

**WR1403: Business Waste Prevention  
Evidence Review  
L2m4-1 – Standards**



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;*
- b) the adverse impacts of the generated waste on the environment and human health; or*
- c) 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 one of a number of 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 waste prevention using the Intervention mechanism of Standards.

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

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## Glossary

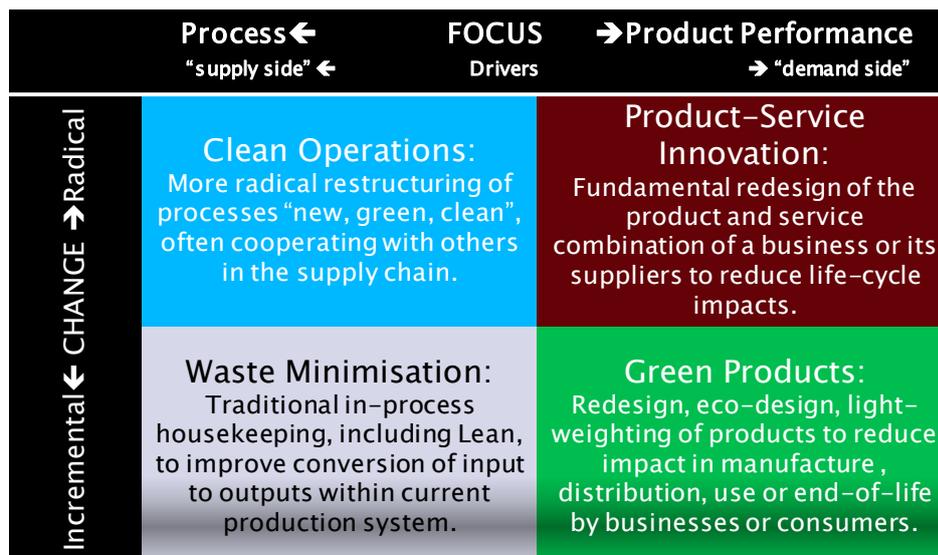
BIS	(Dept for) Business, Innovation and Skills	IEMA	Institute of Environmental Management and Assessment
BRE	Building research Establishment	ISO	International Standards Organisation
BREEAM	BRE Environmental Assessment Method	IT (ICT)	information (and communication) technologies
BS	British Standard, maintained by BSI, the National Standards body of the UK	NAO	National Audit Office
CBI	Confederation of British Industry	PAS	Publicly Available Specification, from BSI a non-mandatory prototype for a BS
EMAS	Eco-Management and Audit Scheme	SME	small/medium-sized enterprise (EU definition)
EMS	Environmental Management System	VOC	volatile organic compound
EPEAT	(US) Electronic Product Environmental Assessment Tool	WEEE	waste electronic and electrical equipment
GPP	Green Public Procurement (initiative)	WRAP	Waste & Resources Action Programme

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



Source: Oakdene Hollins/Brook Lyndhurst

# 1 How Standards Address Waste Prevention

A standard is an agreed, repeatable way of performing an action. It is a document that contains criteria designed to be used as a rule, guideline, or definition. Standards are designed for voluntary use. However, laws and regulations may refer to certain standards, and make compliance with them compulsory.<sup>a</sup> Within this report, individual internal company standards have not generally been considered due to lack of defined boundaries and documentation on their benefits.

Standards can commonly be used in three ways:

1. As a market differentiator for producers to inform procurers of actions they take which are environmentally sustainable.
2. As a selection tool for procurers to ensure that their suppliers meet a set of requirements.
3. As a tool for suppliers to ensure that their product is used in a specified way.

The difference between these uses is the agency and responsibility of the involved parties. Type 1 is usually accompanied by a labelling scheme for consumer goods to help differentiate the product from its competition. Type 2 generally involves business-to-business transactions within a formal tendering framework. Type 3 is used where a business's reputation needs to be protected, for example during disposal of product. Such standards can be used to influence the amount of waste generated in production, use or at disposal.

Independently verified standards schemes provide a clear indication of products that reduce environmental impact. This is important for procurers to ensure that the product being bought meets their environmental requirement.

In addition to standards, an appropriate labelling scheme is commonly needed to identify products that adhere to standards. However, there are problems associated with a lack of information provided by the labels as well as the costs associated with compliance of any such scheme. Labels have been discussed in a separate module **L2m4-2: Labelling**.

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<sup>a</sup> <http://www.bsigroup.com/>

## 2 The Nature of the Evidence

Standards concerned with waste management have largely focused on developing appropriate specifications for the reuse and recycling of waste or landmark work developing carbon foot-printing<sup>a</sup> rather than on waste prevention interventions. Examples include WRAP's efforts on developing Publicly Available Specifications, which have been successful but which focus on improving the quality of recyclates such as glass, tyres, compost, wood and plastics.<sup>b</sup> Such activities are out of scope in the current work.

Implementation of relevant standards has been led primarily by individual companies with very little direct government intervention, hence accessible evidence is limited. In the UK, there is evidence of literature to support and encourage adoption of Environmental Management Systems, EMS, such as that provided by Envirowise who have developed practical guides on reducing waste through the development of an Environmental Management System (EMS), either bespoke to a company or through using ISO 14001 (1). However, there is no evidence of any direct intervention. Internationally, there is more evidence of direct intervention for encouraging the adoption of EMS (particularly Eco-Management Audit Schemes, EMAS, and ISO 14001).

Evidence for the efficacy and scope of standards to address waste prevention is correspondingly sparse. Identified evidence almost exclusively examines diversion from landfill, or is ambiguous in the use of waste prevention. However, it does appear that standards have some effect on waste prevention, but there is uncertainty on quantifying these effects.

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<sup>a</sup> <http://www.footprintexpert.com/PCFKB/Lists/kbdocuments/Guide%20to%20PAS%202050.pdf>

<sup>b</sup> <http://www.wrap.org.uk>

## 3 Evidence of Waste Prevention

Evidence of waste being prevented directly by the development and implementation of standards is sparse. A reason for this is that, with the exception of ISO 14001 and EMAS, the area of using standards for environmental sustainability is relatively new. Recently, activity in this area has increased but, due to the timescale involved in developing and adopting a standard and case studies being developed, evidence of the impact of standards is not available. It is important, however, to describe some of the effort that is underway in this area.

