealing with the full range of C&DW streams. None of these technical solutions are 'right' or 'wrong', though some may be inappropriate to the circumstances they face and the mix of waste requiring to be processed. Figure 9.1 should help to illustrate this point.

Figure 9.1: Matching Recycling Techniques to Circumstances



9.2 It should be stressed that, however sophisticated the technology and techniques available, selective demolition and the avoidance of mixing on the original site is always likely to be far preferable to sorting wastes at a C&DW recycling centre. The justification for this statement lies in a parallel with the waste hierarchy: just as avoidance of waste in general is preferable to its proper management, so avoidance of mixing is preferable to its effective separation. It is also worth noting that where we use the term 'recycling centre' in this Chapter, we mean the sort of 'state of the art' centre described in Chapter 4 that sorts and separates as well as processing C&DW prior to recycling. In other words, a successful C&DW recycling centre actually recycles only those fractions that cannot be re-used without any form of processing.

9.3 We deal with the practical economics of C&DW re-use and recycling by considering three basic combinations of technologies and waste types, shown in Figure 9.1 as 'Levels 1, 2 and 3'. These levels refer to technologies, not Member States, and in many Member States different mixes of two or three of the levels are employed. Having said that, the illustrations have to be drawn from real life, so different levels have to be represented by different groups of broadly representative Member States.

9.4 First we consider the group of Member States where only 'Level 1' technology is in use, taking Spain as our main example. Next we look at a larger group of Member States where a mixture of 'Level 1' and 'Level 2' technologies are used. The main assessment for this group is drawn from the UK, but we also draw on examples and information from France, northern Italy and Belgium. Finally we consider those Member States (including Germany, the Netherlands and Denmark) where all three levels are employed.

9.5 It would be too crude to say that this spectrum simply runs from south to north, or that every Member State can be fitted neatly into one of the three categories. Italy and Belgium provide good examples of countries where different regions are at different technical levels, and which might have been dealt with under 'Level 1' and 'Level 3' respectively.

'Level 1' technology

General

9.6 Most of the comments and figures that follow were obtained through discussions with Spanish companies, but we believe they can be broadly applied to Portugal, Greece and southern Italy as well. Among the key characteristics which typify countries and regions with predominantly 'Level 1' technology are the following:

(i) landfill prices are low, and penalties for infractions are uncommon and (when imposed) generally low;

(ii) primary aggregate materials are cheap;

(iii) as a consequence very few crushers are available to produce C&DW-derived aggregates (as opposed to uncrushed engineering fill).

Spain

9.7 At present the only crushers operating in Spain are mobile ones, though some are more or less permanently installed at fixed sites (landfills).

9.8 The most detailed studies of C&DW recycling options in Spain, including the economics of the various processes involved, have been undertaken in Catalonia, led by the Junta de Residus (Waste Management Board, part of the Catalan regional government). Catalonia is the Autonomous Region of which Barcelona is the Capital. Many of the figures given below come from their studies (see in particular Annex 10, Ref 11.2.3).

9.9 The Junta de Residus has generated a cost model for inert C&DW recycling which has been used to compare the costs per tonne for different combinations of plant sizes and capacity utilisation. Figure 9.2 presents the key findings from their study.

Figure 9.2: Total Processing Costs (in ECU/tonne) Using a Mobile Crushing Plant

Plant annual capacity	30% utilisation	60% utilisation	100% utilisation
50,000 tonnes/yr	10.25	5.50	3.60
100,000 tonnes/yr	6.40	3.40	2.40
200,000 tonnes/yr	4.95	2.75	1.90

Source: Programa de Residus de la Construcció a Catalunya, 1996

9.10 Annex 12 contains our own calculations for crushing costs. Although evidently quite different from each other, the two models produce a very similar result for a well-used 200,000 tonnes a year plant. The Catalan model also illustrates very clearly the importance (in economic terms) of matching the capacity of any crusher to the demands it faces. No business that charged (or paid) 10 ECU/tonne to crush C&DW would survive very long.

9.11 The same report also considers fixed plants with higher capacities (200,000 up to 600,000 tonnes/year), even though no such plants yet exist in Spain. It calculates that these plants would be substantially more expensive than mobile crushers, with a fully utilised plant with a capacity of 600,000 tonnes a year generating a cost of 3.20 ECU/tonne.

9.12 Transport costs around Barcelona are calculated using a formula of (1.25 + 0.075/km) ECU/tonne, which means 2.75 ECU for a typical 20km journey. Delivering unsubsidised C&DW-derived aggregates for less than the 4-5 ECU/tonne that primary aggregates cost is therefore almost impossible, unless the haul distance is very short.

9.13 In Catalonia (where a special company called Gestora de Runes has been established, with the backing of the Junta de Residus, to operate special C&DW landfills and eventually to recycle C&DW) the landfill gate price for inert C&DW depends on the density of the material as delivered. Material with a density of <0.8 tonnes/m^3 faces a gate price of 4.82 ECU/tonne. The equivalent gate price for material denser than 1.1 is 1.80-2.10 ECU/tonne, and for 0.8-

1.1 it is 3.00 ECU/tonne. The specific objective of this range of prices is to encourage better on-site sorting. During 1999 Gestora de Runes plans to acquire C&DW crushers to be located at the larger C&DW landfills or at waste transfer stations serving Barcelona.

9.14 Significant volumes of C&DW and clean soil are currently being used to reclaim land in the Barcelona harbour area. Large volumes of generally clean soil are characteristic of many Spanish construction and redevelopment sites, due to an obligation which is placed on developers to provide underground parking garages for new apartment and office buildings.

9.15 Madrid has for 2-3 years had a pilot C&DW recycling plant (belonging to a company called NAC-3) operating at a landfill site close to the city. In late 1998 it was being moved to another site.

