

REPORT 002

PLASTERBOARD: Sustainability Impacts and Initiatives

September 2009

AN EVIDENCE STUDY

Prepared by Gilli Hobbs on behalf of DEFRA
and the Plasterboard Sustainability Partnership.

A contribution to delivering the targets in the joint
government and industry Strategy for Sustainable
Construction.



PLASTERBOARD: Sustainability Impacts and Initiatives an Evidence Study

This study was commissioned and funded by Defra and prepared by Gilli Hobbs of BRE with inputs from all members of the Plasterboard Sustainability Partnership and other government departments and their regulatory and support agencies.

The views expressed do not necessarily reflect Defra policy or opinions.

This evidence study is part of a series of reports that together provide a plasterboard roadmap. Plasterboard is one of ten pilot product roadmaps that contribute towards DEFRA's programme on Sustainable Consumption and Production.

<http://defra.gov.uk/environment/business/products/roadmaps/index.htm>

The Plasterboard Sustainability Partnership (PSP) formed in response to the stakeholder discussions that took place to prepare this report. The PSP is made up of the broad range of [stakeholders](#) involved in the production, installation and disposal of plasterboard as well as the relevant government departments and regulatory agencies.

<http://plasterboardpartnership.org>

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The Delivering the Strategy Targets series was initiated by Jane Thornback of the Construction Products Association. The Association is the umbrella body for construction product manufacturers and suppliers.

<http://www.constructionproducts.org.uk>

Disclaimer: This study has been prepared by BRE and efforts have been made to reflect stakeholder evidence and opinion. A wide variety of sources have been used and not all statements have been verified by all stakeholders and therefore do not necessarily reflect the views of all stakeholders.

EXECUTIVE SUMMARY

This study has arisen from a DEFRA-funded study in collaboration with industry to examine and document the sustainability impacts of plasterboard, as well as to identify the actions currently taking place to address these impacts and the areas where further work is needed.

The study looked at each stage of the product life-cycle for plasterboard: the extraction of raw materials; production of the plasterboard; retail and distribution; use and maintenance; to end of life. For each of these stages in the life-cycle the report summarises:

- The environmental, economic and social impacts of plasterboard
- The current activities and policies that may reduce these impacts
- Possible gaps and potential future work for concerted action

The study is one of a number of roadmap projects coordinated by DEFRA in collaboration with industry and is a contribution to delivering the targets identified within the joint government and industry Strategy for Sustainable Construction launched in July 2008. It is also an action within the Waste Strategy for England 2007. Throughout the study, which was carried out between 2008 and early 2009, government and industry stakeholders from across the plasterboard supply-chain worked collaboratively.

When making decisions on product selection and replacement, primary importance must be given to the role that a construction product plays in the sustainability of the whole building throughout its life-cycle. Plasterboard is a widely used and essential construction product, with many positive impacts for the built environment. Whilst acknowledged in the report, these positive impacts are not the focus of this study unless it is clear that they can be further enhanced.

The main environmental impact associated with plasterboard relates to climate change due to the energy needed at various stages of plasterboard manufacture, such as in the early stages of calcination and drying of the board¹. Other impacts include the disposal of plasterboard waste created from its installation and when it is removed from buildings at end of life, the latter having an economic impact on those having to dispose of the plasterboard waste. Negative social impacts include the potential health and safety risk resulting from the manual handling of plasterboard sheets during construction.

There has already been a number of major studies assessing the impact of plasterboard and an array of government funded initiatives addressing the most significant impacts. An Umbrella Climate Change Agreement for the Gypsum Manufacturing Sector has existed since 2001 and a more recent Ashdown Agreement on plasterboard includes challenging targets to divert manufacturing and installation waste from landfill. It is a positive situation that these main impacts are already being mitigated. There is scope however, to increase the effectiveness of existing initiatives and to initiate work on a small number of new areas, for example, labelling of plasterboard to promote better manual handling, or reducing the amount of plasterboard waste produced and increasing the recycling of demolition plasterboard waste.

1. This and most of the environmental impact information described in the report is taken from a study on the life-cycle assessment of plasterboard commissioned by WRAP (Waste and Resources Action Programme) undertaken in 2007.

A positive outcome of the work is that the collaboration achieved during the study has led to the formation of a new grouping the Plasterboard Sustainability Partnership (PSP) which comprises representatives from government departments and industry at all stages of the product life-cycle. The Partnership will act as the umbrella body for discussion of plasterboard issues and initiatives and will facilitate coordination to create and foster a partnership of all stakeholders and to improve mutual communication between stakeholders, and to act as a repository of knowledge about the product's sustainability. The PSP website is currently under development to facilitate this knowledge transfer:

The next stage of the work is the development of a plasterboard sustainability action plan. This will be developed in partnership with stakeholders across the plasterboard sector and supply chain, government departments and regulatory agencies. The action plan will focus on issues where there is clear and agreed potential to make significant improvements.

Plasterboard Sustainability Partnership

The following organisations participated in the development of this study.

ORGANISATION	PARTICIPANT	ORGANISATION WEB ADDRESS
Industry		
Association of Interior Specialists	Simon Forrester	www.ais-interiors.org.uk/
British Gypsum	Heidi Barnard Brian Andreas	www.british-gypsum.com/
Builders Merchants Federation	Caroline Green	www.bmf.org.uk/
Building Research Establishment	Gilli Hobbs Katherine Adams	www.bre.co.uk/
Construction Products Association	Jane Thornback	www.constructionproducts.org.uk/
Federation of Plasterers and Drylining Contractors	Paul Jessop	www.fpdc.org.uk/
Geoffrey Osbourne Ltd	Caroline Oldroyd	www.osborne.co.uk/
Gypsum Products Development Association	Crispin Dunn-Meynell	www.gpda.com/
Kier Ltd	Peter Johnson	www.kier.co.uk/
Knauf UK	Paul Lonergan	www.knauf.co.uk/
Lafarge Plasterboard	Lucy Edgar	www.lafarge.co.uk/
Roy Hatfield Ltd	Mark Hatfield	www.royhatfield.com/
Saint Gobain Building Distribution	Steve Millward	www.saint-gobain.co.uk/
Government departments		
Department for Environment, Food and Rural Affairs	Bob Ryder Alice Baverstock Ishani Weerakkody Maria Grace Andrew Gregory	www.defra.gov.uk/
Department for Communities and Local Government	Clover Summers	www.communities.gov.uk/
Department for Business, Innovation and Skills	Richard Gill	www.bis.gov.uk/
Environment Agency	Peter Elliot	www.environment-agency.gov.uk/
WRAP	David Marsh	www.wrap.org.uk/
Health and Safety Executive	Norman Macritchie	www.hse.gov.uk/

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Annex 1 – Summary of relevant reports, policy and initiatives

Annex 2 – Stakeholders

1. Introduction

- 1.1 The purpose of this study is to provide a summary of current UK/EU industry and government actions and initiatives aimed at improving the sustainability of plasterboard, and make some suggestions for future actions. This is the first stage of developing the joint Defra/industry product roadmap for plasterboard.
- 1.2 It brings together information from a number of sources to set out the key sustainability benefits and impacts of plasterboard. The environmental, social and economic impacts are compared to existing industry initiatives and government policy that should reduce them. Gaps or scope to do more, in reducing the impacts, are identified.
- 1.3 Plasterboard is an essential and widely used construction product and has a very positive impact on the built environment and the build process. Whilst these are acknowledged in the appropriate sections, these positive impacts are not the focus of this initial study, unless it is clear that particular positive impacts can be further enhanced through industry action or government policy.
- 1.4 The study contains a number of recommendations for possible future activity which will form the basis for discussions with industry partners to determine how a roadmap should be taken further forward.
- 1.5 Having achieved a consensus that there would be value in government and industry partners working together developing a roadmap for plasterboard, this report provides a starting point for that activity by providing a basis for:
 - identifying and agreeing where there may be gaps in our information and deciding whether further evidence is needed
 - considering how best to build on existing initiatives and prepare for new challenges
 - agreeing any additional practical activities that could be undertaken to further reduce the impact of plasterboard

2. What are product roadmaps?

- 2.1 To help deliver on Defra's Sustainable Consumption and Production (SCP) objectives² and the joint government/industry Strategy for Sustainable Construction³, ten product roadmaps are being piloted. The ten selected products impact significantly on the environment in at least one area or life-cycle stage. They have been drawn from wider product groupings shown to have the highest environmental impacts (food and drink, passenger transport, housing – including construction and appliances, and clothing and textiles)⁴.
- 2.2 The roadmaps capture evidence on the impacts of each product across its life-cycle, highlight existing interventions, good practice and gaps, develop a vision of the future and, based on the evidence, develop and agree practical actions with stakeholders to help transform each product towards that more sustainable future. The first set of roadmaps will focus on the ten products from the four high impact product areas as identified in Table 1.

2. Sustainable Consumption and Production is a key priority for Defra and is described as Achieving economic growth whilst respecting environmental limits, finding ways to minimise damage to the natural world and making use of the earth's resources in a sustainable way.

3. Government and industry – Strategy for Sustainable Construction 2008.

4. The EU-25 study, The Environmental Impact of Products (EIPRO). In this study, buildings, construction and appliances are said to account for 20-35% of all environmental impacts.

Table I: List of product roadmaps

Priority Area	Product
Food	Milk
	Fish and shellfish
Transport	Passenger cars
Buildings (including construction and appliances)	TVs
	Domestic lighting
	Commercial motors
	Window systems
	WCs
	Plasterboard
Clothing/Textiles	Clothing

2.3 Although there is no blue print for developing a roadmap and the ten roadmaps underway are evolving in different ways, a number of common principles is being applied. One key principle is to ensure that any action taken to improve the sustainability of each product under focus is founded on a robust evidence base.

2.4 An early and integral step in developing a roadmap is therefore to gather and analyse evidence on both the key sustainability impacts arising across the life-cycle of each product and the initiatives in place to address them. Plasterboard is one of three construction products to which the roadmapping approach is being applied (others are window systems and WCs).

Steps to producing the roadmap

2.5 It is both for industry and government to agree whether and how a roadmap should be developed for plasterboard, after considering to what extent this will add value to the work already underway (Step 2) to reduce the impacts identified in Step 1, as summarised in Figure 1.