It should also be noted that standards are a cross-cutting tool concerned with outcome, and are therefore generally not prescriptive of what particular approach should be employed to achieve their ends. Accordingly, much of the reviewed materials have been categorized under Mixed Approaches.

### 3.1 *Waste Minimisation*

BSI recently undertook a review of standards for waste and resource management for Defra and BIS (Defra project WR1401 (2)) which resulted in two high priority recommendations. The first was to engage widely with the business community to validate and elaborate a new strategic framework for how standards can support and reflect the concept of the resource efficiency cycle across the economy, while the second was to develop a waste performance benchmarking standard for businesses. We understand that BIS are still considering how best to take these proposals forward.

Box 1 outlines a case study of a project operated by the Oregon Department of Environmental Quality (DEQ) to reduce the use and waste of packaging materials by businesses in the State. The primary sector of interest is Retail, and it illustrates the use of both waste minimisation and clean operation approaches.

*Box 1: Oregon packaging waste prevention pilot project: Norm Thompson Outfitters*

Headquartered in Oregon, USA, Norm Thompson Outfitters is a catalogue and web retailer of clothing, outdoor products and other goods. Annual revenues were approximately \$200 million in 2004. Norm Thompson was a key partner in a 2002-5 pilot project operated by the Oregon Department of Environmental Quality (DEQ) to reduce the use and waste of packaging materials by businesses in the State. The project was funded by the regional government of the Portland metropolitan area and the US Environmental Protection Agency. Norm Thompson committed to cut by 25% both packaging waste generation and the use of virgin packaging material as against 2001 levels and, through the better packaging efficiency and increased use of recycled content material, reduce the amount of virgin packaging material used by 25% from 2001 levels. Key measures taken by Norm Thompson included switching in 2003 to reusable plastic shipping bags for soft goods order fulfilment. The change required the company to **relax an internal standard** that had previously prohibited the use of plastic bags rather than corrugated cartons for shipping higher cost products. Norm Thompson also asked vendors to reduce excessive packaging associated with “Save Your Back” bags, a day bag designed to reduce muscle strain and fatigue. Prior to the change up to 60 bin bags full of wadded-up paper might need to be disposed of in a single day at one distribution centre.

**Business Benefits**

- The increased use of shipping bags at distribution centres alone prevented some 370 tonnes of packaging waste per annum, equivalent to annual savings of \$680,000. The reduced under packing in the “Save Your Back” bags cut costs by a further \$2,900 a year.
- A total of \$77,400 was invested in the Oregon project yielding savings of more than 493 tonnes, or some \$994,000 a year.
- Intangible benefits included the value of educating both Norm Thompson employees and also DEQ and contractor staff on packaging evaluation and environmental considerations.

**Drivers**

- Norm Thompson’s commitment to environmental improvement and sustainability was identified as a motivating factor. Its mission statement is: “[We] will be a leader in developing business practices that sustain, restore and move in harmony with the natural environment.”
- DEQ established the Oregon pilot in response to waste prevention goals adopted by the Oregon Legislature in 2001 couple with the fact that packaging comprised 20–25% of the State’s waste arisings.

**Key Elements for Success**

- DEQ provided support in helping Norm Thompson to identify waste prevention in its own operations and to evaluate environmental marketing claims made by suppliers of packaging materials.
- The fact that certain suppliers were using excessive packing only came to light because of Norm Thompson’s culture of open communication among employees, something fostered by the Oregon pilot. The suppliers were then asked to reduce this packaging.
- Norm Thompson is a large company so could achieve significant change by influencing suppliers
- DEQ, Norm Thompson and other project partners developed a life cycle inventory analysis which helped businesses trade off probable environmental impacts of different packaging options. This tool improved decision-making.
- Although Norm Thompson had already implemented several packaging efficiency measures prior to 2002, the partnership approach embodied in the Oregon pilot created a forum for discussion of this topic.

## 3.2 Clean Operations

A large volume of waste is generated because of the transient nature of events. Because of this problem the BSI developed a new sustainable events standard: BS 8901.<sup>a</sup> It shares many of the common management principles of other management system standards such as ISO 9001 (Quality Management) and ISO 14001 (Environmental Management). It is a relatively new standard and therefore the effect on the industry has not been widely studied. It is well known and appears to be gaining recognition. ISO recently announced<sup>b</sup> that a formal committee will develop British Standard 8901 into a full ISO standard.

As part of the development work for the sustainable procurement standard a series of case studies was developed to showcase the savings possible from the standard. The case studies focus on waste generation, recycling and delegate miles.<sup>c</sup> Measurement is likely to aid waste prevention. The standard is being applied to the London Olympic Games.<sup>d</sup> Activities to prevent waste during the construction of the Olympic sites include (3):

- 97.7% of demolition waste recycled and in some cases reused.
- More than 80% of soil has been cleaned and reused on the Olympic Park.
- Foundations for the Aquatics Centre, Handball Arena and Olympic Stadium have used concrete with more than 30% of recycled materials.
- Off-site prefabrication of bridges and structural frames to reduce construction waste.
- Surplus gas pipes were used in the construction of the Olympic Stadium ring beam, which supports the fabric roof, lighting and staging facilities, thereby reducing the need for new steel to be produced.
- Contractors participate in regular audits to demonstrate how they have prevented waste.

Box 2 outlines a case study from Toyota, using ISO 14001 to improve clean operations. The primary sector of interest is Automotive, and it illustrates the use the clean operation approaches.

