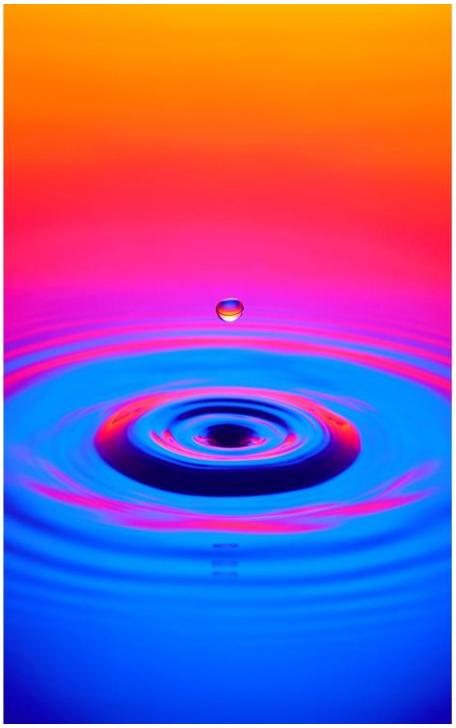
European Commission

Annexes of the Final Report

The opportunities to business of improving resource efficiency

Final report relating to contract n^{o} 070307/2011/610181/ETU/F.1


AMEC Environment & Infrastructure UK Limited and Bio Intelligence Service

February 2013

Third-Party Disclaimer

Acknowledgements

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Document Revisions

No.	Details	Date
1	Draft Final Report Annexes	15 December 2012
2	Final Report Annexes	8 February 2013

European Commission

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The opportunities to business of improving resource efficiency

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AMEC Environment & Infrastructure UK Limited & Bio Intelligence Service S.A.S

February 2013

Report for

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Annex A: Factsheets of selected information-based initiatives promoting resource efficiency

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1 EU Eco-Management and Audit Scheme (EMAS)

Name	Eco-Management and Audit Scheme (EMAS)
Organisation	European Commission together with Competent Bodies in EU Member States
Year	1995, ongoing
Location	EU plus Iceland, Lichtenstein and Norway and EU Accession Countries
Type of information provision policy	Under EMAS information is provided through various ways such as - websites – a central website has been set at the EU level and each MS + Norway has set up a national website to provide information mainly on aspects related to the registration to the scheme. - organisation of events, conferences and seminars in several Member States. - a Helpdesk has been also set up to handle complex enquires. For information regarding specific countries, specific competent bodies have been allocated in each Member State. - training materials - organisation of annual EMAS awards In addition the initiative also aims to increase its visibility through the following: - a single EMAS logo to communicate EMAS in one coherent and distinctive way - development of EMAS Global to encourage the global uptake of the scheme by making EMAS certification possible for organisations and sites located outside the EU Community - undertaking informational and promotional activities of EU Member States and European Commission to support EMAS III - ensuring recognition of other EMS to facilitate upgrade from existing EMS to EMAS In addition under the latest revision of the scheme which was carried out in 2009 (EMAS III), the scheme also: - follows a cluster approach to provide specific assistance to clusters of organisations in the development and implementation phases of EMAS registration - provides environmental core indicators to adequately document environmental performance and create multi-annual comparability within and between organisations - provides sectoral reference documents to facilitate the practical implementation 'on the ground' of EMAS requirements
Funding	The precise budget of EMAS is difficult to establish as it involves many organisations (including Member State public administrations). Main components: • Development of the scheme (European Commission staff, Regulatory Committee and studies) • Handling applications (national competent bodies) • Verification? • Communication and support (incl. helpdesks) • Financial support **The costs of EMAS for organisations** Depends on the size of the company, type of company and which region. Three categories of costs: • Fixed costs: o Validation and verification fees o Registration fees (0 - €1500) o Capital IT system costs o Costs of adding EMAS logo and producing publicity material o Capital expenditure • External costs o External consultant • Internal costs (costs to implement the scheme vary from a few person months to several persons

<table>
<tr><td></td><td>per year – costs in subsequent years are on average half of the first year)
o Environment review
o Development of EMS
o Internal audit
o Preparation of EMAS statement
o Internal staff training
o Modifications to IT systems
o Publication of environmental statement
o Other administrative related costs
Estimated average costs €48 000 the first year, €26 000 annually for subsequent years (IEFE, 2005).</td></tr>
<tr><td>Scope</td><td>Originally the scheme was restricted to companies in the industrial sector. Since 2001 EMAS has been open to all economic sectors including public and private services.

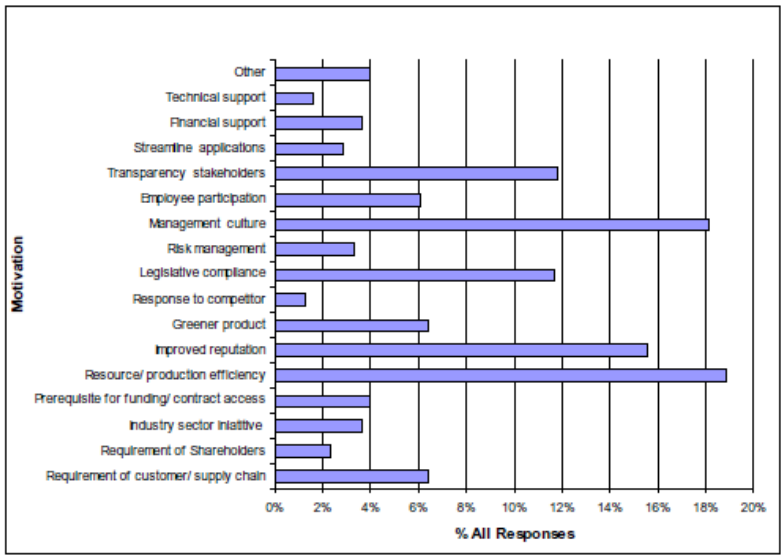
Under the most recent EMAS III, Sectoral reference documents are developed to facilitate the practical implementation 'on the ground' of EMAS requirements.

EMAS proposes six environmental core indicators:
1. energy efficiency (total direct energy use & total renewable energy use)
2. material efficiency (annual mass flow of different materials used)
3. water (total annual water consumption)
4. waste (total annual generation of (hazardous) waste)
5. biodiversity (the use of land)
6. emissions (total annual emissions of greenhouse gases)

EMAS promotes the participation of all employees as mean of a better implementation of the environmental management system.

<table><tr><th>EMAS organisation type (30 March 2012)</th><th>Share</th></tr><tr><td>Micro</td><td>23%</td></tr><tr><td>Small</td><td>33%</td></tr><tr><td>Medium</td><td>26%</td></tr><tr><td>Large</td><td>18%</td></tr></table></td></tr>
<tr><td>Objectives</td><td>The overall objective of EMAS is the promotion of sustainable production and consumption patterns, by providing a framework for the effective management of environmental impacts and for continuous improvement in the environmental performance of all organisations (small or large, from the private or public sector) in Europe, above and beyond compliance with environmental legislation as a minimum.
EMAS is a voluntary tool available for any kind of organisation aiming to:
- Improve its environmental and financial performance;
- Communicate its environmental achievements to stakeholders and society in general.</td></tr>
<tr><td>Type of behavioural change expected</td><td>Compliance with an environmental management system standard (i.e. ISO 14001), which requires third party verification as well as obligations to report results publicly.
To receive EMAS registration an organisation must comply with the following steps:
1. conduct an environmental review considering all environmental aspects of the organisation’s activities, products and services, methods to assess these, relevant legal and regulatory framework and existing environmental management practices and procedures.
2. adopt an environmental policy containing commitment both to comply with all relevant environmental legislation and to achieve continuous improvements in environmental performance.
3. develop an environmental programme that contains information on specific environmental objectives and targets. The environmental programme is a tool to help the organisation in its everyday work when planning and implementing the improvements.
4. based on the results of the review, establish an effective environmental management system (EMS) aimed at achieving the organisation’s environmental policy and at improving the environmental performance continually. The management system needs to set responsibilities, means to achieve objectives, operational procedures, training needs, monitoring and communication systems.
5. carry out an environmental audit assessing in particular the management system in place and conformity with the organisation’s policy and programme as well as compliance with relevant environmental regulatory requirements.
6. provide an environmental statement of its environmental performance which lays down the results</td></tr>
</table>

	achieved against the environmental objectives and the future steps to be undertaken in order to continuously improve the organisation's environmental performance. The scheme provides a systematic, strategic and practical management approach to reducing both the consumption of resources and operating costs. In fact, the financial benefit cited most frequently by respondents of the 'Study on the Costs and Benefits of EMAS to Registered Organisations' (Milieu, 2009) was linked to reductions in energy use and to more efficient resource use. The study found evidence that annual energy savings alone exceeded the annual costs of maintaining EMAS. In order to increase its resource efficiency an organisation should integrate resource efficiency concerns into all EMAS implementation steps following the 'Plan-Do-Check-Act Cycle'.  EMAS involves several implementation steps that provide organisations with a systematic and comprehensive, yet practical, framework to measure evaluate and improve their environmental performance. For example, the six environmental core indicators focusing on resource efficiency help adequately document environmental performance and create multi-annual comparability within and between organisations. Since EMAS does not require organisations to improve all environmental aspects at once, it may be better to initially address those measures related to significant environmental impacts that promise the greatest success in increasing resource efficiency while ensuring the greatest return on investment. The focus on 'quick wins' (e.g. upgrading the lighting systems with more efficient bulbs and light sensors) is helpful to achieving the full commitment of top management and employees when implementing EMAS for the first time. However, since these resource efficiency 'quick wins' are unlikely to be repeated in subsequent years, it becomes crucial for an organisation to set up systematic learning processes in order to also reap the long term benefits of EMAS. Studies indicate that an organisation's turnover increased where EMAS has initiated learning effects. This can be achieved through the interaction of different organisational stakeholders. Resource efficiency and other environmental issues should thus be integrated into the entire value chain of an organisation.
Level(s) of organisational change expected	EMAS encourages all kinds of actions that improve resource efficiency: - Process or product improvement - Product or service redesign - Technology change - System design Through the collection of reliable data, EMAS helps measuring and analyzing input-output flows of resources in the production process in the environmental review, the most significant direct environmental aspects and impacts related to resource efficiency are identified by focusing on areas of high resource consumption ('hot spots'). The overall objectives of the environmental policy should address all significant environmental issues related to resource flows. For example, the main elements of the environmental policy could be to favour the reuse of materials before they enter the recycling process, or to raise awareness of resource efficiency issues among employees and customers. To some extent, the product dimension is already part of EMAS: the environmental management system influences product performance in other phases of the life-cycle and/or in the supply chain.

Expected results and impacts (quantitative and qualitative)	EMAS encourages the participation of employees in the initial environmental review and the subsequent EMAS implementation, since they have a good understanding of resource flows. This enables an organisation to identify specific actions needed to achieve the objectives and targets. Additionally, a suggestion system for employees or joint working groups often result in practical and innovative solutions to manage resource flows better at lower costs. Furthermore, employee training in resource efficiency matters and internal communication are vital to ensuring that management and employees actively support the organisation's resource efficiency goals and actions. Employees, however, are of course not the only stakeholders who can be involved in the process of improving an organisation's environmental performance. The graph below shows the Reasons for seeking EMAS Registration: 
Actual results [quantified]	Currently, more than 4,500 organisations and approximately 7,800 sites are EMAS registered. From the REMAS project (UK Environment Agency, 2006): • There is strong evidence that the adoption of an accredited certified EMS improves site environmental management activities. Overall environmental management is better under ISO14001 than under an informal system; which in turn is better than under no system at all. • There is evidence that overall site environmental management is better under EMAS than under ISO14001; driven largely by better performance in performance monitoring, documentation control and (self) reporting of environmental performance. • There is some evidence that improved site environmental management leads to lower average emission levels. However, the strength of the evidence differs significantly between receiving media, regions of Europe and sectors. • There is strong evidence that improved environmental management has an impact on the number of self recorded permit or licence breaches. The impact may be observed both positively (i.e. because it is reducing the number of breaches), or negatively (i.e. its increasing the number), and varies between regions and sectors. • The mix of positive and negative impacts for the two compliance indicators is consistent with the prediction that improved site environmental management results both in a reduction of the rate at which "non-compliance" incidents (such as permit breaches) occur, and in an improvement in the detection and reporting of incidents when they do occur. Where the scale of the first impact outweighs the second, the overall impact on the compliance indicator is positive. Where the reverse is true, the impact is negative. General figures to what extent EMAS improves the general environmental performance of organisations are difficult to give because: (1) performance improvement can be operationalised in different ways (often improvements on some indicators and worsening on others); (2) it is difficult to assess whether a change in performance is caused by EMAS or by other factors, and (3) the quantitative data of the environmental statements of EMAS organisations are difficult to compare due to the lack of harmonisation in reporting (different indicators, different reporting levels).

According to the EVER study (IEFE, 2005), 94% of the respondents in a survey stated to have experienced improvements in environmental performance over the recent years, especially in the areas of:

- resource and energy use (82% of the respondents)
- solid and hazardous waste (86% of the respondents)
- releases to water (67% of the respondents)
- emissions to air (65% of the respondents)
- incidents and accidents (76% of the respondents)

Comparison of Quantified Benefits of Energy and Resource Efficiency with Costs of EMAS (IEFE, 2005).

Organisation size	**Potential annual efficiency savings (€)**	**First year cost of EMAS (€)** [2]	**Annual cost of EMAS (€)** [2]
Micro	3,000 – 10,000[1]	22,500	10,000
Small	20,000 – 40,000	38,000	22,000
Medium	Up to 100,000	40,000	17,000
Large	Up to 400,000	67,000	39,000

Notes

1. energy savings only; no data available on resource efficiency savings

2. figures rounded

47% of the respondents in the EVER study believed that the monetary costs outweighed the monetary benefits, whereas 24% believed it was the other way around. Still the majority of respondents in the EVER study (73%) considered EMAS a success; 64% of the respondents who believed that the monetary costs from adopting EMAS outweighed the benefits, considered that the financial and nonfinancial benefits outweighed the costs.

The benefits of EMAS are:

- Increased efficiency savings
- Reduced negative incidents
- Market access
- Improved relations with competent bodies (incl. improved legislative compliance and regulatory relief)
- Improved relations with other stakeholders (incl. reputation and transparency with local stakeholders)

Examples of case study results

Different case studies present the benefits of EMAS to individual organisation. See

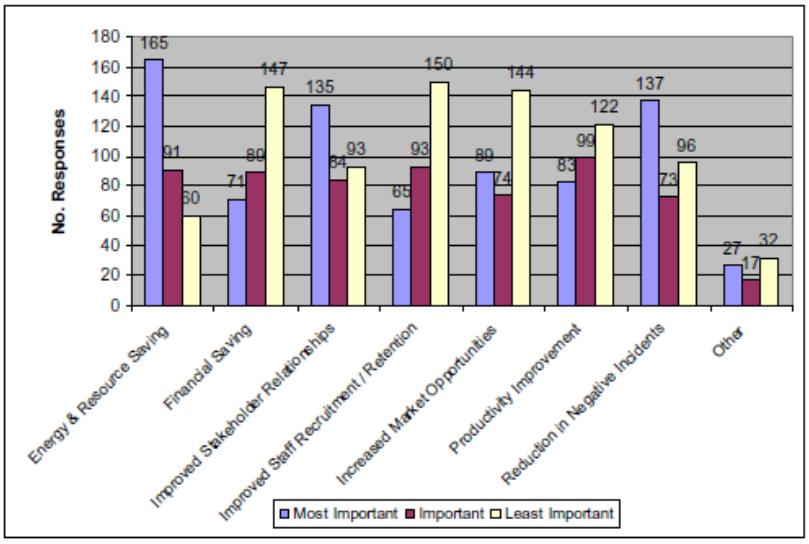
http://ec.europa.eu/environment/emas/casestudies/index_en.htm

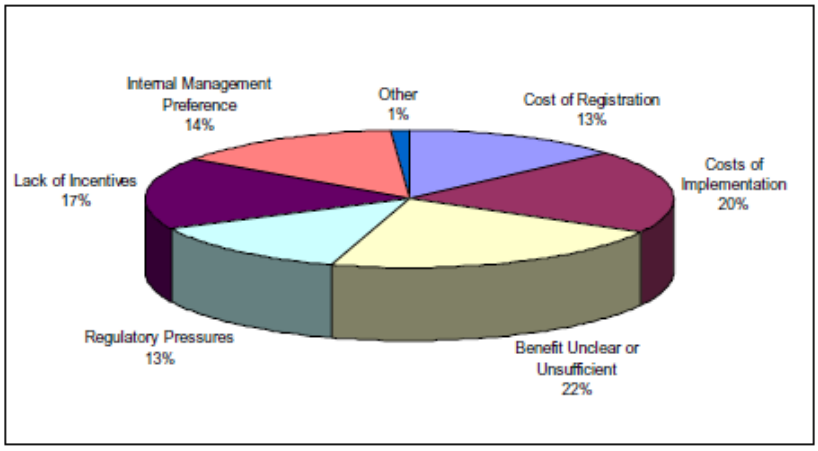
Case study 1

In its environmental policy, a Danish printing company set the key objective of reducing paper and energy consumption, the sources of the biggest environmental impact in the printing process. One specific target was to reduce the amount of paper waste at start-up (resulting from preparing the press for printing) by 50 percent on 16-page orders before the end of 2008/2009. The target was met as start-up waste was reduced by 68 percent following their investment in a 16-page printing machine.

Case study 2

Through the analysis of annual environmental inspections and bi-monthly 'what's new' checks of relevant legal regulations, members of the Environmental Working Group of a large German publishing and printing company identified the need for action. In 2007, 22.93 tonnes of paper were required to produce 1 million square meters of printed newspaper pages; in 2009, it was only 22.56 tons. This corresponds to an increase in paper efficiency of 1.6 percent. With an average price for standard newsprint paper of €542.50 per ton, this means cost savings of €1,671,985. This positive trend is mainly based on technological advancements in printing machinery as well as the high level of qualification and attentiveness of the company's employees.

