WR1403: Business Waste Prevention Evidence Review
L2m7 – Metrics

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Resource Recovery Forum

A report for
Defra

November 2011

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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 <u>before</u> 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 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 Metrics module and considers how waste prevention has been reported over the years.

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

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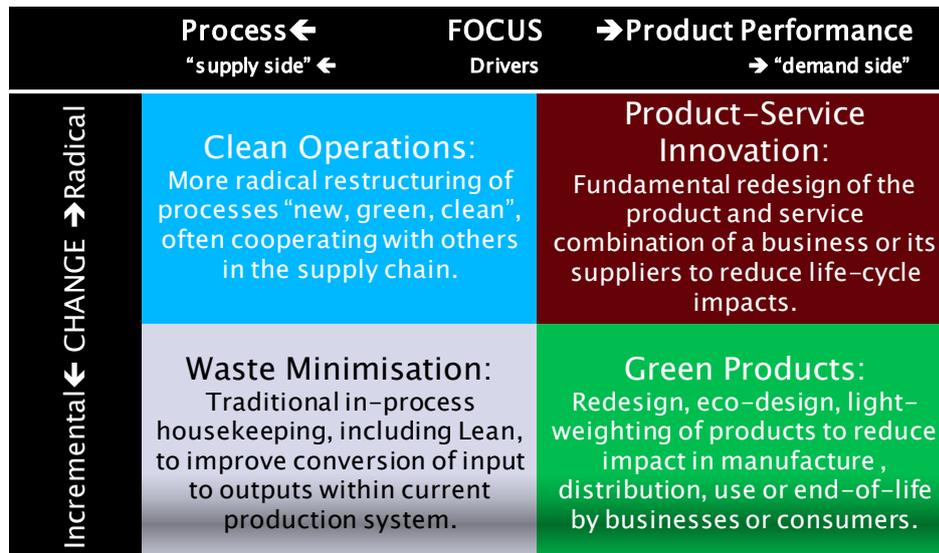|				
BERR	(Department for) Business, Enterprise and Regulatory Reform	NGO	non-Governmental organisation
BIS	(Department for) Business, Innovation and Skills	NWDA	North West Development Agency
BREW	Business Resource Efficiency and Waste	OECD	Organisation for Economic Co-operation and Development
EA	Environment Agency	RDA	Regional Development Agency
EB	Environmental Body	SEEDA	South East England Development Agency
EEF	Engineering Employers Federation	tCO₂e	tonnes of carbon dioxide equivalent
EPA	Environmental Protection Agency	WMC	Waste Minimisation Club
NAO	National Audit Office	WRAP	Waste & Resources Action Programme

Units   Conventional SI units and prefixes used throughout: {k, kilo, 1,000} {M, mega, 1,000,000} {G, giga, 10^9} {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

Process ← "supply side" ←	FOCUS Drivers	→ Product Performance → "demand side"
Clean Operations: More radical restructuring of processes "new, green, clean", often cooperating with others in the supply chain.	(CHANGE → Radical)	**Product–Service Innovation:** Fundamental redesign of the product and service combination of a business or its suppliers to reduce life–cycle impacts.
Waste Minimisation: Traditional in-process housekeeping, including Lean, to improve conversion of input to outputs within current production system.	(Incremental ← CHANGE)	**Green Products:** Redesign, eco–design, light–weighting of products to reduce impact in manufacture, distribution, use or end–of–life by businesses or consumers.

Source: Oakdene Hollins/Brook Lyndhurst

1   Scope and Purpose

This report summarises the main metrics that have been used to quantify waste prevention in the studies reviewed in WR1403 (see Section 2 for an overview of the study methodology). The purpose of this metrics report is to supplement and commentate on the metrics used for waste prevention, over time and by different audiences.

This report is not intended to be a comprehensive review of metrics either for resource efficiency in general or waste prevention in particular. This is a broad topic area of concern to many stakeholders which must reflect a balance of priorities – activities, outputs and outcomes – that are not within scope of this evidence review. The analysis here is intended to show what metrics have been used by which agents over time and infer some general conclusions.

As the WR1403 review has sought out evidence for waste prevention, a couple of topics that one might expect to be included within a report assessing the metrics for waste prevention have become apparent:

1.   Benchmarking indices that are being developed by the Environment Agency (EA) as part of its Resource Efficiency Appraisal and Development (READ) toolkit[a]:

   - EA's Resource Efficiency Management Index (REMI) is a confidential and voluntary tool which assesses a company's management approach to resource use using an interactive questionnaire to generate a profile of the business and give feedback and guidance on priority areas for the business to improve its approach and save significant amounts of money.

   - EA's Resource Efficiency Physical Index (REPI) tool is designed for regulated businesses which hold an Environmental Permitting Regulations A1 permit. It measures physical (or quantitative) performance for raw material, energy and water consumption; and waste production. Provided in questionnaire format, REPI will allow businesses to benchmark themselves against other businesses and sectors. It will also provide year-on-year trend analysis and a review of efficiencies to be achieved.

   The intention of READ is for EA and Defra to use the collective data to analyse trends and help industry improve resource efficiency throughout England and Wales. Annual reports will be published on the EA website. Evidence for READ is not yet available however and has therefore not been included in this metrics report.