9.16 In Madrid the lorries that transport C&DW to landfill are typically owned and operated by haulage contractors rather than by demolition companies, and the stiff competition which prevails between them helps to keep transport costs relatively low. Nevertheless, given the low price of primary aggregates and the low gate prices charged by landfills, transport costs still comprise an important part of most equations. The typical haul distance between demolition site and landfill in Madrid is 20km, for which haulage contractors charge about 3.00-4.00 ECU/tonne. This is a bit higher than the figure generated by the Catalan model, and very similar to typical UK costs (see below).

9.17 Around Bilbao, where interest in C&DW recycling is also growing, landfill prices are believed to be significantly higher (possibly as much as 9.00 ECU/tonne).

9.18 Primary aggregate prices vary from place to place, but most cities are well served by quarries. In the region around Madrid prices at the quarry gate are around 4.30 ECU/tonne for materials which would compete with C&DW-derived aggregates.

9.19 In practice, the consequence of the figures quoted above is that those few crushers that do operate can only obtain a price of around 3.00 ECU/tonne (excluding delivery) for sub-base quality C&DW-derived aggregates. At prices as low as these recyclers cannot afford to pay any rent at all for land (let alone invest in more sophisticated equipment), which means they must either get free space at a landfill (or similar) location, or operate a mobile crusher.

'Level 2' technology

General

9.20 In those Member States where the recycling of inert C&DW is primarily a combination of 'Level 1' and 'Level 2' technologies, the business has generally been driven by considerations of resource efficiency: that is to say it has been promoted as a way of reducing the need to quarry so much primary aggregate material and as a way of reducing the need for landfill space rather than as a way of meeting a regulatory ban on landfilling of mixed C&DW. Material that cannot be economically re-used or recycled may still be landfilled, and often is.

9.21 Most of the Member States considered below do have other facilities (such as composting centres and some materials recovery facilities), but their geographical coverage is distinctly uneven.

The UK

9.22 In the case of the UK the principal C&DW-derived aggregates sold are described as 1A (well graded granular material; typically used for general fill), 6F1 (selected granular material - fine grading; typically used for capping), 6F2 (selected granular material - coarse grading; typically used for capping), 6N (selected well graded granular material; typically used for fill to structures) and 6P (uniformly graded granular material; typically used for fill to structures). These specifications are defined in 'The Specifications for Highway Works Prepared by the Highways Agency of the Department of Transport' (see Annex 10, Ref 12.6.1).

9.23 As a general rule, in the densely populated area of southern England the maximum distance which C&DW can be transported economically is reckoned to be around 25km, at a cost of

3.60 ECU/tonne. This is derived from a formula of (1.35 + 0.09/km) ECU/tonne, which is very similar to the Catalan cost model (see above).

9.24 For typical sub-base materials in central-southern England the delivered cost of primary aggregate (in mid-1998) is generally around 13.75 ECU/tonne (10.15 ECU/tonne for the raw material and 3.60 ECU/tonne for delivery), against 12.30 ECU/tonne for C&DW-derived aggregate (8.70 and 3.60 ECU/tonne for delivery). As will be seen as prices from other Member States are reported below, these are among the highest aggregate costs in the EU-15.

9.25 Since in the case of sub-base material the additional costs associated with using C&DW-derived aggregates are actually close to zero, we can conclude that 1.45 ECU/tonne (i.e. 10.15 - 8.70) is the price premium which aggregate users are prepared to pay for primary aggregates.

9.26 Quite separately from the Catalan cost model (see above), we have estimated the cost of crushing C&DW-derived aggregates at around 2.00 ECU/tonne (see Annex 12 for details of the calculations on which this estimate is based), leaving the recycler to cover all pre-processing transport costs, all other demolition costs and a commercial return on management skills and capital employed from 6.70 ECU/tonne (i.e. 8.70 ECU/tonne sale value minus 2.00 ECU/tonne processing cost).

9.27 About 150km further west from where the above figures were assembled, there are several stone quarries and therefore large volumes of stone off-cuts ('scalpings') available. As a consequence aggregate prices based on these materials are lower, and C&DW-derived aggregates cannot compete, even in the sub-base market.

9.28 As the Catalan cost model and Annex 12 both show, the key to profitability and low unit costs in C&DW processing is to work all of the machinery involved as hard as possible. Industry sources indicated to us that each crusher should aim to earn 1% of its capital cost per day for 4-5 years, at which point it is likely to need to be replaced.

9.29 Other on-site machinery and lorries also need to be worked as hard as possible. Calculating charges on the basis of average costs is not practical: all machinery (and labour) needs to make the highest possible contribution to overheads, which means working as much as possible for returns that are as high as possible, and certainly higher than the marginal (variable) cost. Calculating charges for demolishing structures and processing C&DW is therefore not generally done by reference to a 'menu' of fees, but based on experience of what the market will bear.

9.30 In the absence of a statutory requirement to sort and manage different C&DW streams separately, the price of C&DW-derived aggregates is entirely market-driven. It is therefore considerably more profitable for a demolition contractor to supply crushed concrete direct from a demolition site to a construction site (taking advantage of potentially lower crushing costs - see Annex 12 - and just one lorry journey) than to use a fixed crusher at a specialist recycling centre, assuming that the quality of the aggregate processed at the demolition site is high enough.

9.31 What fixed crushers and their associated storage facilities provide to those demolition contractors who have them is the security of knowing that if a direct site-to-site sale is not possible, the company has somewhere to take the material other than landfill.

9.32 However, since the price of C&DW-derived aggregate is market driven, the premium which a recycling centre can obtain for a standard sub-base or fill material relative to the same product from a mobile crusher is very modest. The impact which this fact has on the economics of fixed C&DW recycling sites is to make them rather sensitive to the cost of land. The opinion of recyclers in the UK suggests that the level of rent normally associated with industrial land cannot be supported, even close to an urban centre. The calculations in Annex 12 suggest that concern may be overstated (because the influence of land costs is modest compared to other operating costs), though it is undoubtedly true that in a highly competitive market one recycler could not afford to pay significantly more than his competitors.