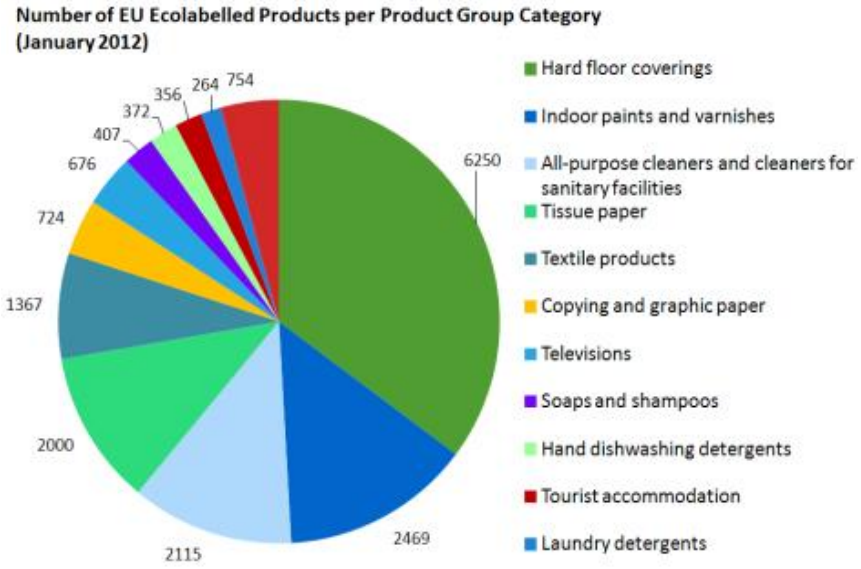
	The figure below shows the benefits of EMAS in order of preference, as this has been declared by participating companies in a survey. 
Strengths	- EMAS builds on widely accepted standards - EMAS provides a comprehensive network for provision of information and support services - Enhanced environmental and financial performance through a systematic framework - Enhanced risk and opportunity management - Enhanced credibility, transparency and reputation - Enhanced employee empowerment and motivation - Most EMAS drop-outs apparently maintain their environmental management system – or parts of it (such as: procedures for operational control, surveillance of relevant environmental aspects, the audit system, etc.) - EMAS is perceived as a useful support for policy makers, regulators and other institutional and economic actors (such as public purchasers), other than the registered organisations - As to the perceived benefits, EMAS strongly improves an organisation's capacity to meet legal and regulatory requirements. - In addition, organisational benefits are strongly associated with EMAS implementation: participants experienced an increase in the motivation and involvement of personnel in management, and a better definition of responsibilities.
Drawbacks	Despite its success, there is a relatively low uptake of EMAS across the EU. Germany, Spain and Italy are the countries with the highest uptake. From the Impact Assessment of EMAS performed in 2008, the main underlying problems are: • Lack of clarity with regard to legal requirements • The system of reporting is not harmonised or uniform (different indicators are used) • Procedures for accreditation and supervision of verifiers are not harmonised • Uneven marketing and promotion of the scheme in Member States • Uneven financial, fiscal and market-related support in Member States of EMAS

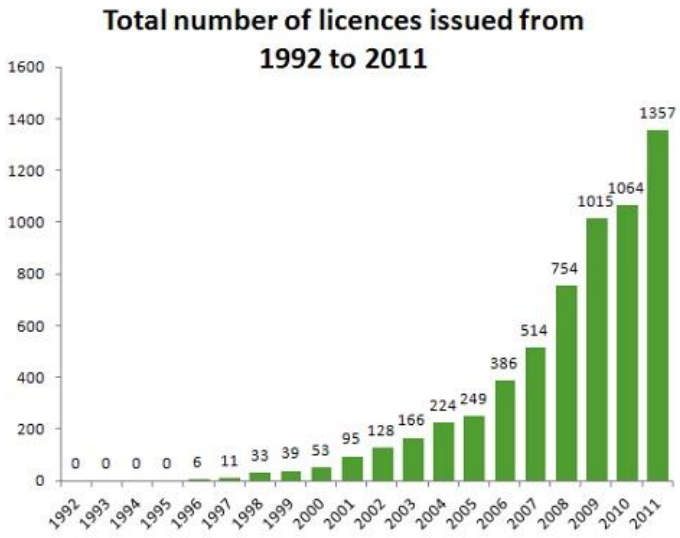
	The figure below shows the most important barriers of EMAS uptake (Milieu, 2009).  The barriers in maintaining EMAS, however, are linked to a lack of external feedback or incentives for the company running the scheme. For SMEs, the main barriers are: • Lack of time • Lack of staff resources • Lack of know-how in the organisation • Costs of external consulting and verification higher barrier than the costs of registration The coexistence of other (including national) environmental management systems is also mentioned as a barrier to organisations. This influences the lack of clarity about the added value of EMAS. It is typically easier to obtain the national systems than EMAS.
Lessons learnt	There is a clear link between the number of support initiatives in the Member States and the uptake of the scheme in the individual Member States, with high uptake in those Member States with a higher number of initiatives.
Contacts	EMAS Helpdesk Débora Dias BIO Intelligence Service
Sources and references	EMAS website, http://ec.europa.eu/environment/emas/about EMAS factsheet - EMAS Boosts Resource Efficiency http://ec.europa.eu/environment/emas/pdf/factsheet/EMASResourceEffiency_high.pdf EMAS factsheet - Fact Sheet "EMAS Benefits" http://ec.europa.eu/environment/emas/pdf/factsheet/EMASBenefits_high.pdf IEFE (2005) EVER: Evaluation of EMAS and Eco-label for their Revision http://ec.europa.eu/environment/ecolabel/documents/EU-Ecolabel-revision.pdf UK Environment Agency (2006) The results of the REMAS project. http://remas.iema.net/pdf/reports/remas_findings.pdf European Commission (2008) Impact Assessment on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) http://ec.europa.eu/environment/emas/pdf/sec_2008_2121.pdf Milieu (2009) Study on the Costs and Benefits of EMAS to Registered Organisations http://ec.europa.eu/environment/emas/pdf/news/costs_and_benefits_of_emas.pdf

2 EU Ecolabel

<table>
<tr><td>Name</td><td>EU Ecolabel</td></tr>
<tr><td>Organisation</td><td>European Commission, the EU Ecolabelling board, the Competent Bodies and stakeholders
Each Member State designates a Competent Body, an independent and impartial organisation that implements the EU Ecolabel scheme at national level. Competent bodies play a central role in the work of the EU Ecolabel scheme and are the first point of contact for applicants. They specifically assess applications and award the EU Ecolabel to products that meet the criteria set for them. As such, they are responsible for ensuring that the verification process is carried out in a consistent, neutral and reliable manner by a party independent from the operator being verified, based on international, European or national standards and procedures concerning bodies operating product-certification schemes.</td></tr>
<tr><td>Year</td><td>1992, ongoing</td></tr>
<tr><td>Location</td><td>European Economic Area (EU-27 plus Iceland, Lichtenstein and Norway), but producers from other countries can also participate, if they place their product on the European market.</td></tr>
<tr><td>Type of information provision policy</td><td>- Website which provides information both for consumer and businesses
- A Helpdesk operating at EU level and national contact points in each participant country
- An annual Communication Award which recognises outstanding achievement of Ecolabel licence holders
- Brochures and several other publication (e.g. factsheets per product category)
- Conferences and seminars</td></tr>
<tr><td>Funding</td><td>The precise budget of EU Ecolabel is difficult to establish as it involves many organisations (including Member State public administrations). The main components are:
• Development of the scheme and criteria (European Commission staff, Competent Body Forum, EU Ecolabelling Board and studies)
• Handling applications (national competent bodies)
• Market surveillance and control of the use of the EU Ecolabel
• Communication and support (incl. helpdesks)
• Financial support
A 2004 estimate for operating the Ecolabel scheme was €3.4 million (AEAT, 2004).
The EU Ecolabel (European Commission) budget for marketing is around €460 000 per year with five dedicated staff helping to run the scheme (EC Impact Assessment, 2008). Development of product criteria and revision is around €150 000 per year per product. Member State budget for marketing is around €1.5 million. There is an estimate total of 36 staff with an annual operating costs of about €2.3 million.
Income from fees was around €260 000 in 2004.

The funding of the scheme is based mainly on the registration and annual fees paid by the participants.
<table>
<tr><th>Type of applicants</th><th>One-off application fee (€)**</th><th>Annual fee (€)</th></tr>
<tr><td>Micro-enterprises</td><td>200-350</td><td>Maximum 350</td></tr>
<tr><td>SMEs and firms from developing countries</td><td>200-600</td><td>Maximum 750</td></tr>
<tr><td>All other companies</td><td>200-1200</td><td>Maximum 1500</td></tr>
</table>
Reductions are available for micro enterprises and SMEs, companies from developing countries and companies registered under EMAS or certified under ISO 14001.</td></tr>
</table>

Scope	The scheme is currently open to all products and services, except for food (currently under consideration), drinks, pharmaceutical products and medical devices.  Producers, manufacturers, importers, service providers and wholesalers placing their products and/or services on the European Economic Area market can all apply for the EU Ecolabel. Retailers can also apply for products placed on the market under their own brand name. For each of the following product categories, different resources are addressed directly: - Beauty care – water and packaging materials - Cleaners – air, water, soil and packaging materials - Textiles – water and air - Paints and varnishes – water and air - Electronic equipment – Glass, metal and plastics - Floor coverings – wood and packaging material - Furniture – wood and packaging materials - Gardening – soil, water and minerals - Household appliances – packaging material - Lubricants – water, soil and relevant raw materials - Paper products – water, air, soil and wood The main staff category affected by the EU Ecolabel are the production managers which must ensure that the criteria are followed.
Objectives	An ecolabel is a voluntary environmental performance certificate that is awarded to products and services. These products and services have to meet specific, identified criteria depending on the product groups, which reduce overall environmental impact. The EU Ecolabel fits the International Organization for Standardization (ISO) definition for a Type 1 Ecolabel. This means the EU Ecolabel is voluntary, based on multiple criteria, where a third party awards the use of the label to indicate overall environmental preferability within a particular product category based on life cycle assessment.

Type of behavioural change expected	The EU Ecolabel scheme promotes the production and consumption of products that have a reduced environmental impact in comparison to existing products on the market (they should correspond indicatively to the best 10-20 % of the products available on the market in terms of environmental performance at the moment of their adoption). The application for an Ecolabel is submitted online and a complete dossier is sent to the relevant Competent Body to be assessed. An application for an EU Ecolabel is evaluated through a set of assessment criteria which are developed in a multi-stakeholder process. Scientists, industry, experts across a wide range of sectors and impartial non-governmental organisations participate in the development the criteria. Every set of criteria undergoes several rounds of discussion between these stakeholders. Criteria are finally adopted through a Decision of the European Commission. Every four years on average, the criteria are revised to reflect technical innovation such as evolution of materials or production processes, as well as factors like emission reduction and changes in the market. When developing EU Ecolabel criteria for products, the focus is on the stages where the product has the highest environmental impact, and this differs from product to product.
Level(s) of organisational change expected	Ecolabel mostly involves: - Process or product improvement - Product or service redesign Unlike the environmental management schemes (e.g. the EMAS) which are focused on the general environmental performance of the company, ecolabelling schemes like the EU Ecolabel focus on the specific products or services of the firm. In this context, the scheme affects the use of resources mainly through the process of product improvement and product or service redesign.
Expected results and impacts (quantitative and qualitative)	When established, the scheme intended to promote products with a reduced environmental impact during their entire life cycle and to provide consumers with accurate, non-deceptive and scientifically based information on the environmental impact of products. The scheme provides guidance to consumers on products with a potential for reducing environmental impact when viewed through its entire life-cycle, and provides information on the environmental characteristics of labelled products.
Actual results [quantified]	By the end of 2011, more than 1,300 licences had been awarded, and the EU Ecolabel can be found on more than 17,000 products. According to the EVER study (IEFE, 2005) many companies use EU Ecolabel criteria to benchmark their products even though they do not apply for the label themselves.  Almost 4 in 10 EU citizens in an Eurobarometer survey (2009) had seen the EU Ecolabel, or had heard about it; nevertheless, only roughly a fifth (19%) said they have also bought products bearing the label. Awareness of the EU Ecolabel was the highest in Lithuania, Denmark and Estonia (between 49% and 51%) and the lowest in the UK, Italy and Sweden (between 26% and 31%), despite that most of the licences have been issues in Italy (over 50%), France (22%) and the UK (9%). A 2004 study by AEAT calculated that Ecolabel brought about resource efficiency savings (environmental benefits and cost savings). Examples of resource-related requirements, which are set under Ecolabel:

	- Where cardboard boxes are used, Ecolabelled light bulbs use at least 80% recycled packaging - Campsites and tourist accommodation awarded with the EU Ecolabel are restricted on the use of pesticides and fertilisers - Choosing EU Ecolabelled paper guarantees paper coming from recycled fibres or sustainably managed forests
Strengths	• Easy for producers to sell across Europe. • Easy for consumers to make environmental choices for products. Unlike other environmental information or labelling, no technical understanding is required to read and understand the label • Guaranteed by the European Commission and trusted by consumers. It enhances reputation and can improve image and increase sales • Product criteria is based on life cycle approach and the criteria set are relatively strict • When new criteria are developed for the EU Ecolabel, it is mandatory to take into account already existing criteria for other officially recognised ecolabelling schemes in the Member States • The EU Ecolabel is actively used by most of the license holders in their marketing campaigns
Drawbacks	The main problems identified in the 2008 Impact Assessment with the EU Ecolabel scheme are: • Low awareness among consumers (about 40% of Europeans recognised the label). • Low uptake by industry The underlying reasons to these problems are: • The regulation is too restrictive • Proliferation of ecolabel schemes / Strong competition from green self-claims • Insufficient co-operation and harmonisation with other ecolabel schemes • Insufficient stakeholder involvement in product group criteria • Excessive bureaucracy due to Ecolabel structures and procedures (these have been simplified) • Low number of product categories • Problems in using the Ecolabel in Green Public Procurement • Fees and costs for potential applicants • Lack of funding for marketing and running the scheme • Lack of transparency with regards to implementation of the regulation in Member States
Lessons learnt	• The EU Ecolabel is a useful benchmark for companies and purchasers (EU Ecolabel criteria can be used for Green Public Procurement) • The marketing budget of EU Ecolabel in Member States are much higher than the European Commission's marketing budget for EU Ecolabel • EU Ecolabelled products are not necessarily more expensive than conventional products (CLCV, 2011)
Contacts	EU Ecolabel Helpdesk Débora Dias BIO Intelligence Service
Sources and references	Main website - http://ec.europa.eu/environment/ecolabel AEAT (2004) The Direct and Indirect Benefits of the European Ecolabel. Report prepared for the European Commission, DG Environment. IEFE (2005) EVER: Evaluation of EMAS and Eco-label for their Revision http://ec.europa.eu/environment/ecolabel/documents/EU-Ecolabel-revision.pdf European Commission (2008) Impact Assessment. Commission staff working document accompanying the Proposal for a Regulation of the European Parliament and of the Council on a Community Ecolabel scheme. European Commission (2011) EU Ecolabel Work Plan for 2011 – 2015 CLCV (2011) Enquête prix produits écolabellisés 2011. Analyse. Consommation logement cadre de vie (CLCV).

3 European Water Stewardship

Name	European Water Stewardship (EWS)
Organisation	European Water Partnership
Year	End of 2011-on going
Location	EU-27 plus candidate countries
Type of information provision policy	Brochures, website and training. Carry out inspection and certification schemes according to the set standards available online for consultation. Communication scheme (technical advice), Partnership
Funding	Sponsored by LIFE (European Commission) The members of the European Water Partnership pay an annual contribution to cover the costs of the foundation's activities. The membership fees are listed below. • Regular Members (non-corporate) € 2 500 • Corporate Members (< 500 employees) € 2 500 • Corporate Members (> 500 employees) € 10 000 • National Water Partnerships € 10 000
Scope	The programme tries to assist meeting the goals of "The Water Vision of Europe", which are the achievement of sustainable management of water resources in every aspect: social, environmental and economic. It focuses on water users in agriculture and industry (any size of company), and aims at reducing the consumption of water Tries to assess, verify and communicate sustainable water management to business and agricultural users. - Set sights on **changing behaviour** and **practices** towards Sustainable Water Management - Shape and integrate water into other **policy and strategy agendas.** - Create a **water saving and efficiency culture** among private, industrial, business and agricultural users. - Support the **shift** from **supply** management to a **balanced supply and demand management** through information, education and training.
Objectives	The programme aims to save water through promoting sustainable water management practice to all water users with the implementation of a voluntary assessment scheme. Behavioural and water use practice changes are targeted for achieving water sustainability. "The EWS is conceived with the focus on water sustainability at river basin level, as water users agree that they share river basins in much the same way as they share sectoral, national or regional concerns." Raising awareness and bringing together industry, governments, NGO's, research organisations and the financial sector, providing a broader coordination on water in Europe. The four principles of the programme are: 1) Achieve and maintain sustainable water abstraction in terms of water quantity. 2) Ensure the achievement and maintenance of good water status in terms of chemical quality and biological elements. 3) Restore and preserve water-cycle related High Conservation Value (HCV) areas. 4) Achieve equitable and transparent water governance.
Type of behavioural change expected	• initiates private actions with independent guidance • provides positive incentives for sustainable water management • helps companies to communicate its successful implementation and achievements at operational level • supports existing legal processes in the European Union.