Figure 1: Steps to producing a roadmap



Steps in the scope of this study

- 2.6 Step 1 – what are the impacts?
Data from a recent life-cycle assessment (LCA) of plasterboard, commissioned by WRAP⁵, has been used to identify and quantify (where possible) the main environmental impacts associated with plasterboard across its life-cycle and supply chain. This has replaced the life-cycle data used in the previous report, which was based upon BRE's Green Guide to Specification⁶. Other sustainability issues are also flagged up, such as economic and social impacts.
- 2.7 Step 2 – what initiatives⁷ are in place?
Most of the impacts identified have been well known to industry and government for some time. Consequently, there are already relevant policy and legislation and industry led initiatives in place. These are presented in relation to the life-cycle stages most affected. Some of the impacts are being addressed at a global level, for example Climate Change Agreements for energy intensive raw materials. Where this is the case, it is assumed that any further or separate actions should not be necessary.
- 2.8 Step 3a – where are the gaps?
This is effectively a gap analysis of the identified impacts compared to the existing initiatives. There is unlikely to be any significant impact that does not have any associated policy or industry led activity. Therefore, many of the gaps are in fact recommendations as to where there is scope to do more to reduce a particular impact, or consolidate multiple policies/activities to have a greater overall effect. There are also evidence gaps that could be filled to enable better decision making across the life-cycle of these products.

Steps not in the scope of this study

- 2.9 Step 3b – what else can be done to reduce impacts?
This report forms part of the process as the starting point for developing a forward approach.
- 2.10 Step 4 – agree an action plan.
The stakeholder group will agree actions that should be taken forward to further improve the sustainability of plasterboard. This should achieve consensus prior to asking for wider stakeholder input. An action plan should clearly set out continuing and additional activities that will be undertaken, set against a timeframe. Any recommendations for additional activity will be consolidated into the plan to reduce impacts over time. This will need to be agreed by government and industry stakeholders.
- 2.11 Step 5 – publish the action plan (roadmap) followed by implementation.
Once agreed and detailed, the action plan can be published, effectively concluding the development stage of the roadmapping exercise. The next vital stage is implementation and it is envisaged that the stakeholder group (see information on plasterboard partnership), alongside government and other stakeholders will continue to meet in order to monitor progress against the action plan. This could also be a useful way of consolidating ongoing initiatives through having a single point of contact for initial industry and government input. The plasterboard roadmap will assist policy makers who have clarity from the industry sector in terms of voluntary activities and have improved evidence to support related policy decisions and may indicate where government can best provide support to help implement the roadmap.

5. Waste and Resources Action Programme: Technical report, Life-cycle Assessment of Plasterboard, www.wrap.org.uk/downloads/Life_Cycle_Assessment_of_Plasterboard.3fc9fd76.5313.pdf

6. Green Guide to Specification, Online 2008 update, can be accessed at www.thegreenguide.org.uk

7. For the purposes of this report, initiatives is used as a term to encompass government policy and legislation; industry schemes, agreements and other actions; codes of practice, standards and other supporting activities, such as Environmental Product Declarations (EPD) and Life Cycle Assessment (LCA).

- 2.12 A key issue for the plasterboard supply chain is to limit the proliferation of initiatives that can be time consuming and duplicative to industry consultees and participants. The roadmap should therefore provide a framework for business support, research and development, and policy development. To facilitate a strong pan-industry overview and consultation route, representatives from across the plasterboard supply chain have been invited to form a Plasterboard Sustainability Partnership⁸. The inaugural meeting of this group was held in February 2009.

3. Environmental impact

- 3.1 Knowledge relating to the relative impacts of raw materials, production and waste disposal is improving all the time. This enables more informed procurement decisions to be made (such as utilising BRE's Green Guide to Specification) and actions to be undertaken to reduce those impacts.
- 3.2 There are always areas of controversy in LCA methodologies as the precise scope and interpretation is not prescribed on a European or international basis. An LCA framework is set out in an ISO standard⁹ and there is work underway to agree standards at a European level through CEN350¹⁰, however this is unlikely to be agreed for several years. An LCA needs to be carried out at a building system level rather than just at the level of the product (e.g. how does the use of this product component support the sustainability of the building). These are complex issues and if the issue is defined too narrowly, incorrect judgements will be made.
- 3.3 It can be difficult to make improvements based purely upon life-cycle data. This can be as a result of data not being readily available on specific issues, such as waste disposal. It can also be due to the global nature of some impacts that make UK or product based initiatives of limited value. Therefore, the information presented should be considered within the context of:
- Is it a significant impact?
 - Can we do anything about it?
- 3.4 Consistency and transparency in quantifying life-cycle impacts are critical areas that require further work and support. In the meantime, impacts have been evaluated primarily from the datasets arising from a LCA study commissioned by WRAP to generate LCA datasets and raise awareness of these impacts. This dataset was used as it has more recent data in than the BRE's Green Guide to Specification methodology. Table 2 summarises the key data developed as part of this work¹¹. Impacts are based upon Type A (12.5 x 1200 x 2400 mm, square edge profile) plasterboard. Thicker types of plasterboard and different types, e.g. foam backed are likely to differ slightly. Also, the results are not in relation to the building or building element life-cycle impact.

8. Further information and documents relating to the roadmap will be available from the plasterboard partnership website in due course. Currently under construction: www.plasterboardpartnership.org.

9. ISO 21930 LCA applied to scenarios in the built environment

10. CEN 350 Sustainability of Construction Work. www.cen.eu/CENORM/Sectors/TechnicalCommittees/Workshops/CENTechnicalCommittees/WPasp?param=481830&title=CEN%2FTC+350

11. Waste and Resources Action Programme – Life-cycle Assessment for Plasterboard Technical report. Note: This is the baseline scenario (low recycling transport) – Table C.1. www.wrap.org.uk/downloads/Life_Cycle_Assessment_of_Plasterboard_3fc9fd76.5313.pdf

Table 2: Life-cycle impact summary table

	Abiotic depletion	Global warming	Ozone layer depletion	Human toxicity	Fresh water aquatic ecotoxicity	Marine aquatic ecotoxicity	Terrestrial ecotoxicity	Photo-oxidation	Acidification	Eutrophication
	%	%	%	%	%	%	%	%	%	%
Gypsum production (conventional)	21%	16%	2%	11%	9%	49%	25%	16%	27%	14%
Gypsum transport (conventional)	4%	3%	9%	9%	2%	3%	8%	11%	22%	14%
Gypsum preprocessing (conventional)	5%	3%	2%	4%	2%	2%	1%	1%	1%	1%
Gypsum production (recycled process waste)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gypsum production (closed loop recycled post-consumer waste)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other recycling outputs	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Gypsum preprocessing (recycled)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Stucco production (gypsum calcining)	17%	11%	9%	12%	1%	9%	4%	3%	3%	2%
Facing paper production	7%	8%	9%	11%	67%	12%	19%	4%	6%	9%
Plasterboard production	35%	26%	23%	31%	7%	18%	20%	6%	6%	21%
Packaging and distribution	7%	10%	31%	10%	4%	4%	10%	13%	11%	24%
Collection and transport for recycling	0%	0%	1%	1%	0%	0%	1%	0%	1%	1%
Collection and transport for disposal	3%	2%	7%	8%	8%	2%	12%	5%	5%	7%
Disposal	1%	20%	5%	3%	0%	0%	1%	40%	19%	5%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.5 Table 2 describes the proportion of each type of environmental impact at various stages of plasterboard's life-cycle: production, distribution, installation and removal. It does not provide a sense of whether the overall impact is large or small as this would require data to be weighted and compared to a benchmark figure. However, it is possible to see where the biggest impact lies within each type of environmental impact category. These are summarised in Table 3.

Table 3: Summary of impact categories

Environmental impact category	Description	Significant areas
Abiotic depletion	Considers the proportion of the available resource (in years) for each raw material consumed by the activities in question and summing their contributions to depletion of known stocks, giving a measure of total depletion. Resource depletion compared with antimony reserves as a reference. Impacts are expressed in kg Sb (antimony) equivalents	Will be higher where using limited, non-renewable resources such as fossil fuels. Highest for gypsum production (extraction of raw material), plasterboard production (fossil fuel use)
Global warming	Gases contributing to the greenhouse effect are aggregated according to their impact on radiative warming compared to carbon dioxide as the reference gas. Impacts are expressed in kg CO ₂ equivalents.	Will be higher where emitting CO ₂ or methane. Highest for plasterboard production (burning fossil fuels), disposal (transport and landfill emissions)
Ozone layer depletion	Gases that contribute to the depletion of the ozone layer; ozone depletion potentials have been developed using CFC-11 as a reference substance. Impacts are expressed in kg CFCF-11 equivalents	Will be higher where CFCs are emitted. Highest for packaging and distribution (diesel lorries)
Human toxicity	Impact categories based on calculated human, aquatic or terrestrial toxicity potentials. These reflect the potential harm to humans or the aquatic or terrestrial environment of a unit quantity of chemical emitted	Highest for plasterboard production (process additives, gas/electricity emissions)
Freshwater aquatic toxicity	Human Toxicity Potentials (HTP) reflect the potential harm of a unit of chemical released into the environment. These are expressed as 1,4-dichlorobenzene equivalents/kg emission Eco-toxicity potentials for the aquatic and terrestrial environments are also expressed as 1,4-dichlorobenzene equivalents/kg emission	Highest for Facing paper production (recycling paper process)
Marine aquatic toxicity		Highest for gypsum production (impact of coal extraction, which links to FGD gypsum)
Terrestrial ecotoxicity		Highest for gypsum production, plasterboard production
Photo-oxidation		Gases contributing to smog formation are aggregated. Compared to ethylene as the reference gas. Impacts are expressed in kg C ₂ H ₄ .
Acidification	Usually proportional to air emissions of ammonia, sulphur dioxide and nitrogen oxides	Linked to coal fired power and transport emissions. Highest for gypsum production, disposal
Eutrophication	Emissions (typically compounds of nitrogen or phosphorus) in an ecosystem. Leads to excessive plant growth and decay, which reduces oxygen levels and is detrimental to fish and other animals	Linked to transport emissions. Highest for packaging and distribution

- 3.6 Those stages that have typically larger proportions across the impact categories include:
- Gypsum production (conventional) – this includes the extraction of natural gypsum and certain impacts relating to the production of Flue Gas Desulphurisation (FGD) gypsum. Most of the impact relating to FGD is not allocated to plasterboard, as it is made as a result of a requirement for coal fired power stations to remove sulphur oxides from air emissions. The power station and its FGD process is normally designed on the basis that the by-product has to be manufactured to be suitable for subsequent use. If such a use were not available, the design configuration – or even the type of fuel used – would be different
 - Calcination (Stucco production) – this is where combined water is driven off to convert calcium sulphate dihydrate to calcium sulphate hemihydrate. This stage requires energy to heat up to 150°C, usually using natural gas. All impacts associated with using fossil fuels will be higher accordingly
 - Plasterboard production – the hemihydrate is mixed with water to form the plasterboard slurry which is then extruded between the facing papers and passed through a dryer at a moderate temperature (to prevent recalcination), usually using natural gas. All impacts associated with using fossil fuels will be increased accordingly
 - Disposal – this relates to the landfilling of plasterboard, mainly transport emissions and some landfill gas emissions
- 3.7 The impacts of recycling are largely allocated to gypsum production (closed loop recycled post consumer waste). These are all relatively low, mainly due to the low levels of recycled post consumer waste being used compared to conventional sources.
- 3.8 Not all aspects are included in the WRAP LCA study, or BRE's Green Guide to Specification. These include issues such as how plasterboard impacts on operational energy usage in buildings and responsible sourcing. There are also clear positive impacts relating to plasterboard that are not readily quantifiable in life-cycle assessment terms such as the thermal performance of the product which is discussed in more detail during the in use section and improving the speed of construction.