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<sup>a</sup> <http://www.bsigroup.co.uk/en/Assessment-and-Certification-services/Management-systems/Standards-and-Schemes/BS-8901/>

<sup>b</sup> [http://meetingsreview.com/news/2010/01/18/Global\\_sustainable\\_event\\_standard\\_to\\_be\\_developed\\_by\\_ISO](http://meetingsreview.com/news/2010/01/18/Global_sustainable_event_standard_to_be_developed_by_ISO)

<sup>c</sup> See : <http://www.organisethis.co.uk/casestudies> for a list of case studies

<sup>d</sup> <http://www.cslondon.org/sustainable-games/sustainable-event-management/>

### Box 2: Toyota and ISO 14001

The automotive manufacturer Toyota has a strong presence in Europe with nine production facilities in the UK, France, Poland, Czech Republic, Russia, Turkey and Portugal representing a total investment of around €7bn. In 1996, Toyota Manufacturing UK (TMUK) became the first UK based car maker to gain ISO 14001 accreditation for its management processes, later asking suppliers to gain the certification by 2003. In 2000, TMUK's sites at Burnaston and Deeside were earmarked as 'model sustainable plants' in which methodologies for achieving optimal environmental performance would be piloted. TMUK set a goal of zero waste to landfill by 2005, tackling it in three stages: reducing waste volume, reusing or recycling unavoidable waste, and treating any waste that could not be re-used or recycled to reduce its environmental impact.

#### Business Benefits

- TMUK has achieved its target of zero waste to landfill and, more recently, zero waste to incineration.
- Between 1993 and 2007, TMUK cut waste from UK car production by 60% to around 10kg per car and reduced the release of hazardous volatile organic compounds by 70% to 20g/m<sup>2</sup> of paint surface. However, whether these savings were directly correlated to the adoption of ISO 14001 is unclear. Greater efficiencies in water and electricity usage per vehicle have also been documented.
- Other benefits from implementing and maintaining an EMS may include marketing advantages by demonstrating to stakeholders that the company is committed to effective environmental management and reduced risk of international non-tariff trade barriers.

#### Drivers

- The EMS was implemented as part of Toyota's commitment to achieve zero waste to landfill. The car maker is generally regarded as setting benchmark standards in 'lean' manufacturing, in other words production processes in which waste and inefficiency are continuously driven towards minimal levels. Toyota Motor Europe's aim is to be 'green, clean and lean' and its long-term objective, as stated in its corporate 'Earth Charter' is production of the 'ultimate eco-car'.

#### Key Elements for Success

- Toyota is famous for its 'kaizen' philosophy of continuous improvement where new ideas are welcomed from anywhere within the global organisation. This approach works in synergy with ISO 14001 for which continuous environmental improvement is a key objective. New waste saving techniques are first proven at a local level within a single site and if effective the relevant procedures are then diffused to the rest of that particular location and then by degrees to the rest of the business.
- Through its environmental purchasing guidelines, Toyota used its power in the supply chain to influence business partners so that they make environmental protection a priority.
- Full commitment by top management to environmental protection is fundamental to the successful implementation of an EMS.
- Provision of skills training and awareness building is important. A valuable approach practised at the Burnaston plant was to take employees on 'eco tours' around parts of the factory they would not normally see such as the waste management facility which improved their understanding of waste.

#### Sources:

<http://www.iema.net/readingroom/casestudies?filter=163%2C189&aid=584>;

<http://blog.toyota.co.uk/behind-the-scenes-toyota-promotes-environmental-excellence-at-the-home-of-auris-hybrid>;

[http://www.iso.org/iso/14001\\_decade\\_ims3\\_07.pdf](http://www.iso.org/iso/14001_decade_ims3_07.pdf)

[http://www.mrcmekong.org/envir\\_training\\_kit/English/Case%20Studies/PDF/CS19%20-%20Toyota%20Motor%20Vietnam.pdf](http://www.mrcmekong.org/envir_training_kit/English/Case%20Studies/PDF/CS19%20-%20Toyota%20Motor%20Vietnam.pdf)

### 3.3 Green Products

A sustainable design Publicly Available Specification is being developed with the Design Council. This will have elements of waste reduction embedded in its principles. Publication is imminent. Meanwhile, Box 3 outlines the Top Runner programme, which aims to reduce energy consumption in the civil and transport sectors in Japan by recognising leading edge performers as benchmarks for others, and which has led to improvements in – mainly – appliances and products.

#### Box 3: Japan's Top Runner programme

Introduced in 1999 and administered by Japan's Agency for Natural Resources and Energy, the Top Runner programme aims to reduce energy consumption in the civil and transportation sectors by stimulating the continuous improvement in energy efficiency of products. Currently, 23 product classes are covered ranging from passenger vehicles and air conditioners to vending machines and even electric toilet seats! Rather than targeting retailers or end-users, Top Runner focuses on the supply-side, with manufacturers and importers required to meet minimum environmental standards. Appliances are tested, with the best performing model serving as a baseline for other manufacturers to meet or exceed. The next time officials set standards, the best available models will thus be even more efficient. In this way, standards are ratcheted up and energy conservation advances through the replacement of machinery and equipment by consumers. The European Union has adopted a similar mechanism to phase out non-energy efficient light bulbs. Although focused on energy efficiency, the Top Runner scheme might equally well be applied to waste prevention.

#### Business Benefits

- The Top Runner scheme has improved many appliances and products. For instance, between 2001 and 2007, the energy efficiency of computers and magnetic disk units increased by 80.8% and 85.7%, respectively, surpassing expectations. These improvements will give Japanese manufacturers a competitive edge in the international marketplace.

#### Drivers

- Japan's scheme works because although businesses realise they will one day have to comply with new more stringent and legally-binding standard (the hidden "stick"), innovation is driven primarily by the "carrot" of competitive advantage. It should be noted, however, that the scheme has been criticised for rewarding incremental rather than transformative change.
- As part of a voluntary "e-Mark" programme, certain products within the Top Runner scheme which meet the latest minimum requirements can display a label communicating this to retailers and consumers.