Level(s) of organisational change expected	The programme set specific guidelines and after inspections have taken place. It targets changing the water consumption of industries and agriculture into a sustainable water management. The entire way that water is managed is expected to change. Use of alternative source of irrigation (i.e. captured rainwater) Use of grey water (for cleaning of equipment) Reduction in the inputs for organic farming. Proposal of more efficient irrigation techniques.
Expected results and impacts (quantitative and qualitative)	No quantified objectives have been communicated at the time of writing
Actual results [quantified]	No quantified evaluation has been carried out at the time of writing
Strengths	In line with the Water Framework Directive, EWS follows the Water Vision for Europe, and is recognised by the EU authorities and stakeholders. Strong partnerships with EC, EEA and many other programmes, institutions and companies from the private sector. In line with other environmental certification schemes (i.e. ISO 14000) Pilot schemes feedback: - The standards set out by the EWS programme are generally complete. - "Strengths and improvement points table is considered to be very practical" - Considered to have a significant improvement over water management even for farms with existing highly developed water management.
Drawbacks	Pilot schemes feedback: - The standards although complete not always comprehensive. Need for the terminology of the standards to be aligned with other environmental monitoring schemes, such as the ISO 14000 - For small farmers, there is a need to develop a group certification scheme since some indicators are too exhaustive on small operations scale. - Compatibility with other Environmental Management Systems and Best Management Practice (BMP) should be addressed. "Additional BMPs should be provided within the checklists as guidance for Stewardship organizations". - Lack of water indicators for some regions. - Need for additional social indicators with aim to achieve better holistic approach. - Indicators regarding water reuse should be developed, in particular for water stressed regions. - Evaluation System: - "The evaluation system is considered to be complex and subjective." The strengths and improvement points system is considered as way of addressing the issue. - Need for better reporting and classification of priority substances, main pollutants and specific pollutants.
Lessons learnt	No evaluation has been carried out at the time of writing
Contacts	Dr. Sabine von Wirén-Lehr http://www.ewp.eu
Sources and references	http://www.ewp.eu/activities/water-stewardship/

4 WIN, Styria, Austria

Name	**Sustainable Business Initiative Styria** in German: "Wirtschaftsinitiative Nachhaltigkeit", abbreviated as WIN
Organisation	WIN was started up as a co-operation between the Styrian Federal Province Government, the Styrian Economic Chamber and the Styrian Business Promotion Agency in December 2002. The programme is co-financed by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.
Year	Start: December 2002
Location	Austria, Styria
Type of information provision policy	A 'one-stop-shop' for facilitating corporate sustainability in Styria. To create awareness WIN offers: - **free information** (for example regional information events to special topics, information folders with best practice examples and videos, possibility of free-downloads on their website) Because enterprises also need concrete and individual advice, WIN offers: - **financial support for consulting projects;** Styrian companies benefit from WIN by subsidies for consulting services offered by external experts. To recognise efforts and provide good examples, WIN also organises: - **Motivation and Public awards (**for example cooperation with the so-called TRIGOS and the Energy Globe Styria Award) **External consultants** During the last nine years WIN has succeeded in building up a **large pool of consultants**. Experts who want to join WIN have to fulfil certain criteria. **Formal Criteria:** They have to present a business licence and must guarantee a neutral and independent advice. Furthermore they have to pay a fee of € 200 per year. **Technical Criteria:** In addition, they must be able to present carried out projects relevant to those fields for which they would like to be submitted. WIN prefers consultants with a certain professional experience. Due to this selection the companies can be confident that a WIN - consultant will offer a high quality consulting service – a fact which is checked by opinion polls in the participating businesses. Being part of the WIN network has advantages for the experts too: they benefit from training seminars, experience exchange and they regard it also as an image improvement. WIN's consulting services are grouped into three core areas and various modules (series of workshops or individual counselling): • **Sustainable Business Management (Core Area A)** is on the top of WIN's portfolio. The aim is to develop future oriented, operational sustainable strategies. Consulting services in this area focus on the broad spectrum of the holistic concept of sustainable development and include all three dimensions of sustainability: economical success as well as social and ecological responsibility. These projects need a longer consulting period and a various number of stakeholders are involved in this process. The modules include: Sustainability Check, Sustainability Strategy and Sustainability Report • **Sustainable Environmental Management Systems (Core Area B) -** WIN supports enterprises with the implementation of an environmental management system like EMAS or ISO 14001. These consulting projects have longer duration (a period of at least 10 consulting days). The modules include: Management Check, EMAS, ISO 14001, Integrated Management Systems, ECOPROFIT. • **Product- and Process-integrated Environmental Protection (Core Area C)** includes consulting projects on issues like environmental and climate protection such as energy saving/efficiency, optimisation of material streams and waste management. This core area is especially intended for companies that want to reduce their environmental impacts or save energy costs. Most of WIN's consulting projects can be found in this area. The modules include: Eco Check, Eco Reporting, Advanced Waste Management Plan, Ecotourism, WIN-Building, WIN Energy and Green IT. Consultations about environmental costs, project financing and environmental monitoring are part of all the above services. **Specific activities:** *Regional information meetings* From December 2008 to March 2009, a total of 11 regional information meetings were held at the regional offices of the Styrian Economic Chamber, with a very good response and numbers of participants, which exceeded all expectations. In total, 540 persons from 400 Styrian companies took part in the events. Not only

	the interest of the companies, but also the interest of the consultants to present themselves and their services was high – which highlights the significance of the regional meetings for the effect with the companies. *Voucher booklet as information and motivation to 10,000 companies* With the objective of informing the Styrian companies about the programme *WINenergy!* and in particular about the producers and providers of services and products from the renewable energies and energy efficiency areas, a voucher booklet with vouchers to the total amount of € 15,000 was issued. Contents of the voucher booklet: • 6 best practice examples for energy efficiency measures performed already • information about regional efficiency meetings • information about qualification for energy representatives • listing of all WIN consultants from the energy efficiency area • promotion overview, above all investment promotion • 32 vouchers for products and services, overall value over € 15,000 *Cooperation with ECO WORLD STYRIA* (www.eco.at), a cleantech cluster located in Styria with about 170 companies and research institutions working on green and cleantech solutions. This cluster forms one of the highest concentrations of companies in the field of energy and environmental technology worldwide and was recognized as the World`s Best Greentech Cluster in 2010.
Funding	The program is co-financed by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. Companies benefit from the program by subsidies for consulting services offered by affiliated consultants. In 2006, the share of public subsidies was 32% in the short term and 12% in the long term. About € **2.8 million of financial support for consulting projects** (from 2003 to 2011) resulted in € **30.1 million investment** for realizing measures in the enterprises. The "Sustainability check", the "Management check" and the "Eco Check" are designed as **one- to two-day on-site consultancies** meant to be a starter for continuing efforts and participation. All checks are subsidised with 70% of net consulting costs (with a maximum subsidy amount of € 1.000). All other services are subsidised with 50% of net consulting costs.
Scope	Companies with operational sites situated in Styria (around 50,000). At the beginning the **most important target group** was private **SMEs**, in the meantime other types of organisations were also supported. There are specific modules targeting specific areas such as tourism, energy, waste, buildings and IT.
Objectives	The aim of WIN is to spread the example of sustainable development in the Styrian economy and to support the conversion financially. WIN wants to engage companies to deal actively with future trends, which have a great influence on society (for example, the **increasing awareness of end-customers** with respect to climate change, environmental protection and sustainable life styles, the **greening of the future tax system** or the **global urbanisation and ageing** of the population) and - of course – environmental impacts should be reduced (waste, hazardous waste, waste water, fossil fuels, CO_2) WIN's range of support services acknowledges that especially small and medium-sized enterprises often do not have the time or the skills to deal with all these issues.
Type of behavioural change expected	The WIN programme aims to raise awareness of the importance of sustainable development within Styrian companies (mostly SMEs), and offers them the technical and financial support for implementing sustainable development strategies. The level of change is a decision of the company.
Level(s) of organisational change expected	Three levels of business change are targeted in the WIN programme: • Sustainable Business Management (Core Area A), which aim is to develop future oriented, operational sustainable strategies, and include all three dimensions of sustainability: economical success as well as social and ecological responsibility. • Sustainable Environmental Management Systems (Core Area B), which supports on the implementation of environmental management systems such as EMAS or ISO 14001. • Product- and Process-integrated Environmental Protection (Core Area C), intended for companies that want to reduce their environmental impacts or save energy costs.
Expected results and impacts (quantitative and qualitative)	All the SMEs located in Styria are targeted by the WIN programme: circa 50,000, but no quantified objectives in economic terms or environmental impacts have been set.

<table>
<tr><td>Actual results [quantified]</td><td>In 2006, 280 companies have participated in WIN activities.

The documentation and evaluation of the effectiveness and efficiency of WIN projects is considered to be important. Therefore the consultants are required to document the measures and the resulting effects on environmental impacts as well as the cost reductions.
All the subsidy cases are managed by an online database. This online - tool includes detail information about the participating companies, the project descriptions as well as the results of the consulting projects.
These data are the basis of the programme evaluation which is carried out regularly by an external expert group (In winter 2006 by the Research Institute for Managing Sustainability of the Vienna University of Economics and Business Administration, in Summer 2010 by the Saarland University, actually by the Vienna University of Economics and Business Administration again).
The evaluation process includes interviews with companies, consultants and stakeholders and an analysis of the documented measures. Overall, the evaluation has shown hardly any weaknesses of the WIN program.
• The cooperation of three Styrian institutions turned WIN into a one-stop-shop for facilitating corporate sustainability in the province.
• The use of public funds is efficient.
The participating businesses are mostly satisfied with the qualification of the consultants and the services.
According to the 2006 Evaluation Report, the businesses participating in the WIN programme are mostly satisfied.

Achieved environmental effects from 2003 to October 2011
<table>
<tr><th>Resource</th><th>Implemented measures</th><th>Planned measures</th></tr>
<tr><td>Raw materials</td><td>-833,000 kg/a</td><td>-112,000 kg/a</td></tr>
<tr><td>Auxiliary materials</td><td>-45,000 kg/a</td><td>-439,000 kg/a</td></tr>
<tr><td>(Drinking) Water</td><td>-77,000 m3/a</td><td>-940,000 m3/a</td></tr>
<tr><td>Hazardous Waste</td><td>-735,000 kg/a</td><td>-2,300 kg/a</td></tr>
<tr><td>Non-hazardous waste</td><td>-1,564,000 kg/a</td><td>-20,000 kg/a</td></tr>
<tr><td>Waste water</td><td>-134,000 m3/a</td><td>-17,000 m3/a</td></tr>
<tr><td>Fossil energy sources</td><td>-27 GWh/a</td><td>-173 GWh/a</td></tr>
<tr><td>Electricity</td><td>-4.6 GwH/a</td><td>-42 GWh/a</td></tr>
<tr><td>CO2</td><td>-7,970 t/a</td><td>-54,600 t/a</td></tr>
</table></td></tr>
<tr><td>Strengths</td><td>- One-stop-shop for facilitating corporate sustainability in the province.
- Structure of the programme is thematically straight forward and flexible enough to integrate new issues.
- Network of approved external consultants
- Qualifications of the external consultants
- The cooperation with the ECO World Styria is one of the key factors for WIN's success, because WIN offers the consultants and ECO World Styria has the solutions for the implementation of the measures.</td></tr>
<tr><td>Drawbacks</td><td>Due to the complexity of sustainable development sometimes it is different to explain WIN's goals and portfolio.
WIN realises that it is useful to focus on a key issue. For example, during the last two years they created a compaign on energy efficiency, called "WINenergy!".</td></tr>
<tr><td>Lessons learnt</td><td>WIN consultants have the possibility to offer on-site consulting services as well as workshop series with several enterprises grouped together. This form of consultancy causes lower costs and the businesses profit by experience exchange.</td></tr>
<tr><td>Contacts</td><td>Silke Leichtfried
Styrian Federal Province Government
Department of Waste Management (FA19D)
www.win.steiermark.at</td></tr>
<tr><td>Sources and references</td><td>www.win.steiermark.at</td></tr>
</table>

5 OVAM – MAMBO and Eco-efficiency Scan Programme, Belgium

Name	OVAM Mambo and Eco-Efficiency Scan Programme
Organisation	OVAM (Openbare Afvalstoffenmaatschappij voor het Vlaams Gewest) – in English: the Public Waste Agency of Flanders Worked with the Enterprise Agency on the Eco-Efficiency Scan Programme
Year	MAMBO software created in 2006, updated in 2011. On-going. Eco-efficiency scan created in 2006, on-going.
Location	Flanders, Belgium.
Type of information provision policy	Company visits and follow-ups, online tools, helpdesk, workshops, information requirements on demolition and dismantling waste. OVAM initiated a cooperation agreement with actors in the supply chain for plaster board liner, which commits them to closing the plaster supply chain loop. OVAM is looking to do the same for cellular concrete and bitumen. OVAM also has an agreement with Flemish Young Enterprises (VLAJO) to encourage mini-businesses to include eco-efficiency in their business plans. Together OVAM and VLAJO organise Eco-efficiency Awards. Together with Design Flanders, OVAM also arranges Ecodesign Awards.
Funding	OVAM's funding is mainly from the Flemish Government, the MINA fund, Financing Fund for Debt Reduction and One-Off Investment Expenses (FFEU) and revenue from its own activities. Total revenue in 2009 was €79.8 million. OVAM foots the bill for the Eco-Efficiency Scans
Scope	All resources targeted in SME production process. MAMBO software tool is best suited for manufacturing companies with more than 20 employees. MAMBO can also work for service organisations, but requires some interpretation.
Objectives	The Flemish Government will promote eco-efficiency and eco-design stimulation through the provision of an Eco-Efficiency scan. The aim is to encourage businesses to invest in eco-efficient operations to cover the costs of the company and increase future chances of the product or to increase production. In general, to encourage businesses to invest in eco-efficient operations.
Type of behavioural change expected	The aim of the ***Eco-Efficiency Scan programme*** is to identify opportunities for eco-efficiency improvements within small and medium enterprises (SMEs). Companies are given the opportunity to work with an advisor paid for by OVAM to explore possible eco-efficiency measures. The advisor performs a broad scan which includes analysing whether the amount of waste can be reduced, whether more materials can be recycled, whether the energy and water consumption can be reduced. The advisor follows up with the company six months and a year after the investigation. Concrete tools and calculators are used to identify realms of production that are not resource efficient. By identifying the possibilities for both major environmental and financial savings through resource efficiency, companies will be motivated to adapt their practices. The eco-efficiency scan includes the following components: • a brief analysis of the company • an overview of eco-efficient measures grouped by topic. Companies indicate which measures are most relevant, improvement aspects are then incorporated into a comprehensive report. • the possibility of calculating a number of indicators • a reporting module with an in depth look at the options selected The initiative MAMBO refers to 'Less waste, more profit'. By means of a software package developed by OVAM, companies are able to calculate the true costs of their waste production. The tool indicates that true waste costs are up to 10 times higher than the visible disposal costs and amount up to 5% of production costs. The objective of MAMBO is to raise awareness among companies and stimulate them to focus on waste prevention. MAMBO provides a cost-benefit analysis of resource efficiency measures.

Level(s) of organisational change expected	• Process or product improvement • Product or service redesign • Technology change • System design • Improved employee knowledge
Expected results and impacts (quantitative and qualitative)	The five objectives for 2010 – 2015 are: • Closing material supply chain loops • Eco-efficient production • Innovating • Focusing on industrial waste Environmentally responsible consumption
Actual results [quantified]	Over a period of 3 years the ***Eco-Efficiency Scan*** programme has reached about 1000 Flemish SMEs. Research at 70 companies showed that the annual costs of waste management vary from €20,000 to €7.6 million, with an average of €890,000. Example of results from the MAMBO-analysis: **Case study Astra Sweets NV:** Based on the MAMBO-analysis, a number of proposals to reduce waste costs launched: Reuse of waste candy if possible; New drainage for candy waste by GMP (Good Manufacturing Practices)-product sheet: savings of around €26,929; Separate collection of PE (polyethylene) film: €4,943 Separate collection of high-calorific waste plastic: €2,004 In addition to these specific measures were also a number of general measures. A waste working group was responsible for the coordination of the waste project. Besides the savings, greater environmental awareness has grown among the employees at Astra Sweets.
Strengths	The MAMBO software tool offers the possibility to do a quick and simple estimate of waste costs based on data from other companies, but also a more accurate and detailed estimate based on a company's actual waste streams or processes and products. This allows user to quickly get interested in using the tool.
Drawbacks	No evaluation has been communicated at the time of writing
Lessons learnt	No evaluation has been communicated at the time of writing
Contacts	Mambo (OVAM) Veerle De Ridder http://ovam.be/
Sources and references	OVAM (2010) Activities Report 2009. http://www.seeproject.org/casestudies/The%20Public%20Waste%20Agency%20of%20Flanders

6 MOTIVA, Finland

Name	Material Efficiency Centre and Material Efficiency Audit Tools
Organisation	Motiva Ltd. Motiva's entire stock is Finnish State ownership.
Year	Material Efficiency Centre was established in 2008. The development project has been carried out by Motiva from 2011 to 2013. The official Material Efficiency programme is to be launched in 2014.
Location	Finland, but also international cooperation
Type of information provision policy	Expert services promoting energy and material efficiency including,method development, providing information, and networking among professionals. The consultants performing the on-site audits are from other consultant companies approved by Motiva. The consultants have previous experience in energy audits within the energy efficiency programme carried out by Motiva during 15 years and with 200 approved auditors, which proved to be a good approach. The Material efficiency programme is expected to be as successful as the energy efficiency programme, and is following the same structure. The Material efficiency programme also organises workshops for companies in which specific topics or resource efficiency strategies are explained. The Material Efficiency Centre is the national coordinator, information source and networker in the field of material efficiency.
Funding	Motiva's entire share stock is in Finnish State ownership. During the ongoing development project (2011-2013) funded by the Ministry of Employment and Economy material, audits can receive support through Motiva, as long as a consultant approved by Motiva carries out the audit. The development project has been designed to decide and test how the official programme should be run from 2014 onwards. A number of consultants have been selected and trained to carry out material audits in different companies with the objective of testing the method and gathering data and experiences that will allow to estimate the potential of the programme, the expected costs and benefits, etc. The objective is that in the future material auditing activities will be performed within a subsidized material audit programme, which may get underway no earlier than the beginning of 2014. The granting of such support and the amount is considered on a case-by-case basis, and can be up to 30% to 50% of the total cost. It is possible to apply for funding if resource efficiency measures require funding. The price of a material audit depends on the time needed for it and the consultant's fee. The auditing process can last from a few months to half a year depending on the company's size, area of operation, level of initial data and the available resource for the job. The consultant's work on the audit requires approx. 2-3 months, but can vary. The average cost of these audits is estimated to be around € 16,000 to € 30,000, but these figures are highly variable depending on the company.
Scope	All industrial sectors and materials. After the development programme, the results of the material audits performed will be analysed to evaluate whether there should be a focus on any specific sectors or materials.
Objectives	Motiva and the Material Efficiency Centre promote material efficiency by emphasising the importance of pro-activity and early adaptation. The Material Efficiency Audit aims to be a systematic widely accepted and used audit tool for companies in all industrial sectors to find cost savings, save resources and reduce environmental effects. No quantified objectives have been defined at the time of writing. The results of the development programme will help defining these objectives. During the development programme, 10 companies will participate per year in the material audits. During the official programme, it is expected that at least 30 companies will participate per year.