2.   The ongoing work on how to measure waste prevention at a 'macro' level; that is at a national or sector level. This is necessary in order to judge the progress being achieved. Current indicators that address recycling and landfill diversion do not provide sufficient basis for evaluating waste prevention efforts at a national or sector level, neither do they provide a foundation for establishing quantifiable and measurable waste prevention targets (1). Recommendations from an OECD workshop on the subject concluded that using the Pressure-State-Response model and Material Flow Accounting provide a suitable means from which to develop waste prevention indicators (1). A further point on this relates to the need to index waste arisings data to some measure of economic activity (such as gross value added), in order to distinguish between improvements with regards to waste prevention activity as opposed to a decline in economic activity[b]. Work is ongoing at an EU level with the Joint Research Centre issuing a draft for public on "Decoupling indicators, Basket-of-products indicators, and Waste management indicators".[c]

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[a] See http://www.environment-agency.gov.uk/business/topics/performance/110996.aspx for further details [accessed 22/12/2010]

[b] Oakdene Hollins for Defra (2010), "Further Benefits of Business Resource Efficiency", [forthcoming]

[c] See http://lct.jrc.ec.europa.eu/pdf-directory/Indicators-framework-for-public-consultation-16082010.pdf [accessed 22/12/2010]

Some limitations and caveats to the study methodology that are of relevance to this metrics report have become apparent:

- **Scope:** At Defra's request, waste prevention has been treated with a relatively strict adherence to the Waste Framework Directive intent. This is has ruled the activities and practices of many companies, trade organisations and public bodies out of scope because of their focus on landfill diversion.
- **Time constraints in sourcing:** Limited time available to complete this project means that some relevant sources may have been missed.
- **Self-selected reporting:** The evidence found may to some extent have been self-selected, due to the emphasis placed by agencies charged with assisting businesses on promoting positive outcomes; on the other hand, there are limited benefits to companies to report benefits of internal, voluntary initiatives.
- **Disaggregation of waste prevention:** Waste prevention is seldom reported as a stand-alone but is often aggregated in a range of other waste or materials activities. Quantifying benefits and linking them to specific actions is therefore difficult.
- **Language shifts:** The language of businesses, public sector agents, consultancies, NGOs and activities has diverged over time making it hard to compare activities and results.
- **UK-centric nature of the evidence:** The search was conducted primarily in English language. As a result sources from UK, Commonwealth, US and the EU featured heavily, although with native German speakers on the team, an equivalent German keyword search was conducted in parallel.

2 Methodology Used for Mapping the Metrics

This report concerns the metrics that have been used to quantify waste preventions which have been used by different programmes and studies with evolution over time and audience. It assesses the metrics used within studies that addressed measuring waste prevention at a 'micro' level; that is: what was the effect of a particular programme or case study?

Within this report a two step process was taken to map the metrics used to measure waste prevention:
1. Create a list of the significant reports written on waste prevention.
2. Record the metrics used and the order in which they appear in the report or results table.

2.1 Significant Reports

There were two parts of the methodology of creating the list of significant reports:

a. Review reports that had been explicitly tagged as being relevant to the topic of metrics.
b. Generate a reading list of other noteworthy reports from the literature review.

The criteria that the significant reports had to meet were the following:

- contain evidence of what metrics were use d for a particular action or programme
- be of a sizeable length, i.e. 10 pages or longer
- provide a good level of detail on the organisation and nature of the action or programme
- not just be case study material.

For the first part of the methodology, we considered only reports dealing with metrics assessed as 'good' or 'excellent'[a], which yielded 24 (49%). This was winnowed down to 17 by removing very short reports, those only containing case study data and reports concerned with potential rather than actual benefits including policy impact assessments. Table 1 provides details on the title, author and year of these 17 reports.

In the second stage, we conducted a quick check across the abstract database to ensure that potentially useful reports (which might have been incorrectly classified) were not missed. A further 15 reports were added in the process. Table 2 provides details on the title, author and year of these 15 reports.

The 'significant reports' list comes with a caveat. We have taken care to make this as objective as possible and to ensure that all the major policy programmes and bodies are represented e.g. Defra, WRAP, BERR/BIS, EPA, RDAs and Trade Associations as well as academic literature. The significant reports are typical of the broad body of evidence reviewed in this study. The evidence found may to some extent have been self-selected, due in part to the emphasis placed by agencies charged with assisting businesses on promoting positive outcomes (see Sections 1 and 2 for more details). A couple of authors (Paul Phillips from University of Northampton and consultants Oakdene Hollins) featured relatively prominently in the significant reports list. Possible reasons are:

- relative abundance of published relevant material produced on waste prevention
- ease of accessibility of the material to the researchers: Oakdene Hollins' archive was available for searching and Paul Phillips's articles were publicly available from academic journals; whereas other sources were not widely available i.e. not public or removed from websites.