4. Economic impact

- 4.1 Use of plasterboard has been on the increase for many decades, ahead of the trend in construction sector growth. Manufacturers attribute this to the fact that plasterboard is a low cost material which speeds up the construction process while creating high performance building systems.
- 4.2 The total value of the gypsum sales in Britain and Ireland is around £600 million, with production figures of around 3.5 million tonnes in 2000. In the UK, direct employment in the gypsum industry is around 2,500 with more than 20,000 indirectly employed (builders merchants, installation and others)¹². The European Gypsum Industry has an annual turnover of around £10 billion. It employs more than 28,000 people directly and another 85,000 people indirectly¹³.
- 4.3 Substantial amounts of FGD gypsum, have contributed significantly to the decline of mined gypsum, since 1994. This gypsum is a by-product from the emissions cleaning process, (flue gas desulphurisation), at power stations. FGD gypsum is produced by several coal-fired power stations in the UK. These power stations sell FGD gypsum, reducing the need for naturally mined gypsum. It may also have a cost benefit versus importing raw materials from Europe. Continued use may be dependent upon the types of

12. Figures from Gypsum Products Development Association website, www.gpda.com

13. Eurogypsum. Sustainability of Gypsum: Our assets. 2008. www.eurogypsum.org

power station operating in the future. No coal-fired power stations have been built in the past 30 years and the long-term future of coal-fired electricity generation is uncertain. In the medium term, supplies of FGD gypsum will increase as further FGD plant installations are planned for several more coal-fired power stations¹⁴.

- 4.4 About 60% of the gypsum consumed in the UK is used in the manufacture of plasterboard (around 3 million tonnes of 5 million tonnes consumed)¹⁵. There are three plasterboard producers in the UK: British Gypsum, Knauf and Lafarge Plasterboard and together they produce an estimated 270 million m² of plasterboard each year (prior to the economic recession). They supply to distributors of building products (builder's merchants), main contractors and specialist contractors (both drylining and interior fit out). Economic issues affect other sectors in the industry, notably demolition contractors, plasterboard recyclers and waste disposers. Ultimately, the economic benefits and costs of plasterboard affect the building owner where plasterboard is being installed or removed. For example, cost effectiveness of the product or cost of disposal.
- 4.5 The domestic, commercial and industrial construction sectors all use plasterboard and have increased their use over the last 20 years. In the UK, this is being driven by several factors:
- Lack of skilled plasterers
 - Quicker to construct
 - Cheaper to construct
 - Compliance with Building Regulations Part E (Acoustic), Part L (Thermal) and Part B (Fire).
 - A plasterboard based lining system replaces some of the underlying structure and provides solutions for higher-performance building lining systems
- 4.6 In the UK, the most common plasterboard product dimensions are:
- Thickness - 12.5 mm and to a lesser extent 9.5 mm
 - Width - 900 mm and 1200 mm
 - Length - most common lengths are 1800 mm, 1829 mm (6 ft), 2400 mm and 2438 mm (8 ft)
- 4.7 The long-term consumer demand for higher levels of sound resistance and tightening Building Regulations is likely to drive up board weights in terms of mass per unit area.

Economic downturn¹⁶

- 4.8 Data from Building Magazine for the last quarter of 2008, shows that the tender cost index for construction dropped by around 7.5%. At the same time the building cost index rose by 7.4%. Access to credit has also been restricted. During January 2009, there were several notifications of price rises for key construction products such as aggregates (12%), concrete (12%), bricks (12-15%), plaster and plasterboard (9%).
- 4.9 The combination of these trends inevitably leads to an overall reduction in construction activity. The Construction Product Association's State of Trade Survey for 2008 key findings are¹⁷:
- 78% of construction product manufacturers report sales to fall in 2009 Q1 compared to Q4 2008
 - 91% of construction product manufacturers report sales lower than in same quarter last year
 - 82% expect sales to fall in 2009 compared with 2008 and 75% of these expect sales to fall by more than 5%

14. MTP briefing note: BNPBI: Plasterboard - industry, product and market overview. 2008. www.mtprog.com.

15. WRAP report, January 2006. Review of Plasterboard Material Flows and Barriers to Greater Use of Recycled Plasterboard.

16. Building Magazine online 30 January 2009

17. Construction Product Association Weekly notes 13 February 2009

- 4.10 The entire construction supply chain has suffered decline in the last six months of 2008 and this is expected to continue in 2009 and 2010. A large number of jobs has been and will continue to be lost and a significant number of companies will go out of business. More than half of small and medium-sized contractors in a Federation of Master Builders' state of trade survey made redundancies in the last three months of 2008. More than half also expect to have to make further redundancies in the first half of 2009, around 90,000 job losses.
- 4.11 However, oil prices have dropped over the last year; investment in public building is being brought forward and interest rates are heading to zero, which could help improve the outlook for construction supply chain companies.

5. Social impact

- 5.1 The social impact of plasterboard is more difficult to define. For the purpose of this report, it is considered to be as follows:
- Health and safety aspects, such as airborne dust and manual handling
 - Fire performance
 - Acoustic performance
 - Indoor air quality
 - Local environmental issues, such as fly tipping and transport
 - Employment
 - Quality of buildings
- 5.2 Plasterboard has low toxicity; high purity natural gypsum (calcium sulphate) has been used safely as a food additive for many years. However, with regard to airborne dust, Health and Safety Executive (HSE) has set Occupational Exposure Limits (OELs) for certain building materials. For gypsum products, the OELs are 4 mg/m³ for respirable and 10mg/m³ for inhalable, airborne dust particles. These limits are unlikely to be exceeded except in poorly ventilated or confined spaces,¹⁸ in which case measures should be taken to control risk, e.g. provision and use of suitable personal protective equipment (PPE). However, the generation and inhalation of significant amounts of airborne dust should first be avoided where possible and dustless methods of working and cleaning used where reasonably practicable.
- 5.3 The movement and handling of panel products, including plasterboard, may give rise to risk of musculoskeletal injury. The level of risk depends on factors including the nature of the task, load, environment and the individuals involved. In particular, manual lifting and handling of loads while bending or twisting the back may cause spinal injury, especially if this activity is repetitive or takes place over extended timescales. Such risk may, for example, arise in the construction phase if persons manually handle large or heavy panels, particularly over uneven ground, up or down stairs, in wind, or in restricted space such as in buildings. Where relevant risk of injury exists, the Manual Handling Operations Regulations 1992 require employers to avoid employees undertaking such operations, so far as is reasonably practicable. Where handling is not avoidable, employers should assess risk and introduce suitable controls, preferably by substituting safe mechanised techniques. As larger and heavier sheets of plasterboard come into use, it is vital that suitable controls be implemented for their handling. Conversely, some manufacturers offer ergonomic sheets of reduced size and mass, just as in the early 1990s bags of plaster were reduced from 40kg to 25kg, facilitating better risk control. Clearly,

18. GPDA, Healthier Building with Gypsum Products, No. 1 The CDM Regulations and Safety, Health And Welfare At Work (Construction) Regulations, 1995

such helpful measures are only effective if users resist the temptation to manually handle more units simultaneously which negates any benefit.

Issues relevant to safe storage, handling and cutting of plasterboard include:

- Safe packaging of stock to prevent its slippage/damage in transit
- Safe storage of stock to prevent its unplanned movement
- Planning and scheduling of construction phase activity to control risk
- Reducing manual handling, especially bending/twisting lifts, up/down stairs
- Promoting mechanical handling, e.g. use of lifts in construction phase
- Controlling falls/falling objects in work at height
- User awareness of risk/effective control, e.g. board weights/safe lifting
- Design, especially impact of any unusual design aspects
- Impact of off-site fabrication
- Access to services
- Dust control at source - minimise amount of board cutting needed
- Dust control in air – local extraction/ventilation of confined spaces
- Number of different plasterboard types/sizes

HSE has recently launched an initiative to address unsafe manual handling of plasterboard. This seeks to support the construction industry supply chain in developing and implementing improved risk control.

- 5.4 Plasterboard has low flammability and, as indicated, constructions using plasterboard can show excellent fire performance¹⁹. Materials used in lining ceilings and walls can have a major effect on the spread of fire and on its intensity within buildings. Greater compartmentalisation, e.g. by room sub-division and use of internal walls, can have a positive impact on reducing the spread of fire and allow occupants more time to escape. One of the essential requirements in EU harmonised product standards (used for CE marking under the Construction Products Directive) is fire performance. The two key measurements are reaction to fire and resistance to fire. Standardised testing and classification results are presented in a European Classification System of Euroclasses. In terms of reaction to fire, these range from A1 (non combustible) to E (easily flammable) or F (very easily flammable or not tested). Most plasterboard is classified as A2 (no contribution to fire) as long as the paper grammage of the liner does not exceed 220g per m², or class B (very limited contribution to fire) if paper grammage is between 220 and 320g per m². In fire situations, the gypsum core becomes dehydrated, forming a surface crust that can withstand even higher temperatures. In practical terms, this means that A or B classed plasterboard used appropriately in a construction could help delay the spread of fire for up to four hours.
- 5.5 Noise complaints and disputes between neighbours have increased with the density of house building. It is far easier to build improved sound insulation into new buildings than it is to fix the problem retrospectively. Plasterboard products and systems can provide high standards of sound insulation in all types of building. The latest version of the Approved Document guidance on Part E of the Building Regulations (England and Wales), dealing with resistance to the passage of sound came into effect in July 2003. This introduced higher requirements for acoustic performance for residential buildings. It is estimated that in new dwellings, as many as 40% of separating floors and up to 25% of separating walls may fail to meet the current standards²⁰. Robust details and pre-condition testing guidelines have been issued by the Gypsum Product Development Association (GPDA) to promote higher performance targets than the constructions described in Approved Document E. This guidance recommends the use of deeper cavities with denser, acoustic boards to improve sound insulation and acoustic comfort for the occupants.

