WR1403: Business Waste Prevention Evidence Review

L3m2 – Reuse & Material Use Efficiency

A report for
Defra

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Context of Project WR1403

Waste prevention is at the top of the waste hierarchy. A major priority of the coalition government is to move towards a zero waste economy, and an important element of this will be to encourage and increase waste prevention. This review aims to map and collate the available evidence on business waste prevention. It will help inform the preparation of England's National Waste Prevention Programme as required under the revised EU Waste Framework Directive (2008).

The focus is on aspects of waste prevention that are influenced directly or indirectly by businesses - it complements a previous evidence review, WR1204, which focused on household waste prevention. The definition of the term 'waste prevention' used here is that in the revised Waste Framework Directive:

'Prevention' means measures taken before a substance, material or product has become waste, that reduce:

a) *the quantity of waste, including through the re-use of products or the extension of the life span of products;*
a) *the adverse impacts of the generated waste on the environment and human health; or*
b) *the content of harmful substances in materials and products.*

Recycling activities or their promotion are outside the scope of this review.

Context of this Module

This module is part of the Level 3 Cross-Cutting Theme reports. It refers to the accompanying Level 2 modules that contain analyses of Approaches, Interventions, Sector Issues and other aspects of the review. This module deals specifically with the aspect of Reuse and Material Use Efficiency as contributors to waste prevention.

A full map of the modular reporting structure can be found within **L1m2: Report Index**.

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Glossary

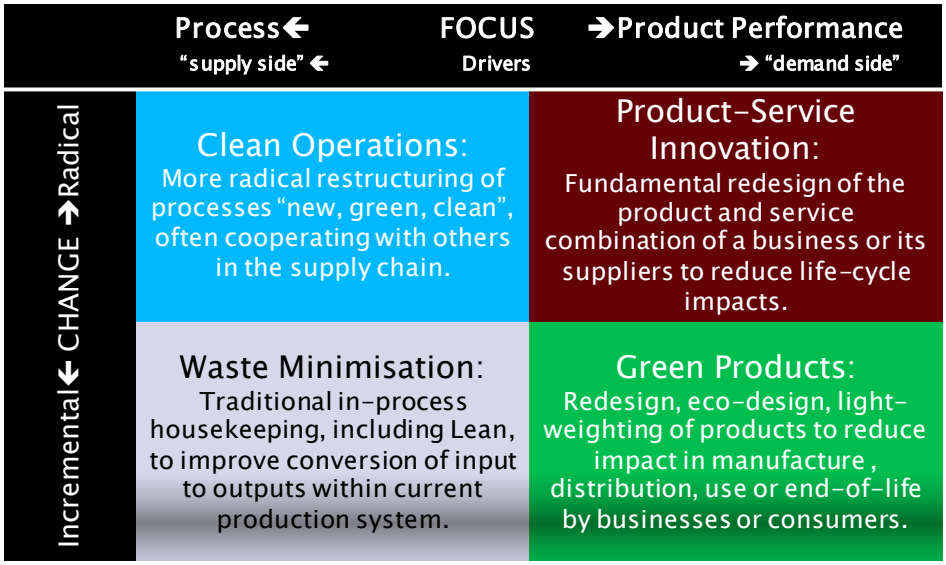
bre	A commercial organisation formerly known as the Building Research Establishment	MUE	material use efficiency
BREEAM	bre's Environmental Assessment Method (for buildings)	NISP	National Industrial Symbiosis Programme
BREW	Business Resource Efficiency & Waste	PR	public relations

Units Conventional SI units and prefixes used throughout: {k, kilo, 1000} {M, mega, 1,000,000} {G, giga, 10^9} {kg, kilogramme, unit mass} {t, metric tonne, 1000 kg}

Language used in this report

This report has used a framework for evaluating both the actions a business takes to prevent waste (the Approaches), and the mechanisms that have catalysed the actions (the Interventions). The detailed description of Approaches and Interventions may be found within the respective modules **L2m2: Approaches** and **L2m4-0: Interventions Introduction**, but a brief reference outline to the Approaches is given here:

Positioning of approaches in response to business drivers including waste



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1 Introduction

This module is provided as an addendum to the main report and examines one of a number of cross-cutting issues, namely actions by companies to address waste prevention through reuse of surpluses.