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[a] 10 reports had been retained and tagged as metrics with an evidence quality of poor or none, but these did not contain any useful information on metrics

Table 1: Significant assessments collated from literature tagged as metrics

Ref ID	Document title	Author/Client	Year
(2)	Milton Keynes-Waste Reduction in Industry	EB Milton Keynes	2002
(3)	Profiting from waste reduction in retail stores	Envirowise	2002
(4)	Aylesbury Vale Waste Reduction in Industry-Final Report	EB Bucks	2004
(5)	The value of resource efficiency in the food industry: a waste minimisation project in East Anglia, UK	Journal of Cleaner Production	2004
(6)	Packaging reduction saves money: industry examples	Envirowise	2004
(7)	The Application of Waste Minimisation to Business Management to Improve Environmental Performance in the Food and Drink Industry	Hertfordshire University	2005
(8)	Saving money and raw materials by reducing waste in construction: case studies	Envirowise	2005
(9)	Business Packaging Waste Prevention Project (2002 – 2005)	Oregon Dept. of Environmental Quality	2006
(10)	Building the future 2005-06 A survey on the arising and management of construction and demolition waste in Wales 2005-06	Environment Agency Wales	2006
(11)	Business Resource Efficiency and Waste (BREW) Programme Metrics Results for 2005/06	Defra	2008
(12)	Business Resource Efficiency and Waste (BREW) Programme Metrics Results for 2006/07	Defra	2008
(13)	Resource efficiency - Business benefits from sustainable resource management	EEF	2009
(14)	Sustainability in Practice	British Soft Drinks Association	2009
(15)	Potential For Resource Efficiency Savings For Businesses	BIS	2010
(16)	Reducing the impact of business waste through the Business Resource Efficiency and Waste Programme	NAO	2010
(17)	Courtauld Commitment –A Little History...	WRAP	2010
(18)	An Economic, Environmental and Strategic Impact Evaluation of Envision	Ekosgen	2010

Table 2: Significant assessments collated from wider WR1403 literature

Ref ID	Document title	Author/Client	Year
(19)	Waste prevention pays off companies cut waste in the workplace	United States EPA	1993
(20)	UK waste minimisation clubs: a contribution to sustainable waste management	Resources, Conservation and Recycling	1999
(21)	The role and success of UK waste minimisation clubs in the correction of market and information failures	Resources, Conservation and Recycling	2000
(22)	The Bedfordshire Waste Reduction in Industry Project	EB Bedfordshire	2002
(23)	Corby Waste Not: an appraisal of the UK's largest holistic waste minimisation project	Resources, Conservation and Recycling	2002
(24)	Third generation waste minimisation clubs: a case study of low cost clubs from Northamptonshire, UK	Resources, Conservation and Recycling	2002
(25)	Remanufacturing in the UK; A Significant Contributor to Sustainable Development?	Biffaward, SEEDA	2003
(26)	Unpublished Internal impact assessment of the Envirowise Programme in 2005	Envirowise/WRAP	2005
(27)	A radical new proposal for delivering and financing waste minimisation clubs in England, due to the loss of landfill tax credit scheme funding	Resources, Conservation and Recycling	2006
(28)	Evaluation of the ENWORKS NW Minimisation Project: A Final Report to NWDA	NWDA	2008
(29)	Co-ordinator's Report on the SustainableTechnologies Initiative	BERR	2008
(30)	Unpublished internal evaluation of the BREW Programme 2005-2008	South West RDA	2008
(31)	Unpublished internal evaluation of the Envirowise Resource Efficiency Clubs Programme April 2005 – March 2008	Envirowise/WRAP	2008
(32)	Remanufacturing in the UK: A snapshot of the remanufacturing industry in the UK in 2009	Centre for Remanufacturing and Reuse	2009
(33)	Practical Resource Efficiency Savings – Case Studies	BIS	2009

In addition, we have used only the metrics that are of relevance to waste prevention as defined in this study; metrics such as water savings and waste diverted from landfill, for example, are excluded. This may be unfair to programmes that had other – possibly mixed – objectives than that of waste prevention alone. Similarly, for some of these metrics used in broader resource efficiency programmes, not all of the outcomes can be attributed to waste prevention activities; again, the reports do not generally present the results to enable us to unpick the different effects.

2.2 Recorded Metrics

The second step in the methodology was to record the metrics used and in the order in which they appeared in the report or results table.

In order to have a manageable number of different metrics, we grouped together broadly similar types. For example:

- Cost savings to business, reduction in input costs, annual financial savings etc were grouped together as financial savings on the basis that they all represented cost reductions.
- Additional sales, value added, turnover generated were grouped together on the basis that they all related to revenue and economic activity accruing to the business.
- Virgin raw material saved, increased material efficiency, waste savings etc were grouped together as material / waste reduction on the basis that they all were measured in tonnes and were conceptually very similar, albeit that they used differing terminology.

The full list of metrics recorded is listed in Table 3. It is clear that a variety of financial and environmental measures have been used. Additionally some other types of metrics have been used, notably those relating to employment. Although we have grouped some of the metrics, we are aware that the assumptions and methods used to calculate them may not be consistent between the types themselves or different programmes. This topic is discussed further in Section 4 of the report.