19. Eurogypsum 2008, Fire and the Construction Products Directive, Why are Gypsum Products so effective in Fire?

20. GPDA, Approved Document E: Robust Details and PCT. www.gpda.com

- 5.6 Indoor air quality is becoming more of an issue as buildings become more airtight, particularly where adequate ventilation has not been designed in. Gypsum can help regulate humidity through absorbing water vapour when a room is humid, automatically releasing it if the indoor air becomes too dry. Plasterboards also have a limited heat-storing ability. Small temperature increases are absorbed and radiated back later when the temperature in the room decreases²¹. It is possible to further enhance air quality improvement through the addition of zeolites in the gypsum mix. This could help remove volatile organic compounds, such as those responsible for odours²².
- 5.7 Transport emissions and nuisance can be minimised through greater use of rail and water networks. For example, British Gypsum has a five year rail contract for delivery of gypsum to its manufacturing plants at Kirkby Thore, East Leake and Robertsbridge. This means that around 80% of all raw material gypsum deliveries for their UK operations have been moved from road to rail²³. In Scotland, there has also been a shift from road to rail with more plasterboard being delivered in this way.
- 5.8 Some industry stakeholders have suggested that the latest position statement from the Environment Agency relating to the disposal of plasterboard may lead to an increase in flytipping which can cause a local nuisance and impact on the local environment. From April 2009, plasterboard waste needs to be separated from other waste, typically by the producer of the waste, for recycling or to monocell landfill. While Defra expects compliance with this requirement to be high, there is a risk that some producers may dump the waste illegally rather than dispose of it in accordance with the EA requirements: CD and E waste formed more than 31% of flytipping incidents dealt with by the Environment Agency in 2005-2006 and nearly 60,000 incidents involving construction-related waste were reported to English local authorities²⁴.

6. Raw materials and production

- 6.1 Table 2 summarised the key impacts from the raw material and production part of the product life-cycle, based on data from the LCA undertaken by WRAP for plasterboard, which was based on data provided by the GPDA. Table 4 converts this data into the cumulative proportion of each environmental impact criteria attributable to the raw material and production phase of the plasterboard life-cycle. This includes the following stages:
- Gypsum production (conventional)
 - Gypsum transport (conventional)
 - Gypsum preprocessing (conventional)
 - Gypsum production (recycled process waste)
 - Gypsum production (closed loop recycled post-consumer waste)
 - Other recycling outputs
 - Gypsum preprocessing (recycled)
 - Stucco production (gypsum calcining)
 - Facing paper production
 - Plasterboard production

21. Eurogypsum. Sustainability of Gypsum: Our assets. 2008. www.eurogypsum.org.

22. Eurogypsum Congress 2008. Case study: How to improve indoor air quality with plasterboards.

23. What's new in building online 20 June 2008. www.wnibi.com/Building/Articles.aspx/22742.

24. England Waste Strategy 2007, Annex C3 Construction, demolition and excavation waste. www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-annex-c3.pdf.

Table 4: Combined proportion of raw material and production impact

Environmental impact criteria	Combined
Abiotic depletion	89%
Global warming	68%
Ozone layer depletion	57%
Human toxicity	77%
Freshwater aquatic toxicity	87%
Marine aquatic toxicity	93%
Terrestrial ecotoxicity	77%
Photo-oxidation	42%
Acidification	64%
Eutrophication	63%

Additional notes

- 6.2
- British Gypsum owns rights to all natural gypsum currently mined in the UK. Therefore, other companies must import natural gypsum unless they can source sufficient synthetic gypsum
 - Flue Gas Desulphurisation (FGD) is required by law at 70% of UK coal fired power stations. FGD gypsum is used almost exclusively by the plasterboard industry. Increased FGD would result in increased use of FGD gypsum. FGD gypsum has occasionally been imported in the past. FGD gypsum counts towards the overall recycled content of the product
 - Facing paper typically comprises more than 90% recycled fibre

Initiatives to address the impact of production

Climate Change Agreements

- 6.3
- Climate Change Agreements (CCAs) allow eligible energy intensive business users to receive up to an 80% discount from the Climate Change Levy (CCL) in return for meeting energy efficiency or carbon saving targets. The Umbrella Climate Change Agreement for the Gypsum Manufacturing Sector²⁵ was signed off in 2001 and covers the manufacture of gypsum products using Part A combustion plant. Sector targets were established based on a given level of throughput and product mix. These targets are revised periodically (most recently in 2008) to ensure CCA targets and performance supports the UK's climate change programme objectives. Government is consulting in mid 2009 on all aspects of CCAs post 2012.

25. Umbrella Climate Change Agreement for the Gypsum Manufacturing Sector 2001.
www.defra.gov.uk/environment/climatechange/uk/business/cca/pdf/agreements/202gpda.pdf

EU Emission Trading Scheme

- 6.4 In the UK, gypsum is one of six new sectors which entered into EU Carbon Emissions Trading for its second phase, 2008-2012. In Ireland, the gypsum industry entered Emissions Trading in Phase I. In EU ETS2, participating companies are allocated a cap of tonnes of carbon dioxide equivalent allowances. Companies have the flexibility of determining where and the most cost effective way, emissions reductions will be achieved, whilst government regulates the amount of emissions produced in aggregate by setting the overall cap for the scheme.
- 6.5 To a limited extent, each Member State can make their own interpretation as to which industries fall within EU ETS2. Most Member States have chosen not to include plasterboard manufacturing which may lead to a distortion of the single market²⁶.
- 6.6 Rules for Phase 3, 2013-2020 are being developed at the current time – but will include less discretion at Member State level and a move towards auctioning rather than allocation of allowances. Thus, market distortion at EU level in EU ETS2 could be replaced in EU ETS3 by competitiveness issues vis-à-vis non-EU sources.

Integrated Pollution and Prevention Control/ Environmental Permitting Regulations

- 6.7 There are additional requirements relating to the IPPC Directive, now regulated in England and Wales by the Environment Agency, who have issued guidance and requirements for Part A (1) activities listed in Schedule 1 of the Environmental Permitting Regulations²⁷. This includes consideration of the impact energy efficiency measures may have on other impacts, for example:
- Where the choice of fuel impacts upon emissions other than carbon, e.g. sulphur in fuel
 - Where the minimisation of waste by waste-to-energy does not maximise energy efficiency, e.g. by Combined Heat and Power (CHP)
 - Where the most energy-intensive abatement leads to the greatest reduction in other emissions
- 6.8 If a company holds an EU Emissions Trading Scheme (EU ETS) permit, the EA will not impose, through the environmental permitting regime, any requirements to reduce CO₂ emissions directly from those activities covered by an EU ETS permit.
- 6.9 IPPC measures, to ensure the efficient use of raw materials and water, are now included under environmental permitting. Where it applies, general techniques to reduce emissions to water include using water efficient technologies, recycling water and treating effluent²⁸.
- 6.10 Plasterboard manufacture already uses a great deal of by-product and secondary feedstock. Investigations into the technical limits for the use of recycled gypsum from plasterboard waste generated on construction sites should be undertaken, considering the nature of the feedstock and its variability.
- 6.11 A significant impact at this stage is any waste associated with the manufacture, as this increases the amount of raw material required to make the product. An important initiative to reduce plasterboard waste and divert it from landfill is the Manufacturer Agreement, or Ashdown Agreement. The Agreement set four targets, two of which are quantifiable:

26. GPDA Biennial review and Outlook 2005 -2006.

27. EA 2008. How to comply with your environmental permit, getting the basics right

28. EA 2008. How to comply with your environmental permit, getting the basics right

- To reduce the amount of waste sent to landfill from manufacturing operations in Great Britain to 10,000 tonnes per year by 2010
 - To increase the take back and recycling of plasterboard waste for use in plasterboard manufacture, to 50% of new construction waste arisings (currently estimated at 300,000 tonnes) by 2010
- 6.12 Good progress was made in the first year of the industry's voluntary Ashdown Agreement²⁹, according to a report issued by WRAP in September 2008. Between April 2007 and March 2008 nearly 54,000 tonnes of plasterboard waste from construction was recycled back into new plasterboard. Manufacturers have also reduced the waste sent to landfill from their production operations to less than 6,000 tonnes.
- 6.13 As a result of the landfill disposal target for 2010 being met in year one, the target to reduce the amount of manufacturing waste sent to landfill has been tightened from 10,000 to 7,500 tonnes per year by 2010.
- 6.14 There is significant use of train and water transport for raw materials which reduces transport related impacts.
- 6.15 The Code for Sustainable Homes and BREEAM promote the specification and use of responsibly sourced materials, through attaining credits where it can be proven. The criteria for recycled products is considered unworkable by the GPDA for plasterboard, as it is impossible to achieve 100% recycled content owing to the need for chemical additives³⁰.
- 6.16 BRE has produced a responsible sourcing standard for all construction products in consultation with key industry bodies. BSI (British Standards Institution) is currently developing standards which will assist organisations with responsible sourcing. The draft BS 8902 Responsible sourcing sector certification schemes for construction products – Specification, is currently out for consultation until the 31 July 2009. There are also numerous other responsible sourcing schemes that have been developed in-house by various companies or clients.

Gaps/further work

- 6.17 The cost of fuel and requirements of the CCA and EU Emissions Trading Scheme has meant that manufacturers have implemented many of the process improvements that can reduce energy consumption. The plasterboard manufacturing process will always need a large energy input and it is unclear whether significant improvements in energy efficiency and/or a move towards renewable energy, such as biomass, or waste-to-energy are viable technically or economically. An action could be to raise awareness of energy improvements made to date and scope out R and D or capital needed to further increase energy efficiency or replace fossil fuels with renewable and waste derived fuels. There is potential to bring forward R and D through the recently announced Technology Strategy Board £15 million joint public sector initiative to tackle CO₂ emissions through carbon-reducing technologies³¹. Emphasis will be on new technologies that tackle CO₂ emissions from power plants and large process industries.
- 6.18 There could also be scope to consider specific activities of smaller installations not covered by CCA, i.e. <50MW thermal input, to reduce their primary energy requirements.

29. The annual report of the Ashdown Agreement is available from www.wrap.org.uk/ashdown.

30. Email communication from GPDA 2008

31. Press Release - Reducing CO₂ Emissions Through Technological Innovation 12 February 2009. www.innovateuk.org.

- 6.19 Manufacturers through their IPPC permits have committed to requirements for energy, raw materials and water usage, avoidance of waste and emissions to air, water and land. An action could be to raise awareness of measures that are already in place and report on continuing progress for remaining measures that should be considered under EA guidelines and requirements.
- 6.20 The availability of FGD gypsum is likely to be limited in the medium to long term as the UK moves away from coal fired power stations to meet its Kyoto carbon reduction commitment. This would increase dependence upon natural gypsum, unless the input is being met by post consumer, recycled, gypsum. Therefore, an action could be to establish long term storage of FGD gypsum to secure this resource for a longer period of time³².
- 6.21 The Ashdown Agreement provides a good focal point for recycling manufacturer and installation plasterboard waste. The former is going very well, whereas achieving the latter by 2010 could be a challenge. Therefore, additional activities to retrieve and recycle plasterboard waste from construction sites will need to be identified and adopted in a very short timescale. This will also provide additional feedstock to replace natural or imported gypsum. The intention behind the Ashdown Agreement was to bring other sectors into the Agreement, under a framework, as to achieve the recovery of plasterboard more than one supply chain member is required to play a part.
- 6.22 Optimisation of all packaging should be considered for all products. This will help achieve the 20% reduction in construction packaging waste target³³. The Producer Responsibility Obligations (Packaging Waste) Regulations 1997 created the legal obligation to reduce /improve packaging performance.