9.33 Fixed crushers are more expensive partly because they are operationally more flexible. However, no crusher can simply be set to obtain a specific final material. In the UK (by contrast with the Netherlands) it is reckoned to be economically better to aim for a high rate of material throughput, accepting that some material may have to go through twice. In practice this means that with a mobile ('jaw') crusher it is generally better to set the jaws further apart than the target specification would suggest (100mm rather than 75mm), and then to re-crush the over-sized fraction. The cost of sieving is very small.

9.34 By comparison with the costs of machinery and land, the cost of labour is not so critical, but the quality is. Most demolition contractors operate their own lorry fleets, and each driver costs 22-30,000 ECU/year plus overheads, or around 43,000 ECU/year in total, excluding all lorry-related costs. In a highly competitive sector, at least some of the profitability of C&DW recycling businesses in the UK depends on having drivers who are flexible and entrepreneurial (i.e. who make a real effort to maximise the proportion of time that their lorry is fully loaded).

9.35 Landfill charges vary quite widely within the UK, but in central southern England (where the figures above were collected) typical charges are 16 ECU/tonne for soil or similar materials when consolidated. Contaminated soil costs around 44 ECU/tonne to dispose of when consolidated, and 'special' waste costs 95-100 ECU/tonne. Waste oil is the only material which often goes for incineration. Despite regulations to the contrary, it is clear that small but significant volumes of wood, plastics and packaging are burned on construction and demolition sites.

9.36 For other materials prices can change quite rapidly. During the second and third quarters of 1998, scrap steel prices fell from almost 90 ECU/tonne to 30 ECU/tonne.

France

9.37 The following information is drawn from the ADEME report (see Annex 10, Ref 7.1) and a 1997 Brite-EuRam report (see Annex 10, Ref 2.1). It refers primarily to the area around Paris, where C&DW recycling is well established. In most other regions C&DW-derived aggregates cannot compete with primary materials.

9.38 Fixed recycling centres charge up to 5.50 ECU/tonne (including tax) to receive the inert fraction of C&DW, compared with inert landfills which charge around 12-13 ECU/tonne to dispose of inert C&DW.

9.39 The price charged by recyclers for C&DW-derived aggregates is roughly 6 ECU/tonne, compared to 4 ECU/tonne for primary material, so the competitiveness of recycled materials depends almost entirely on lower transport costs for C&DW in the Paris area compared to bringing primary materials from well outside the region.

9.40 The ADEME report contains a very arresting statistic: the costs of dealing with C&DW can amount to 6% of the value of a building project.

Italy

9.41 There are about 10 relatively large fixed C&DW recycling centres in Italy, predominantly in the north, including sites at Castellarano (near Reggio Emilia), Spilamberto (near Modena, operated by Camer), Corbetta (near Milano, operated by Ecoter) and Villaguardia (near Como, north of Milano and very near the Swiss border, operated by Consorzio Comense Inerti).

9.42 Consorzio Comense Inerti belongs to a group of over 100 construction companies, and as well as crushing inert C&DW the operating company runs a green waste composting plant and is landfilling/restoring an old quarry site using incoming materials unsuited to crushing and grading. Graded materials are sold as 0-150mm and 0-30mm, or occasionally 30-70mm.

9.43 Primary aggregates suitable for industrial paving or road construction sell for around 4.15-5.20 ECU/tonne, but contractors are only prepared to pay around 2.50 ECU/tonne for C&DW-derived aggregates.

9.44 The charge for landfilling inert C&DW is about 2.25 ECU/tonne, including a landfill tax of 1.00 ECU/tonne.

Belgium

9.45 The prices in Figures 9.3 and 9.4 (for Belgium) come from a Brite EuRam report on C&DW (see Annex 10, Ref 2.1), and although they are unlikely to have changed by much, are not quite as recent as most of the others cited in this report. Landfill charges in Flanders are around 16 ECU/tonne, which gives operators of C&DW recycling centres there (as in France) some scope for charging a higher gate price than in the UK or Italy.

Figure 9.3: Gate Prices for Incoming C&DW at Belgian Recycling Plants	
Material	**ECU/tonne**
Concrete (not reinforced)	free of charge
Reinforced concrete	1.25-2.50
Heavily reinforced concrete	6.25-12.50
Masonry	2.50-6.25
Mixed C&DW (including wood and plastics)	2.50-12.50

Figure 9.4: Prices for C&DW-Derived Aggregates in Belgium	
Material / use / application	**ECU/tonne**
Crushed mixed masonry and concrete for use as a sub-base or base material	5.25
Crushed concrete sieved to a size range of 4-32mm, for use in concrete	5.75-6.50 (2.50 less than primary aggregates)
Crushed masonry (0-56mm) for engineering fill and carparks	3.75
Sieved and crushed sand, for pavement sub-base or embankments	1.25-2.50
Recycled asphalt aggregates for roads and carparks	3.75-5.75

Source: Brite EuRam (Figures 9.3 and 9.4)

'Level 3' technology

General

9.46 In those Member States where 'Level 3' technology is applied it is probably fair to say that C&DW management has always been viewed primarily as a waste management issue, and that economic instruments (such as higher waste disposal charges) have followed more traditional command and control regulation. Annex 6 gives details of the full range of measures used in all Member States to encourage C&DW recycling.

9.47 However, it appears that when economic instruments have been introduced, they have provided a powerful reinforcement to the more traditional approaches.

9.48 Nevertheless, according to the information provided in Annex 6, the gate prices paid at inert waste landfills in this group of Member States vary very widely. Landfill tax rates (i.e. excluding the main charges) are 45 ECU/tonne in Denmark, 30 ECU/tonne in Sweden (not yet in place), 19 ECU/tonne in Finland and 13.60 ECU/tonne in the Netherlands. The total gate price in Germany is typically 7-10 ECU/tonne, and in Austria it is 4.5-7 ECU/tonne. The correlation between these landfill charges and the level of recycling activity appears to be relatively weak.