Table 3: List of metrics recorded

Financial Metrics	Environmental Metrics	Other Metrics
Financial Savings (£)	Material / Waste Reduction (t)	Number of Employees Trained
Sales, Value Added, Turnover (£)	Hazardous Waste Reduction (t)	Jobs Created & Saved
Social Savings (£)	Carbon (tCO_2e)	Holistic Score (%)
Payments to the Project (£)		
Payback Period (years)		

3 Results of Mapping Exercise

3.1 Overall Results

The results of the simple mapping exercise are shown in full in **Appendix L2m7-A: Metrics Used in Significant Reviews**, but are summarised below. Table 4 presents the list of metrics which have been used in the 32 reports.

The most popular by far are financial savings, which was included in 29 of the reports (91%), and material / waste reduction, which was included in 26 of the reports (81%). Other widely used metrics included carbon savings, sales / value added / turnover and hazardous waste reduction; although all of these metrics were used in fewer than half of the reports.

On average, each report included just over three metrics. A number of patterns are evident in the results, notably in relation to which audience the report was targeting and according to the year of publication. These are discussed below in Section 3.2.

Table 4: Occurrence of metrics used in the 32 significant reviews

Type	Number of reports used
Financial Savings (£)	29
Material / Waste Reduction (t)	26
Carbon (tCO$_2$e)	15
Sales, Value Added, Turnover (£)	9
Hazardous Waste Reduction (t)	7
Number of Employees Trained	5
Jobs Created & Saved	4
Payments to the Project (£)	2
Payback Period (years)	2
Holistic Score (%)	1
Social Savings (£)	1
Total	**101**

Figure 1 charts the frequencies of metrics which were first to be mentioned in a report. These results give some impression of the relative prominence that the authors gave the different metrics. The clear conclusion of this analysis is the dominance of reporting financial values as the primary metric. 72% of the reports choose to present a financial metric, be it financial savings, sales, value added or turnover; with financial (cost) savings the metric of choice for more than half of the reports. The only other metric reported more than once as the first metric was material / waste reduction (five times).

Figure 1: First metric mentioned in the 32 significant reports
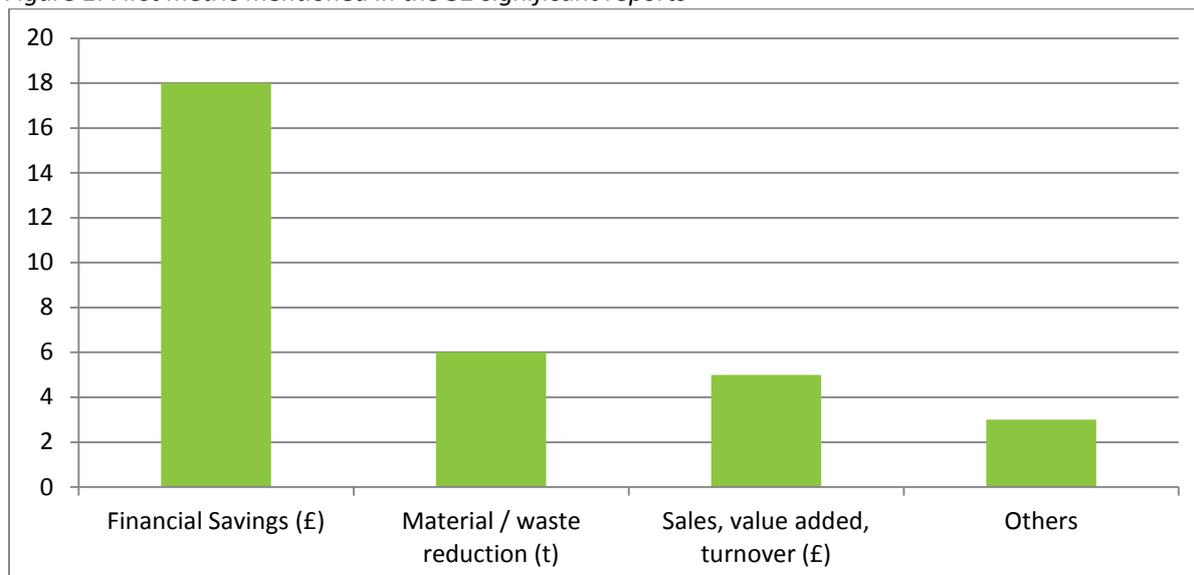
3.2   Patterns in Metrics

3.2.1   Audience

Not surprisingly, the choice of metrics has reflected the intended audience for the final report; this is expected given that this is often the organisation that is sponsoring the work or the report. The choice of metrics is also usually governed by how the report will be used e.g. to guide policy, promote regional development or attract business involvement. As such, we saw four main audience groups:

- policy
- regional
- academic
- business.

Policy-focussed audiences are typically government departments such as Defra, BERR/BIS and the National Audit Office (NAO). Most reports for this audience used around five metrics including financial savings, carbon savings, material / waste reduction, sales / value added / turnover and hazardous waste reduction. Hazardous waste reduction is prominent for this audience: In comparison, almost none of the reports for other audiences report on this metric. The reason for such a wide range of metrics could be the need to address multiple stakeholders. Notably, though, most of these reports are published more recently (see Section 3.2.2).

Regional audiences such as RDAs and local initiatives include - on average - fewer metrics than the policy audiences: generally four or fewer. Material / waste reduction and financial metrics are the most common, but the number of employees trained, jobs created or saved, and payments into the project are prominent.