Type of behavioural change expected	A material audit is a practical and systematic tool for companies to improve the efficiency of their operations and to manage their material flows. The material audit is performed collaboratively between the company and consultant using the auditing method developed by Motiva. The consultant is responsible for the work's progress and reporting, bringing to the process his/her specialist experience and outsider's perspective. The audit draws on the enterprise's own expertise and skills in initial data collection, assessing the production processes and in identifying improvement targets. With material audits it is possible to identify the stages of the production process where reductions can be made in the use of materials, the amount of waste that is produced and information about environmental aspects. The audit also brings significant financial savings as it takes into account the indirect costs that relate to material flows. It assigns or allocates energy, labour and other costs to each material flow, applying the Material Flow Cost Accounting (MFCA) approach. The material audit results in specific proposals (measures for improvement, savings potential and investment requirements) on what measures to take to guarantee savings. An estimate is made of the benefits of these measures, the potential for savings and possible investment needs, plus suggestions for further action. Based on the material audit it is easy for companies to begin to carry out improvements systematically. The improvement measures are related to process improvement, technology changes and also to product redesign. Often these are based on simple things that require low or no investment, such as better training of the employees, minor changes in the production process, provision of better instructions to employees, reuse and recycling of by-products, etc.
Level(s) of organisational change expected	**The Material Audit consists of:** • Systematic evaluation of material flows in production (material balance of factory and processes); • Tracing direct and indirect costs related to material use; • Identification of improvement points; • Proposals for concrete actions to achieve these improvements; • Estimate of benefits, feasibility and savings of the suggested actions; • Possible recommendations for further examination and activities; and • Consideration of environmental aspects of production and materials. On the basis of a material audit the majority of material efficiency improvements concern the production process, such as the way the process is driven, cutting losses, detecting errors, better instructions and training of employees. Some improvements can also concern product design issues.
Expected results and impacts (quantitative and qualitative)	In 2011, Motiva launched a project to prepare the start up of a material audit programme for industry. The audit programme will cover requirements concerning the training and qualification of auditors, and the quality assurance of audits. The audit programme will also enable the collection of data from the outcomes of auditing activity and from the environmental benefits achieved. In addition, the project will prepare the subsidy policy concerning material audits by agreeing with the government the principles of subsidies for audits and the criteria for granting it. The aim is that the material audit programme will start from the beginning of 2014. During the project period (2011-2013), the objective is that material audit activity will proceed and gain momentum. Benefits of material audits • Cost savings in raw material purchases • Savings in energy and labour costs • Improved business competitiveness • Reduced use of natural resources • Reduced environmental burden (e.g. CO_2-emissions) • Forecasting of tighter permit and other requirements • Improvement of company environmental image • Improvement of company material efficiency know-how and consciousness • Better employee engagement in material efficiency improvements

Actual results [quantified]	The material audit model is seen as a very functional tool for achieving cost savings and environmental benefits. The results of the first material audits carried out in Finland have been promising. In the audits an average of 40 – 100 concrete savings measures were identified. The calculated yearly savings potential in the material audits carried out in five medium-sized industrial enterprises was € 0.3 – 1 million a year per company, of which an estimated 20-50% is realized during the first year. The savings potential of a single material flow is reckoned to be as much as 30%. Examples of results: *Case Study: URV Ltd.* At the URV foundry, which manufactures cast iron components as a small series of products, material issues are often considered in terms of small units and not as flows. The material audit pointed out nearly 70 possible measures to improve efficiency with a savings potential of nearly € 600,000 a year. *Case Study: Lumon Ltd.* The material audit carried out at Lumon, which manufactures balcony and glass terraces proved to be a profitable overall inspection. The audit highlighted 68 suggested measures for improving efficiency with an annual savings potential of almost € 800,000.After 1.5 years from the material audit, Lumon had already gained €400,000 savings per year.
Strengths	The audit uses the company's own information and expertise. Knowledge among production personnel is seen as valuable for identifying areas for increasing efficiency. Material auditing brings significant cost savings to companies.
Drawbacks	No evaluation of the programme has been carried out at the time of writing.
Lessons learnt	No evaluation of the programme has been carried out at the time of writing.
Contacts	Paula Eskola Henrik Österlund Motiva Ltd. http://www.motiva.fi/
Sources and references	http://www.motiva.fi/

7 Eco-Emballages, France

Name	Eco-Emballages Packaging Advisory
Organisation	Eco-Emballages (part of the PRO EUROPE – the umbrella organisation of 33 national producer responsibility systems engaged in the selective collection and recycling of packaging waste, which manages the 'Green Dot' system)
Year	2006, on-going (Eco-Emballages was created in 1992)
Location	France
Type of information provision policy	The website provides information on material efficiency (concepts , articles, audiovisual material etc) Several services are offered to Eco-Emballages members: • Intensive one-day ecodesign training sessions for engineers and designers with a focus on packaging minimisation. Courses use simplified life cycle analysis methodology. • Packaging audits, conducted in two days with an expert on site, identify ways to optimise packaging use and minimise waste. • Partnerships with students at ESIEC, a French engineering school specialised in packaging, where the student leads a company project on packaging prevention.
Funding	Through the Green Dot (Le point Vert) license which is based on a small fee (€0.60) per packaging unit. Eco-Emballages turnover in 2010 was € 518 million. The Packaging Audit (Diagnostic rapide des emballages) is free for SMEs that are members of Eco-Emballages and pay less than €40,000 annually in fees. Companies that pay more than €40,000, but less than €500,000, pay €1,500 to participate. For companies that contribute more than €500,000 in annual license fees, the costs are €2,000.
Scope	Packaging of household products (glass, paper/board, aluminium, tinplate and plastics). Members of Eco-Emballages.
Objectives	Waste prevention through innovation and ecodesign of packaging.
Type of behavioural change expected	• Packaging audits (diagnostic rapide des emballages) has an expert visit the company and results in a report with recommendations to optimise the packaging system in prioritised order. Before the visit of the expert, the company must fill out a questionnaire regarding technical aspects of the packaging system. The audit consists of an on-site visit, interviews with actors and a review of the packaging specifications. The expert follows up six months after the intervention to evaluate the progress and identify any barriers to implementation.
Level(s) of organisational change expected	Mainly packaging system improvement and product redesign
Expected results and impacts (quantitative and qualitative)	No quantified objectives have been communicated at the time of writing
Actual results [quantified]	Eco-Emballages student partnerships usually deliver a packaging reduction of 10 to 20% by weight. Packaging audits result in an average 0.4% increase in turnover. The result of ecodesign education is harder to quantify, but the integration of waste prevention principles at the design stage has evident long-lasting ramifications for packaging waste in the environment.
Strengths	No evaluation has been communicated at the time of writing
Drawbacks	No evaluation has been communicated at the time of writing
Lessons learnt	No evaluation has been communicated at the time of writing

Contacts	Laurence Cavallini Marie-Dominique Vauclin Eco-Emballages http://www.ecoemballages.fr
Sources and references	http://www.ecoemballages.fr

8 demea, Germany

Name	Impulse Programme Material Efficiency
Organisation	Deutsche Materialeffizienzagentur (demea) / The German Materials Efficiency Agency was created at the initiative of the Federal Ministry of Economics and Technology
Year	2006, on-going
Location	Germany (nationwide initiative)
Type of information provision policy	• VerMat – programme provides support for consultation of SMEs • NeMat – programme supports the establishment of networks (regional and along value chains or sectors) • Material Efficiency Award Tools • Website provides information on material efficiency (concepts , articles, audiovisual material etc) • A database of good practices, searchable by 12 business sectors, 16 materials and 15 material processes. Currently the database includes 24 good practices • Online tool for the self- assessment of the potential material savings • Newsletters • Organises conferences and workshops For a potentiality analysis up to € 30,000 consulting costs are funded. Funding rates: • 67% funding up to € 15,000 • 50% funding up to € 30,000 • Total amount of subsidies per voucher is € 17,550 • Only one voucher per SME eligible • Co-funding is not possible Day rates for consultants are up to €1,100 includes at least 8 hours with pre- and post counselling. SME pays own contribution of project costs to consultant. After an evaluation of the project report by demea, subsidies are paid to the consultant.
Funding	Funded by the Federal Ministry of Economics and Technology (BMWi), no specific budget has been communicated.
Scope	The beneficiaries of the programme are manufacturing SMEs. Energy efficiency can also be considered, but the focus is on materials.
Objectives	• To provide information and funding to accompanies to achieve resource and material efficiency • To develop networking, cooperation and exchange of best practices on the field of resource efficiency • To provide advice and expertise • To identify the most successful practices (through an annual “material efficiency award”)
Type of behavioural change expected	The aim of the program is to raise public awareness about the importance of resource and material efficiency. The programme provides funding for specialised consultation services to identify the potential for resource efficiency. Funding is provided through vouchers (go-Inno), which cover a full 50 percent of cash expenses for qualified advice to increase the resource and material efficiency. The payment of subsidies to SME is done after the evaluation of the action by demea. The companies must complete a self-assessment tool (13 questions) before receiving the voucher. demea programme includes different types of consulting: - Potential analysis (four weeks) includes quantitative resource flow analysis, identification of internal material losses, micro-economic analysis of possible resulting saving potentials and recommendation of ways to realise the saving potentials - In-depth consultation /implementing aid (up to nine months). Measures for complex resource flows are subdivided and planned more in detail.

	Under demea a pool of consultants has been developed. Only consultants which have the necessary skills are registered. The quality of the services provided by the consultants is assessed and monitored in a regular basis.
Level(s) of organisational change expected	The actions funded by demea cover different levels of change: - Product design and dimensioning (Choice of material, geometry, cutting optimization, ...) - Production process (Machining processes, process parameters, consumables, cleaning and preparation procedures, auxiliary materials, recycling of production waste, ...) - Production system (Transport processes, warehousing, packaging, ...) The specific activities covered include: • Resource and material efficiency projects • Material substitution • Use of new materials • Reduction of the product range • Product changes and product re-engineering • Change in the technical production process • Introduction of a new production process • Introduction of efficient methods for recycling the waste produced production In this context the programme covers all levels of organisation.
Expected results and impacts (quantitative and qualitative)	In Germany, the value of materials processed per year is € 500 million. The increase in material efficiency by 20% would have a potential annual savings of € 100 billion. For this reason, the Federal Government set to increase material efficiency in manufacturing firms. Based on the examination of over 1,000 analyses, the potential savings were estimated at € 210,000 per year per company. This is translated to an annual increase of profits by 1.8%.
Actual results [quantified]	The number of applications increased notably each year. The amount of solicitudes for services on “analysis of potentiality” was around 125 in 2008; 250 in 2009 and 380 in 2010, with a total of about 755 in the three years. The number of applications for services on “in-depth analysis” was of around 37 in 2008; 30 in 2009 and 80 in 2010. The total number of applications in the three years was around 145. *No specific results have been communicated.*
Strengths	Some of the achievements of the programme are: • Support on the creation of high-quality jobs (e.g. consultancy) • Promotion of innovation in all levels of the production process • Provision of a standardised step-by – step process for funding projects • Creation of a pool of about 550 consultants working in the Programme. Consultants are freelancers or from a private consulting agency • The programme’s and agency’s design allows flexibility towards challenges and problems during the process of implementation
Drawbacks	No evaluation has been communicated at the time of writing
Lessons learnt	No evaluation has been communicated at the time of writing
Contacts	Mario Schneider Julia Rasch DEMEA http://www.demea.de
Sources and references	http://www.demea.de Wuppertal Institut: (2007) Evaluation of the scheme - http://www.demea.de/umfeldinformationen/evaluation/EvaluationEndbericht%20final.pdf

9 Netzwerk Ressourceneffizienz, Germany

Name	National Resource Efficiency Network / Netzwerk Ressourceneffizienz
Organisation	The network was established in 2007 by the Ministry for Environment and the Federal Environment Agency. The Network co-ordination is realised by the Wuppertal Institute (project management) in co-operation with the German Material Efficiency Agency (demea) and the Efficiency Agency NRW. The network is framed by the project "Material Efficiency and Resource Protection" which is funded by the Federal Ministry for Environment, Nature Protection and Nuclear Safety as well as by the Federal Environmental Agency. The core actors of the network are: - Aachen Foundation Kathy Beys - Federal Chamber of Engineers - BITKOM eV (Federal Association for Information Technology, Telecommunications and New Media) - Federal Ministry of Economics and Technology - German Materials Efficiency Agency (demea) - German Trade Union Federation (DGB) - DIN German Institute for Standardization - Efficiency Agency North Rhine-Westphalia (NRW EFA) - Research Centre for Environmental Policy (FFU), Berlin - Hans-Böckler Foundation - IG Metall - IZT (Institute for Futures Studies and Technology Assessment) - Council for Sustainable Development - VDI / VDE Innovation + Technik GmbH - Association of German Engineers - Wuppertal Institute for Climate, Environment and Energy
Year	2007
Location	Germany (nationwide)
Type of information provision policy	The programme offers diverse information activities: - A website as information platform for the topic of resource efficiency, especially for companies - Conferences which focus on Good Practice examples and network activities - Newsletters including dates, interesting information from the network and Good Practice examples - Organisation of common activities and initiatives of network members, e.g. dialogue processes, pilot projects or further training - Company-based workshops, development of specific suggestions for improving resource efficiency and branch conferences - Information on the financing possibilities of innovative technologies - Organisation of local and regional events (e.g. on-site events that take place in an industry)
Funding	The programme is funded by the Federal Ministry for Environment, Nature Protection and Nuclear Safety and by the Federal Environmental Agency. No specific budget has been communicated.
Scope	The network covers several sectors such as: • Metal industry • Plastics producing industry • Green office computing • New building technologies • Electric cars • Large scale energy production projects In the context of the network, diverse stakeholders, ambassadors and multipliers are assigned to increase the efficiency of the scheme: • Business associations and networks • Chambers • Unions • Environmental and consumer organizations • Promoters of economic development Within the network dialogues are developed between producers, consumer organisations, R&D and policy makers.

Objectives	The Resource Efficiency Network intends to bundle know-how and experience regarding resource efficient production, products and management. It provides possibilities for mutual exchange of information between all relevant actors. The main objectives of the network are: - To foster resource efficient use of products and services in production, retail and consumption - To unite actors from policy making, business, associations, trade unions and society and co-ordinate their activities - To initiate the exchange of experience on successful applications for efficient resource use - To develop proposals for the design of framework requirements that provide incentives and reduce barriers - To set impulses to interlink among and within regions and sectors
Type of behavioural change expected	The network aims to provide companies with the knowledge for developing resource efficient services and products, and to apply sustainable management practices. Other stakeholders present in the network (e.g. chambers, unions, environmental and consumer organizations) participate in the development of policy, public administration, science, education and the media's commitment to introduce a more efficient use of resources.
Level(s) of organisational change expected	Process or product improvement Product or service redesign Technology change System design The network aims to: - Optimize production processes - Use of innovative energy-and material-saving technologies - Develop new environmentally friendly technologies - Incorporate the life-cycle thinking in product design - Ensure quality and to minimize risks - Increase recycling - Improve work processes and production flows - Develop appropriate expertise through training and - To think in terms of product-service systems In this context all levels of organizational change are addressed, although it is more focused on the product and process level.
Expected results and impacts (quantitative and qualitative)	The network is part of the economic and political strategy of the German Government to enable German industry to be one of the most competitive suppliers for “green technologies“ and resource efficient production. It aims to raise public awareness and start a critical dialogue in society. An important part of the Resource Efficiency Network is the support of dialogue projects.
Actual results [quantified]	No specific results have been communicated.
Strengths	The network received a wide recognition from several sectors and other stakeholders in Germany and also worldwide. Some of its strengths are: - It brings together all tools and processes of resource efficiency which have been developed in Germany (and also non-German initiatives) - It covers all aspects of resource efficiency (e.g. technologies, monitoring, education, funding) - It sets a strong communication platform between industry, research and policy making
Drawbacks	No specific drawbacks have been communicated
Lessons learnt	No specific evaluation has been communicated
Contacts	Sandra Kolberg Wuppertal Institute for Climate, Environment and Energy Dr. Stefanie Pfahl Federal Ministry for Environment, Nature Protection and Nuclear safety

Sources and references	http://www.netzwerk-ressourceneffizienz.de/en http://ressourcen.wupperinst.org/uploads/media/NeRess_Flyer.pdf http://www.resourcecentre.etuc.org/linked_files/documents/climate_change/Presentation%20P.%20Wilke%20-%20Network%20Resource%20Efficiency%20in%20Germany.pdf

10 EffNet, Germany

Name	Effizienznetz Rheinland-Pfalz (EffNet)
Organisation	In 2005, Rhineland-Palatinate created the EffNet, as a central consulting and information platform for SMEs including the areas of resource efficiency and environmental technologies. Central Network joint: Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht Rheinland-Pfalz and Energieagentur Rheinland-Pfalz GmbH
Year	2005, on-going
Location	Rhineland-Palatinate, Germany
Type of information provision policy	- Central contact for resource efficiency, energy and environment in Rhineland-Palatinate. - Website provides/includes information on concepts, processes and legislationrelated to resource efficiency - Organisation of events to promote resource and energy efficiency in companies - Brochures on energy efficiency for SMEs and others - Information about existing and future environmental technology – mainly through news about interesting facts and events - procurement of contactpersons - *Web- based benchmarking tool "BUDA"for SMEs in the sectors of bakery, printing, hairdressing, garages and service stations and butcheries. The tool allows companies to compare their performance in the areas of procurement, water, energy, sewage and waste management.***abandoned in 2008** - EffCheck: Financial support, Funding to SMEs and others to obtain consulting services on the potential savings in the fields of energy, water, materials, emissions and waste and on the identification of operational measures.
Funding	The programme is funded by the Rhineland-Palatinate regional government, no specific budget has been communicated.
Scope	The Effnet programme is available for all companies from all sectors, mainly but not only for SMEs, including also big companies and communities. The activities within the Effnet programme include all kind of materials: plastics, wood, etc; waste, water, workload and energy. In terms of material efficiency the programme EffCheck covers the following areas: • Waste and Material Flow Management - optimization of material flow rates and also the prevention of waste, e.g. by closing loops • Material and resource efficiency - covers materials in production processes and other resources such as mineral resources, water, air and land • Efficient energyconsumption, mobility and renewable energies • Emissions and pollution – covers both large industries and smaller companies • Energy efficiency in business – includes all sectors • Environmental Management – focuses on environmental management systems
Objectives	- To link the individual initiatives into a common network and act as a virtual platform for comprehensive information and expert advice on questions to the topic of resource and energy efficiency. - Provide advice on funding opportunities - Provides advice to companies to fulfil compliance to the environmental law
Type of behavioural change expected	The activities planned within the Effnet programme aim to provide the companies with the knowledge to implement resource efficiency strategies, and with a benchmark to compare the performance of different companies in the sector. This information is supposed to help companies start working on strategies to improve resource efficiency.