#### Key Elements for Success

- The Top Runner scheme is a non-confrontational approach to environmental protection. Although minimum standards once established become compulsory, the voluntary nature of progress towards better environmental performance harnesses businesses' own in-house expertise.
- Primary stakeholders are themselves involved in setting targets so awareness and commitment levels are high, while targets are not overly ambitious. Moreover, Japan has a culture of close cooperation between business and regulators.
- The scheme's iterative and flexible nature allows failures to be addressed and remedied.
- The "free-rider effect" is an advantage because businesses already performing well at the start of a cycle become free-riders in needing to invest less additional effort during the subsequent compliance period.
- Name-and-shame sanctions are effective deterrents in Japan.

#### Sources

[http://www.asiaeec-col.eccj.or.jp/top\\_runner/index.html](http://www.asiaeec-col.eccj.or.jp/top_runner/index.html) ;  
<http://www.enecho.meti.go.jp/policy/saveenergy/toprunner2010.03en.pdf>  
<http://www.aid-ee.org/documents/018TopRunner-Japan.PDF>

### **3.4 Product/Service Innovation**

The Centre for Remanufacturing and Reuse has developed a standard to encourage remanufacturing of products. The impact or uptake of this standard is unknown because it is newly published.<sup>a</sup>

An internal document, produced by the Centre for Remanufacturing and Reuse for WRAP, mapped the landscape of available national and international standards associated with reuse and remanufacturing. Over 50 different standards were identified, but research into their impact was not undertaken. The majority were developed to ensure safe working practices or quality of a final product rather than to reduce waste. It would appear – in general – that further work is needed in this area to prepare evidence of and waste prevention benefits of these standards.<sup>b</sup>

The WEEE Advisory Board is in the process of developing a standard for the reuse of used electrical and electronic equipment. The standard aims to increase product reuse, preventing additional disposal to landfill. It is currently being finalised and is due for publication before the summer of 2011. A proposed use of the standard is to enable the export of electrical equipment for genuine reuse, helping control and prevent the illegal export of WEEE.

Box 4 outlines the approach taken by the London Olympic Games Organising Committee. Purchasing standards were applied largely to control the impact of the construction of what would be temporary facilities by seeking evaluation and declarations. Hospitality will be targeted in the “in use” phase of the games.

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<sup>a</sup> <http://shop.bsigroup.com/ProductDetail/?pid=00000000030205839>

<sup>b</sup> Unpublished results, WRAP 2010

#### Box 4: London 2012 Olympic Games development

Waste prevention has been evident in the preparations for the London 2012 Olympic and Paralympic Games with this objective being met partly with the application of procurement codes and standards. (11) While landfill diversion is a priority - LOCOG (the London Games' organising committee) has the objective of sending 'zero waste to landfill' – several measures have been taken to reduce the waste arising in the first place. For instance, LOCOG favours the leasing of temporary venues and other elements to limit the volume of material needing to be disposed of after the Games. These include seating, tented and modular buildings, flooring, fencing, furniture, signage, tensile fabrics, cabling and pipework. Where new permanent developments are needed, off-site manufacturing has been adopted with construction materials and products for bridges and structural frames procured in pre-assembled form. Particular construction and fixing methods are also prescribed by LOCOG to facilitate disassembly and maximise the options for reuse or recycling. Finally, LOCOG's Sustainable Sourcing Code required that, where practicable, all packaging and products could be reused, recycled or recovered and certain hazardous materials (e.g. PVC with heavy metal additives) avoided. Suppliers and licensees were also expected to calculate the carbon impact of their products and services.

##### Business Benefits

- Quantitative evidence is not yet available on the amount of waste that LOCOG has avoided through these initiatives and the financial costs saved, but the figures are likely to be impressive.

##### Drivers

- Although LOCOG had already pledged to divert 90% of construction refuse from landfill, its ambition was further boosted by WRAP's Halving Waste to Landfill commitment which it signed up to in 2009. LOCOG wanted to demonstrate it was part a much bigger government initiative and to show leadership

##### Key Elements for Success

- LOCOG clearly set out its intentions in *Towards a one planet 2012*, the sustainability plan it published in 2009.
- Given the scale of the Olympic development, the organisers were in a strong position to put pressure on a range of suppliers to prevent waste in their activities. LOCOG saw its Sustainable Sourcing Code and Materials Policy as an opportunity to inspire change and catalyse industry innovation.
- LOCOG helped develop a new standard: BS 8901 Sustainability Management Systems for Events – which in turn guides preparations for the Games.

### 3.5 Mixed Approaches

Environmental Management Systems (EMSs), such as ISO 14001 and EMAS (an EU-led management tool for companies to evaluate, report and improve their environmental performance, similar to ISO 14001) provide many examples of business waste prevention. A systems approach and an internal auditing process are required for ISO 14001. However, these standards do not provide an organisation with explicit tools concerning how to understand and measure its waste, discharges and emissions, nor do they identify options for preventing waste and emissions (4). EMAS builds on ISO 14001 by also requiring the reporting of key indicators. These systems do not specify a reduction in waste generation.

There is good evidence (5) to suggest that an EMS has had a positive effect on the environmental performance of an organisation, especially in a number of facility-related aspects such as water pollution, air emissions, waste management and resource use. However, the effectiveness of these schemes is greatly improved by external assessment and certification of these systems. This is echoed by a Northern Ireland Environment Agency report that reviewed eleven studies into the effect of EMSs on environmental performance. The research indicates that they do provide environmental improvements,

although the study could not conclude the benefit of their ability to provide improvements in legislative compliance.<sup>a</sup>

An article in the Journal of Operations Management discussed the premise that Lean Manufacturing techniques are complementary to those described in EMSs. The implementation of Lean alongside an EMS could result in an increase in the use of waste prevention rather than waste diversion, because Lean examines ways to reduce costs in process rather than preventing disposal during production (6). EMS in combination with Lean may thereby compensate for the incoming supply chain perspective of Lean which takes no account of the full life cycle.<sup>b</sup>

Internationally, there is a large disparity between EMS uptake in SMEs in the UK and, for example Germany, Denmark or Austria, where it is significantly higher. No formal explanation was reported (7), but factors such as an Austrian Government initiative to subsidise companies applying for ISO 14001 are likely to be a significant. Several other countries offer similar schemes to encourage adoption.<sup>c</sup> In response, Defra has commissioned White Young Green to gather evidence on the benefits of EMS for SMEs, to encourage uptake of environmental management systems by smaller businesses. Findings are expected to be reported in March 2011.