Germany

9.49 In Germany, quite apart from the ban on landfilling mineral demolition waste and unsorted C&DW, high landfill charges applicable to non-inert wastes provide a strong economic incentive to separate the various C&DW streams (see Annex 6 for details). However, many of

the essential characteristics of the C&DW recycling industry are very similar to those described above for the UK. Specifically:

(i) not much C&DW travels over 20km to be processed, and virtually none goes over 30km;

(ii) this is because transport costs are an important element in the cost:benefit calculations, with a cost formula very like those in Spain and the UK, or approximately (1.25 + 0.075/km) ECU/tonne, or 2.75 ECU for a 20km haul distance;

(iii) the profitability of C&DW processing is heavily dependent on maintaining a high throughput: 75-85% of a crusher's design capacity;

(iv) the economics of fixed recycling centres are sensitive to land prices and the investments (such as hard standings and noise bunds) required to protect the local environment;

(v) C&DW recyclers are having to become more and more flexible and entrepreneurial, and must understand the complete supply chain from demolition to new construction.

9.50 However, the C&DW recycling industry is structured very differently in Germany from the UK, where small and medium enterprises are the dominant players. The largest German C&DW recycler, Remex (formerly Deutag Remex), operates around 40 processing centres for mineral C&DW, 10 sorting plants and four processing plants which can accept and process both mixed and mineral C&DW.

9.51 Some of these centres were established, with the approval of the local authorities concerned, as local monopoly service providers (i.e. with an exclusive franchise area, not unlike those awarded to many car dealerships). These monopolies have subsequently been broken, and with increasing competition the industry appears to be moving back towards a greater emphasis on 'Level 2' technology.

9.52 The C&DW-derived aggregates which are produced are used in road sub-base, car parks, sports fields, 'green' roofing surfaces (incorporating crushed bricks and soil, to slow down rainwater run-off as an aid to flood control), soil improvement, landfill engineering (gas collection ducts etc) and similar applications. Although there is ongoing technical interest in recycling crushed concrete into new concrete, it is a very marginal issue for commercial recyclers.

9.53 Local conditions placed on C&DW-derived aggregates vary, with the result that a road specification that is acceptable on one side of a local authority border may cease to be acceptable on the other. Provided that a material's engineering performance is acceptable, the focus of its acceptability is its environmental impacts, particularly with regard to leaching.

9.54 A technical difference between Germany and the UK (and which Germany shares with several other Member States where 'Level 3' technology is widespread) is an emphasis on removing 'fines' (particles of 0-5mm) from C&DW-derived aggregates. Although such fines can generally be sold as recycled sand, it is considered preferable to avoid them in the first place, possibly by using a different type of crusher.

9.55 Prices of all aggregates have fallen in recent years in Germany, partly as a result of competition from the central European countries, as have the prices of other recycled materials (like steel). This has driven down the prices which recyclers can charge end users for C&DW-derived aggregates at the same time that increasing competition has pushed down the gate prices which they can charge to demolition contractors. The prices in Figures 9.5 and 9.6 refer to the densely populated areas of western Germany (the valleys of the Ruhr and the Rhein). There is some evidence that higher gate prices are charged in areas such as Mecklenburg-Vorpommern (to the north of Berlin), and that higher prices can be achieved for C&DW-derived aggregates. In general the regional variations that can be observed depend, as in the UK, on the availability and prices of local primary materials.

Figure 9.5: Gate Prices for Incoming C&DW at German Recycling Plants

Material	ECU/tonne
Clean mineral C&DW	3.00-5.00
Masonry	7.50-10.00
Mixed C&DW (less than 20% mineral content)	50.00-75.00

Figure 9.6: Prices for C&DW-Derived Aggregates in Germany	
Material / use / application	**ECU/tonne**
Pre-sieved, non-crushed sub-base material (0-45mm)	1.00-1.50
Pre-sieved, non-crushed material (5-45mm)	2.50
Sieved and crushed sand, for pavement sub-base or embankments	1.50-2.50
Crushed branded aggregate (0-45mm or 5-45mm), for use as base material	3.00-5.00
Crushed branded aggregate (>45mm)	4.00

Source: Brite EuRam (Figures 9.5 and 9.6), updated in 1998 by industry sources

9.56 Crushing costs are broadly comparable to the estimates in Annex 12, and sieving costs are estimated at around 0.50 ECU/tonne. As the prices above show, sieving the 0-5mm fraction out of sub-base material raises the value of both the sand and the remainder of the aggregate.

9.57 Any actions which rely on labour, including quality control and hand picking are very expensive in Germany, and the gate price levied on mixed C&DW (see Figure 9.5) provides a strong incentive to selective demolition and good site management practices. This gate price is much higher than the equivalent in Belgium (see Figure 9.3).

The Netherlands

9.58 Landfill gate prices (i.e. including the landfill tax) in the Netherlands vary considerably from area to area, from 40 to 127 ECU/tonne, with a 'typical' level of 80. The only C&DW which is permitted to be landfilled is material which cannot be recycled (see Annex 6).

9.59 C&DW-derived aggregates go mainly for use as road sub-base, a market from which primary aggregates have been largely excluded by market forces. The main competition comes from blast furnace slag, which can be bought for around 6.80-7.70 ECU/tonne, excluding transport costs. Prices of C&DW-derived aggregates are around 4.50-5.40 ECU/tonne.

9.60 C&DW-derived aggregates seldom travel much more than 25km by road, but water-borne transport is also widely available in the Netherlands. Since delivered prices for C&DW-derived aggregates are reported to be typically 6.80-8.35 ECU/tonne, this means that transport (at around 2.50 ECU/tonne for a typical journey) is cheaper than in the UK, by about 30%.

9.61 A study published in 1991 (see Annex 10, Ref 2.3) estimated the cost of crushing, sieving and washing concrete in the Netherlands at 5-10 ECU/tonne, plus further costs for sludge and sand tipping. This is significantly higher than the crushing costs estimated in Annex 12, and the sieving costs reported above for Germany.