7. Packaging and distribution

- 7.1 The key impacts from the Life-cycle Assessment (Table 2) have been converted into the cumulative proportion of each environmental impact criteria attributable to the distribution phase of the plasterboard life-cycle as shown by Table 5. The larger numbers in the table are typically associated with impacts relating to transport emissions.

Table 5 Proportion of distribution impact

Environmental impact criteria	Combined
Abiotic depletion	7%
Global warming	10%
Ozone layer depletion	31%
Human toxicity	10%
Freshwater aquatic toxicity	4%
Marine aquatic toxicity	4%
Terrestrial ecotoxicity	10%
Photo-oxidation	13%

32. Email communication from GPDA 2008

33. 20% reduction in packaging waste by 2012, as detailed in the Strategy for Sustainable Construction June 2008.

Environmental impact criteria	Combined
Acidification	11%
Eutrophication	24%

Initiatives to address the impact of distribution

- 7.2 There is limited evidence of initiatives that directly target reducing impacts of plasterboard distribution although recent ones include distribution of plasterboard by rail and waste transport. WRAP has carried out work looking at plasterboard waste take-back using distributor reverse logistics, undertaking trials to evaluate this alternative waste haulage model. British Gypsum uses reverse logistics for the collection of post-consumer plasterboard waste. In one case-study³⁴, EJ Berry introduced a new take-back scheme for waste plasterboard that combines delivery of plasterboard with collection of pre-paid waste bags. The prepayment of £25 per bag provides sites with an incentive to both use and return bags. The bags themselves are branded to prevent non pre-paid bags being added in, for ease of segregation and advertising. The waste plasterboard bags also have a serial number to facilitate full traceability and allow bags to be assigned to specific construction sites, which is common practice.

Gaps / further needs

- 7.3 In the analysis of the possible actions, there are limits to what the manufacturers can commit to, due to the nature of the industry being confined to three manufacturers. These are competing businesses which must abide by competition law and for whom their own commercial interests will prevent them from sharing information in the public domain and thus their competitors.
- 7.4 Discussions with a distributor³⁵ highlighted that they are often asked by their customers for products that will help them reach certain levels within the Code for Sustainable Homes. Therefore, an action is for manufacturers to ensure that their product ranges (including plasterboard) contribute to helping new buildings meet future building regulations and the higher code levels, whilst recognising that environmental impact and performance will always be judged at a whole building level. This will involve research and design activities.
- 7.5 The EA recent ruling on removing the 10% allowance of plasterboard waste to landfill is likely to have a significant impact. Distributors could take back small amounts for return to manufacturers, there is an exemption that can be used and would charge per bag to cover collection costs. There is scope here to bring them into an agreement similar to Ashdown. The single biggest problem is the perceived administration burden in maintaining the paper trail necessary, i.e. being able to track (physically and financially) a bag of plasterboard waste from the producer, to distributor site, to reprocessor site/ manufacturer (although plasterboard sacks are traceable), as well as the exemption required to store waste and the duty of care documentation. The main reason for having the audit trail is in case other materials have been mixed in and may not become apparent until the bag is emptied. An action could be to set up a plasterboard waste retrieval/tracking system for small amounts of waste, utilising systems that are already in place that can be easily applied and maintained, such as tagging.

34. EJ Berry, Plasterboard take-back using reverse logistics.
www.wrap.org.uk/downloads/EJB_Case_study_-_APPROVALS_FINAL_f7b07e33.6216.pdf

35. Verbal communication with Jewsons/St Gobain 2009

- 7.6 The removal of the 10% allowance to landfill could increase transport impacts and fly tipping as already discussed. A long term action is to reduce the transportation of products and waste by finding the best balance across the sustainability spectrum i.e. environmental, social and economic impacts and encouraging licensed capacity for disposal in the short term and reprocessing in the short to medium term.
- 7.7 The builders merchants would like packaging optimisation to prevent damage to products, but also to minimise the amount of packaging waste arising. Most packaging is removed by distributors for onward supply to building sites which can be a mix of plastic wrap, strapping and wooden pallets. The pallets cannot be resold although the manufacturers do have pallet repatriation schemes, which need to be improved. Returnable pallets are not usually an option as the merchants charge for them which would increase paperwork and create possible disputes. An action is to optimise packaging to decrease waste and promote the stability of the pack. i.e. reduce risk of slippage.

8. Installation

- 8.1 Operational impacts are not considered as part of the WRAP LCA study, so could not be quantified in relation to overall environmental impact. Those shown in Table 6 relate to the installation of plasterboard.

Table 6: Installation impacts

Description	Key Impacts	Significance as % of Impact Category
Installation	<p>Site wastage: additional raw materials usage (wastage rate varies from 5% to 48%)</p> <p>See Table 2 for percentage breakdown of impacts</p>	Additional wastage % of product impact

- 8.2 The amount of waste produced at this stage will dictate the amount of additional plasterboard used, i.e. if the wastage rate is 25% then 1.25m² of plasterboard is needed for each 1 m² of installed plasterboard. Therefore, all the impacts associated with manufacturing and distributing this additional plasterboard could be increased or decreased at this stage of the supply chain in line with the wastage rate. Figures vary in terms of wastage rates for plasterboard, from 5% (Green Guide to Specification) to 48%³⁶ which suggests that more evidence is required on actual wastage rates. A report by Kier Group suggests that even where a focus on reducing plasterboard waste is in place on site, wastage rates of around 20% are still likely³⁷.
- 8.3 The true cost of waste is significant at this stage of the supply chain. This cost includes the following:
- Cost of product not installed (typically the highest cost of the three)
 - Cost of labour to segregate waste for disposal or recycling.
 - Cost of disposal or recycling
 - Initiatives to address the installation and operational impact

36. Construction Resources and Waste Platform 2008. Wastage rate report. www.crwplatform.co.uk

37. Kier Green Apple Awards 2007 Plasterboard or Plasterbarred?

Initiatives to address the impact of installation

- 8.4 Guidance on the reduction of gypsum dust during cutting is provided by GPDA.
- 8.5 The Ashdown Agreement provides a recycling focus for manufacturing plasterboard waste. A further Agreement has been developed to focus on the waste arising through installation³⁸. Developed by the FPDC³⁹ and supported by the Construction Confederation, this agreement sets out the following targets for 2010:
- To reduce the amount of plasterboard waste generated from new construction and refurbishment in both residential and commercial projects to 15%
 - To encourage reuse, recycling and recovery of plasterboard waste at all sites, detailing plasterboard waste management in their site waste management plans (SWMPs)
- 8.6 The agreement also sets out the requirement to monitor performance. FPDC is implementing this through use of BRE's site waste management planning tool, Smartwaste Plan⁴⁰. The data collected will be reviewed by July 2009, with results issued via CRWP⁴¹ to Defra.
- 8.7 There is also a number of independent plasterboard recyclers in the UK who collect and accept waste plasterboard from installation projects and process it into recycled gypsum⁴².
- 8.8 Site Waste Management Plans are a mandatory requirement in England for construction projects over £300,000. There are additional reporting requirements to meet the Code for Sustainable Homes, with extra credits available for reducing and recycling at least three types of construction waste.
- 8.9 The true cost of waste calculator can provide an estimate of the amount of money and carbon that can be saved through reducing specific construction product waste, including plasterboard⁴³.
- 8.10 The recent update of BREEAM allocates up to three credits where evidence provided demonstrates that the amount of waste generated on site is the same as, or better than, good or best practice levels. For example: BREEAM healthcare⁴⁴, where non-hazardous construction waste generated by the building's construction phase (excluding demolition and excavation waste) meets or exceeds the following resource efficiency benchmarks as shown by Table 7.

38. The Contractors and Developers Voluntary Agreement for the Reduction of Plasterboard Waste, launched July 2008. www.crwplatform.co.uk.

39. Federation of Plastering and Drywall Contractors

40. Smartwaste Plan. Free to use web-based site waste management planning tool www.smartwaste.co.uk.

41. Construction Resources and Waste Platform www.crwplatform.co.uk.

42. A directory of plasterboard recyclers in the UK is available at www.wrap.org.uk/construction/plasterboard/plasterboard_4.html

43. CRWP true cost of waste calculator 2008, www.wastecalculator.co.uk.

44. BREEAM Healthcare assessor manual

Table 7: Credits available in BREEAM for the amount of waste generated per 100m² GIFA (gross internal floor area)

	m³*	tonnes
One credit	13.0 - 16.6	6.6 - 8.5
Two credits	9.2 – 12.9	4.7 - 6.5
Three credits	<9.2	<4.7

*Volume (m³) is actual volume of waste (not bulk volume)

8.10 Data from certain construction projects, suggest that plasterboard typically represents a significant proportion of total site waste, e.g. 21% by volume of healthcare site waste⁴⁵, or 3 m³ out of 14.4 m³ /100m². Therefore, it should be one of the waste types targeted for reduction to achieve maximum credits.

Gaps / further needs

8.11 There is a great deal of variation and lack of consensus in reported and proposed wastage rates for plasterboard. This means that the impact at the time of installation cannot be estimated with any degree of confidence. Further evidence gathering work to improve confidence levels in typical plasterboard wastage rates is therefore required. Irrespective of this, there is a lot that needs to be done to reduce the installation of plasterboard waste. The FPDC consider that there needs to be more than a halving of wastage rates over two years to achieve the Installation waste target. The FPDC⁴⁶ has identified a number of key activities that will help achieve this target, these include:

- Development of design specification and detailing, e.g. Eco door jamb detail
- Improved dimensional and structural co-ordination, e.g. room size optimised for standard board width
- Better site logistics, planning and handling
- Reduce waste arising from inter-trade issues, e.g. cutting of service holes
- Streamline use of boards
- Sector issues require specific guidance, e.g. hospital issues very different to low rise residential plasterboard installation issues

These require a combination of training, awareness raising and specific/targeted guidance development.

8.12 Kier Group adopted similar strategies at the Ipswich Hospital, Suffolk development⁴⁷. These included using the design expertise of their dry-lining installer and supplier Knauf Drywall, reducing the number of layers of plasterboard required and limiting the types of board needed to three. Rationalising the number of board types simplified installation for the dry-lining teams, reducing the scope for error and therefore wastage. Drawings were also colour coded to assist the dry lining teams. Also, a board was manufactured to specifically match the 3 m room height, eliminating a horizontal joint below the ceiling. It should be noted that manufacturing customised boards can in some cases lead to increased waste if the product is over-ordered and there is not an alternative sale or use. Therefore it is important to ensure that wastage rates are reduced as much as possible.