Reports published in journals or by universities for academic audiences include either two or three metrics. All of them included financial savings, and most also included material / waste reductions. Authors occasionally added their own metric such as a holistic measure of the scheme (social progress, prudent use of resources and maintenance of high and stable levels of economic growth and employment) (23) or an estimate of the social savings generated (27).

Business-focussed audiences include industry trade associations and arms-length delivery bodies such as Envirowise and WRAP. Here, studies include the fewest number of metrics with - on average - two indicators included: usually financial savings and material / waste reductions. This may reflect a desire to minimise the cost associated for businesses in measuring the metrics.

Figure 2 summarises the results of the mapping exercise amongst the four target audience groups, showing the average number of metrics included by each. As discussed above, policy-focussed audiences have the greatest number of metrics, with business-focussed audiences having the fewest.

Figure 2: Average number of metrics included by the four audience groups
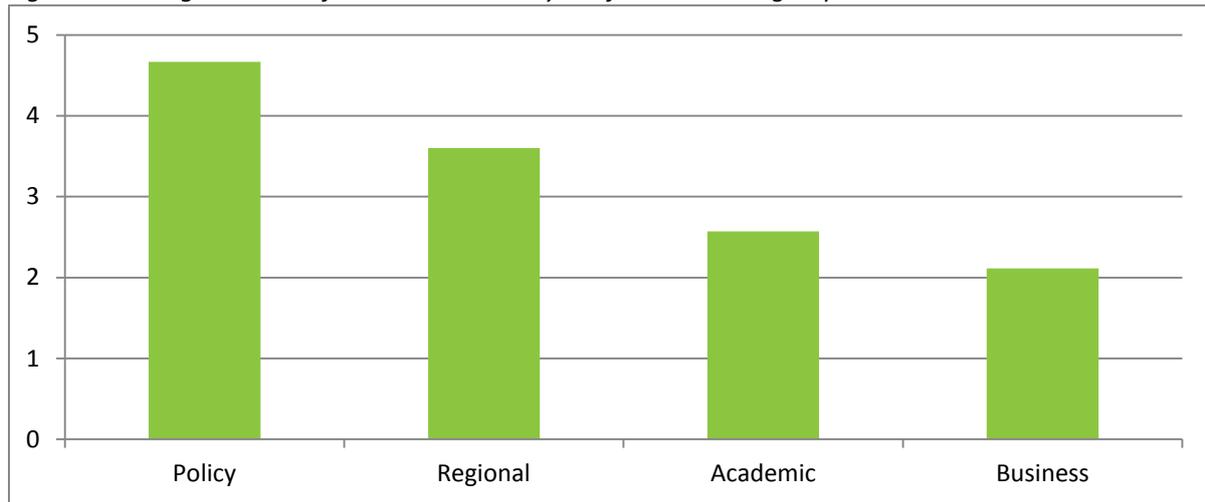
Source: Oakdene Hollins/Brook Lyndhurst

3.2.2 Changes over time

A number of patterns emerge in the choice of metrics over time. The most obvious trend is in the number of metrics included, with earlier studies selecting both fewer measures than later studies, and having less complexity in terms of, for example, projections of future benefits.

We can see this by splitting the significant reports into those published up to 2006 (18 reports) and those published from 2008 onwards (14 reports). This is a sensible temporal break to make, as we included no reports from 2007.

- The earlier studies include typically two or three measures (almost always financial saving and material / waste reduction). The additional metrics tend to reflect the sponsor interests, as described above.
- The later reports include around four measures on average. As with the earlier reports, financial saving and material / waste reduction are almost always included, but notably carbon[a] has now become as important. Other notable metrics in the later reports are sales / value added / turnover and hazardous waste reduction.

This analysis is summarised in Figure 3, which compares the percentage of reports including specific metrics before and after the 2007 temporal break. As noted above carbon metrics have become as important as financial savings and material / waste reduction after 2007; with sales / value added / turnover and hazardous waste reduction also gaining prominence.