WR1403 has documented forms of reuse which, while not fitting neatly into traditional waste prevention, are nevertheless of relevance to the topic. These activities go beyond merely donating old laptops to charity. They are typically symbiotic in character, involving a change of perspective in the supply chain such that a surplus material or end-of-life product, previously regarded as mere waste, is now treated as a valuable resource to be exploited in its current form or processed into something else. Usually, but not always, the surplus resource needs to be passed onto a new business or individual in order for its value to be realised. A key distinction with most of the other forms of waste prevention reviewed in WR1403 is that in these forms of reuse efforts have not been made to prevent the surplus from arising in the first place, merely a strategy has been developed to recover value before it becomes classed as waste and, in passing, allow material efficiencies.

Approaches fall into two categories:

- **Reuse:** A range of tactics that extends useful life and reduces net resource-use per useful 'finished product' life including: repair, remanufacture, and servicisation (i.e. product/service innovation).[a] Reuse concerns the redeployment of identical fabricated products.

- **Material use efficiency (MUE):** Less a strategy, more an *ad hoc* response to virgin material surpluses (e.g. from over-ordering), but still requiring a shift in perspective such that the value of unwanted excess materials is recognised and exploited. MUE concerns continuous resources.

N.B. There is substantial parallel work sponsored by Defra to examine 'product life extension' interpreted as designing for longer product lifetimes. The reuse strategies here consider improvements to useful life of products already in service or materials already in the market.

[a] http://www.indigodev.com/Stahel.html

2 Evidence of Reuse

It has been difficult to find collated evidence of reuse, but certain industries and initiatives appear to have been successful and even exemplary. The automotive sector is a 'leading light' with reuse growing in prominence, notably in the form of remediation and remanufacturing of used vehicle (and other product) components. Remanufacturing – a series of manufacturing steps acting on an end-of-life part or product to return it to like-new or better performance, with warranty to match – has been exploited at global level by the giant automotive company Caterpillar. It takes back, cleans and remanufactures a wide range of components and products, reporting that 43,000 tonnes of material have been reused by the global remanufacturing business (1). Re-treading is another important example: here the life of worn-out vehicle tyres can be extended by adding a new rubber surface. This technology has become an accepted practice for knowledgeable customers with around half of all replacements for tyres of commercial vehicles in Europe being re-treads (2). With regard to simple reuse: with EU support, Achmea Parts Service established a system in conjunction with insurers in the Netherlands for using used parts for repairs (3). In 2001, approximately 60 tonnes of parts were reclaimed for reuse. See the module **L2m5-5: Automotive Sector** for more information.[a]

The National Industrial Symbiosis Programme (NISP), established in the mid 2000s with *inter alia* Defra BREW funding, has been engaged in facilitating physical exchange of materials, energy, water, wastes or by-products and expertise. It has produced numerous cases of 'cascaded' reuse across several sectors. Typically, these involve the transfer of packaging such as intermediate bulk containers (4), wooden packing cases (5) or plastic drums (6) from one business no longer requiring them to a second company. A more unusual example concerns the drinks manufacturer Diageo which wanted to find a 'greener' outlet for surplus hessian sacks originally used for shipping in the aromatics for their gin. NISP arranged for the sacks to be reused as packaging by a local firewood supplier (7).

In the construction sector, surplus engineered building components such as bricks, air-conditioning, windows, doors, structural steel, fixtures and fittings frequently arise when pre-existing buildings are demolished or products are over-ordered. These items have traditionally been removed from sites for reuse or resale in their primary function, a practice known as reclamation. This reclamation activity is defined as reuse under product/service innovation and can be promoted by adopting a so-called 'planned deconstruction' strategy, often facilitated by a pre-demolition audit (8). Examples, published by NISP, include mixed insulation off-cut materials being passed on from a construction contractor to a video production company which was building a new studio and would reuse the products as heat insulation and sound proofing (9), and another company who extended the life of surplus wooden pallets by passing them to a second company who could reuse them (10).