45. BRE benchmarks from www.smartwaste.co.uk

46. FPDC presentation at launch of Contractors and Developers Voluntary Agreement, July 2008.

47. Kier; Green Apple Awards 2007 Plasterboard or Plasterbarred?

- 8.13 Discussions with AIS⁴⁸, suggested that the following issues needed further consideration:
- Manual handling of plasterboard e.g. getting up several flights of stairs. The importance of planning of movements e.g. lifts in beforehand
 - Waste: recycle wherever possible but space and ease of disposal may detract from this
 - The new EA ruling will have a big impact on small sites in terms of: storage, segregation, transportation and space. The extra difficulties could encourage flytipping and hiding plasterboard in with other wastes. Small jobs/contractors cannot get easy access to the recycling schemes set up by manufacturers
- 8.14 In line with tightening requirements on the segregation and disposal of plasterboard waste, additional work is needed to ensure levels of flytipping do not increase. This could be through a combination of awareness campaigns of the new requirements, improved accessibility to small scale plasterboard waste recycling, greater enforcement of Site Waste Management Plans and ensuring an appropriate geographical spread of monocells for high sulphate waste.

9. In use

- 9.1 All gypsum plasterboards provide fire protection and sound insulation, with a range of boards available with enhanced performance. For example, glass reinforced gypsum boards can provide high standards of fire protection.
- 9.2 In addition, there are boards which can provide moisture resistance; water vapour resistance; greater impact resistance; or sound absorption. Laminates which incorporate gypsum boards and thermal insulating backings are used to provide insulated wall linings in new buildings and to upgrade the thermal insulation of walls and ceilings in existing buildings. Retrofitting internal or external insulation to solid walled homes helps improve energy performance.
- 9.3 Thermal laminates can also be used to provide insulation at the rafter level of pitched roofs. Laminates which incorporate moisture resistant glass reinforced gypsum lining can also produce higher standards of thermal insulation in situations such as exposed floors where the perimeters are open to the elements.
- 9.4 The Code for Sustainable Homes assesses the performance of walling systems under the materials category, which is based on BRE Green Guide ratings. The use of higher rated systems will therefore contribute credits towards the score/code level of the whole building.
- 9.5 Encouragement to specify low U-values in the building fabric is linked to attaining credits in BREEAM⁴⁹ for reducing fabric heat loss and improving operational CO₂ emissions.

Gaps / further needs

- 9.6 Innovation in board production could further enhance thermal performance and consideration should be given to this and be discussed as part of the Plasterboard Sustainability Partnership.

48. Verbal communication, Association of Interior Specialists 2009. www.ais-interiors.org.uk

49. Building Research Establishment Environmental Assessment Methodology. Download 2008 Assessor manuals from www.breeam.org.

10. End of life

10.1 Table 2 summarised the key impacts from the raw material and production part of the product life-cycle, based on data from the Life-cycle Assessment undertaken for WRAP. Table 8 converts this data into the cumulative proportion of each environmental impact criteria attributable to the end of life phase of the plasterboard life-cycle. This includes the following stages:

- Collection and transport for recycling
- Collection and transport for disposal
- Disposal

Table 8: End of life proportion of impact

Environmental impact criteria	Combined %
Abiotic depletion	4
Global warming	22
Ozone layer depletion	13
Human toxicity	12
Freshwater aquatic toxicity	8
Marine aquatic toxicity	2
Terrestrial ecotoxicity	14
Photo-oxidation	45
Acidification	25
Eutrophication	13

10.2 The highest proportional impact relates to photo-oxidation, typically associated with high levels of volatile organic compounds. These are mainly related to landfill gas emissions.

10.3 In April 2009, the EA revised their guidance to remove the 10% (gypsum/plasterboard mixed with other wastes) guideline value as already mentioned, to encourage the reuse and recycling of more gypsum and other high sulphate bearing waste while reducing the potential production of hydrogen sulphide gas at a landfill.

10.4 This position applies to loads of waste containing identifiable gypsum-based materials (e.g. plasterboard). This material must not be landfilled with biodegradable waste. Producers of gypsum waste should separate it for recovery and recycling wherever possible. Where a load of gypsum is sent to landfill, it must be deposited in a separate cell with waste that does not have a biodegradable content that exceeds specified limits. There is limited provision for landfill of plasterboard in terms of monocell capacity.

10.5 Recycling capacity has increased through manufacturer take back schemes, though this can be limited to large users of plasterboard. Smaller sites and plasterboard arising from demolition tend to deal with transfer stations or independent recycling facilities.

10.6 There can be environmental benefits associated with recycling compared to landfill disposal. However, the transport of material is a big influence on impact both for recycling and landfill disposal.

Initiatives to address the disposal impact

- 10.7 A Demolition Contractors Agreement and Waste/Resource Management Contractors Agreement is currently under development as part of the CRWP programme of work for 2008-2009. These initiatives build on the Ashdown Agreement and the Contractors and Developers Agreement to extend waste reduction and landfill diversion commitments across the plasterboard supply chain. These initiatives will set targets for demolition contractors and Waste/Resource Management contractors and promote collaboration across the supply chain.
- 10.8 Existing options for recovery include recovery back into plasterboard and recycling by use as a soil conditioner/improver and use in cement production. As there is very limited current capacity, the manufacturers have worked with WRAP, the Environment Agency and BSI to promote the development of existing and new markets. These initiatives have resulted in the draft Quality Protocol for Recycled Gypsum from Waste Plasterboard and PAS 109: 2008, a specification for the production of recycled gypsum from waste plasterboard.

Gaps / further needs

- 10.9 Post consumer plasterboard cannot currently go back into new plasterboard where there are contamination and composition issues. Further technical solutions that would increase the scope for closed loop recycling could be very beneficial.
- 10.10 In terms of the REACH Regulations, recycled gypsum does not need to be registered as it is already covered by the registration of calcium sulphate earlier on the supply chain; however recyclers were encouraged by the EC Guidance to pre-register the substance and this was free of cost, to ensure they would be exempt from the registration later on. The recyclers still have to demonstrate REACH compliance when supplying plasterboard manufacturers which may be a barrier for some independent recyclers from sending material to that customer if the gypsum waste is classified as a product. Currently, recycled gypsum is not defined as a product as the Quality Protocol is at a draft stage. It is recommended that this issue is explored further with the Health and Safety Executive (the UK Competent Authority for REACH).
- 10.11 Addressing the regulation of the composition of the plasterboards produced by the manufacturers. All current risk assessments carried out by the EA of the effects of using recycled plasterboard have been based on historic and current composition plasterboard. Future developments in plasterboards could restrict future recyclability, for example, foam backed boards could become standardised across the entire range of boards to promote thermal efficiency. This would make the process of recycling more difficult / costly unless new technologies were in place. This point was also raised by the GPDA⁵⁰, who consider thermal laminate boards as having growth potential in light of the need to insulate existing homes, especially solid wall types. Future recycling definitely looks problematic, so an initial action could be to research the potential impact of future waste arisings and the technical viability of recycling thermal laminate boards.
- 10.12 A demolition specific agreement for plasterboard (part of the supply chain agreements initiated by the Ashdown Agreement) is currently under development. Strip out or demolition plasterboard waste can be recycled by independent plasterboard recyclers providing reasonable steps are taken by the waste producer to limit contamination. Therefore, the ongoing agreement work with the demolition industry should consider this as an area for action.

50. Email communication from GPDA 2008.

- 10.13 This agreement should also consider the criteria set in the draft Quality Protocol for the production and use of products derived from gypsum arising from the processing of waste plasterboard⁵¹. Once the protocol has been fully implemented and these criteria are met, gypsum from waste plasterboard will normally be regarded as having been fully recovered and has ceased to be waste when it has been dispatched to the customer. This applies to the use of gypsum from waste plasterboard in the following market applications:
- As a raw material for use in the manufacture of new gypsum-based products, e.g. plasterboard and coving products
 - As a soil treatment agent for agricultural benefit
 - As an additive in cement clinker
- 10.14 The EA's current position on the use of the draft waste protocols is as below:
While the work of the Waste Protocols Project is in progress, our position is that these waste streams remain waste until the point of final use. However, during the process of determining whether a Quality Protocol can be produced, we recognise it may not be appropriate to take enforcement action if an operator does not hold an environmental permit or exemption from permitting for that final use of waste. An operator carrying out an interim process will need an environmental permit or exemption from permitting. The draft Quality Protocol makes reference to PAS 109: 2008 (A specification for the production of recycled gypsum from waste plasterboard) which supports all of the relevant end use applications.
- 10.15 It is essential that recovery and recycling routes are developed for end of life plasterboard. This should take into account the need to keep reprocessing energy and transport emissions to a minimum to avoid environmental impacts exceeding environmental benefits. Since this is not an obvious threshold, further work to clarify and help to make the best environmental decision is required.
- 10.16 Improved geographical spread of recycling and disposal capacity would reduce transport impact related to managing plasterboard waste. Local development plans/predicted forward construction and demolition activity should be cross referenced to the availability of facilities to manage the likely waste arising, such as plasterboard waste⁵². This would then flag up where gaps in facilities exist, ideally followed by a proactive approach to establish additional infrastructure to collect and recycle these materials.
- 10.17 Recovery and recycling options, capacity and infrastructure are likely to be underdeveloped for the end of life waste stream for some time. This needs to be addressed in light of the targets likely to arise from the remaining Agreements, drivers such as the increase in Landfill Tax, the target to halve construction, demolition and excavation waste to landfill by 2012 and the overall aspiration to have zero plasterboard waste going to landfill.

51. EA/ WRAP – Draft Quality Protocol for production and use of waste gypsum from plasterboard / www.environment-agency.gov.uk/static/documents/Business/mwrp_017_2077226.pdf

52. CRWP – LA resource planning spreadsheet available upon request (adamsk@bre.co.uk)

11. What next?

- 11.1 The next stage is for policy and industry stakeholders to develop further the actions into an agreed action plan to improve the sustainability of plasterboard throughout its life-cycle via the Plasterboard Sustainability Partnership.