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[a] Or CO_2 or CO_2e

Figure 3: A comparison of the metrics included before and after 2007 (% of reviews that include metric)
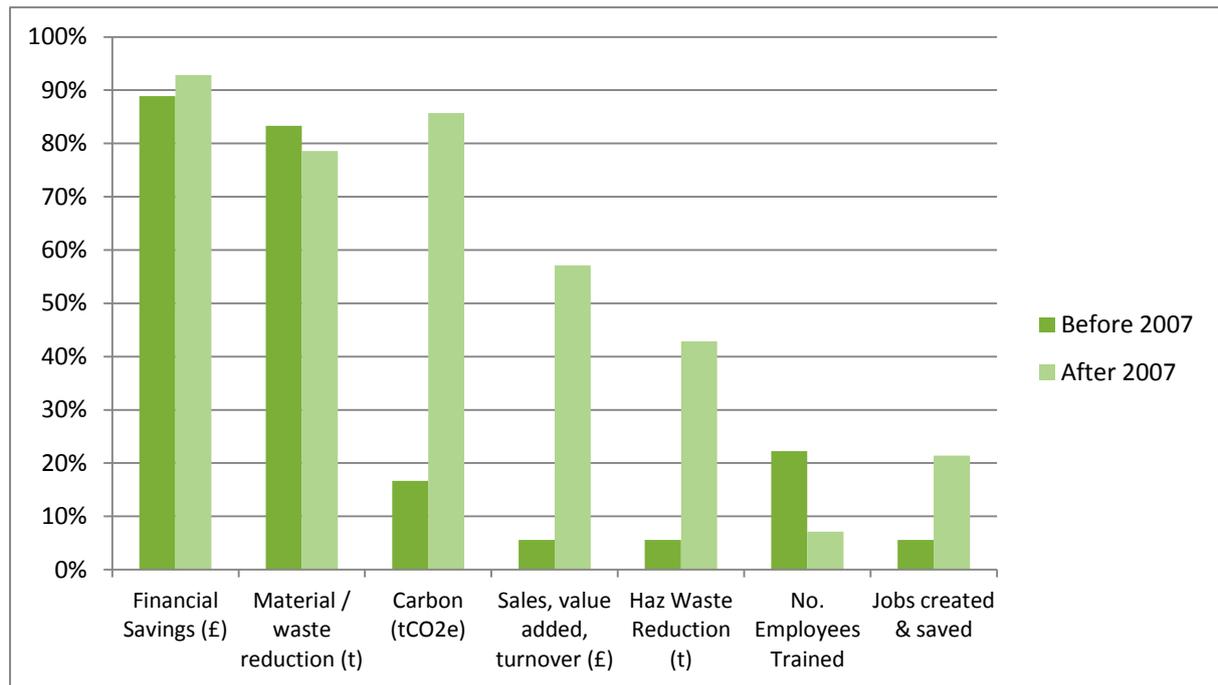
Source: Oakdene Hollins/Brook Lyndhurst

4 Developing Best Practice in Waste Prevention Metrics

The subject of metrics shows a number of recurrent issues. These are discussed in turn below and can offer some guidance in developing best practice.

4.1 *Attribution*

The first issue concerns the level of attribution that has been applied to the waste prevention savings reported. By attribution we mean how much of any benefit could be ascribed to the actions of the assisting organisations. Two key questions are of particular relevance here:

1. What level of implementation was achieved?
2. To what extent would these implementations have happened anyway?

In general the degree of attribution that has been applied is not clear, nor is there any consideration of whether the implementations would have occurred in the absence of interventions (16), although two reports, below, clearly report the attribution made and the methodology underpinning it. On attribution, Defra suggests that (11; 12):

- Attribution should not be attempted where savings measures are only identified, not implemented, or where diffuse activities are taking place.
- Where savings measures are being implemented, businesses should be asked to allocate a proportion of savings to be attributed to delivery body activities.
- Part of the attribution survey of businesses should identify whether the business was working with other delivery bodies on the same project in order to minimise the risk of double counting the benefits.

An impact assessment of Envirowise in 2005 (26) considered:

- The level of implementation that had occurred of the savings opportunities identified (this was 53% of the sites visited in 2005).
- The extent to which the savings were achieved as a result of Envirowise, as reported by the companies' view on the importance of Envirowise in implementation (attributing 100% if they could not have implemented the measure without Envirowise help, 50% if Envirowise provided some guidance, 25% if Envirowise helped confirm them that it was the right thing to do or signposted them to useful sources and 0% is Envirowise had not been used or did not help the savings).

Another report that seriously addressed attribution was by Ekosgen on the impact of the Envision programme (18), which considered:

- how likely a company was to have undertaken the approaches without Envision (attributing 100% if very unlikely and 75% if quite unlikely etc.)
- the timescale in which a company was likely to have implemented without Envision (if within a year then 0.5 year's savings computed, if 1-2 years then 1.5 years' computed and if more than 2 years then 100% attributed to Envision).

4.2   *Persistence*

The second issue of persistence concerns how to measure the level of continuing benefit from delivery body interventions in future years. On persistence Defra suggests (11; 12):

- If a persistence figure is provided by a participating organisation, that should be used i.e. the programme evidence defines the persistence methodology.
- Otherwise there should be a default figure if persistence cannot be estimated or no evidence exists (i.e. where the benefit declines to zero over five years). This is intermediate between the benefit persisting infinitely and the benefit being estimated for the first year only.
- For particular sectors, retrospective sectoral surveys could establish the degree of spill-over benefit from demonstration projects or other interventions.

4.3   *Ease of Comparison*

Although this evidence review is not concerned with evaluating value for money of different waste prevention activities, this is an important policy concern which deserves some discussion. Debate about the relative importance of different metrics (where different or multiple metrics have been included) or whether such a comparison is actually appropriate, for example where interventions have very different target sectors or types of companies (24) is inevitable. However if a comparison must be made between initiatives, then having common metrics that have been calculated using equivalent assumptions and methodologies clearly aids this process. Here, the results obtained in Section 3 do indicate a high degree of use of common metrics (financial savings and material / waste reduction in particular), but the equivalence of assumptions and methodologies for calculating the metrics warrants further discussion.