Interestingly, a tension exists between this form of reuse and recycling: surplus products with the potential for reclamation are now instead routinely segregated on site and crushed/shredded into their constituent materials for recycling: i.e. into woodchip, glass cullet, aggregate and so on. While cutting construction waste by 7.6 million tonnes between 2005 and 2008 (11), this practice has also led to a decline in reclamation, with the volume of material reclaimed from building sites falling by a quarter from 1997 to 2007. The trend may, however, be counter-productive both for the environment (12) and financially, while the value of unused surplus products outweighs that of the raw materials.

Developing A Strategic Approach To Construction Waste is a 2007 draft report for comments by bre (sic) (formerly known as Building Research Establishment) which feeds into Defra's Construction sector 'roadmap'. It sets as 'best practice' targets - based on current technology and on data from pre-demolition audits - an increase in reclamation from 13% to 28% (while landfill and recycling rates would fall accordingly). While buildings would require more time and labour to demolish in order to reclaim

[a] Both Achmea and CAT examples appear in more detail within module L4m2: Case Studies.

products, BRE believes the increased value of reclamation products would offset these costs (13). See module **L2m5-1: Construction & Demolition** for further discussion and numerous examples of reclamation in the construction sector.

Reuse is also seen in the hospitality sector in the form of charitable donations of surpluses. For instance, hotels give away un-required towels and bed linen, toiletries, clothing, carpets, crockery and so on to homeless shelters and other 'good causes' (14) (15) (16)**:** See module **L2m5-3: Hospitality**. The donation of surplus but still edible food for redistribution to needy people can also be considered here. Examples include Carlson Hotels Worldwide, Radisson Hotels & Resorts, Marriott International and Fairmont Hotels and Resorts who "donate untouched food from catering displays" (14), and Lomita, a city in California which diverts "leftover, edible food from restaurants, food courts, hotels, and hospitals" to organisations that work with impoverished people (17 p. 51). In the UK a national charity, FareShare, redistributes surplus food in the community and is well known for its participation with retailers and food manufacturers as well as hospitality companies. Modules **L4m5-2: Food & Drink** and **L4m5-3: Retail** have more information on FareShare, and there is a case study in module **L4m2: Case Studies**.

A common form of reuse now seen in the food and drink manufacturing sector – and to a lesser extent among the large food retailers – is the selling-on of surplus foods as animal feed. Businesses not only avoid the costs of disposal but also achieve a modest revenue, although more money would be saved by avoiding the surpluses in the first place (18). Again, this activity could be considered as either reuse or material use efficiency depending on whether the surplus is a final product (e.g. unsold ready-meals in a supermarket) or a raw ingredient/process by-product (e.g. spent hops in a brewery). The practice is subject to strict regulations which prohibit it for any forms of animal by-products (or catering waste) and competes with other disposal routes attracting energy by-product subsidies, such as anaerobic digestion: See module **L4m5-2: Food & Drink**.

NISP has also been active in promoting charitable donations. In one case, when demand for plants at a nursery dropped leading to a surplus of plants, NISP helped the nursery organise an agreement with local hospices where the plants could be utilised (19). In another example, NISP supported an initiative to divert end-of-use paving into reuse via a charitable reclamation outlet (20).

The reuse of office furniture is a common form of reuse, particularly when conducted on a commercial basis.[a] Examples identified during this work include a NISP-facilitated partnership between consultancy group Scott Wilson and Park Road Baptist Church, in which the church benefited form being able to reuse the furniture in its buildings. This extended the product's life and saved the Church £1,940 (21). NISP also put a Bath-based furniture retailer, which collected old furniture from its customers as part of its service, in touch with a charitable furniture reuse project (22). Despite these initiatives, some 165,000 tonnes of office furniture are thrown away yearly from British businesses, of which around half is thought to be reusable.[b]

[a] Furniture reuse which involves post disposal recovery and repair would be classified as "Preparation for Reuse"; this is not the subject of this work.
[b] http://www.remanufacturing.org.uk/furniture/