Denmark

9.62 Roughly 25% of all Danish C&DW is processed at the Copenhagen Recycling Centre, which has an area of 7.5ha allocated to C&DW (as well as similar areas for green waste composting and contaminated soil processing). The C&DW centre employs around 40 persons, and in 1996 it processed 700,000 tonnes, representing a capacity utilisation of over 85%.

9.63 Landfill charges are very high in Denmark: 65-95 ECU/tonne for the inert fraction of C&DW, including a landfill tax of 45 ECU/tonne. Despite this, and despite the fact that holders of C&DW are obliged by law to sort and recycle their waste, C&DW recycling centres only charge around 9.00 ECU/tonne for receiving concrete. Crushed concrete suitable for road

sub-base can then be bought from the recycling centre gate as cheaply as 5.00 ECU/tonne (against an 'official' list price of 7.00 ECU/tonne, and down from around 8.00 ECU/tonne in 1996). The quarried primary material with which it competes costs roughly 4.00 ECU/tonne (against a list price of 5.50 ECU/tonne) at the quarry gate, or 7.00-8.00 ECU/tonne after a typical haul distance of 50km. From this we can conclude that haulage in Denmark is surprisingly cheap.

9.64 On the basis of the figures above we can see that the recycling centre has 'captured' around 14.00 ECU/tonne in added sales value for a basic crushed C&DW-derived aggregate (i.e. 5.00 ECU/tonne in income, minus -9.00 ECU/tonne in input costs). The same report which estimated Dutch costs for crushing, sieving and washing concrete in 1991 (see Annex 10, Ref 2.3) put the equivalent costs in Denmark at 7.5-10 ECU/tonne. Even at these relatively high cost levels, it would appear that the main recovery process as applied to 'core' C&DW should be profitable in Denmark.

Conclusions

9.65 The commercial realities described above largely confirm what economic theory (see Chapter 3 and the conclusions of Chapter 8) tell us we ought to expect. Those regions where 'Level 1' technology is used are meeting some (but not all four) of the preconditions set out in paragraph 8.7, while those where 'Level 2' is the norm are meeting the pre-conditions but not going much further. 'Level 3' is typical of countries which have used administrative controls to require more C&DW recycling than market forces alone would deliver, and in particular to require (or at least encourage) the recycling of wood and plastic wastes. Some of the main theoretical points are summarised in Figure 9.7.

9.66 In practice, where landfill gate prices are low, the gate prices charged by recyclers to the holders of C&DW tend to be very similar (but seldom if ever higher). Where landfill gate prices are higher, this link has generally been broken, either by competition or by regulation.

9.67 Although there appears to be a link between the levels of landfill costs and the extent of C&DW recycling when the various Member States are compared, the statistical correlation does not appear to be very strong. This suggests that (as one would expect) other differences between Member States are significant. However, there is some circumstantial evidence that when such differences are removed, the link is stronger. This evidence comes from the UK, where there is widespread agreement that the introduction of a landfill tax in 1996 (at a rate of 2.90 ECU/tonne for inert waste) triggered a major shift away from landfilling of C&DW and into recycling.

9.68 So long as the link between recycling centre and landfill gate prices persists, and in Member States where there is a landfill tax, holders of waste (in this case owners of buildings which are to be demolished) therefore pay what amounts to a levy to the recycling centre at the same level as the landfill tax. The big difference is that whereas the landfill tax goes to the Government, the full value of the higher recycling centre gate charge is 'captured' by the operator of the centre. Ultimately the users of new buildings built on demolition sites (i.e. the wider community) pay this higher price in return for a more expensive treatment process (or higher profits to the operator of the recycling centre).

Figure 9.7: Relationships Between Disposal, Processing and Recycling

Disposal of C&DW	Value of Recycled Product	Outcome
Cheap and legal	Low	Processing costs must be low enough to compete with landfill if any recycling is to occur. Transport costs are very important. (For inert C&DW, this is typified by 'Level 1' technology).
	Higher than disposal costs	Processing costs can rise above those of 'Level 1' technology. Competition among processors becomes more important as a way of containing costs for holders of waste.
Expensive but legal	Low	Processing costs (but not the prices received for recycled products) can rise above those of 'Level 1' technology, and these rises can be passed on to holders of waste (i.e. owners

		of buildings), thereby allowing more sophisticated recycling. Competition between demolition contractors and between processors becomes more important as a way of containing demolition and recycling costs.
Illegal	Not important	Since prices for recycled materials are largely governed by non-recycled alternatives, competition between processors is essential to keep gate prices for recyclable products low. Any temptation to award processors monopolistic concessions will probably lead to cost-plus charging and generally higher gate prices. Only competition between processors or sophisticated and well informed regulation will keep costs to holders of waste down.

9.69 With around 180 million tonnes of 'core' C&DW spread among the Member States, any tendency to add further processing costs to C&DW could amount to a substantial transfer of financial resources in return for the benefits of an improved rate of recycling.

9.70 Where 'Level 3' technology is in use and demolition contractors are obliged to separate and treat C&DW (as in Germany and the Netherlands, for example), the evidence reported in the earlier sections of this Chapter shows that both landfill and C&DW processing charges are generally higher than where 'Level 2' technology predominates. Although no causal link between these two observations can be established, it is clear that the cost of landfilling such material is irrelevant, and the demolition contractors have little option but to pay the fees demanded by the recycling centre. It is by no means impossible that recycling centres which operate under such favourable circumstances (irrespective of who they may be operated by) may tend to lose touch with demand-led market forces because their incoming flow of materials is effectively guaranteed. This would allow them to operate on the basis of cost-plus prices. The tighter the local monopoly which a recycling centre may have (as was formerly the case in Germany), the stronger this trend will be in the absence of strong regulation.

9.71 Under these circumstances, the demolition contractor and/or the recycling centre will between them 'capture' at least part of the value of the relevant landfill charges, which they then either spend adding value to the raw material (through recycling), or retain as 'excess' profits. Theory tells us that 'excess' profits attract new competitors. Given that the barrier costs which a new entrant to the demolition business would have to pay are not very great, the scope for 'excess' profits in demolition is equally modest. By contrast the entry costs, and therefore the scope for 'excess' profits, in recycling are considerable, and in areas where the local authority has a share in the existing recycling centre and both the means and the motivation to prevent a competitor from becoming established, virtually infinite.