Annex I - Summary of relevant reports, policy and initiatives

Name	Description	Website	Date
LCA Studies			
BRE - Environmental Profile	LCA study, results used to inform BRE's Green Guide to Specification 2008	www.thegreenguide.org.uk	2008
WRAP - LCA study	LCA study, results used to inform this report	www.wrap.org.uk/downloads/Life_Cycle_Assessment_of_Plasterboard_3fc9fd76.5313.pdf	
Ecobilan (France)	Life-cycle inventories	www.ecobilan.com/index_uk.html	n/a
Ecoinvent (Netherlands)	Life-cycle inventories	www.pre.nl/ecoinvent/default.htm	n/a
UK government publications (as relates to England only)			
PRODCOM PRA26620 – Plaster Products for Construction Purposes 2005	Government collated statistics on UK markets	www.statistics.gov.uk/downloads/theme_commerce/PRA-20050/PRA26620_20050.pdf	2005
The Code for Sustainable Homes	The Code measures the sustainability of a new home against nine categories of sustainable design, rating the whole home as a complete package	www.communities.gov.uk/planningandbuilding/buildingregulations/legislation/codesustainable/	2008
The Building Regulations Approved Document B	Covers fire resistance for dwellings and non dwellings	www.planningportal.gov.uk/approveddocuments	2006
The Building Regulations Approved Document E	Covers resistance to the passage of sound and introduced higher requirements for acoustic performance for residential building	www.planningportal.gov.uk/approveddocuments	2003
The Building Regulations Approved Document L	Covers conservation of fuel and power for dwellings and non dwellings	www.planningportal.gov.uk/approveddocuments	2006
DEFRA - Waste Strategy for England 2007	This sets out the government vision for sustainable waste management. Annex C3 relates to construction, demolition and excavation waste	www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-strategy.pdf	2007

Name	Description	Website	Date
Government and industry – Strategy for Sustainable Construction	The Strategy is a joint industry and government initiative intended to promote leadership and behavioural change, as well as delivering benefits to both the construction industry and the wider economy in England	www.berr.gov.uk/whatwedo/sectors/construction/sustainability/page13691.html	2008
DEFRA - Site Waste Management Plans for the Construction Industry	Regulations and guidance on site waste management plans – mandatory for developments costing more than £300,000 from April 2008	www.defra.gov.uk/constructionwaste	2008
DEFRA Consultation on the Draft Soil Strategy for England Draft strategy and consultation responses available	This draft Strategy sets out the pressures on soils and the priority work areas identified on the basis of these pressures. It explains current policy measures which are in place to achieve sustainable soil management and then sets out in broad terms what it is hoped will be achieved, along with some initial steps to be undertaken in the next few years	www.defra.gov.uk/ENVIRONMENT/land/soil/sap/	2008
EA/ WRAP - Quality Protocol for production and use of waste gypsum from plasterboard Due to be adopted in late 2009	The Quality Protocol sets out criteria for the production and use of products derived from gypsum arising from the processing of waste plasterboard. If these criteria are met, gypsum from waste plasterboard will normally be regarded as having been fully recovered and have ceased to be waste when it has been dispatched to the customer: Applies to the use of gypsum from waste plasterboard in the following market applications: <ul style="list-style-type: none"> • As a raw material for use in the manufacture of new gypsum-based products, e.g. plasterboard and coving products. • As a soil treatment agent for agricultural benefit. • As an additive in cement clinker. 	www.environment-agency.gov.uk/business/topics/waste/32154.aspx	2009

Name	Description	Website	Date
<p>EA – position statement on landfilling of gypsum waste including plasterboard</p> <p>Mandatory from 1 April 2009</p>	<p>In January 2009, the EA revised their guidance to remove the 10% (gypsum/plasterboard mixed with other wastes) guideline value, to encourage the reuse and recycling of more gypsum and other high sulphate bearing waste while reducing the potential production of hydrogen sulphide gas at a landfill.</p> <p>This position applies to loads of waste containing identifiable gypsum-based materials (e.g. plasterboard). This material must not be landfilled with biodegradable waste. Producers of gypsum waste should separate it for recovery and recycling wherever possible. Where a load of gypsum is sent to landfill, it must be deposited in a separate cell with waste that does not have a biodegradable content that exceeds specified limits</p>	<p>www.environment-agency.gov.uk/static/documents/Business/mwrrp007_2163539.pdf</p>	<p>2009</p>
<p>EA Building the future: 2005-2006 A survey on the arising and management of construction and demolition waste in Wales 2005-2006</p>	<p>Funded by the Welsh Assembly Government and the Aggregate Levy Sustainability Fund. A C and D waste survey. Data from 228 demolition, construction, civil engineering and refurbishment companies in Wales on the amounts and types of waste produced by their activities</p>	<p>http://publications.environment-agency.gov.uk/pdf/GEWA0308BNRR-e-e.pdf?lang=_e</p>	<p>2006</p>
<p>Defra - Key facts about: waste and recycling</p>	<p>Information on the composition and amount of industrial and commercial waste in England</p>	<p>http://www.defra.gov.uk/environment/statistics/waste/kf/wrkf11.htm</p>	<p>2002/03</p>
<p>Climate Change Agreement and levies</p>	<p>Improve manufacturing energy efficiency. Climate Change Agreements (CCAs) allow eligible energy intensive business users to receive up to an 80% discount from the Climate Change Levy (CCL) in return for meeting energy efficiency or carbon saving targets. Covers manufacture of gypsum products using Part A combustion plant. Sector targets have been established with periodic review dates</p>	<p>www.defra.gov.uk/environment/climatechange/uk/business/cca/</p>	<p>Current</p>

Name	Description	Website	Date
Waste Management and Environmental Regulations	Various waste management regulations controlling the handling and disposal of controlled waste for the protection of the environment	www.netregs.gov.uk	Current
Respect for People	Respect for People continues as a key strand of the industry improvement agenda as first set out in Rethinking Construction (1998). Since then, the Strategic Forum for Construction has produced a set of Commitment to People principles as part of its wider Construction Commitments	www.berr.gov.uk/files/file48680.pdf	2008
Health and Safety Executive	Tackling key issues in relation to construction health and safety including manual handling of plasterboard. Under development is the HSE safe handling of plasterboard initiative (plasterboard stakeholder forum)	www.hse.gov.uk/construction/index.htm	Current
CLG - Minerals planning	Guidance for mineral extraction and associated planning issues	www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/mineralsandwaste/	Current
EU policy			
EU Directive 2006/21/EC on the Management of Waste from the Extractive Industries	Details of the EU Directive on Mining Waste	http://ec.europa.eu/environment/waste/mining/index.htm	2006
CEN 350	Standards under development covering the sustainability of construction works CEN Technical Committee 350 is working on frameworks standards for the life-cycle environmental assessment of buildings and products, which should be useable (in the next few years) for product-specific declarations on environmental impact	www.cen.eu/CENORM/Sectors/TechnicalCommittees/Workshops/CENTechnicalCommittees/WP.asp?param=481830&title=CEN%2FTC+350	Current

Name	Description	Website	Date
Landfill Directive	The objective of the Directive is to prevent or reduce as far as possible negative effects on the environment from the landfilling of waste, by introducing stringent technical requirements for waste and landfills	http://ec.europa.eu/environment/waste/landfill_index.htm	1999
Waste Framework Directive 19 November 2008 (2008/98/EC). The new Directive must be transposed into national law by 12 December 2010	Recently revised, sets out the framework for the definition and management of waste across the EU. The waste hierarchy states that prevention comes first, then preparing for re-use, then recycling, then other recovery (e.g. energy recovery), and then disposal. Article 11 contains a specific obligation for the construction sector: By 2020, Member States must make national action plans for the re-use, recycling and other material recovery of non-hazardous construction and demolition waste and this re-use and recovery must increase to a minimum of 70% by weight. By 2014, the Commission can propose to sharpen these targets	http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32006L0012:EN:NOT	2008
REACH (Registration, Evaluation, Authorisation and Restriction of Chemical substances)	REACH is a European Union regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals. It came into force on 1 June 2007 and replaces a number of European Directives and Regulations with a single system. Once fully recovered or recycled, substances cease to be waste and waste management controls no longer apply. REACH may potentially apply instead at that point. Recovery businesses are considered to be manufacturers under REACH, so may have registration obligations, unless certain exemptions apply	www.hse.gov.uk/reach	2007
Integrated PPC (Part A (1) activities regulated by environmental permitting 2007)	Where applicable, there may be IPPC requirements for energy, raw materials and water usage, avoidance of waste and emissions to air, water and land and monitoring all the above	http://publications.environment-agency.gov.uk/pdf/GEHO0908BOTD-e-e.pdf	

Name	Description	Website	Date
ISO and EN standards	Standards for assessing construction product performance and EU harmonised standards for CE marking	www.iso.org/iso/home.htm http://www.cen.eu/cenorm/homepage.htm	Various
EU ETS	The EU Emissions Trading Scheme is one of the policies introduced across the European Union (EU) to help it meet its greenhouse gas emissions reduction target under the Kyoto Protocol. The scheme operates by the allocation and trading of greenhouse gas emissions allowances throughout the EU - one allowance represents one tonne of carbon dioxide equivalent. Each year, operators are required to ensure they have enough allowances to cover their installation's emissions. They have the flexibility to buy additional allowances (on top of their free allocation), or to sell any surplus allowances generated from reducing their emissions. Regulated by the Environment Agency in the UK	www.environment-agency.gov.uk/business/regulation/38817.aspx	Current
Construction Product Regulation (to replace Construction Products Directive)	New basic works requirement (the essential criteria for works upon which standards for the products used are based) - sustainable use of natural resources, focusing on the life-cycle assessment of products (from manufacture to demolition and disposal). Negotiation throughout 2009, likely implementation around 2012, regulated by the member state.		Current
Green Public Procurement (GPP)	Consider performance over the whole life-cycle of a product. Seek products that can demonstrate their green credentials through the use and European and National certification and labelling schemes and standards. Criteria being set for certain construction products, including windows. Links to EU public procurement directive timetable unknown, ongoing consultation with member states		Current

Name	Description	Website	Date
Lead Market Initiative – Sustainable Construction Sector	Action Plan for sustainable construction for Standardisation, Labelling, Certification: Assessment method and benchmarks for assessing the sustainability performance of buildings and of the construction value chain; Potential to expand the development of Eurocodes into the areas of energy and environmental engineering, Construction Products Regulation, better procedures to obtain European Technical Approvals and better recognition in Member States for sustainability issues		Current
Action Plan on Sustainable Consumption and Production / Sustainable Industrial Policy	SCP Action Plan and GPP Communication Recast of Ecodesign Directive; Recast of Energy Labelling Directive; Proposal for a revised Ecolabel Regulation; Proposal for revised EMAS Regulation. Adopted by EU December 2008, Review of Actions: 2012, Extended Ecodesign and Labelling directives		Current
Industry – general			
Our steps towards sustainable construction	Industry sustainability commitment and progress report	www.eurogypsum.org	Current
GPDA sustainability strategy		www.gpda.com/	Current
Eurogypsum Specification for Recovered Gypsum		www.eurogypsum.org	
Ashdown Agreement	An industry commitment together with WRAP, MTP and DEFRA aimed at resource efficiency, increase recycling and waste reduction and waste reduction to landfill	http://www.wrap.org.uk/wrap_corporate/news/industry.html	2007
The Contractors and Developers Voluntary Agreement for the Reduction of Plasterboard Waste	Follow on from the Ashdown Agreement – contractor equivalent agreement to reduce waste and increase recycling	www.crwplatform.co.uk	2008