3 Evidence of Material Use Efficiency

Examples of businesses exchanging excess raw materials with others rather than disposing of them can be found in many sectors and are again the subject of numerous case studies published by NISP. Of particular interest, the Anglo-Norwegian biotech firm Axis-Shield passes on excess chemicals (still within their use-by dates and frequently unopened) from one of its UK sites to a different company in the same sector, Alchemy Laboratories Ltd, which is located nearby, to mutual advantage (23). With NISP support, companies such as DENSO Manufacturing UK Ltd have also participated in waste exchanges, including the transfer of potassium aluminium fluoride wastes to an aluminium alloy manufacturer, MilVer, which could use them in its process, thus avoiding hazardous waste treatment (24). Similarly Chemson, in Tyne & Wear, moved off-spec plasticisers to Polymer Industries UK avoiding 120 tonnes of disposals (and virgin) and saving £8,000 (25). More examples from the chemicals industry are likely, but this sector was not one of those selected for analysis.

Research – if not actual activity - on material use efficiency (MUE) is on-going in the food and drink sector. In 2004, *Total Food,* an international forum held in Norwich on the subject of "exploiting co-products – minimizing waste" enabled a range of interested groups including food processors, research scientists, consumer scientists and non-Governmental organisations to meet and exchange knowledge about co-product exploitation. (Typical co-products include: traditional brewing yeasts into Marmite™; diversion of brewing hops and grains, and vegetable skins into animal feeds; and straws, grains and peeling residues into bio-derived fuels. Emergent examples include: wine production residues forming the basis for cosmetics; chitinous shell-food wastes for cosmetic and other applications; and farm lignin/cellulose i.e. straws, grasses and pods being converted into bio-packaging. These last two are the subject of recent Technology Strategy Board collaborative research projects, partially funded by Defra.) Much of the discussion centred on new technologies for converting what would otherwise be sent to disposal into valuable by-products. However, little evidence was provided on realised cost savings(26). See module **L4m5-2: Food & Drink** for more information on this sector.

Similarly, in the construction sector, several instances have been documented of surplus aggregate materials being reused. In one case, stone from a nearby road that was being altered was used to build a temporary access road to a construction site. The access road was then dug up and used again as hard-core elsewhere (27). In another example, roadside drainage filter media was removed, crushed and used as fill on-site, or cleaned and reused elsewhere (28). In another example, again facilitated by NISP, a foundry (MJ Allen) co-operated with its sand supplier to have used sand taken back, avoiding landfill and allowing the supplier to reuse the sand as a filling material in construction (29). NISP also worked with Keanes Environmental to engineer a recovered construction material made from excavated aggregates reducing waste to landfill (30). See module **L2m5-1: Construction & Demolition.**

As with reuse, MUE can also take the form of charitable donations. For example, NISP supported an initiative to promote diversion of textile offcuts from a manufacturer to a charitable youth group foundation (31).

4 What Stimulates the Change in Approach?

Many examples of both MUE and extended use have been enabled and publicised by NISP. Motivators may include the opportunity to save on disposal costs (for the donor), raw material costs (for the recipient) and greenhouse gas emissions (23).

Evidence suggests that a decision to reclaim surplus building materials (rather than crush and recycle) is typically made by the building's user and architects, i.e. at the design stage or just prior to work commencing on the build stage of the project. The BREEAM certification system, updated in 2008 to require the undertaking of pre-demolition or pre-refurbishment audits (32), may go some way to halting the decline in reclamation. In general, this form of reuse is more likely to be successful when sufficient time and space are available and the benefits are clearly communicated (8): See module **L2m5-1-Construction & Demolition**.

In published evidence studied during this work, the donation of surpluses to charity is more commonly associated with larger organisations in the food and drink, hospitality and retail sectors. This suggests that the decisions may be taken in response to corporate social responsibility pressures; such acts are undoubtedly 'good for PR'. The desire to be seen to be 'green' seems to have motivated the drinks company Diageo to work with NISP to find an alternative disposal route for its surplus hessian sacks (7).

In the case of selling surplus food or ingredients as animal feed, the financial motive for this form of reuse is beyond dispute, but whether the opportunity to save costs or make money would always stimulate reuse or material use efficiency is far from certain. Judging by the experience from the construction sector, when presented with surpluses businesses generally respond by recycling rather than reusing them, even though the potential financial gains of the former – in terms of saving on landfill disposal costs – could be outweighed by the latter. The thrust of bre's findings (13) is that the heavy promotion of recovery and recycling, with associated systems and infrastructures, may have squeezed out higher value options that perhaps require more complex management to enable them.