Level(s) of organisational change expected	The activities planned within the Effnet programme aim to improve the resource efficiency mostly at process level: waste prevention, closing of loops, implementation of environmental management systems, etc.
Expected results and impacts (quantitative and qualitative)	Under the "Effcheck" programme, investigations were carried out in 46 companies and the saving potential was estimated at € 2.8 million per year, with an investment of € 13 million. This corresponds to an annual reduction of 20,000 tonnes of CO_2.
Actual results [quantified]	No quantification of results has been carried out at the time of writing
Strengths	- Focuses on SMEs (also in terms of funding) which need more assistance - Covers a wide range of resources and all media - Covers a wide range of sectors - Follows a horizontal approach by including both energy and non-energy resources - Consists of a network of numerous organisations from different areas - Conjunction of the EffNet-partners - Conjunction with other federal states in Germany - Improvement of the focus on the topic "resource efficiency" - Cost savings in the companies - Environmental savings - Better competitiveness of the companies - Focuses not only on SMEs (also in terms of funding) - Covers a wide range of resources and all media - Covers a wide range of sectors - Follows a horizontal approach by including both energy and non-energy resources - Consists of a network of numerous organisations from different areas - Has short tracks - Is very pragmatic (down to earth) - Is user-based
Drawbacks	- The benchmarking system projected (BUDA) was not successful, due to low participation of companies and network partners. - The lack of manpower limited the success of the programme.
Lessons learnt	The companies that participated in the EffNet programme gained good technical knowledge and a network of contacts, which are supposed to help them developing resource efficiency strategies in the future in a more autonomous way.
Contacts	Robert Weicht Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht Rheinland-Pfalz http://www.luwg.rlp.de/ http://www.effnet.rlp.de
Sources and references	http://www.effnet.rlp.de

11 Effizienz-Agentur, North-Rhine Westphalia, Germany

Name	Effizienz-Agentur North-Rhine Westphalia (EFA NRW)
Organisation	Effizienz-Agentur NRW is part of an initiative set up by the Ministry for the Environment in the region of North-Rhine Westphalia in Germany.
Year	The programme was founded in 1998
Location	North Rhine-Westphalia, Germany
Type of information provision policy	The Effizienz-Agentur NRW programme acts as the centre for small and medium-sized manufacturing enterprises in North Rhine-Westphalia as well as outside this state and has cooperated in several companies and institutions in Europe and internationally. The Effizienz-Agentur NRW programme works as an intermediary between industry, science, politics, the media and the public. Together with partners from industry, science and politics, Effizienz-Agentur NRW develops numerous instruments for enhancing resource efficiency in companies. The programme is based on information provision to companies by means of: • Website • Brochures with success stories • Information forums Within the Effizienz-Agentur NRW programme, a toolbox has also been put in place aiming at helping SMEs increase their resource efficiency. This toolbox includes support in two aspects: • An audit of the resource consumption, advising on how to reduce this consumption and the associated costs for the company • Funding to put in place these improvements. In order to support SMEs, the Effizienz-Agentur NRW programme provides consulting services with the aim to achieve comprehensive strategic and technical improvements concerning the sustainable economy through new strategies, innovative technology and ecologically-oriented measures. The tools and services provided by Effizienz-Agentur NRW cover production, product design, costing and acquisition of funding: **Production** Effizienz-Agentur NRW has developed the PIUS-Check (Cleaner Production), to provide companies in North Rhine-Westphalia with a tried and tested instrument for the development of new business opportunities. With the check, the relevant material flows and the current level of production technology are recorded and the possible improvements in production are illustrated In addition, Effizienz-Agentur NRW developed the “Eco-Efficiency Check for Craftsmen” tool for companies with less than 250 employees. The result of the Check is a plan of measures with solid proposals for process improvements, resulting in the optimization of operational results. **Product design** Effizienz-Agentur NRW has also developed the JUMP-Tool: an instrument for optimising the product development process in terms of eco-design. **Costing** Resource Cost Accounting (RCA) is an environmentally-oriented extension of a business’ cost accounting. It is EFA’s instrument for the recording and illustration of the resource-related cost-reducing potential in a company. The RCA software, links technical and business information and the incurred cost factors identified. RCA aims to increase transparency and harmonisation of the business processes, achieve long-term guarantee of process efficiency and its continuous increase, and increase in resource productivity, increase of the added value in the company. **Acquisition of funding** Effizienz-Agentur NRW provides guidance to implement and speed up investments in Cleaner Production measures. It also supports and assists companies in the application process to acquire funding.
Funding	No information was found.

Scope	*The programme is focused mostly on SMEs.* Several resources are targeted (among others: energy, water, raw materials such as steel, and waste reduction), although the focus is mainly on water management and renewable organic raw materials (e.g. substances of animal or vegetable origin, such as biodegradable lubricants, materials based on vegetable oil, packaging materials based on corn, etc.) A focus area of Effizienz-Agentur NRW activities in process water management is the food industry with its high level of hygiene standards.
Objectives	The main objective of the EFA NRW programme is to develop comprehensive strategic and technical improvements concerning the sustainable economy. In order to do that, the EFA NRW has two main functions: • To act as an authority for optimised knowledge transfer and target-oriented project activities. EFA coordinates services from developers, providers, funding bodies and users of possible innovations. • To support pilot projects by means of funding
Type of behavioural change expected	The EFA NRW aims to raise awareness on SMEs about resource efficiency and provide them with the information and support needed to implement resource efficiency strategies. The strategies promoted are mostly focused on product and process improvement.
Level(s) of organisational change expected	The information and services provided by the Effizienz-Agentur NRW for implementation of resource efficiency are mainly focused on two levels of change: • Process improvement • Product design
Expected results and impacts (quantitative and qualitative)	Under the PIUS-Check Projects (Cleaner Production) projects started, an overall investment of circa € 66 million is expected. From this, an estimated saving of factory supplies of approximately € 19 million per year will be the result. For water resources, savings of around 2.1 million cubic meters per year are expected.
Actual results [quantified]	In the food industry, through an investment of € 15,000, the annual heating oil consumption was reduced by 24,000 litres and the annual water consumption by 3,564 m^3. The total financial savings amount to € 70,000 per year. Effizienz-Agentur NRW also provides support on the application of membrane technology for separating liquid substances mixtures. The application of the technology in the plastics industry resulted to a reduction of groundwater use by 75% to 80%. Since the start of the project in the year 2000, over 500 PIUS-Checks have been initiated. 216 companies have implemented measures and introduced new and renewable production structures with an investment of over € 36 million. The saving of factory supplies alone amounts to approximately € 10.4 million per year for these projects.
Strengths	The programme acts as a link of energy exchange of different actors and through this resource efficiency has been achieved is several companies through innovative solutions. The efforts are focused of SMEs, where more support is needed. The proposed solutions are driven by economic benefits and not only environmental legislation.

Data for 2006	**Previously implemented projects**	**Long-term total capacity of all projects (estimated)**
Number	143	325
Investment	€ 23 million	€ 52.2 million
Annual savings in the production processes	€ 5.4 million	€ 12.2 million
Annual savings water/waste water	759,181 m3	1,730,000 m3
Annual savings of energy	39.3 GWh	89.3 GWh
Annual savings of waste/hazardous waste	10,083 t	15,344 t

Drawbacks	No evaluation has been communicated at the time of writing
Lessons learnt	No evaluation has been communicated at the time of writing
Contacts	Dr Peter Jahns Effizienz-Agentur NRW
Sources and references	http://www.efanrw.de/ http://www.unido.org/fileadmin/import/58381_Presentation_Topic_III_Peter_Jahns.pdf

12 Prevent and Save, Ireland

Name	"Prevent and Save" - Packaging Waste Prevention Programme (PWPP) part of the National Waste Prevention Programme
Organisation	Repak (part of the PRO EUROPE – the umbrella organisation of 33 national producer responsibility systems engaged in the selective collection and recycling of packaging waste, which manages the 'Green Dot' system) and EPA (Ireland)
Year	2007 – on-going
Location	Ireland
Type of information provision policy	- General free information through websites (www.preventandsave.ie). - Organising seminars for members, publications and research on consumer behaviour and preference. - Carry out a Packaging survey (site visit) of 2-4 hours, free to members of Repack. - Advice: providing feedback on the site visit in the form of a confidential report with recommendations on the main areas where improvement is needed. - Organise conference for promoting the programme and waste prevention. Companies of any size are free to contact the programme. Sometimes big companies are contacted directly by PWPP as it is possible to achieve higher waste prevention. - Free services: Information (Best practice examples in the retail sector brochure), access to websites and newsletters.
Funding	An initial funding of 200,000€ was given to the programme. Today it is equally co-funded by the EPA of Ireland (through the NWPP) and Repack. Each year a different budget is put in place depending with the agenda (workload) from a steering group including representatives from Repack, EPA, Enterprise Ireland, Musgraves Ltd and the Department of the Environment, Community and Local Government. The services of PWPP are provided for free to member of Repack hence, part of the fee's for Repack would be allocated for PWPP. For non-members of Repack, the PWPP services are not for free and fees are charged.
Scope	Addressing all businesses with all kinds of packaging of goods or services. Targeting prevention and minimisation of waste production from packaging including: plastics, paper, cardboards, glass etc without affecting the service customers need. The Packaging Waste Prevention Programme aims to utilise the best indigenous and international experience and practice to educate and promote improvements in packaging utilisation including product minimisation, material light weighting and replacement strategies. Conferences, seminars and other informative tools are predominately targeted towards decision making roles, such as managers, design and production staff etc. Nevertheless, depending on the case the information can be targeted to all the staff or business communities in order to spread awareness and the possible impacts of legislation. On the same page, PWPP deems necessary to disseminate information towards a wider audience in relation to the role packaging has in society and ways in which people as consumers can help to reduce it.
Objectives	Provide practical assistance to Irish businesses to reduce the amount of packaging they place on the market. Educate and raise awareness about packaging minimisation and recycling. Promote improvements and best practice available by setting exemplar best practices and rewarding them for packaging design. Try to prevent or minimise waste production. Support companies on packaging design (though the available websites). Development of a carbon footprint for calculator for member companies. Development of an interactive householder carbon footprint calculator.
Type of behavioural change expected	Series of awareness seminars to businesses and general public. Create competition between companies by giving out awards (Packaging Design Awards) that can be used for communication purposes. Provision of a "Self-Audit Tool" that helps companies comply with the legislation and document their efforts'.

	Changes on the transportation of products by grouping them together before delivering them to the retailers can result in the reduction of packaging. Packaging optimisation: redesign of packaging, trying to create less waste in the first place, such as: • Prevention, removing or avoidance of certain packing (e.g. substitution of rigid trays to bags,) • Minimisation, lightening of packaging (e.g. change from punnet casing to skin pack) • Increasing the amount of recyclable packing (promotion of returnable cases) Promote exemplar practice for others to follow (concrete examples)
Level(s) of organisational change expected	Mainly design and manufacturing processes of packaging are expected to change. The surveys and toolkit look on all the packaging entering and exiting the companies. There are three main categories of packaging that the programmes aims at reducing: • Primary - surrounds the product sold to the consumer • Secondary - collates the sales units for ease of handling. Tertiary - facilitates handling and transport of a number of sales units or collated sales units.
Expected results and impacts (quantitative and qualitative)	The PWPP helps businesses reduce waste created and achieve savings through: • Prevention and minimisation of waste production, “stop waste before happening”. • Avoid over packaging and disposal. • Reduce/eliminate non-reusable or non-recyclable products where possible. Reduce product cost associated with “pay by weight” fee structure that exists in order to discourage excess packaging.
Actual results [quantified]	Results for each company are mostly confidential with only selected companies publishing their achievements due to the services of PWPP. The PWPP team is working towards calculating the overall environmental and financial benefits throughout the course of the programme and they are expected to be published later on this year or early of the next one. Some of the overall savings achieved during 2010 are: • “In the period between July 2010 and June 2011 the programme worked with over 30 companies on packaging related projects and carried out 12 formal packaging optimisation surveys” • It is estimated that more than 77,000 tonnes of packaging has been removed from products of Repack members. This translates to 13% of the total packaging placed in the market by the Repack members. • “More than 145 prevention related news stories uploaded on the website”. Some case studies results: **1) Diaego Baileys** Daiego Baileys prevents almost 53 tonnes of cardboard (over 900 trees) and 378 tonnes of glass (1.2 million glass bottles) every year thanks to the innovative industrial design of its new bottle introduced in 2004. **2) Georgia-Pacific** By developing a ‘coreless’ toilet roll, Georgia-Pacific reduced the cardboard packaging by 100%. As well as using 100% recycled paper, by improving pallet utilisation and reducing packaging film, it reduced primary packaging by 76%.
Strengths	- It includes all businesses and services involved in packaging, from hospitals to industry. - It stresses out the importance of prevention and minimisation. - Provides a lot of information, examples of good practice and support to Repack and the programme members - It provides experience guidance and support to members via the programmes Packaging Technologists. - Stays ahead of current legislation. - Economic benefits and financial savings are achieved by businesses joining the PWPP at the same time as reducing the environmental impact of products. - Businesses joining the PWPP can use their achievements as a communication tool. - Businesses joining either the PWPP or any of the other programmes available under the NWPP have accesses to the other programmes as well. The PWPP is in collaboration with other programmes within the NWPP and hence, giving “access” to other services that could help reduce the environmental impact of businesses.

Drawbacks	No overall results available yet. Results from case studies focus mainly on waste prevention achieved and not concrete economic benefits, which could further promote the programme. However, the PWPP team is working on it to provide such information. There are difficulties in communication between the EPA, NWPP and other programmes, making it hard to coordinate and provide a more complete holistic approach (one spoke in a wheel). There are some difficulties in coordinating with EPA Ireland. The time available for each project is limited.
Lessons learnt	Feed back and return record shows that companies are satisfied with the outcome from joining the programme and usually come back for further consultation. Same companies (usually SME), which approach the programme themselves are more enthusiastic and willing to implemented suggested measures from bigger companies approached by the PWPP team. Experience has shown that there is a need for building trust between the programme and companies/businesses. This is due to the access to confidential information that the team members of PWPP come across during the site surveys and the measure they suggest might have boarded consequences. The programme team have identified the need for better communication of the programme and its attributes. There are some difficulties on communicating some of the results of companies as they do not wise so and the information has to be confidential.
Contacts	Eoin Kennedy Colm Munnelly John Coleman Repak http://www.preventandsave.ie/
Sources and references	http://www.preventandsave.ie/ http://www.preventandsave.ie/Introduction_to_Packaging_Prevention.html http://www.epa.ie/whatwedo/resource/nwpp/

13 Money Back Through the Window, Hungary

Name	Money Back Through the Window (Ablakon Bedobott Pénz)
Organisation	KÖVET Association for Sustainable Economies. KOVET is an association, which was established to promote environmentally aware business management towards enterprises. KÖVET is a non-profit, non-governmental organization and the Hungarian member organization of INEM (International Network for Environmental Management), CSR Europe and Global Footprint Network through which it is linked to international sustainable business initiatives and projects. KÖVET has about 80 member companies, and 23 associated members (universities, other NGOs).
Year	2002, on-going
Location	Hungary (national)
Type of information provision policy	- Website which provides guidance on resource savings for business - A book called „Money Back through the Window" is published annually in Hungarian and contains case studies on cost savings through environmentally frinedy measures (including resource efficiency) in business. The books are also available online. - A database of case studies which is searchable by sector, resource and other parameters - An annual award called "the Environmental Savings Awards" which is given in three categories every year. The categories are differed according to the payback period of the measures. There are immediately remunerative changes (which don't need investment), measures that payback in three years, and investments with a payback period more than three years. - Organisation of workshops - The case studies are presented in KÖVET's annual conference in Budapest
Funding	The annual budget of KOVET association comes from tenders and applications - 30%, from offered services - 55% and from membership-fees - 15%. Regarding the membership fees these are as follows: **Number of employees** / **Annual fee for 2010 (EUR)** 1-2: 110 3-10: 270 11-100: 670 101-500: 1260 501-1000: 1780 Above 1000: 3040 The total budget of KOVET is € 330,000, which is specifically allocated for the Money Back Through the Window
Scope	Resources and materials covered include, air, energy, fuels, soil and water. Sectors include fisheries and forestry, mining and quarrying, manufacturing, electricity and water supply, construction, the commercial sector, hotels and restaurants, transport and logistics, real estate and others. All company sizes are represented. The scheme does not focus on specific staff categories. However the environmental managers of the winning companies receive an award worth € 340.
Objectives	The objective of the scheme is to act as a platform of exchange of best practices on environmental practices with a good return on investment. In addition through its annual award it provides an additional incentive to the companies to implement initiatives on resource efficiency, since it can be included in their marketing strategy.
Type of behavioural change expected	The initiative does not provide specific guidance on how to achieve resource efficiency. It mainly aims at continuously building a database of best practices, which can serve as a source of inspiration for other companies.