A report by the Northern Ireland Environment Agency illustrated environmental savings made through implementing EMAS (based on Envirowise case studies):<sup>d</sup>

- Dairy Produce Packers Ltd. decided to undertake a waste audit in the run-up to the certification of their EMS, with the intention of producing a waste minimisation strategy. In relation to waste prevention, the company greatly improved the ratio of materials such as wooden pallets that were re-used. Overall, as well as this reduction in terms of environmental impact, the company made cost savings of an estimated £46,000/yr.
- McKechnie, a plastic component manufacturer, through the development of an EMS, delivered cost savings of £93,000/yr including reductions in new packaging and the generation of scrap.
- Michelin implemented ISO 14001:2004 and included specific targets for controlling volatile organic compounds. A 54% reduction in solvent use and therefore in VOC emissions was achieved and have since targeted reductions of 75%.
- Through the implementation of ISO 14001, GPS Colour Graphics reduced their carbon footprint, and also lowered waste by 14% by efficiency improves; they also introduced a new platemaker that reduced chemical usage at the site by 50%.

Table 1: Examples of savings from use of EMS

Category	Supported	Description	Outcomes	Ref ID
EMS	No	A CBI report on Smiths Aerospace gives an example where ISO 14001 attained	Waste to landfill down 30%. Waste minimisation not reported	(8)
EMS	No	Toyota implemented ISO 14001 in 8 plants throughout Europe. Part of this commitment was to achieve zero waste to landfill. It is unclear whether there is a direct correlation between adopting a standard and achieving these savings or whether the savings were made and ISO 14001 was obtained.	Over 14 years, they reduced the waste from car production by 60% to 10kg per car. They also reduced VOC release (hazard) 70 % to 20g/m <sup>2</sup> of paint surface.	(9)
EMS	Yes	Office blocks working towards ISO 14001 practices of duplex printing and paper re-use	12 reams at a cost of c.£25	(10)

Source: Collated by Oakdene Hollins/Brook Lyndhurst

<sup>a</sup> [http://www.ni-environment.gov.uk/measuring\\_the\\_effectiveness\\_of\\_ems\\_phase\\_1-2.pdf](http://www.ni-environment.gov.uk/measuring_the_effectiveness_of_ems_phase_1-2.pdf)

<sup>b</sup> <http://remas.iema.net/content/newsletters.htm>

<sup>c</sup> <http://dcmsme.gov.in/schemes/sciso9000.htm>

<sup>d</sup> Measuring the effectiveness of Environmental Management Systems Phase 1: Desktop Report, Northern Ireland Environment Agency, June 2009

## Procurement Standards

A standard for sustainable procurement, BS 8903: Principles and Framework for Procuring Sustainably was launched in summer 2010. Developed, in part by Action Sustainability, BS 8903 provides guidance on adopting and embedding sustainable procurement principles and practices. It covers all stages of the procurement process and is applicable across industry, public, private and third sector organisations<sup>a</sup>.

Green Public Procurement (GPP) is a European Union voluntary instrument for individual Member States and public authorities. By using their purchasing power to choose goods and services with lower impacts on the environment, they can make an important contribution to sustainable consumption and production. The impacts of GPP have been investigated showing good carbon dioxide and financial savings. However, no equivalent study has been identified examining the effects of GPP on waste prevention or reductions in the use of toxic materials.<sup>b</sup>

Selective purchasing can influence the market: by promoting and using GPP, public authorities can provide industry with incentives for developing green technologies and products. There are currently ten products covered by the criteria, which range from IT equipment to textiles.<sup>c</sup>

Government Buying Standards<sup>d</sup> is a UK Government initiative with the aim of setting sustainable criteria for procurement of a variety of product categories. The standards are mandatory for all central government departments and incorporate GPP in addition to other criteria. There is active development of these standards with the expectation that the number of different product groups covered will increase in the coming years. These standards were originally devised in 2003 under 'QuickWIns', but were rebranded to their current name in 2010. In 2009, they formed part of the recommendations in the NAO Report Addressing the Environmental Impacts of Government procurement.

There are currently over 30 products covered under Government Buying Standards including construction, electrical equipment and furniture. Within these specifications there are requirements to use products that minimise the use or release of hazardous materials (for example, using low volatile organic compounds within paints and low-ozone depleting refrigerants) and at least one example of specifying reuse (furniture). Impact assessments have been published for a limited number of the product groups, but these forecast the benefit rather than assess actual impact.

Other examples of procurement-led standards include:

- The Mayor of London's Green Procurement Code was launched in 2001; its original purpose was to help create a market for recycled products. The Code was re-launched in October 2007 and now encourages as technical product specifications and the sourcing of sustainable products. Since this re-launch over £742 million has been spent on certified products, diverting 191,131 tonnes of waste from landfill and saving of 78,863 tonnes of CO<sub>2</sub> emissions. The signatories to the code reportedly purchase from over 680 suppliers which supports 1300 jobs (11). The Code relies on the GPP and Government Buying Standards criteria as a benchmark.

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<sup>a</sup> <http://www.actionsustainability.com/BS8903.aspx>

<sup>b</sup> [http://ec.europa.eu/environment/gpp/pdf/statistical\\_information.pdf](http://ec.europa.eu/environment/gpp/pdf/statistical_information.pdf)

<sup>c</sup> [http://ec.europa.eu/environment/gpp/index\\_en.htm](http://ec.europa.eu/environment/gpp/index_en.htm)

<sup>d</sup> <http://www.defra.gov.uk/sustainable/government/advice/public/buying/products/index.htm>

### Area-specific standards

EPEAT is a registry for sustainable electronics, focusing largely on ICT and computing sectors.<sup>a</sup> EPEAT uses criteria for design, production, energy, materials use and recycling to rate a products sustainability. Certain criteria are mandatory whereas optional criteria can lead to Silver or Gold Award status under the scheme. These standards are independently verified. In total, over 3,200 products from 45 manufacturers registered in 41 countries have sought EPEAT certification. The focus of the criteria is waste prevention, disassembly, recycling and life extension; energy efficiency is targeted though mandatory compliance with the Energy Star standard.