9.72 A measure of the value being 'captured' by recycling centres is the difference between their gate price and their sale price (for comparable materials). As can be seen above, if we look simply at products like crushed concrete, the differences in Member States where 'Level 3' technology can be found are generally larger than in those where 'Level 1' and 'Level 2' technology is the norm. This suggests that the marginal technical benefits of 'Level 3' technology over its 'Level 2' equivalents may be being subsidised by materials which could perfectly well be produced by 'Level 2' techniques.

9.73 The technical and cost differences between 'Level 1' and 'Level 2' technology are not very great, and in reality very few recycling industries would consciously stop at 'Level 1'. However this is not so where the leap from 'Level 2' to 'Level 3' is concerned, because a 'Level 3' recycling centre has been reported from Germany to require a level of investment of up to five times that of a 'Level 2' centre. We also recognise that the choice between 'Level 2' and 'Level 3' technology is essentially a political one directly equivalent to the one over BAT *versus* BATNEEC (best available technology *versus* best available technology not entailing excessive costs). One of the purposes of this report is simply to point out some of the economic costs entailed in ignoring the NEEC element, and by whom they would most probably be paid.

9.74 To date no Member State has achieved a significant rate of utilisation of C&DW-derived aggregates in new concrete, irrespective of the level of sophistication of the processing

technology used. Based on the data in Annex 4 no Member State (with the exception of the Netherlands) faces a situation where C&DW-derived (and secondary) aggregates are likely to represent a significant share of total aggregates market. Under the circumstances it is very hard to see that more expensive processing can be economically justified where reasonable at-source separation of C&DW (and soil) is being achieved.

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10. SUMMARY OF MAIN CONCLUSIONS AND EFFECTIVE INTERVENTIONS

Introductory comments

10.1 This Chapter draws together the findings from elsewhere in this Report in a series of proposals for interventions which, in the view of the study team, are more likely than most to be effective in boosting C&DW prevention, re-use and/or recycling without imposing unexpected costs on government, industry or society. These proposals are grouped under a set of headings which refer to possible interventions at the level of the EU-15, the Member States, regional or local government and the construction and demolition industries. Given the considerable differences that exist between the administrative structures of the 15 Member States, we regard these headings as helpful pointers rather than definitive categories, and we would urge readers to study the text that appears under each heading in order to get the full picture.

10.2 We should also say quite clearly that we have not sought to re-state (either selectively or in full) the 54 detailed recommendations and accompanying discussion contained in the third volume of the C&DW Priority Waste Streams Project report (see Annex 10, Ref 1.1). It was the view of the project group that drew up that report that their recommendations should be treated as a package, and that all had roughly equal weight and significance. Reproducing them here would therefore be inappropriate for two quite separate reasons: firstly they represent the collective views of others rather than the conclusions of this study, and secondly they cover about 30 pages (which would unbalance this report if inserted here). However, we consider that all 54 recommendations remain relevant, even though the majority have still to be implemented.

10.3 Over the course of this study we found no clear evidence to suggest that any of the individual recommendations (which we refer to below as PWSP recommendations, with their individual numbers where relevant) have become inappropriate, and in general we endorse them. The recommendations cover:

(i) waste management (29 recommendations);

(ii) pre- and post-construction activities (9 recommendations);

(iii) construction and demolition site management (9 recommendations);

(iv) implementation of the strategy (3 recommendations); and

(v) monitoring of, and follow up to, the strategy (4 recommendations).

10.4 We would therefore encourage all readers of this Report with responsibility for policy making to refer back to the C&DW Priority Waste Streams Project report as an essential complement to this document.

Main conclusions

10.5 In Chapter 9 we describe three broad levels of recycling technologies and their applications:

(i) ‘Level 1’, which comprises mobile crushing and sorting plant, and is only really suited to the processing of inert C&DW;

(ii) ‘Level 2’, which also has metal removal and more complex sorting and sieving facilities, and is therefore capable of dealing with mixed (mainly inert) C&DW; and

(iii) ‘Level 3’, which adds hand sorting, washing plant and facilities for other C&DW streams (such as wood) to ‘Level 2’ plant, and can deal with any (mixed and contaminated) C&DW if required.

10.6 As we point out in Chapter 9, these levels may all be present in a single Member State due to regional differences, not least as regards the availability and pricing of primary aggregates. These regional differences are an important characteristic of the C&DW sector, since they

can render a recycling technique which is fully justified in one place completely uneconomic less than 100km away, and with no change in regulatory framework. However, as a general observation it is fair to say that 'Level 1' technology is mainly associated with low levels of recycling, 'Level 3' with high levels, and 'Level 2' with an intermediate position.

10.7 We conclude (in Chapter 8) that no single policy intervention can bring about a transformation in C&DW recycling practice on its own, and that before C&DW recycling can be expected to reach a significant level at which it will be sustained and economically viable, there appear to be four conditions which must be met, as follows:

(i) landfills must be well managed, and 'fly tipping' of waste must be uncommon and subject to sanctions;

(ii) the holder of the C&DW must face a significant financial cost for landfilling waste, with hazardous or mixed wastes facing significantly higher costs (to avoid contamination and to discourage mixing);

(iii) the opportunity must exist for the main bulky inert fraction of the C&DW to be treated (crushed and sorted) prior to re-use or recycling;

(iv) there must be at least a tacit acceptance (by users, specifiers and other similarly interested 'actors') that suitably prepared C&DW-derived aggregates may be used to displace primary aggregates. Positive action to draw up technical standards is not essential, but C&DW-derived aggregates should not be discriminated against on the basis of their origins alone.