<table>
<tr><td>Level(s) of organisational change expected</td><td>The initiative does not target any specific type of organisational change and all types are covered. Based on the case studies provided, it seems that most of them focus on technology change.
For example a rubber plant modernised its water pre-treatment system by using membrane filters which replaced an ion-exchange based water softening system, saving 162 tonnes of regeneration salt and 40 000 m^3 of fresh water.
In addition a brewery applied different measures to reduce water-consumption, which included the installation of a new can filler production line and a closed-system flash pasteurizer, which uses less water and energy than the older production line tunnel pasteurizer.</td></tr>
<tr><td>Expected results and impacts (quantitative and qualitative)</td><td>Depending on the case studies gathered so far, an average of € 88 000 can be saved with measures that need no investment at all. The payback time of the “Low hanging fruits” is one year, and brings an average saving of € 180 000. The so called “High hanging fruit” measures need more than € 3 million investment in average, and have a payback period of 8 years. This means € 400 000 saving annually.</td></tr>
<tr><td>Actual results [quantified]</td><td>The results achieved by the Money Back through the Window Programme for the period 2002-2007:
- 262 measures implemented with environmental and financial benefits in 56 organisations employing 108 people
- The 56 organisations annually saved together:
o 1,510 litres of cleaning agents
o 503,000 litres of fuel
o 5 tonnes of ammonia
o 788 tonnes of solvents
o 539 tonnes of alkali
o 19.7 million m^3 of water
o 410,000 tonnes of non-hazardous waste
o 51,000 tonnes of hazardous waste
- A total of € 58.8 million

<table>
<tr><th>Type of measure</th><th>Number of projects between 1991and 2007</th><th>Total investment</th><th>Total annual operation cost</th><th>Total annual saving</th><th>Average payback period</th></tr>
<tr><td>“Washed fruits on the table” (no investment needed)</td><td>95</td><td>€ 0 (only reorganisation)</td><td>€ 213,200 (€ 2,900 average)</td><td>€ 12.8 million (€ 134,000 average)</td><td>Immediate</td></tr>
<tr><td>“Low hanging fruit” (payback period less than three years)</td><td>106</td><td>€ 20.6 million (€ 200,000 average)</td><td>€ 2 million (€ 15,600 average)</td><td>€ 20.3 million (€ 180,800 average)</td><td>1 year 2 months</td></tr>
<tr><td>“High hanging fruit” (investments with over three years payback period)</td><td>61</td><td>€ 177.6 million (€ 3.1 million average)</td><td>€ 2.3 million (€ 25,600 average)</td><td>€ 24.4 million (€ 412,000 average)</td><td>8 years 1 month</td></tr>
</table>
</td></tr>
<tr><td>Strengths</td><td>The five volumes of the case studies (published between 2002 and 2007) altogether contain 56 case studies from leading companies (e.g. Alcoa, Audi, Ericsson, Flextronics, GE, HP) and small enterprises. These companies represent 25% of the country’s industrial output and 11% of all employees in the manufacturing sector.
The initiative seems to receive a wide recognition (e.g. the award winners seem to include this achievement in their marketing activities)
Covers all sectors and wide range of resources
It offers both knowledge sharing and an incentive to achieve resource efficiency (through the award)
It can act as an example which can be followed by other new Member States</td></tr>
<tr><td>Drawbacks</td><td>- Lack of environmental information
- Incompetence of Small and Medium size Entreprises (SME) executives
- Misbelief that environmental protection is expensive
- SMEs plan for short time (deal when problem arise)</td></tr>
</table>

Lessons learnt	
Contacts	Mónika Besenyei KOVET Association www.kovet.hu
Sources and references	EMAS Easy Project in Romania, TAIEX seminar 17th of September 2009 http://www.mmediu.ro/vechi/departament_mediu/controlul_poluarii/Taiex_emas2009/KOVET%20EMAS8Country.ppt http://www.ablakonbedobottpenz.hu/letoltheto_anyagok/english_summary.pdf Website of the organizing body: http://www.kovet.hu Official website in English: http://www.environmental-savings.com Official website in Hungarian: http://www.ablakonbedobottpenz.hu/

14 IHOBE, Spain

Name	Eco-efficiency programme for Basque Companies 2010-2014
Organisation	IHOBE, Basque Government's Environmental Management Company
Year	2010, ongoing until 2014
Location	Basque region, Spain
Type of information provision policy	Free services for businesses: • Environmental information tools: Ihobe provides information on all environmental-related areas in the world of business: legislation, paperwork, technical tools, practical guides, case studies. • Tools for training for action: workshops, expert courses, specific training on-demand • Tools for supporting business and technology decision-making: environmental observatory of best practices, regulations, knowledge, etc. Forums on challenges, opportunities and best practices. • Tools for environmental action: environmental audits and plans for resource savings and CO2 emissions reductions funded by Ihobe. • Tools to support the application of environmental guides and methodologies: Ihobe accompaigns companies in implementing environmental management systems, ecodesign, ecolabelling, green purchasing, etc. • Tools to support recognition: expert advice to apply for environmental awards, promotion of certificates and best practices
Funding	15 million € - includes funding/subsidies (50% of total budget)
Scope	All types of business and sectors, including SMEs. All types of resources (including energy) Priority is given to companies with Environmental Management Systems: EMAS and ISO 14001.This ensures a better tracking of the benefits obtained. Priority to the following sectors: • products affected by ErP Directive • renewable energies • transport and mobility • machine tool • building • food • industries affected by IPPC • metal transformation • surface treatment • industry of plastics • foundry Training tools oriented to engineers and designers. Decision support tools oriented to managers and directors.
Objectives	**Generic**: To make the Basque Country into one of the EU's leading regions for the implementation of environmental management and eco-design systems. To promote the incorporation of cleaner technologies into businesses To help companies bring out new, greener products and services To increase green procurement at companies To publicise actions and results at companies so that knowledge is shared and there is greater recognition for the environmental efforts of those involved **Specific**: To reduce GHG emissions in the Basque Country To increase the proportion of waste produced by companies that is valorised To prevent the consumption of raw materials, with the subsequent financial savings The objectives for the programme are: • 1,000 companies participating in 2014 (out of 4,500 companies with more than 10 employees in the

	Basque region) • 100 new companies involved in eco-design • 100 companies with EMAS registration • 150 companies implementing cleaner technologies
Type of behavioural change expected	Some of the services influence decision making, while others are focused on capacity building or support for action. The services are open to all the companies interested, and they are announced and promoted in conferences and publications. The companies interested have to make a formal service demand. The companies sign a compromise of carrying out at least one improvement action per year, but the level of change is not specified.
Level(s) of organisational change expected	The level and nature of changes in businesses are not specified by the programme. The companies make a commitment of improving their products or processes in a yearly basis, but there are no criteria for evaluation. The programme is based on promoting the collaboration between private and public companies. The market and the initiative of the companies would drive other companies to implement resource efficient technologies. The companies collaborate in a network where they can share information and the role of the public administration is that of an advisor. The services provided can help the company at different levels: • Process improvement (production, waste management) • Product or service redesign • Technology change
Expected results and impacts (quantitative and qualitative)	• 100,000 tonnes GHG reduction • 100,000 tonnes of waste valorised • 200,000 tonnes of raw material consumption reduction
Actual results [quantified]	No evaluation has been performed at the time of writing. Some of the services provided within this programme were already running beforehand. The services related to ecodesign had a cost of € 5 to € 10 per tonne of CO2 eq. saved per year. Ihobe expects to reduce this cost in the present programme, since the implication of private companies is higher and that of the public administration is lower.
Strengths	The programme has been prepared in collaboration with private companies and industry associations, with the aim of responding to their needs. It promotes the collaboration between companies and reduces the public spending.
Drawbacks	SMEs do not have enough resources to achieve results. This programme is focused on companies that already have done some work on environmental issues, which is not always the case of SMEs. Some sectors are more resistive to get involved in the programme: • paper industry • steel industry • chemical industry • food
Lessons learnt	The knowledge transfer within a network formed by the businesses has proved to be an effective way of informing and training companies. The companies with more experience in resource efficiency participate in the organisation of workshops for other companies.
Contacts	Ander Elgorriaga IHOBE S.A. www.ihobe.net
Sources and references	www.ihobe.net

15 On Course for Zero Waste, Scotland

Name	On Course for Zero Waste
Organisation	Zero Waste Scotland
Year	2011
Location	Scotland, UK
Type of information provision policy	Free online training course with expert in resource efficiency and waste management as mentor. The course is accredited by the Chartered Institution of Wastes Management (CIWM) and can count as Continuing Professional Development (CPD). The course provides free tools and easy to use templates. The course consists of four 40 minute training modules: • Module 1: Waste and process mapping • Module 2: Measuring and monitoring • Module 3: Develop an action plan • Module 4: Gaining support and an extra four advanced, in-depth practitioner modules: • Module 5: Resource efficiency and process improvement • Module 6: Behaviour change • Module 7: Supply chain management and sustainable procurement • Module 8: Environmental management systems (EMS)
Funding	Scottish Government and WRAP (Waste and Resources Action Plan), UK
Scope	SMEs, all industries, all materials. The course is designed for office managers, administrators, environment managers, health and safety personnel, purchasing teams and other environment champions. Training also covers soft skills.
Objectives	To provide Scottish SMEs with the skills and tools to: • understand how much waste their organisation produces • identify how waste costs are affecting profits • identify simple ways to start reducing waste and save money • be able to measure the waste and cost savings made • be able to bring about change • benefit from improved skills and expertise
Type of behavioural change expected	The training programme is focused on providing with the knowledge to be able to reduce waste production and diverting waste from landfill.
Level(s) of organisational change expected	The Course for Zero Waste aims to reduce the waste of all materials generated in all industries in Scotland. It includes better governance practices and also management of the supply chains, environmental management systems, etc.
Expected results and impacts (quantitative and qualitative)	No quantified objectives have been established at the time of writing
Actual results [quantified]	No evaluation has been carried out at the time of writing
Strengths	Quick, structured access to knowledge

Drawbacks	No evaluation has been carried out at the time of writing
Lessons learnt	No evaluation has been carried out at the time of writing
Contacts	Joanna Hartga Zero Waste Scotland Business Resource Efficiency Programme http://www.zerowastescotland.org.uk/
Sources and references	http://www.zerowastescotland.org.uk/ http://smetraining.zerowastescotland.org.uk/

16 Hackefors, Sweden

Name	Hackefors Model Sweden
Organisation	Altea AB
Year	In 1996 by a group of small and micro sized enterprises in the Hackefors district. On-going
Location	Hackefors district (Linköping), Sweden
Type of information provision policy	**Database** of environmental legislation to obtain the ISO 14001 certification, **Individual Consultation** is provided to adjust to specific needs of each enterprise in order to analyze their environmental performance, **General Meetings** are hold monthly during the EMS implementation phase to exchange general advances, Website The Hackefors Model **does not have its own website.** Altea AB as consultancy provides the basic information about the programme.
Funding	In the start-up phase **50%**of the Hackefors **the model was funded by the government**. With the commercial reproduction of the Model by the consultancy Altea AB networks are now funded by participation fees of enterprises, which depend on the number of enterprises involved in the network and vary according to enterprises size. Fees are mainly used to finance the central co-ordinator and the support group (E.g. the service provided by Altea.) Experience showed that the process is working well without subsidies however the amount of training had to be reduced in order to keep the costs low enough to be affordable for SMEs.
Scope	-Aim for increased energy efficiency -The prototype network Hackefors consists of 30 SMEs. Until 2004 approximately 600 enterprises in about 40 different networks took part.
Objectives	The Hackefors Model aims to improve the environmental performance of SMEs by facilitating the implementation and maintenance of an Environmental Management System (EMS), so that SMEs can achieve a joint ISO 14001 certification. Participating enterprises benefit from economies of scale and scope as through a joint certification process costs, time and human resources can be shared. Benefits for SMEs to join the network are of the expected positive impacts on their business (e.g. image improvement through an ISO 14001 certification) as well as improved environmental performance (e.g. reduction of emissions, increased energy efficiency and substitution for more environmentally sound goods).
Type of behavioural change expected	**Provision of information** is done by the consultancy Altea AB. They provide a database of environmental legislation to obtain the ISO 14001 certification. The Altea AB adjusts the database to specific operations and needs of participating enterprises. The body includes accounting rules for the financial department, taxation and social security contributions for the payroll department, employment law for safety officers and environmental law for environmental managers. The database is updated regularly to the latest version of environmental law. **Individual Consultation** is provided to adjust to specific needs of each enterprise in order to analyze their environmental performance. The co-ordinator and the steering committee prepare a guideline that facilitates the specific identification of environmental improvements according to ISO 14001 within each SME. Each enterprise carries out its own assessment according to the guideline while the co-ordinator and the support group (Altea AB) assist and supervise them within their progress. Dedicated enterprise visits are intended to discuss own reviews and set individual objectives and targets. **Training** is conducted by Altea AB in form of regular courses and seminars at different levels. Topics are among others: Environmental Basics - the environmental impact, environmental management, quality management, chemical education, internal audit training, hazardous waste &recycling and risk analysis. Environmental trainings are not only made for the selected environmental agents of each enterprise. The training of all employees is essential to motivate them to participate effectively and make them understand how to cope with environmentally related tasks. **General Meetings** are held monthly during the EMS implementation phase to exchange general advances. Enterprises agree on certain homework tasks that have to be fulfilled within the next month. General meetings provide an opportunity to share experiences and discuss systems with other enterprises of the group. Group meetings are not only organized for the implementation of EMS but also to maintain relations within the network afterwards. **Meetings on specific topics** were set up in Hackefors by enterprises themselves, as they became aware of the benefits within a network approach. Thus the model encouraged relationships also outside the EMS process. Enterprises in Hackefors increased the categories of waste collected separately, so some categories could be re-used by other enterprises within the network. Further collaboration was the establishment of coordinated transportation, joint purchase of energy, a creation of a district heating system, shared of collective services (pool for workers, caretakers, security guard) and shared office equipment. information

	about the programme, however it is only available in Swedish. **Marketing/PR** Altea AB and the Hackefors Model do not use any active communication or marketing strategy. However the model raised awareness in many regions across Sweden through word of mouth recommendation. Districts and enterprises contact Altea AB directly when hearing about existing networks and their success. On the international level the model has been mentioned and discussed as a prototype in academic research and several publications. **Best practise** The Hackefors Model as a network approach and the environmental achievements of the participating SMEs serve as best case examples for further enterprises that adopted the concept. **Monitoring of SME performance** is done through internal and external audits. Each enterprise set individual objectives and targets according to the collective objectives the network. Together they serve as a guideline for the networks' process. Internal audits are set by enterprises own environmental agents, which receive auditing trainings. Since auditors should judge objectively environmental agents do not audit their own enterprises to ensure independence and neutrality. In case of non-conformance with environmental laws, results are compiled and discussed within the network meeting. External assessors audit the enterprise in order to obtain the ISO 14001 certification. Afterwards regularly audits follow to maintain the certification. **Monitoring of the whole network process results** from the certification of the whole group at the same time. SMEs act together like a large company purchaser and benefit from bargaining advantages. Costs for the external audit process are cut down.
Level(s) of organisational change expected	The resource efficiency measures covered include all types of changes, but often they are focused on process improvement and best governance practices.
Expected results and impacts (quantitative and qualitative)	No quantified objectives were established at the time of writing
Actual results [quantified]	The first initiative, held in the Hackefors district, involved 36 SMEs, the majority of which were, surprisingly, micro firms. Since that time, the model has been reproduced in 40 different groups in several other Swedish regions, and in 2004 the number of firms being certified to ISO 14001 as a result of this model raised to 600. Amongst these, 59.1% of certificates have been issued to micro enterprises; 29.6% to small enterprises; 9.4% to medium-sized companies and 1.9% to large companies. It is also worth mentioning that 8.2% of all the enterprises that adopted the model had only one employee. According to a recent study on the Hackefors model, the initiative has resulted in energy cost savings, improved relationships with customers, increased interest in training, and certification cost savings as a result of group certifications. In the same study, surveys revealed that over one third of the involved companies had undertaken further collaboration with other network members in many areas such as training and recycling. This seems to imply that the model, more generally, has made participants more aware of the benefits of network approaches
Strengths	The model's effectiveness was such that this initiative spread, especially at national level, without the need for communication and marketing tools. The initiative also gained credibility at the international level, having been discussed in several publications, academic research and in the European Commission's 'Best' Project of 2004. Main strengths: - Takes a network approach, which can be used by a variety of firms from different industrial sectors. - Makes ISO 14001 more affordable for SMEs: the network approach requires less human and financial resources and may lead to significant cost savings, compared to individual certification. Provides an experienced coordinator, offering support throughout the process. - Is delivered through a network of environmental representatives from each company, and coordinated centrally. - Encourages relationships between companies, which may then cooperate in other network activities (such as training, district heating, electricity purchase, etc). Characteristics contributing to the identified strengths: a. Communication No communication strategy has been developed so far, although the Hackefors model has a good reputation among the customers and promotion has worked well through word of mouth. b. Delivery The model is applied to enterprises as a service provided by Altea, which acts as central co-ordinator responsible for the network and the common parts of the system (see fig.1) c. Management The experience of the co-ordinator is a key factor for the success of the initiative. The co-ordinator is a

	member of Altea, thus a well trained professional with proven experience in the field of group certification. d. Funding The initiative is well functioning even without public funding. The price for companies was not raised when the funding was suspended. e. Other The method of group meetings has proven to be highly beneficial, not only for the implementation of the EMS, but also for building relations between the involved companies Other factors which may have contributed to its success An increased awareness and interest of SMEs in EMSs was noted, particularly since they have been required when applying to some public contracts/projects
Drawbacks	Although the initiative has managed to attract SMEs without a marketing campaign, in the future it may suffer from the lack of a communications strategy. The absence of such a strategy may restrict its visibility with less well informed companies and companies outside of Sweden. Main weaknesses: According to research, disadvantages may include dependence on the central organisation/coordination. The central coordinator is a crucial figure, who must be a good communicator, a capable leader and should have a good understanding of the entire district. The central design of the EMSs may result in decreased flexibility of the individual company EMS. Also noted was the fact that the whole standardised EMS process could be too much of a burden administratively for the smallest firms taking part in the networks. It is not always easy for some companies to maintain network links after certification is achieved.
Lessons learnt	If this initiative were to be replicated, what key lessons would you share? - It is important to keep in mind that the network of companies can include companies of very different sectors and with different internal skills. - It is important for the co-ordinator to be flexible and understand companies' peculiarities and needs, in order to relate with each of them in accordance with their capabilities to understand and adopt a management system. - A good engineering expertise may be needed to properly assess the environmental impacts and management requirements of each different firm involved. Good training of the co-ordinators is a key factor for transferability.
Contacts	Mr. Kurt Börjesson Altea AB http://www.altea.se/ Andrew Briggs NQA Nordic AB
Sources and references	http://ec.europa.eu/environment/sme/pdf/hackefors_model_en.pdf