In 2009, it has been estimated that the EPEAT scheme world wide<sup>b</sup>:

- reduced use of primary materials by 19 million tonnes
- reduced use of toxic materials, by 1,537 tonnes
- avoided the disposal of 72,000 tonnes of hazardous waste
- eliminated over 29,000 tonnes of waste.

A voluntary scheme is offered by the Sustainable Restaurant Association and certifies against a set of sustainability criteria. The standard communicates the performance of the restaurant through awarding a one, two or three star rating. In relation to waste prevention, criteria include alternative portion sizes and doggy bags for customers to reduce customers wasting food.<sup>c</sup> The ranking system means that these waste prevention activities are not mandatory since high quality restaurants are unlikely to offer the waste prevention measures mentioned above (12).

The Green Tourism Business Scheme is a sustainable tourism certification standard for the UK. Originally developed in partnership with Visit Scotland, it is now validated by Visit Britain. The standard provides a comprehensive list of criteria, those relating to waste prevention include: returnable and reusable packaging, reducing waste in marketing, portion control and the use of rechargeable batteries.<sup>d</sup> Several case studies have documented the environmental savings of the standard, but there is limited evidence relating to waste prevention. One example identified reuse of furniture as part of the assessment, saving approximately £1,000.<sup>e</sup>

BREEAM (BRE Environmental Assessment Method) is a widely used environmental assessment method for buildings. It is a series of standards in sustainable design and is used to describe a building's environmental performance (13). Over 115,000 buildings are certified through BREEAM; it sets the standard for best practice in sustainable design and measures a building's environmental performance. Credits are awarded in ten categories according to performance, which are then added together enabling the building to be rated. The categories include water, energy, material use and waste with a comprehensive list of criteria. The BREEAM criteria are developed from cross-industry support.<sup>f</sup> On-site reuse of building products are used as criteria within the standard, along with requirements for site waste management plans. These criteria are relatively new, meaning that there is little evidence of their impact on preventing waste. The scoring system employed within the standard also means that waste prevention does not necessarily need to be taken into account during the construction project. BREEAM is also used by public procurers through the Government Buying Standard scheme.<sup>g</sup>

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<sup>a</sup> <http://www.epeat.net/default.aspx>

<sup>b</sup> <http://www.epeat.net/FastBenefits.aspx>

<sup>c</sup> <http://www.thesra.org/index.php>

<sup>d</sup> <http://www.green-business.co.uk/index.asp>

<sup>e</sup> [http://www.green-business.co.uk/PDF\\_2007/Case\\_Study/Ninebanks%20-%20Furniture07.pdf](http://www.green-business.co.uk/PDF_2007/Case_Study/Ninebanks%20-%20Furniture07.pdf)

<sup>f</sup> [http://www.breeam.org/filelibrary/BES5053-3\\_0\\_BREEAM\\_Healthcare1\\_2008.pdf](http://www.breeam.org/filelibrary/BES5053-3_0_BREEAM_Healthcare1_2008.pdf)

<sup>g</sup> <http://www.defra.gov.uk/sustainable/government/advice/public/buying/products/construction/new-build.htm>

BRE has recently launched a framework standard for the responsible sourcing of construction products - BES 6001:2008. The standard addresses issues on material source, worker welfare and environmental impact (14).

An alternative set of sustainable construction standards: LEED Green Building Standard is a set of independently certified standards for construction developed by the US Green Building Council. The standard is comprehensive, covering waste, water and energy use within construction and building design. Certain criteria focus on aspects of waste prevention, for example minimising waste through efficient use of structural timber. Data on waste prevention from implementing the standard was not available.<sup>a</sup>

### **3.6 Areas Outside Scope**

It is well known that standards have been evolving in parallel areas to waste, notably embedded CO<sub>2</sub> impacts of manufacture and use, for example PAS 2050 in the UK, Energy Using Products Directive (and Product Design Directive in formulation) across the EU. The implementation of these standards, often in conjunction with labels, is outside the current scope, but may well have significant learning potential.

### **3.7 Hazardous Waste Reduction**

Standards, particularly EMSs, are used extensively to reduce hazardous waste. In addition to those presented above, several examples described here highlight their role in reducing hazardous waste generation.

As part of a review driven by their EMS, ISO14001, BAE Systems identified possible improvements in paint spraying. An investment in a new paint flocculation, filtration and de-watering unit was made to limit pollution release. Although requiring a capital investment of £32 000, annual cost savings of £13,000 in reduced hazardous waste disposal costs and reduced cleaning costs of approximately £7 000 were realised. It also led to a reduction in disposal of hazardous waste to landfill of 170 000 litres/yr (15).

As part of the company's drive for continual improvements within ISO 14001, Henkel undertook a review in 2004 to reduce the volume of hazardous waste produced from cleaning out chemical lines. This was costing A£9,000/yr. A new system was implemented to collect specific washings and blend them into the product. In addition to the waste disposal and storage costs savings, this process also offset the need to procure more raw material (16).

<sup>b2</sup> Automotive Components Ltd, which designs and manufactures high-quality steering systems, through ISO 14001 identified the generation and disposal of waste coolant oil and water as a key environmental issue. A new oil filtration system was purchased, leading to a £5,500/yr reduction in disposal cost and preventing the generation of 100,000 litres/year of hazardous waste (17).

Box 5 illustrates how the intervention of the Environment Agency, facilitating a number of approaches, including ISO14001 and sector-based initiatives, has tackled reduction of hazardous waste and content targeting high impact sectors.