10.8 We conclude that if any of these four conditions is not met, then that Member State or region will find it effectively impossible to progress beyond 'Level 1', and even that level of technology will be hard to justify in parts of the territory concerned. By contrast, 'Level 2' and possibly even 'Level 3' technology is likely to follow as soon as all four conditions are met.

10.9 However, we believe that widespread and consistently high levels of recycling (by which we mean 75% or above of 'core' C&DW being recycled in most regions) is likely to be achieved only if some form of ban on landfilling C&DW is imposed and enforced, or if a requirement is put in place that all C&DW must be separated with each stream being directed to some form of re-use or recovery operation. Doing this would effectively remove the second condition from the list in paragraph 10.7 above.

10.10 By contrast, we believe that relying on a mechanism such as a tax on landfill or a tax on primary aggregates would not on its own achieve high recycling rates under all circumstances, because the tax would have to be set at politically unacceptable levels before it changed the behaviour of engineers and demolition contractors in areas with easy access to landfills (or quarries). Varying the tax rate to match local conditions would create considerable distortions to trade, and would therefore probably be equally unacceptable.

10.11 In Chapter 9 we conclude that the economic costs of banning landfilling and/or requiring separation (which have to be set alongside the undoubted environmental and resource-saving gains) are not trivial. Although there are too many imponderables to make it possible to estimate with real confidence how large the extra costs are, we note that C&DW processing charges (but particularly those applied to mixed materials) are generally higher in those Member States which have 'Level 3' technology. In effect such additional costs are almost certainly borne in the first instance by the construction industry, and passed on to the owners, occupants and users of new buildings and infrastructure through higher construction costs.

Interventions at the level of the EU-15

10.12 It would be desirable if a guidance note on the interpretation of waste in the specific context of C&DW management could be issued. Any such guidance needs to address how those materials which the holder intends to re-use without further processing should be dealt with. We conclude that adopting the principles set out in the OECD's 'Final guidance document for distinguishing waste from non-waste' (as discussed in Chapter 3) would meet most if not all of

the objections which we have identified in the specific context of C&DW, and we believe that equivalent guidance from the Commission on C&DW management would be helpful.

10.13 Attention should urgently be given to addressing inconsistencies in the way in which C&DW statistics are recorded by completing the current reviews of the EWC and the hazardous waste list, and the specific classifications applicable to C&DW (see Chapter 2 and Annex 9). When this has been done, written guidance should be provided by the Commission to Member States on the new system. This could (but need not) be combined with the guidance on interpreting the definition of waste which is called for in the previous paragraph.

10.14 We also recommend in Chapter 3 that the Commission should apply appropriate pressure to the participants in working groups convened by CEN and RILEM to consider issues related to specifications. In the interim, we consider that the Commission might issue a guidance note drawing attention to the fact that formal specifications, however convenient, are not actually necessary, and discouraging the citing of their absence as a reason to hold back on using C&DW-derived aggregates.

10.15 The remaining proposals are not necessarily all directed at the Commission. Some of them could equally well be implemented by a trade association or fully commercial organisation (such as a technical publisher).

10.16 Valuable work has been done in several Member States in implementing research, development, pilot and demonstration projects, and in documenting best practice in fields such as selective demolition, the operation of recycling centres, and material-by-material processes.

10.17 Most research and development projects and best practice recommendations are as relevant to other Member States as they are to their 'host' countries. Although pilot and demonstration projects are by their nature tied to a particular time and place, they can nevertheless be of real help to other interested parties if properly recorded and made more widely available.

10.18 We would therefore propose that a more detailed appraisal be made of these topic areas, building on the outlines provided in Chapters 4-6 and Annex 6 of this Report.

10.19 Ideally such an appraisal should result in the production of a best practice synthesis document (or documents) which could then be translated into two or more of the official languages of the EU, with the material made available as printed documents and/or via the Internet.

10.20 The Internet also offers scope for establishing 'bulletin boards' for government officials, regulators, researchers, commercial recyclers and others to exchange information and views. This facility could be linked to the various Internet-based waste exchanges which are springing up in several Member States.

Interventions at the level of individual Member States

10.21 Member State governments should ensure that there are no particular barriers to the use of C&DW-derived aggregates in road construction and for general engineering fill in civil works, including unintentional barriers created by the widespread use of specifications which were originally based on the characteristics of primary materials. Adopting performance-based specifications can help to remove such barriers.

10.22 They may wish to go further and adopt specifications which actively include C&DW-derived aggregates. Such specifications are now widely available, and the effort required to put them in place need not be duplicated.

10.23 Any barriers to the holding of reasonable stocks of C&DW-derived aggregates (which may be treated by regulators as waste materials) should be removed prior to any EU-level guidance on the interpretation of waste being given. For example, we believe that levels of non-inert 'contraries' (such as wood, plastic, rags and paper) which are acceptable in primary aggregates should also be acceptable in C&DW-derived aggregates, enabling them to avoid

classification as waste. At present some regulators treat crushed C&DW-derived aggregates as waste even when they are fit for use and intended for use.

10.24 Where landfill charges are very low (less than 10 ECU/tonne for inert waste) and resources dedicated to the enforcement of good landfill management practices are scarce, consideration should be given to raising charges (possibly but not necessarily through the introduction of a landfill tax), and a high priority should be given to reinforcing enforcement measures before C&DW-specific initiatives are put in place. One of the advantages of a landfill tax is that it generates the necessary resources to pay for improved enforcement.

10.25 As a quite separate measure, we consider that Member States should adopt policies which commit them to encourage and promote (or even to require) selective demolition, certainly where larger structures are concerned. We recognise that the actions necessary to put such a policy into effect will largely be taken at local level, but we believe the signal which a national policy can send would be beneficial.

10.26 Voluntary agreements (VAs) can be used to raise the awareness of developers, demolition contractors and civil engineering contractors alike to the potential for C&DW recycling and the extent of existing knowledge about best practice. Although unlikely to be very effective on their own, VAs can usefully supplement other policy measures and interventions by signalling clearly a preferred approach to complex issues such as selective demolition and on-site use of C&DW-derived aggregates.