17 Courtauld Commitment, UK

Name	Courtauld Commitment
Organisation	WRAP (Waste and Resources Action Programme)
Year	Phase 1: 2005-2010 Phase 2: 2010-2012
Location	UK
Type of information provision policy	WRAP facilitates change through forums and workshops to encourage best practice being taken up across the sector and provides information such as a variety of different case studies on packaging reduction in grocery retail sector in the UK.
Funding	The approximate costs for the delivery of the Courtauld Commitment have typically been around £3.5 million (€ 4.3 million) per year. However, the costs have been steadily reducing – the programme is currently being delivered for less that £3 million (€ 3.7 million) per year. These costs include administration, development of the evidence base, all tools and resources, key account support, impact monitoring and evaluation and communications. The emphasis has shifted from funding of collaborative research (e.g. a multi-partner project to look into options to reduce the weight of glass used for bottles) in Phase 1, to more direct support for individual businesses in Phase 2. The majority of funding comes from the UK national governments (including Scotland, Wales and Northern Ireland).
Scope	The Courtauld Commitment is a responsibility deal aimed at improving resource efficiency and reducing the carbon and wider environmental impact of the grocery retail sector. **Phase 1** was a voluntary agreement between WRAP and over 40 major retailers, brand owners, manufacturers and suppliers aimed at developing solutions across the whole supply chain to reduce both household packaging and household food waste. **Phase 2** moved away from solely weight-based targets and aims to achieve more sustainable use of resources over the entire lifecycle of products, throughout the whole supply chain. It considers the journey of products, from manufacturer to disposal, to see where the greatest efficiencies can be made both environmentally and economically. At the launch of Phase 2 on 4th March 2010, 29 major retailers and brand owners had already pledged their commitment to this voluntary agreement. Today there are now 52 signatories. The Courtauld Commitment helps businesses to: • Save costs and cut waste and CO2 emissions • Improve the resource efficiency of products and their packaging • Help improve industry practice and drive innovation in the sector • Create a support network and vehicle for change • Better position organisations for a carbon-constrained future • Deliver against consumer expectations (e.g. demand for less waste) • Support for delivering the requirement of future UK and EU legislation
Objectives	**Phase 1: 2005-2010** • Design out packaging waste growth by 2008 • Achieve absolute reductions in packaging waste growth by 2010 • Identify solutions to the food waste problem (objective at inception) and help reduce UK food waste by 155,000 tonnes by 2010, against 2008 levels (objective was quantified following review of initial evidence-based research) **Phase 2: 2010-2012** • Packaging – to reduce the weight, increase recycling rates and increase the recycled content of all grocery packaging, as appropriate. Through these measures the aim is to reduce the carbon impact of this grocery packaging by 10%. • Household food and drink waste – reduce by 4%. • Supply chain product and packaging waste – to reduce traditional grocery product and packaging waste in the grocery supply chain by 5% - including both solid and liquid wastes. It should be noted that the targets set out in the Courtauld Commitment are for WRAP, not individual signatories; the signatories sign up to the Commitment in order to support WRAP in achieving the targets.

Type of behavioural change expected	WRAP is responsible for the agreement and works in partnership with leading retailers, brand owners, manufacturers and suppliers who sign up and support the delivery of the targets. Although not signatories, the British Retail Consortium and the Food and Drink Federation are also aligned with the Commitment's principles. These industry associations have been close working partners with WRAP, providing significant assistance. In particular, their involvement has provided another vehicle for communications – both from WRAP to signatories and as a conduit for feedback from signatories to WRAP. Courtauld Commitment signatories work with WRAP's key account managers to develop implementation plans. They also work on their own drives for more efficient operations, for example: • Through their supply chains to encourage common goals. This has a crucial role in helping future-proof their businesses and their customer base. • With consumers at home who use their products. Shoppers are more likely to take action if the grocery sector makes the solutions affordable and easy. Phase 2 has supported key account managers (these are both WRAP consultants and subcontracting consultants) with centrally developed methodologies and tools. The key account management resources have been both increased (with a focus on training/expertise in delivery) and supported by small expert teams that specialize on one of each of the three issues targeted (household food waste, packaging and supply chains). This approach has proved to be cost-efficient, maintaining a high level of impact at the same time as achieving cost reductions. Reporting requirements have been kept as simple as possible to reduce the burden on signatories – only essential information is required, and reporting is annual.
Level(s) of organisational change expected	The Commitment tries to ensure that there is strategic alignment, that the day-to-day mindset of business operations follows the targets set out. Signatories are encouraged to implement the findings of their individual review with their supply chains, so that resource efficiency can reduce the cost of produce from suppliers. New packaging strategies developed by retailers for implementation across their supply chain focus on: • Biopolymers and compostable packaging • Providing consistent on-pack recycling information for consumers • Household food waste reduction initiatives • Company-specific internal targets • Best practice sharing through case studies In addition, initiatives around recycling infrastructure have taken place, altering the design of the recycling system by providing consumers with alternative options (e.g. provision of recycling facilities for plastic bags and films). Hence, all levels are covered.
Expected results and impacts (quantitative and qualitative)	Independent assessment of the potential savings available to UK business from resource efficiency measures, estimates that total cost savings could be as high as £ 6.5 billion (€ 8 billion) per annum. Thirteen UK food and drink manufacturing site reviews identified where efficiencies could be made around food and packaging waste; the results showed that this sector could save about 720,000 tonnes (£ 404 million / € 500 million). Programme targets are set out in the 'Objectives' section.
Actual results [quantified]	**Phase 1: 2005-2010** 1.2 million tonnes of food and packaging waste have been prevented over the last five years through the success of Phase 1. The results announced in September 2010 show that 670,000 tonnes of food waste and 520,000 tonnes of packaging have been avoided across the UK between 2005 and 2009. This avoided waste is the equivalent of: • Approx £ 1.8 billion (€ 2.2 million) worth of food and packaging waste that could be avoided • Around 3.3 million tonnes of CO_2 equivalent emissions **Phase 2: 2010-2012** First Year Results (2009 vs 2010) First year progress results show that signatories are already half way to achieving the packaging reduction target and three quarters of the way to reaching the household food waste objectives. The supply chain impact is significantly less at only 0.4% but this is a new area for the Commitment and will be an area of additional focus going forward. The 2011 results may be published in late 2012. A final collective outcome is due to be reported in 2013.

	First year reduction	3-year target
Packaging	5.1%	10%
Household food and drink waste	3.0%	4%
Supply chain product and packaging waste	0.4%	5%

Strengths	The approach taken is critical; engagement by key account managers on a one-to-one basis and through on-the-ground support. The deeper relationship at senior and operational levels helps to secure strategic buy, encouraging business objectives to overlap with the objectives of the Commitment. This close relationship also allows WRAP to keep up to date informally with the progress achieved towards the target, which compensates to some extent for the irregular (annual) reporting. The fact that WRAP is responsible for meeting the targets removes the pressure from individual signatories from achieving specific targets (signatories may have varying ability to achieve such targets depending on factors such as their opportunities for resource efficiency or progress in redesign/waste reduction action). A more collaborative approach to accelerate change through voluntary agreements or responsibility deals, encouraging the whole sector to work collectively towards common goals and foster rapid innovations that work 'with the grain' of business. A strength that businesses have highlighted is the value offered by the opportunity to meet with peers in a non-competitive environment. There are no onerous reporting requirements, and WRAP organise regular reporting workshops to listen to feedback from signatories and respond. A regulatory approach would be likely to have high administrative costs. The voluntary approach offers significant flexibility. Phase 1 focused on avoiding landfill, whereas Phase 2 has evolved to focus on climate change mitigation. The Commitment has also adapted to signatories' increased ability to meet more complex reporting requirements, and their changing ambitions and focus on climate change. There are other examples of this flexibility – a seasonal confectionary group was established to work on reducing the packaging of Easter eggs (target of 25% reduction by weight) – WRAP funded a few designers to offer preliminary ideas, and the signatories took responsibility for meeting the target, finally achieving reductions of up to 80%. The group's focus has now moved onto recyclability. The learning from these types of initiative can then become the 'norm' in industry.
Drawbacks	Although the implementation plans have worked well with manufacturers, retailers have been more reluctant to constrain their actions with the type of wording typically included in such plans. The impact of reporting on the signatory (i.e. time and cost to signatory) – over-burden of reporting requirements may alienate the signatories, while annual reporting hinders the opportunity to respond in a timely manner to occasions were progress is falling short of the targets (or other deficiencies arise). For example, the relatively small improvement toward the Phase 2 supply chain target has been addressed through a more intensive support programme – however, the results of this action cannot accurately be judged until the 2011 results have been submitted and collated (scheduled for late 2012). The cost of delivering the programme – the change that may have happened without the implementation of the programme should be considered. On the other hand, the programme has been effective in ingraining change in practice within signatories and it is questionable whether the same levels of commitment would have occurred without it.
Lessons learnt	WRAP has learnt how to run voluntary agreements, and that these initiatives cannot be imposed on business – they need to be implemented in agreement. WRAP understands the 'language' of both government and business, and this is appreciated by all parties. The high value that business places on maintaining confidentiality – WRAP never publishes or shares with governments any results from individual signatories; all results are presented in aggregated formats. That, in terms of funding, it is not necessary to spend a lot – what is essential is having people with the right experience and connecting with the right individuals in businesses. However, some funds are needed to develop case studies and tools, and direct support to deliver greatest cost savings. Moving to a carbon-based target in Phase 2 was more effective and led to reduction in overall carbon impact, as it is affected by the recycling rate and recycled material content of packaging. The previous weight-based target in Phase 1 was described by signatories as being too blunt and led only to a reduction in the weight of packaging. Participating businesses have learnt a lot about resource efficiency and haw to implement it in their business. They have also learnt how voluntary approaches can work well and the sorts of actions that need to be taken to make them work (e.g. consistency in reporting to enable aggregated measures of impacts).
Contacts	Andy Dawe WRAP www.wrap.org.uk/courtauld
Sources and references	http://www.wrap.org.uk/retail_supply_chain/voluntary_agreements/courtauld_commitment/phase_2_targets_pro.html http://www.wrap.org.uk/retail_supply_chain/voluntary_agreements/courtauld_commitment/phase_1/ http://www.wrap.org.uk/downloads/CC2_First_Year_Progress_Report_05_Dec_11_final.c2457d43.11547.pdf http://www.wrap.org.uk/downloads/Evaluation_of_Courtauld_1_Food_Waste_Target_final.5ef87ae9.11463.pdf http://www.wrap.org.uk/downloads/CC_Info_Sheet_12_Jan_2012.d25bcb3b.9220.pdf

18 Envirowise, UK

<table>
<tr><td>Name</td><td>Envirowise</td></tr>
<tr><td>Organisation</td><td>Envirowise evolved from the former Environmental Technology Best Practice Programme (ETBBP) which ran from 1994 -1999, Envirowise is no longer an operational programme. (However, from April 2010 the Waste and Resources Action Programme (WRAP) took over responsibility for promoting the benefits of Resource Efficiency to business, initially continuing to facilitate access to the Envirowise material whilst a review was undertaken to identify the key pieces of information that would be retained and/or updated.; The Envirowise site is now closed, and information can be accessed via the WRAP Business Resource Efficiency hub www.wrap.org.uk/brehub</td></tr>
<tr><td>Year</td><td>1999 – 2009 (Resource Efficiency support for business is now available through WRAP)</td></tr>
<tr><td>Location</td><td>UK</td></tr>
<tr><td>Type of information provision policy</td><td>Envirowise Advice Line (0800 585794): Point of contact for companies seeking free, confidential and tailored advice on resource efficiency.
www.envirowise.gov.uk: Information available on the website included best practice guides, case studies and a calendar of topical environmental events. The online Publications Wizard enabled users to create a tailor-made guidance document, drawn from all of Envirowise's 620 publications, free of charge and tailored to their needs.
Events: Each year, Envirowise met a number of businesses at a range of seminars, exhibitions and practical workshops around the UK. This included industry sectors such as food & drink, construction and manufacturing and covered specialist topics such as eco design and supply chain management.
Onsite Visits (available across the UK until 2008, then only in Scotland, Wales and Northern Ireland until 2010): A range of free and confidential onsite visits, including a follow-up report with a tailored solution and description of potential savings.
<u>Note</u> – these services are no-longer available, except where WRAP has taken them over, and in all cases the current service differs from the Envirowise provision in scope.</td></tr>
<tr><td>Funding</td><td>The Programme funding was complex. Originally BERR (then DTI) and Defra (then DoE) jointly funded the programme. BREW was also providing funding at certain stages:
<table>
<tr><td colspan="6">Envirowise funding 2004 – 2009 (in £ 000 / € 000)</td></tr>
<tr><td>Year</td><td>2004/2005</td><td>2005/2006</td><td>2006/2007</td><td>2007/2008</td><td>2008/2009</td></tr>
<tr><td>Defra</td><td>£2,704 / €3,345</td><td>£2,292 / €2,836</td><td>-</td><td>.</td><td>£9,390 / €11,617</td></tr>
<tr><td>BERR</td><td>£2,704 / €3,345</td><td>£1,250 / €1,547</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>BREW</td><td>-</td><td>£12,000 / €14,846</td><td>£15,898 / €19,669</td><td>£18,885 / €23,365</td><td>-</td></tr>
<tr><td>Total</td><td>£5,408 / €6,691</td><td>£15,542 / €19,229</td><td>£15,898 / €19,669</td><td>£18,885 / €23,365</td><td>£9,390 / €11,617</td></tr>
</table>
Source: http://archive.defra.gov.uk/environment/business/support/documents/resource-efficiency-delivery-landscape-review.pdf
The Envirowise programme is no longer supported by any of the UK governments.</td></tr>
<tr><td>Scope</td><td>Envirowise offered businesses of all sizes and sectors a range of free, independent and practical advice designed to improve their processes, profitability and competitiveness, covering the following topics and issues:
Eco-design
EMS
Hazardous waste
Legislation
Managing Behaviour Change
Packaging
Waste Management
Water</td></tr>
</table>