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<sup>a</sup> <http://www.usgbc.org/DisplayPage.aspx?CategoryID=19>

**Box 5: HazRed**

Launched in 2004, the three-year HazRed project aimed to check the rise in hazardous waste generation across Europe. Funded through the EU Life Programme, the project sought to address hazardous arisings from small and medium-sized enterprises. In the UK, HazRed was co-sponsored by the Environment Agency, Scottish Environment Protection Agency, Envirowise, Waste Recycling Group and others. They tracked and targeted areas of highest hazardous waste arisings and impact across focus sectors including pharmaceuticals, printing, automotive and construction. Training workshops were run and specialist advisors sent to specific businesses. Measures taken included removal of such substances as chromium, cyanide and volatile organic compounds from protective finishes, paints, strippers, inks and cleaning fluids.

**Business Benefits**

- Some 1,200 tonnes of hazardous waste were diverted from landfill and savings to business totalled more than £440,000.

**Drivers**

- Businesses saw their involvement in HazRed as a way not only to save costs but also to ensure compliance with ever more stringent hazardous waste regulation.
- One company wanted to participate because taking action to limit environmental impact was 'a central part' of its strategy. Another pointed out that customers working towards their own sustainability targets, including the standard ISO 14001, expected suppliers to demonstrate a similar commitment.

**Key Elements for Success**

- The backing of the Environment Agency has been crucial to the success of HazRed. The Agency maintains an interest with schemes such as the European Pathway to Zero Waste targeting construction and other high-impact sectors.
- Recognising that larger companies are better placed to benefit from the environmental guidance and exploit advances in clean technology, the HazRed project deliberately targeted SMEs.
- Various communications tools were used to recruit companies and influence behaviour including sector champions, workshops, member communications within trade associations, regional and national press, Project Partner events, websites and newsletters.

## 4 Behavioural Aspects

### 4.1 Motivators

A study in Finland showed that take up of EMS by SMEs is driven by external stakeholders and not by any potential for exploiting environmentally related market opportunities or environmental risks (18). An EMS functions on a top-down principle: customers and directors of corporations demand that sub-contractors and subsidiary companies implement environmental management systems (19).

In addition to supply chain demand, other significant drivers include (20):

- Financial: An EMS should allow greater efficiency by eliminating waste, leading to financial savings. Moreover, alternative benefits such as many bank insurance companies give preference to organizations with reduced environmental risk.
- Legislative: Organisations with an effective EMS have fewer environmental incidents and a reduced risk of breaking the law.
- Community and employee relations: In many cases, businesses work forces embrace environmental management enthusiastically and businesses have a better relationship with its local community.

A study of Austrian companies with ISO 14001 (4) found that they were motivated by the expectation of cost reductions. The motivation seems to be different for Austrian companies participating in EMAS as they where improvements in public image and better internal and external communication figure more highly. It should be noted that EMAS participation in Austria has been strongly subsidised.

Organisations that have adopted EMAS tend to find that it is a useful tool that supports their efforts to improve performance. However, EMAS is not one of the most important determinants of environmental performance and it appears not to be a strong autonomous driver for improvement. The elements of EMAS that were considered by participants and stakeholders to be most important for achieving improvement in practice are (21):

- requirement for legal compliance
- technical progress
- employee involvement.

### 4.2 Barriers

The results of a European survey on EMAS certification identified three important barriers to further take-up of the system<sup>a</sup>:

- The benefits were not clear or not justified given the general lack of awareness and demand amongst customers and the public.
- Costs of implementation, both the internal costs of allocating personnel and the external costs of verifiers and auditors, were high.
- There was a lack of financial incentives.

The point was made by many Member States that, in general, organisations see little incentive to go beyond the requirements of ISO14001, since in most cases there appears to be no clear advantage of being EMAS-registered rather than ISO14001-registered.

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<sup>a</sup> [http://ec.europa.eu/environment/emas/pdf/news/costs\\_and\\_benefits\\_of\\_emas.pdf](http://ec.europa.eu/environment/emas/pdf/news/costs_and_benefits_of_emas.pdf)

In comparison, the focus of EMS is towards waste diversion rather than waste prevention (22). The environmental management systems are good tools for SMEs to reach their statutory requirements, but they do not appear to provide much impetus for SMEs to implement waste prevention. The balance could be redressed if clear material efficiency and total life-cycle impact criteria are incorporated (18).

It has also been reported (23) that costs associated with setting up, operating and maintaining standards may be particularly prohibitive to small enterprises.

A report by the Sustainable Development Research Network suggested that Environmental Management Systems encourage a more sustainable supply chain. Organisations that adopted EMSs expanded their focus beyond their own boundaries to minimise wider environmental impacts. However, cooperation between the purchasing and environmental departments within a company may not be sufficiently achieved when implementing of ISO 14001, making the communication of customer requirements to suppliers less efficient. Building close relationships with suppliers is important to overcome initial difficulties, but this often conflicts with having a large supplier base (24).

### **4.3 Enablers**

One report identified that the most commonly used incentives were financial support, guidance documents and reduced regulatory enforcement. The incentives identified as most important by respondents were promotion of EMAS registered organisations, reduced regulatory enforcement and financial support to register.<sup>a</sup>

Studies have shown that environmental performance following EMS adoption was linked to managers' belief that additional environmental and financial performance can be achieved. Linked to this, perceived competitive advantage is also seen as important. This suggests that the success of an EMS is dependant on the involvement of firms' external stakeholders (distributors, customers, community members, and regulatory agencies) (24).

A study on how to encourage EMAS uptake within Europe identified that technical assistance offered by governments (including guidance documents, dedicated websites, training of consultants) was less valuable than financial incentives. Also, public procurement wasn't considered a major benefit to organisations.<sup>a</sup>

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<sup>a</sup> Study on the Costs and Benefits of EMAS to Registered Organisations, DG environment, October 2009.