Government business support is often behind many reuse initiatives, notably the Defra-funded Centre for Remanufacturing and Reuse. NISP also supports reuse and MUE, mainly through networking opportunities, for example (33) (23) (21). An internet-based waste exchange project was also an element of the Bedfordshire Waste Reduction in Industry (2000-2002) project (34).

A number of charities also promote reuse in the UK. For instance, Wastewatch instigated *Waste Alert Clubs* in London with "waste materials exchange" among a number of services offered to small businesses including pubs, clubs and restaurants for a small fee (17). The Furniture Reuse Network, Green-Works, and the Yorkshire and Humber exchange *Why Waste* are among many social enterprises now active in the area. However, data on waste prevented through their activities were not available.

In general, business support (including from not-for-profit organisations) provides the following services:

- identification of markets for excess material or product – purchased or manufactured – to avoid landfill
- identification of external agents for 'closed loop' treatment and recycling of materials, solvents etc.
- identification of 'extended life' opportunities for products through hand-on to other companies.

Business support can be instrumental in trialling new technologies or systems; for instance, the EU-funded a trial of Achmea's system of reusing old car parts in the Netherlands (3). The development and proving of new technologies is often required to stimulate reuse. Tyre re-treading is one of many examples where new technology has been an enabler, cost a driver (2). Research into technologies

exploiting food co-products is another potentially promising area (26). See modules **L2m4-7: Waste Minimisation Clubs** and **L2m4-8: Other Business Support** for more information.

Sometimes governments can be more prescriptive. For example, in Taiwan, where 18 million tonnes of industrial wastes were being generated annually in the late 1990s, the Environmental Protection Agency drafted several new waste management regulations to address this issue and established waste exchange services for at least 14 specific industrial wastes. The new regulations required that reuse and exchange were considered first, and only then the options of disposal, treatment and recycling (35).

5 Conclusions

The topics of what most people generally consider to be 'reuse' cover a broad range of activities. The Waste Framework Directive defines this as activities associated with products. An important fraction of reuse comes within the scope of waste prevention and is covered under the product/service innovation approach in the main modules. In this context it mainly embraces commercially driven systems based on selling product performance, product servicisation, repair and remanufacture which are clearly driven by profit motives. In this area, traditional generalist advice from publicly supported bodies is inappropriate as problems are bespoke and intertwined with the business model. It is likely that long-term education and "setting the business / environmental framework" through standards and 'global' outcome metrics, such as carbon, will be more productive in encouraging resource efficient behaviours.

At the informal, less standards-driven end (for example in reuse and refurbishment) social enterprises take a greater role with, clearly, social objectives. Furniture and white goods are typical targets. These organisations require some external support, but could be assisted in 'professionalising' their operations for the benefit of consumers. (We have not covered the informal exchange of products between users, e.g. as mediated by ebay or freegle.)

In the centre ground, there is a fertile area of cascaded reuse, where relatively simple products and engineering materials enjoy a second or third life (not to say a first life for excess stock). NISP has been particularly active in this area across many sectors, redistributing packaging, building materials and other engineered materials. We have also noted the activities of retailers, especially food, in ensuring that products reaching sell by date are not wasted, which has both social and financial benefits.

The popular concept of reuse also includes dealing with materials which, unlike products, tend not to conform to fixed shapes, sizes and performances. Similarly to products we have observed 'high end' activities, again with NISP playing a leading role, in redistributing both excess virgin materials and 'factory ends' of materials, with many such examples reported as occurring in the construction and chemicals sectors.

There is clearly a very large informal sector operating in this area, with many companies donating excesses, seconds and site scrap to charities, social enterprises and even schools. Much of this appears to happen through social media (but not evidenced in this report), but NISP has played a role.

In the centre ground is the commercial activity typified by on-site recovery. Here, otherwise land-filled materials are recovered, up-cycled and down-cycled into re-deployable raw materials. This activity has made substantial impact on demolition wastes arising in the construction sector.

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