10.27 VAs may also be effective in encouraging best recycling practice in sectors where there are only a few suppliers, such as gypsum, plastics and glass. They could also be used to discourage excessive use of bonding materials which make separation of C&DW more difficult than it need be.

10.28 Efforts should be stepped up into the collection and dissemination of statistics on C&DW arisings, treatment and end use using a common basis agreed at EU level (see the discussion above on the EWC and PWSP recommendations 2, 4 and 5 taken as a set).

10.29 Those Member States which have achieved most by way of C&DW recycling have also run extensive research, pilot and demonstration projects in the past. It is not so obvious that (with the possible exception of demonstration projects) other Member States need to repeat this process, because the accumulated experience is extensive and overlapping. Exceptions to this statement would include research into:

(i) selective demolition and processing of those construction materials (such as glass and plastics) which are becoming significantly more widely used; and

(ii) designing for deconstruction, and finding alternatives to materials and techniques (such as the widespread use of bonding agents) which are economically driven at the manufacturing and construction stages, but which create problems at the point of demolition where direct re-use is not an option.

10.30 A number of Member States are using EU funding to encourage wider provision of C&DW processing and recycling centres, and to operate demonstration projects. This is likely to continue to be a valuable method of encouraging best practice in Member States with little or no tradition of C&DW recycling.

Interventions at the regional or local level

10.31 Land use and/or waste plans (whether at the local, regional or even national level) should specifically deal with C&DW. Among other things, at the level where zoning is dealt with they should identify zones and/or locations where C&DW recycling can be considered to be acceptable on a temporary or medium-term basis. Cities which have ‘green belts’ around them should seek to identify locations on the city side of the belt. Where the private sector has shown no interest in developing C&DW processing and recycling centres it may be appropriate for the local authority (or a group of local authorities) to consider establishing a centre on their own or in association with the private sector. In all cases sufficient locations

should be identified to facilitate competition (or the threat of competition) between recycling centres as a means of containing processing charges.

10.32 PWSP recommendations 14-19 (and the accompanying discussion) are particularly relevant in the context of waste planning. PWSP recommendation 17, which we endorse, deals with the difficult question of recycling targets, and calls for detailed targets to be set at the local level, "... where the issues affecting recovery from, and disposal of, the wastes can be identified". Targets set at the regional, national and EU level were viewed by the PWSP as suitable only for providing encouragement to the general process of improvement. The evidence which we have found (and which is reported above and in Annex 5) is that regional factors have a great influence on rates of C&DW recycling.

10.33 There is some evidence to suggest that by requiring a demolition plan and a C&DW management plan to be submitted before a demolition permit is issued (thereby enabling a site to be re-developed), selective demolition and C&DW recycling is encouraged. In our view, introducing such a requirement (which would be consistent with PWSP recommendations 26 and 27) would be likely to have positive consequences, and unlikely to have significant negative ones, since the larger property developers already produce such plans, making the marginal cost of submitting them to the local authorities relatively minor. It is noticeable that in those Member States where demolition plans are required, C&DW recycling rates tend to be higher.

10.34 As purchasers of aggregates in their own right, and/or as major clients for civil engineering works, regional and local authorities have considerable scope for 'green procurement' (by specifying that C&DW-derived aggregates and other re-used or recycled C&DW will either be treated as equivalent to, or even given preference over, primary materials, subject to general single market principles and obligations). This is generally consistent with PWSP recommendation 38.

Interventions by the construction and demolition industries

10.35 Chapter 4 deals in some detail with selective demolition, and concludes that it is a pre-requisite for widespread economic C&DW recycling, Separating materials prior to demolition (which is at the heart of selective demolition) is greatly preferable to sorting of mixed C&DW at a recycling centre. Such a procedure is very expensive, with hand sorting being unpleasant and potentially dangerous for the personnel involved. PWSP recommendation 40 called for greater selective demolition, and we endorse that call.

10.36 As we discuss in Chapter 3 (and briefly above) specifications have historically been the key mechanism used to manage the risks associated with the performance of materials used in construction contracts. The construction industry is traditionally 'conservative' in nature, and has a tendency only to use specifications that have been tried and tested over considerable periods of time. The majority of these specifications are 'recipe' based rather than 'performance' based. We recommend that, independent of any initiatives which may be taken by the EU or national governments, designers and specifiers should be encouraged to use performance based specifications, placing the emphasis on the identification of the properties and qualities required of materials appropriate to the intended use.

10.37 However, as is also pointed out in Chapter 3, specifications are not strictly necessary to good design. In practice several alternative mechanisms are available, and may be used to manage material performance risks provided they are acceptable to all parties to the contract. There is no reason why the present absence of national and international standards should stand in the way of the increased use of C&DW-derived aggregates, or any other potentially re-usable or recycleable C&DW.

10.38 The construction industry should therefore be encouraged to use alternative methods of managing material performance risks, including contract- or sector-specific specifications, or by the external verification of quality certification of C&DW-derived materials. It should not be necessary to wait for nationally or internationally agreed specifications.

10.39 Construction site managers should seek to implement best practices as regards the provision of efficient storage facilities, good stock control, proper training of the labour force and

efficient control of sub-contractors. This should help to reduce damage and reduce over-ordering. Having an internal accounting systems which enables undamaged surplus materials to be returned to the supplier or transferred to another site would also help to reduce the surprisingly large volume of good quality construction materials which goes to landfill as mixed waste. While we do not consider that a VA is a suitable mechanism to achieve this in many cases, we do recommend that the relevant professional bodies should give thought to how best a code of conduct might be more widely applied.

10.40 Developers play a key role in deciding how quickly the sites in their portfolio are cleared and redeveloped, and this in turn strongly influences the extent to which selective demolition is practical. A sector-wide VA to encourage selective demolition on large sites could provide a worthwhile stimulus to greater recycling, particularly if backed up by the threat of regulation if ignored, and we recommend that the relevant industry bodies give this serious consideration.

ANNEXES

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