## 5 Conclusions

### 5.1 Learning

- **The majority of evidence on standards with respect to waste prevention is associated with use of Environmental Management Systems.** EMSs do not explicitly require waste prevention activities, but this need can be implied under certain criteria. There is good evidence that EMSs reduce waste arising. However, the reports do not permit distinction in attribution between landfill diversion, waste minimisation and waste prevention.
- **The sustainable procurement standard is being taken up more widely in business as evidenced by a number of case studies, although the benefits are not well quantified.**

### 5.2 Insights

Due to the timeframe for development and implementation of new standards, it is likely that there will be a significant lag between publication and the appearance of good supporting evidence of impacts on waste prevention.

There are strong links between labelling and standards: labels generally require either formal or informal standards as award criteria.

When implemented, EMSs are commonly applied to target a wide range of environmental impacts, not just single issues. A strong enabler appears to be the linkage in managers' minds of environment, financial benefits and associated competitive advantage. However, the communication of environmental priorities both externally (customers and suppliers) and internally (between environmental and other functions) needs careful attention.

With respect to EMAS uptake in Europe, a financial incentive (as an output) rather than technical support (as an input) was deemed more valuable.

### 5.3 Research Gaps

- **Examine the need for a new environmental standard aimed at the service sector.** ISO 14001 is perceived as a standard for the manufacturing industry, uptake by the service sector is low; there may be a need to look at developing a service-sector specific standard for reducing environmental impact. **N.B.** A prior project WR1401 has explored the potential of standards in waste management and may have relevance.
- **Specific research into the role of EMS on reduction in waste generation is needed.** Although there is inferred evidence of waste prevention, there is little evidence of EMS preventing waste.
- **Learn from procurement:** Understanding the drivers that made the sustainable procurement standard successful may be useful in the development of new standards.
- **Examine what learning may be available from the voluntary IEMA standards.** Within the time of this review we were unable to conduct any significant examination of the Institute of Environmental Management & Assessments ([www.iema.net](http://www.iema.net)) guidance and outcomes.

## 6 Bibliography

1. **Envirowise.** *Waste minimisation for managers.* Didcot : Envirowise, 2002. id 713.
2. **BSI British Standards.** *Review of Standards for Waste and Resource Management Research Project: Final Report.* London : Defra/BIS, 2009. id 951.
3. **LOCOG.** *Towards One Planet: London 2012 Sustainability Plan, 2nd Edition.* December 2009.
4. *Small and medium sized enterprises and experiences with environmental management.* **Fresner, J.** 2004, *Journal of Cleaner Production*, Vol. 12, pp. 545–547. id 422.
5. *Assessing the impact of environmental management systems on corporate and environmental performance.* **Melnyk, S.A., Sroufe, R.P. and Calantone, R.** 2003, *Journal of Operations Management*, Vol. 21, pp. 329–351. id 593.
6. *Lean Production and EMSs: Aligning Environmental Management with Business Priorities.* **Tice, J., Ahouse, L. and Larson, T.** s.l. : Environmental Quality Management, 2005, Vol. Winter 2005, pp. 1-12. id 827.
7. *On the effectiveness in implementing a waste-management-plan method in construction.* **Tam, Vivian W.Y.** 2008, *Waste Management*, Vol. 28, pp. 1072–1080. id 473.
8. **Article 13.** *CSR Case Study Smiths Aerospace.* s.l. : Article 13, 2005. id 635.
9. **Farish, M.** *plants that are green.* s.l. : Engineering & technology, 2009. id 826.
10. **CO2 Sense.** *EMS Programme: Cidon Construction.* Leeds : CO2 Sense. id 391.
11. What is the Green Procurement Code? *Green Procurement Code.* [Online] [Cited: 24 January 2011.] <http://www.greenprocurementcode.co.uk/?q=node/75>. id 925.
12. **Ward, M.** Savoy reopens, claiming title of London's greenest five-star hotel. *Green Wise Business.* [Online] 12 October 2010. [Cited: 5 January 2011.] <http://www.greenwisebusiness.co.uk/news/savoy-reopens-claiming-title-of-londons-greenest-fivestar-hotel-1854.aspx>. id 886.
13. **BREEAM.** What is BREEAM? *BREEAM.* [Online] 2009. [Cited: 24 January 2011.] <http://www.breeam.org/page.jsp?id=66>. id 922.
14. **BRE.** BRE Global Launches New Framework Standard For Responsible Sourcing Of Construction Products. *BRE.* [Online] 2008. [Cited: 24 January 2011.] <http://www.bre.co.uk/newsdetails.jsp?id=513>. id 924.
15. **Envirowise.** *Aerospace company finds solution to disposal of hazardous paint spray waste - CS497.* Didcot : Envirowise, 2005. id 941.
16. —. *Consumer adhesives manufacturer seals out hazardous waste disposal costs - CS499.* Didcot : Envirowise, 2005. id 940.

17. —. *Hazardous waste review steers automotive company towards cost savings - CS498*. Didcot : Envirowise, 2005. id 939.
18. *Waste minimisation in small and medium-sized enterprises—do environmental management systems help?* **Ilomäki, M. and Melanen, M.** 2001, *Journal of Cleaner Production*, Vol. 9, pp. 209–217. id 595.
19. *How does industry respond to waste policy instruments—Finnish experiences.* **Kautto, P. and Melanen, M.** 2004, *Journal of Cleaner Production*, Vol. 12, pp. 1–11. id 594.
20. *Environmental management systems as sustainable tools in the way of life for the SMEs and VSMEs.* **Zorpas, A.** 2010, *Bioresource Technology*, Vol. 101, pp. 1544–1557. id 437.
21. **IEFE- Università Bocconi.** *EVER: Evaluation of EMAS and Eco-Label for their Revision*. Brussels : European Commission, DG Environment, 2005. id 831.
22. **Envirowise.** *Profiting from waste reduction in retail stores*. Didcot : Envirowise, 2002. id 711.
23. **EEF.** *Resource efficiency - Business benefits from sustainable resource management*. London : EEF, 2009. id 341.
24. **Walker, H.** *Successful business and procurement: what lessons for sustainable public procurement can be drawn from successful businesses?* London : Sustainable Development Research Network, 2010. id 879.

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