Name	Description	Website	Date
Plasterboard Sustainability Partnership	To facilitate a strong pan-industry overview and consultation route, representatives from across the plasterboard supply chain have been invited to form a plasterboard partnership. The inaugural meeting of this group will be on the 25 February 2009. This site will be used to provide a central reference source for those working in the plasterboard supply chain and those seeking to provide support or guidance in the area of plasterboard and sustainability	The website is currently under construction: www.plasterboardpartnership.org	Current
BSI standards committee STS1/6 Draft for consultation due Spring 2009, with standard planned for early 2010	Developing standard relating to responsible sourcing. It is proposed that the work will initially focus on the responsible sourcing of construction products, but is expected to grow into other sectors	www.bsi-global.com/en/About-BSI/News-Room/BSI-News-Content/Sectors/Construction--Building/Responsible-Sourcing-announcement/	Current
Construction Products Association Waste Working group	Chaired by St Gobain/Jewson, current focus on packaging waste issues	www.constructionproducts.org.uk	Current
Strategic Forum for Construction	Have recently set up waste task group, Chair provided by UK contractors group, secretariat provided by CRWP	www.crwplatform.org.uk	Current
Specific technical issues	All from www.eurogypsum.org		
Raw Material Extraction Study (Eurogypsum)	Managing the use of natural resources in a sustainable way	www.eurogypsum.org	
Study of high sulphate mineral waters	Study of sulphate concentrations in groundwater	www.eurogypsum.org	
BRGM (France)	Study of sulphate concentrations in groundwater	www.eurogypsum.org	
Quality of air study	Promote the use of FGD to fossil fuel plants to protect quality of air	www.eurogypsum.org	2008
Water institute study of gypsum in water	Study of sulphate concentrations in groundwater	www.eurogypsum.org	

Name	Description	Website	Date
Eurogypsum waste policy: Building Value for Society	Summary of legislation, resource efficiency approaches and industry best practice	www.eurogypsum.org	
Manual Handling of gypsum products	Gypsum products ergonomics based upon risk assessments	www.eurogypsum.org	
Roskill economic study	Economics of gypsum and anhydrite extraction	www.eurogypsum.org	
Vauhours-Caubron study (France)	Ten year study of restoration of open-pit quarry	www.eurogypsum.org	
TierWelt in Gipssteinbruchen (Germany)	Study of bio-diversity in 15 gypsum quarries	www.eurogypsum.org	
Sulphate Bearing Waste: Determination of a Concentration Limit for Separate Disposal	Research used to justify the revised Environment Agency position statement on the landfilling of gypsum waste including plasterboard. It will confirm that the relationship between sulphate in waste and the production of hydrogen sulphide gas is complex, but will conclude that the EA cannot set a practicable limit for gypsum wastes	www.eurogypsum.org	
Market Transformation Programme	All published documents available from www.mtprog.com		
MTP briefing notes	Evidence base for MTP developing resource efficiency and waste agendas – could not locate this online	http://www.mtprog.com/cms/product-strategies/subsector/building-products	2008
WRAP (Waste & Resources Action Programme)	Directly linked to plasterboard resource efficiency	All published documents downloadable from www.wrap.org.uk	
Material flows and barriers to greater use of recycled plasterboard	Background information and opportunities and barriers to recycling	www.wrap.org.uk/document.rm?id=2424	2006
Waste plasterboard market scoping study	Scoping study evaluating markets for recycled gypsum and ability for recycling sector to supply these markets		

Name	Description	Website	Date
Evaluation of plasterboard waste arising from the demolition sector	Scoping study drawing together data and estimating plasterboard waste arising from this source	unpublished	
Recycling plasterboard waste from refurbishment sites	Viability of alternative recovery/ recycling options from refurbishment sites	www.wrap.org.uk/document.rm?id=3461	
Capture of plasterboard waste on construction sites	Evaluation of cost effective methods of plasterboard collection from construction sites	www.wrap.org.uk/document.rm?id=4740	
Capture of plasterboard waste on construction and demolition sites	Evaluation of plasterboard collection from different types of C and D sites		
Plasterboard collection trials at household waste recycling centres	Viability of waste plasterboard collection from this source	www.wrap.org.uk/document.rm?id=4579	
Encouraging plasterboard collection at household waste recycling centres	Viability of waste plasterboard collection from this source	www.wrap.org.uk/document.rm?id=5914	
Plasterboard waste take-back using distributor reverse logistics	Trials to evaluate alternative waste haulage model	www.wrap.org.uk/document.rm?id=6216	
Publicly available specification for recycled gypsum	Defines a product specifications and quality management requirements for the processing of waste plasterboard. PAS 109:2008	www.wrap.org.uk/pas109	2008
WRAP - Plasterboard case studies	Highlights segregation, collection and recycling of waste plasterboard and its use in a range of applications	www.wrap.org.uk/construction	Various

Name	Description	Website	Date
WRAP	Indirectly linked to plasterboard e.g. part of construction and demolition waste stream: <ul style="list-style-type: none"> • Halving waste to landfill • Waste minimisation and management • Achieving resource efficiency • Designing out waste • Recycled content • Net waste tool • SWMP template • Materials logistics plans • Off-site construction • Procurement guidance 	www.wrap.org.uk/construction	Various
BRE	Published documents available from www.bre.co.uk or as specified		
Smartwaste system and benchmarking website	Site waste management planning and waste monitoring tool used by over 2600 companies. Plasterboard contractor bespoke version to provide monitoring for the contractor's agreement under development. Benchmarks for plasterboard waste have also been produced for all main construction sectors – residential, commercial office, leisure, public buildings, education etc	www.smartwaste.co.uk	Current
BREMAPP	A geographical information system with all licensed disposal and recycling sites, including plasterboard related	www.bremapp.co.uk	Current
Green Guide to Specification	Updated in 2008, the Green Guide gives relative performances of various building elements and looks at a range of materials or products used in a number of elements (such as walls, floors, and roofs), assessing their overall impact, over a 60 year study period, in EcoPoints (weighted sum of 13 environmental impact criteria)	www.thegreenguide.org.uk	2008
BREEAM	BRE's Environmental Assessment Methodology for non-residential buildings	www.bre.co.uk	Current
BRE responsible sourcing standard	A framework standard for the responsible sourcing of construction products	www.bre.co.uk/responsiblesourcing/page.jsp?id=1514	2008

Name	Description	Website	Date
Be Aware	Part government, part industry funded project to develop a method of optimising resource use across the life-cycle of any given construction product. Plasterboard not assessed yet but is an aspect of certain sector guidance documents – modern methods of construction	www.beaware.org.uk	2009
Construction Resources and Waste Platform (CRWP)	A Defra funded program to provide industry support on construction resource efficiency and help shape policy. Various reports on construction waste issues	www.crwplatform.co.uk	Current
NISP.	Published documents available from www.nisp.org.uk or as specified		
NISP Case study Gypsum Recycling	Case study focussing on Roy Hatfield Ltd, who have been recycling wastes for more than 35 years including plasterboard	www.nisp.org.uk/article_main.aspx?feedid=casestudy&itemid=116	2006
NISP East of England Study into the current markets for Gypsum		Could not locate this document online	n/a
NISP case study: IBC exchange saves money and diverts waste from landfill	Involved packaging waste from Lafarge Plasterboard	www.nisp.org.uk/region_article.aspx?feedid=casestudy&itemid=15&regionid=4	2005
Other plasterboard			
Oakdene Hollins - Diverting plasterboard waste from landfill in the UK	Identification of sources of plasterboard waste and disposal options for FPDC	www.oakdenehollins.co.uk/pdf/fpdc_Plasterboard_waste.pdf	2006
Kier – Green Apple Award 2007 Plasterboard or Plasterbarred?	Kier Group won this award for an initiative to reduce wastage rates and improve recycling rates of plasterboard used in the construction of the new Garrett Anderson Diagnostic Treatment Centre, Ipswich Hospital, Suffolk	www.thegreenorganisation.info/PDF/greenbook-191-233.pdf page 219	2007

Name	Description	Website	Date
Other			
CIRIA – Construction and demolition waste guidance	Demonstrating waste minimisation benefits in construction (C536) Principles of design for deconstruction to facilitate reuse and recycling. Waste minimisation in construction - site guide	www.ciria.org.uk	Various
SEDA - Design and detailing for deconstruction	Guide for designing for deconstruction	www.seda2.org/dfd/	Unknown
Waste Aware Construction - National site waste colour coding scheme	National colour coding scheme for segregated waste skips on C and D sites - includes signage for plasterboard waste	www.wasteawareconstruction.org.uk	Current

Annex 2 - Stakeholders

The following organisations participated in the development of this study.

ORGANISATION	PARTICIPANT	ORGANISATION WEB ADDRESS
Industry		
Association of Interior Specialists	Simon Forrester	www.ais-interiors.org.uk/
British Gypsum	Heidi Barnard Brian Andreas	www.british-gypsum.com/
Builders Merchants Federation	Caroline Green	www.bmf.org.uk/
Building Research Establishment	Gilli Hobbs Katherine Adams	www.bre.co.uk/
Construction Products Association	Jane Thornback	www.constructionproducts.org.uk/
Federation of Plasterers and Drylining Contractors	Paul Jessop	www.fpsc.org.uk/
Geoffrey Osbourne Ltd	Caroline Oldroyd	www.osborne.co.uk/
Gypsum Products Development Association	Crispin Dunn-Meynell	www.gpda.com/
Kier Ltd	Peter Johnson	www.kier.co.uk/
Knauf UK	Paul Lonergan	www.knauf.co.uk/
Lafarge Plasterboard	Lucy Edgar	www.lafarge.co.uk/
Roy Hatfield Ltd	Mark Hatfield	www.royhatfield.com/
Saint Gobain Building Distribution	Steve Millward	www.saint-gobain.co.uk/
Government departments		
Department for Environment, Food and Rural Affairs	Bob Ryder Alice Baverstock Ishani Weerakkody Maria Grace Andrew Gregory	www.defra.gov.uk/
Department for Communities and Local Government	Clover Summers	www.communities.gov.uk/
Department for Business, Innovation and Skills	Richard Gill	www.bis.gov.uk/
Environment Agency	Peter Elliot	www.environment-agency.gov.uk/
WRAP	David Marsh	www.wrap.org.uk/
Health and Safety Executive	Norman Macritchie	www.hse.gov.uk/

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