For the BREW programme, for example, data are available on the key performance indicators to assess the performance of the individual initiatives. However, the NAO noted that the data were captured and reported by the different delivery bodies, but they were of uncertain comparability (16). Defra expands this point further stating that the degree of consistency of reporting between delivery bodies has improved following the introduction of the BREW metrics, particularly in the aspect of consistency of attribution (11; 12). Peer-reviewing of a project's outputs, as opposed to simple self-reporting, offers greater potential for ensuring that an appropriate approach and methodology has been used for the calculation of metrics. Examples of studies that have been reviewed by an external body include Enworks by SQW Consulting (28) and Envision by Ekosgen. Ekosgen is noteworthy because it developed a database system that made it easy to track and audit resource efficiency savings throughout a project (18).

There is a number of useful comparative studies in this area. For example, Professor Paul Phillips at the University of Northampton has compared the effectiveness of Waste Minimisation Clubs (WMCs) (21; 34; 27). Typically these data have been used to determine a 'league table' of WMCs, ranking each Club according the financial savings per unit cost, or alternatively by the number of opportunities per Club, volumes or the payback periods. Similarly the BREW metrics can be used to compare the effectiveness of the individual initiatives, although this is complicated by the often mixed objectives in programmes (11; 12).

4.4   Credibility with Business

There also appears to be a credibility gap between the audiences and organisations involved in running waste prevention programmes and the businesses implementing them, notably for waste minimisation clubs in particular. Evidence for this includes:

- difficulties in recruiting participating companies for WMC (24)
- low take-up in the suggested interventions, suggesting not all are worthwhile (18) (30)
- declining demand for the waste minimisation services over time (18).

There may be many reasons for the above, including business attitudes and behaviour (see module **L2m3: Attitudes & Behaviours**); however, some lessons are important for metrics:

- The large choice of metrics can be an issue, especially where a focus is on the environmental rather than business metrics: Keeping metrics simple and relevant for the business audience is important (4).
- The way in which the financial savings are calculated in the studies does not reflect that used by business technologists and accountants e.g. persistence (18): Ideally the financial values should be those recognised day-to-day by business and with transparent methodologies used to calculate them (4; 22; 2).
- Some of the metrics used are based on generic savings achieved by similar businesses, which may not be appropriate for the specific business in question (3).

5 Conclusions and Implications

5.1 Mapping the Metrics used for Waste Prevention

The following conclusions can be drawn from the mapping exercise:

- A wide range of metrics has been used to measure waste prevention, but **by far the most common metrics are financial savings** (which is also most likely to be reported first) and **material / waste reduction**.

- The metrics used has varied considerably by audience:
  - Policy audiences have the most metrics and they are the main audience interested in hazardous waste reduction.
  - Regional audiences have particular interests in jobs created and saved, number of employees trained and payments made into the project.
  - Academic audiences limit the metrics used to two or three, and may develop their own metric.
  - Business audiences have the fewest metrics and tend to focus only on financial savings and material / waste reduction.

- **The metrics used have changed over time**, becoming more complex and latterly including carbon savings as a priority alongside financial savings and material / waste reductions.

5.2 Learning

The evidence suggests a number of learning points regarding best practice in measuring waste prevention:

- **Ensure that savings are attributed** according to whether savings were implemented and the extent to which the initiative was responsible.

- **Ensure ease of comparison** by developing common metrics and following common assumptions and methodologies for calculating them. Peer-reviewing may aid this process.

- **Ensure that metrics are credible** to business by keeping them appropriate and simple, and by reporting the financial impacts that are observed by business.

Historically, metrics have sought to link waste prevention with waste disposal costs and subsequently to avoidance of raw material costs. Of late, the introduction of carbon metrics offers a route to link virgin materials to embodied carbon to Carbon Reduction Commitments / Scope 3 costs, especially for larger business which are obliged to report on them. This would link waste prevention to an existing incentive mechanism, integrate it within wider resource efficiency policy and align it with competing business pressures; legislative, economic and social.

6   Bibliography

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Appendix L2m7-A: Metrics Used in Significant Reviews

Figure 4: Metrics Used in Significant Reviews (date order)

Ref ID	Document title	Author/Client	Year	Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6
(19)	Waste prevention pays off companies cut waste in the workplace	United States EPA	1993	Financial savings (£)					
(20)	UK waste minimisation clubs: a contribution to sustainable waste management	Resources, Conservation and Recycling	1999	Financial savings (£)	Material / waste reduction (t)				
(21)	The role and success of UK waste minimisation clubs in the correction of market and information failures	Resources, Conservation and Recycling	2000	Financial savings (£)	Material / waste reduction (t)	Carbon (tCO$_2$e)			
(22)	The Bedfordshire Waste Reduction in Industry Project	EB Bedfordshire	2002	Financial savings (£)	No. emps trained	Material / waste reduction (t)			
(2)	Milton Keynes-Waste Reduction in Industry	EB Milton Keynes	2002	Financial savings (£)	Payments to the project (£)	Material / waste reduction (t)	No. emps trained		
(23)	Corby Waste Not: an appraisal of the UK's largest holistic waste minimisation project	Resources, Conservation and Recycling	2002	Holistic score (%)	Material / waste reduction (t)	Financial savings (£)			
(24)	Third generation waste minimisation clubs: a case study of low cost clubs from Northamptonshire, UK	Resources, Conservation and Recycling	2002	Financial savings (£)	No. emps trained				
(3)	Profiting from waste reduction in retail stores	Envirowise	2002	Financial savings (£)	Material / waste reduction (t)				
(25)	Remanufacturing in the UK; A Significant Contributor to Sustainable Development?	Biffaward, SEEDA	2003	Sales, value added, turnover (£)	Material / waste reduction (t)	Carbon (tCO$_2$e)	Jobs created & saved		
(4)	Aylesbury Vale Waste Reduction in Industry-Final Report	EB Bucks	2004	Financial savings (£)	Payments to the project (£)	No. emps trained	Material / waste reduction (t)		
(5)	The value of resource efficiency in the food industry: a waste minimisation project in East Anglia, UK	Journal of Cleaner Production	2004	Financial savings (£)	Material / waste reduction (t)	Carbon (tCO$_2$e)			
(6)	Packaging reduction saves money: industry examples	Envirowise	2004	Financial savings (£)	Material / waste reduction (t)				
(7)	The Application of Waste Minimisation to Business Management to Improve Environmental Performance in the Food and Drink Industry	Hertfordshire University	2005	Material / waste reduction (t)	Financial savings (£)				
(8)	Saving money and raw materials by reducing waste in construction: case studies	Envirowise	2005	Material / waste reduction (t)	Financial savings (£)				

Ref ID	Document title	Author/Client	Year	Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6
(26)	Unpublished internal Impact Assessment of the Envirowise programme in 2005	Envirowise/ WRAP	2005	Financial savings (£)	Material / waste reduction (t)	Haz waste reduction (t)			
(27)	A radical new proposal for delivering and financing waste minimisation clubs in England, due to the loss of landfill tax credit scheme funding	Resources, Conservation and Recycling	2006	Financial savings (£)	Social savings (£)	Payback Period (years)			
(9)	Business Packaging Waste Prevention Project (2002 – 2005)	Oregon Dept. of Environmental Quality	2006	Financial savings (£)	Material / waste reduction (t)				
(10)	Building the future 2005-06 A survey on the arising and management of construction and demolition waste in Wales 2005-06	Environment Agency Wales	2006	Material / waste reduction (t)					
(11)	Business Resource Efficiency and Waste (BREW) Programme Metrics Results for 2005/06	Defra	2008	Sales, value added, turnover (£)	Financial savings (£)	Material / waste reduction (t)	Carbon (tCO2e)	Haz waste reduction (t)	
(12)	Business Resource Efficiency and Waste (BREW) Programme Metrics Results for 2006/07	Defra	2008	Sales, value added, turnover (£)	Financial savings (£)	Material / waste reduction (t)	Carbon (tCO_2e)	Haz waste reduction (t)	
(28)	Evaluation of the ENWORKS NW Minimisation Project: A Final Report to NWDA	NWDA	2008	Jobs created & saved	No. emps trained	Financial savings (£)	Carbon (tCO_2e)	Material / waste reduction (t)	
(29)	Co-ordinator's Report on the SustainableTechnologies Initiative	BERR	2008	Material / waste reduction (t)	Carbon (tCO_2e)	Haz waste reduction (t)	Financial savings (£)	Sales, value added, turnover (£)	
(30)	Unpublished internal evaluation of the Business Resource Efficiency and Waste (BREW) Programme 2005 - 2008	South West RDA	2008	Carbon (tCO_2e)	Material / waste reduction (t)	Haz waste reduction (t)	Financial savings (£)	Sales, value added, turnover (£)	Jobs created & saved
(31)	Unpublished internal evaluation of Resource Efficiency Clubs Programme April 2005 – March 2008	Envirowise/ WRAP	2008	Financial savings (£)					
(32)	Remanufacturing in the UK: A snapshot of the remanufacturing industry in the UK in 2009	Centre for Remanufacturing and Reuse	2009	Sales, value added, turnover (£)	Carbon (tCO_2e)	Material / waste reduction (t)	Jobs created & saved		
(33)	Practical Resource Efficiency Savings – Case Studies	BIS	2009	Financial savings (£)	Material / waste reduction (t)	Carbon (tCO_2e)	Haz waste reduction (t)	Sales, value added, turnover (£)	
(13)	Resource efficiency - Business benefits from sustainable resource management	EEF	2009	Financial savings (£)	Material / waste reduction (t)				
(14)	Sustainability in Practice	British Soft Drinks Association	2009	Material / waste reduction (t)	Financial savings (£)	Carbon (tCO_2e)			
(15)	Potential For Resource Efficiency Savings For Businesses	BIS	2010	Financial savings (£)	Payback Period (years)	Carbon (tCO_2e)			

Ref ID	Document title	Author/Client	Year	Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6
(16)	Reducing the impact of business waste through the Business Resource Efficiency and Waste Programme	NAO	2010	Sales, value added, turnover (£)	Financial savings (£)	Material / waste reduction (t)	Haz waste reduction (t)	Carbon (tCO$_2$e)	
(17)	Courtauld Commitment –A Little History...	WRAP	2010	Material / waste reduction (t)	Financial savings (£)	Carbon (tCO$_2$e)			
(18)	An Economic, Environmental and Strategic Impact Evaluation of Envision	Ekosgen	2010	Financial savings (£)	Carbon (tCO$_2$e)	Sales, value added, turnover (£)			

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