Objectives	Envirowise aimed to: • persuade businesses of the benefits of resource efficiency; • provide businesses with accurate, credible and action orientated advice; • provide better integrated advice and support provided to business through partnership working ensuring a 'no wrong doors' outcome; • ensure outcome targets are being achieve through impact assessment; • ensure Envirowise's credibility as a recognised and valued provider of practical, independent and confidential advice is maintained and enhanced; and • increasingly embed resource efficiency into everyday business practises.
Type of behavioural change expected	In addition to the information provision exercises, Envirowise provided free tools that were designed to help businesses get the most out of the Envirowise program. (A small number of these are still available via WRAP, indicated with a star). • **Green Street***: Green Street is a novel and fun way to help businesses consider their environmental impact, improve their knowledge of resource efficiency and save money. The street consists of a hotel, restaurant, public house, office and factory. Each building has up to six different rooms relating to the type of services each establishment provides. Within the different rooms there are a variety of hotspots containing tips and advice on how to make that item more resource efficient and where to find more information. (This tool has now been upgraded and identified as Green Town and is used as the gateway to information on the WRAP Business Resource Efficiency hub. It can be accessed directly at www.wrap.org.uk/greentown • **Eco Design Stories**: Focuses on improvement of the quality of products, saving money and improve the green credentials. Envirowise's "Eco-design Stories" are interactive eco-design case studies showcasing products and packaging with high environmental credentials. Four case study companies highlight how they have benefited from applying the principles of eco design. Explains how to improve design solutions and achieve cost savings. • **Embedding Behaviour Change**: This tool provides businesses with practical advice on how to motivate staff and influence senior management to bring about behaviour change. A change in culture can increase resource efficiency and give the company greater cost savings. • **Envirowise Publications Wizard***: Information selection by sector and topic, presented with a tailor-made PDF. www.wrap.org.uk/epub • **EMS- Envirowise Publications Wizard**: An EMS (Environmental Management System) provides a framework to systematically manage environmental issues. It can help businesses implement and report on their environmental initiatives. • **Envirowise Indicator**: An interactive web-based tool designed to allow all UK businesses, irrespective of their size or industry sector, to gain a useful indication of their company's environmental impact and the financial savings that can be made by addressing it. • **Savings Calculator**: In three simple steps, the Envirowise Savings Calculator tool can identify the potential cost savings you could make around an office each year. In addition to calculating savings, the tool offers practical guides to help business on its path to reducing costs. • **Green Officiency Toolkit**: The Green Officiency CD ROM Toolkit can help any company who has an office. The campaign aims to reduce resource use and waste creation in offices by encouraging staff and managers to work together. • **Supply Chain Toolkit**: The Supply Chain Toolkit is aimed at organisations who want to establish a partnership with their own suppliers. The toolkit contains all the information, presentations and notes that you will need to make your supply chain partnership successful. • EDIT – Eco-Design Indicator Tool: Free web-based tool to assess the environmental impact of products and packaging designs. After a series of simple steps the tool builds an environmental profile of your product and/or packaging and clearly demonstrates what the greatest impacts are and how to reduce them. Water Tools • Monitoring tool*: Helps to easily record and track where water is being used in a company and analyse findings. www.wrap.org.uk/watermonitor • Water account tool: Enables to compare water consumption with other businesses in a given sector. • Mogden formula tool*: Calcuates the charges applied to industry for the conveyance and treatment of their effluents discharged to sewer. www.wrap.org.uk/mogden • Water Efficiency Tool: A series of modules providing guidance and call to actions for water efficiency. Construction • SWMP builder: An excel spread sheet that aids in organising all the likely types and quantities of waste arising on a construction site, offering options for waste management, reduced ordering; reusing on site or recycling etc. Chemicals • Try the online Green Chemistry Diagnostic Tool: This Excel spreadsheet tool enables to measure business against the 12 principles of green chemistry and target areas for improvement. Retail • Managed Shopping Centre Toolkit: The Managed Shopping Centre Toolkit is aimed at owners of shopping

	centres who wish to improve their environmental performance and need to involve tenants. The toolkit provides advise and information for the shopping centre management on how to engage with the tenants and also includes separate advise for tenants. Engineering Tools • Platewise: An Excel-based tool to help electroplating companies optimise productivity by increasing materials efficiency and environmental performance. This tool enables to identify cost savings through the calculation of the costs and investment for a broad range of surface treatment systems and processes. • Paint for Profit CD ROM: This CD ROM, geared towards the vehicle body repair industry, provides ways of reviewing the amount of paint and solvent used, and the latest tips and techniques for managing and handling materials. It offers practical information to keep companies competitive by maximising the use of raw materials.
Level(s) of organisational change expected	Mainly process/product improvement and/or product/service.
Expected results and impacts (quantitative and qualitative)	Independent assessment of the potential savings available to UK business from resource efficiency measures, estimates that total cost savings could be as high as £6.5 billion per annum. Each year a set of outcome aims were proposed. For example, goals for the programme in England for 2008/09 were that, for every £1 million spent, the programme would achieve attributed outcomes of: • £7.5 million of cost savings to industry and commerce; • 33,000 tonnes of landfill diversion; • 800,000 m3 of water savings; • 28,000 tonnes of total carbon reduction (including embedded carbon).
Actual results [quantified]	By the year 2000 the ETBPP had helped save UK businesses more than £125 million. Envirowise has helped UK businesses save over £2 billion and significantly reduce their environmental footprints. In terms of efficiency and value for money this represents a saving of £38 for business for every £1 invested by Government. Since 2007 approximately 20% of the total target market used the programme's services. Businesses working with Envirowise doubled their savings from resource efficiency measures, compared with those that do not work with Envirowise. Manufacturing businesses working with Envirowise have saved up to £1,000 per employee per year. Businesses based in England that took advantage of the free advice offered by Envirowise were saving £13,000 per company site per year. In January 2008, Envirowise worked closely with the Food and Drink Federation (FDF) to develop a new sector-wide agreement to improve water efficiency amongst businesses in the sector, the Federation House Commitment (FHC). In July 2009, the FHC was able to announce that 500,000 cubic metres of water had already been saved in the first year of the Commitment by thirty six of the UK's leading food and drink manufacturers.
Strengths	• Service was free to the end user, so cost was not a barrier. • Information was presented in a clear and concise manner so that it could be easily understood and made effective use of signposting to more detailed information once the business had mastered the basics. • The duration of the programme meant that the material developed a lot of "street cred" – i.e. businesses that used it once were able to come back for other things and build up confidence in the material. This was in contrast to some other activities that only had a short duration. • Advice was independent and practical. • Solutions were driven by the specific needs of individual firms. • The breadth and depth of material developed meant that it covered a very wide range of business needs, different sector/sizes, etc. • Envirowise was independently audited.
Drawbacks	The fact that the service was free could sometimes prove to be a potential barrier, as individuals may assume there is a "catch" and that the programme would later seek a percentage of savings achieved (this was not the case). Another assumption for individuals could be that if something is "free" it is not necessarily valuable information. In addition, too much information was generated over the lifetime of delivery, which could make it difficult for the end user to locate the key pieces that would be beneficial. This was partially due to the length of time the programme was in existence and the changing delivery requirements of the sponsoring government departments.

Lessons learnt	Tighter controls on content, both generation and maintenance of, should have been introduced to either archive material and/or update of key information. Direct interaction at site level often proved the "tipping point" in helping companies to take action, and in any new programme some form of face-to-face engagement should take place. Initially events proved very popular, but for them to be a success it was imperative that delegates always took away at least one key action that they felt they could implement when they returned to their workplace. Over time, attracting delegates to events proved to be become a greater challenge and the programme found that more businesses tended to prefer the on-line webinar style which reduce travelling and time out of the office, and the delegate could also view the presentation again at a time to suit them.
Contacts	Carl Nichols WRAP http://www.wrap.org.uk
Sources and references	http://envirowise.wrap.org.uk/ http://archive.defra.gov.uk/environment/business/support/documents/resource-efficiency-delivery-landscape-review.pdf http://archive.defra.gov.uk/environment/business/support/documents/0607-disaggregated-metrics-report.pdf Dr Adrian Cole, Business Resource Efficiency Programme, AEA (previously programme manager for Envirowise when being delivered by AEA on behalf of UK governments) Roger Papworth, Business Resource Efficiency, WRAP (previously part of the Envirowise team at AEA)

19 ENWORKS, UK

Name	ENWORKS
Organisation	ENWORKS was established in 2001 as a positive response to the challenges of climate change, resource scarcity and security of supply. It is an independent partnership of organisations delivering environmental business support across the North West of England. ENWORKS has successfully delivered multiple regional projects, using a range of different funding streams, primarily from the European Regional Development Fund (ERDF) and UK Government agencies. ENWORKS is a not-for-profit service. Its hands-on business support focuses on finding cost-effective ways to boost profitability and reduce greenhouse gas emissions, by using energy, water and material resources more efficiently.
Year	2001 – on-going
Location	North West of England, UK
Type of information provision policy	ENWORKS provides a wide range of resource efficiency support, tailored to the individual circumstances of different businesses, including: • On-site reviews to identify ways of managing environmental risks and improving resource efficiency • Ongoing technical support with implementing improvement actions (e.g. assisting businesses with clean design, process improvements and residual waste management) • Access to the ENWORKS Online Resource Efficiency Toolkit - award-winning, bespoke software developed and launched by ENWORKS in 2004, which helps business managers to quantify and prioritise their resource efficiency improvements, and report on the resulting savings • Knowledge and skills transfer (e.g. through events, case studies and online resources such as the ENWORKS In a Box portal, www.enworksinabox.com, and the business-facing www.getsupport.enworks.com website) • Environmental information services, including the ENWORKS Green Intelligence service (http://www.greenintelligence.org.uk/), which delivers tailored e-bulletins of green business news and information, directly to the inboxes of more than 1,550 business people in the North West of England, each fortnight.
Funding	ENWORKS is currently partway through a project starting in October 2009 running until June 2013 supported by the European Regional Development Fund (ERDF) and Single Programme monies (currently administered by UK Government Department for Business, Innovation & Skills). The funding breakdown for the project is as follows: ERDF: £3.5 million (€ 4.3 million) Single Programme: £5.8 million (€ 7.2 million) TOTAL: £9.3 million (€11.5 million)
Scope	The programme engages with businesses of all sizes and across all sectors, across the North West of England, in both urban and rural areas. The majority of businesses supported are within the manufacturing and service sectors. ENWORKS removes the barriers to engaging them in environmental performance improvements by offering support across a wide range of issues, from addressing environmental risk through to reaping the rewards of taking action. This ensures that there is a holistic approach to targeting resources, focusing on energy, materials, water and waste, covering eco-design, process efficiency, sustainable procurement, carbon footprinting, climate change adaptation and more. The programme works with the most appropriate individual within each company, be it a business owner, a technician, a procurement lead or an energy manager. It helps them make cost-effective environmental improvements and provides them with support, where required to make the argument for further investment in resource efficiency within the business, or to access external sources of finance.
Objectives	The key objectives of ENWORKS are to: 1) Improve the market penetration, quality, consistency and impact of resource efficiency and waste minimisation support to businesses in the region 2) Improve the competitiveness and productivity of North West businesses by reducing their exposure to environmental risks such as resource scarcity and market volatility, and by improving their resource efficiency 3) Reduce the CO_2 emissions, energy, water and material consumption of businesses in the North West, and help them with diverting waste away from landfill.
Type of behavioural change expected	All ENWORKS support is tailored to individual business needs, rather than being a 'one size fits all' solution. ENWORKS also recognises that companies need ongoing support, so advisors work with them for months or even years, often as part of their team, to help them embed sustainability into their all aspects of their business model and operations. Through ongoing skills transfer the programme turns business awareness into action, helping to ensure that changes of approach will be sustained. ENWORKS offers one-to-one, on-site support, and encourages businesses to get together and share their best practice. The support and advice is delivered by partner organisations that each have a strong track record of delivering high quality, effective advice, through in-house teams of qualified environmental auditors. They, in turn, are supported by a bank of specialist, private sector consultants, who provide additional capacity and technical support when needed. Advisers visit businesses to carry out comprehensive on-site resource efficiency reviews. Each opportunity for

	improvement identified as a result is then researched and quantified, with financial and environmental savings and any relevant payback periods, and presented to the company in a bespoke report. Reviews are followed up by ongoing, hands-on assistance with implementing the recommendations, including help with monitoring and reporting on resource consumption and savings, securing finance where necessary and accessing technical support from specialist consultants. Every business supported by the programme has free access to the bespoke ENWORKS Online Resource Efficiency Toolkit. This helps managers to understand, prioritise, track and assess their improvements, giving them control over often complex data and the confidence to implement and promote their achievements. It is unique to ENWORKS and has been a vital tool in helping to catalyse change within businesses. Examples of these improvements that ENWORKS are supporting businesses to make include finding ways to improve industrial processes so that energy, water or material consumption is reduced, or finding ways to minimise waste generation and to recycle, re-use or recover any residual waste, to avoid it going to landfill. ENWORKS hosts over 40 events each year to transfer knowledge and skills to individuals in various different business roles and skill levels. The workshops and courses cover a wide range of environmental topics including waste awareness, carbon reduction, energy efficiency to facilitate wider knowledge and skills transfer and help with softer skills for driving cultural change. ENWORKS also manages a range of information services for businesses suitable for business people at all levels of an organisation, ranging from telephone advice to online references and tailored Green Intelligence e-bulletins.
Level(s) of organisational change expected	Businesses are helped to reduce their resource consumption (across all types of energy, fuel, water and material inputs), to substitute resources for alternatives with lower environmental impacts (e.g. substituting virgin for recycled, or hazardous for non-hazardous), and to follow the 'waste hierarchy' approach of minimising, re-using, recycling and recovering residual waste. For example, businesses may be supported with reducing the amount of mains water they use in their products, processes or facilities, or with reviewing how raw materials are procured and used, so that they can identify ways of making more with less. Companies are also encouraged to treat residual waste as a fresh resource or income stream, to help tackle rising waste collection and delivery costs and to save the waste from going to landfill. They are also supported to make the switch from conventional energy to renewable energy, whether it is simply by helping companies to switch to renewable electricity tariffs, or to research and install renewables on site, including solar photovoltaics, wind turbines, solar water heating, biomass burners and air-source heat pumps. A wide range of practical examples of businesses ENWORKS has supported can be found online at: http://www.enworks.com/case-studies.
Expected results and impacts (quantitative and qualitative)	ENWORKS support helps businesses to turn environmental risks into opportunities and to grow and thrive, by: • Reducing environmental risks • Cutting costs • Increasing profitability • Up-skilling the workforce • Safeguarding jobs • Creating new jobs • Retaining sales contracts • Winning new contracts • Improving corporate reputation More specific project targets for the period October 2009 – June 2013 are as follows: • £54.35 million (€67 million) annual cost savings from resource efficiency • 230,972 tonnes CO_2e saved annually • 1.857 million m^3 water saved annually • 153,981 tonnes material saved annually • 122,422 tonnes waste diverted from landfill annually • 1,197 businesses assisted • 232 applications of low carbon technologies • 176 jobs created • 367 jobs safeguarded • £22.64 million (€28 million) sales increased
Actual results [quantified]	To-date the programme has achieved the following results against the quantified project targets listed above: • £61.66 million (€76 million) annual cost savings from resource efficiency • 230,007 tonnes CO_2e saved annually • 1.342 million m^3 water saved annually • 66,345 tonnes material saved annually • 179,833 tonnes waste diverted from landfill annually • 1,171 businesses assisted • 210 applications of low carbon technologies • 148 jobs created • 290 jobs safeguarded • £16.94 million (€21 million) sales increased • £33.78 million (€41.8 million) sales safeguarded In total, the cumulative **savings-to-date** since the start of the ENWORKS programme in 2001 are as follows: • £117 million (€145 million) cost savings to date • 556,000 tonnes CO_2e savings to date

	• 6.2 million m^3 water savings to date • 19.4 million tonnes material savings to date • 331,000 tonnes waste diverted from landfill to date • 7,800 jobs created or safeguarded • £271 million (€335 million) sales increased or safeguarded
Strengths	An important aspect of the ENWORKS support provision is the breadth and depth of the offer to businesses. It also works with the most appropriate individual within each company. By helping businesses to improve their productivity and competitiveness and focusing on the economic benefits of action on resource efficiency, ENWORKS has achieved significant reductions in the North West's CO_2e emissions, energy, water and material consumption, and in diverting waste from landfill. This has been done consistently, by recommending simple, low-cost initiatives (e.g. behavioural changes in the workplace) as well as more complex process improvements and product redesign work. All impacts are carefully monitored and quantified using the Toolkit software. The savings achieved through simple, low-cost or no-cost efficiency measures go straight onto a business's bottom line, and ENWORKS encourages them to re-invest by making further improvements, that will bring even greater, long-term savings. 54% of the projects recommended in businesses have required no capital investment to implement. Where capital investment is required, ENWORKS has supported businesses to make smart investments to the value of £21.4 million (€26.5 million) in the low carbon goods sector. ENWORKS has been recognised with 16 awards and accolades for its environmental business support since 2001 and has become a leading authority on the business resource efficiency agenda. The independent evaluation of ENWORKS's most recently completed three-year project (EBS, 2007-10), confirmed that its support was the most cost-effective of its kind compared to the UK's other regional and aggregated national support programmes. It concluded that the total funding invested over the three years delivered a €215.2 million (£178 million) net additional GVA to the UK economy. The most recent customer satisfaction results also show that ENWORKS is meeting business needs with its service offering, with an overall customer satisfaction rating for the service of over 95% for its EBS project. More importantly, 95% would also happily recommend ENWORKS to others. 90% of the businesses reported that they would implement some or all of the recommendations ENWORKS had made, and 87% said the impact of those interventions would be over and above what they would otherwise have done. This shows how ENWORKS support has a catalytic effect in bringing action forward, and also an absolute effect in terms of the amount of action taking place.
Drawbacks	The current ENWORKS project from 2009 – 2013 is on track to deliver its contracted targets and previous ENWORKS projects have performed strongly, as verified by independent evaluations.
Lessons learnt	Every new ENWORKS project draws on lessons learned from its predecessors, to ensure that it is continually learning and evolving, to attain high standards of support and impact. Several key success factors are summarised below: • **Mix of public funding sources** – no exclusions / no postcode lottery for businesses • **Partnership of organisations** – locally embedded & trusted by beneficiaries and other stakeholders • **Breadth of services** – no barriers; address energy, water, materials and waste, covering eco-design, process efficiency, sustainable procurement, legal compliance, climate change adaptation…. risk and reward • **Targeted and tailored support** – linked to the potential to make savings, hands-on on-site advice and off-site services, focus on cost effectiveness and end results • **ENWORKS Online Resource Efficiency Toolkit** – data is turned into information, it both catalyses action in business and the sharing of best practice across the project
Contacts	**Samantha Nicholson** Melanie Tapodi ENWORKS http://www.enworks.com/
Sources and references	http://www.enworks.com/ http://www.enworks.com/case-studies http://www.enworksinabox.com/ https://www.efficiencytoolkit.net/default.aspx http://www.greenintelligence.org.uk/ http://www.getsupport.enworks.com/

20 National Industrial Symbiosis Programme, UK

Name	National Industrial Symbiosis Programme (NISP)
Organisation	From 1 April 2010, the Defra funded UK Government agency the Waste and Resources Action Programme (WRAP) took over the management of the NISP programme, contracting International Synergies Ltd to implement the programme in England. NISP has over 13,500 member companies including companies such as Shell UK and Lafarge Cement, micros and SMEs (which make up over 90% of NISP's membership). NISP has a network covering 9 regionally based teams across England.
Year	In 2003, NISP originated as successful regional pilot schemes in Scotland, West Midlands and Yorkshire & Humberside. The programme was officially launched at national level in 2005
Location	England (national initiative, implemented regionally)
Type of information provision policy	- A website which includes publications of the initiative and general information on NISP. There is also a selection of case studies searchable by type of resource / material - Ad hoc regional newsletters - Organisation of regional workshops and seminars: around 20 workshops over the year with the participation of around 40-50 companies.
Funding	NISP is funded by Defra through the Waste and Resources Action Programme (WRAP). A new commercial model will be introduced in September 2012 which will allow NISP to operate as a stand-alone business without Government subsidy. In 2006 the funding of the scheme was set at £6 million (€7.4 million).
Scope	The resources targeted are the core materials as addressed in line with WRAPs business plan 2011-15. These are mixed plastics, food waste, WEEE (*Waste Electrical and Electronic Equipment), textiles, wood and metal.* The resources can come from any industry however there is a particular emphasis on the hospitality and events sectors, The majority of NISPs work is with SMEs however there are a range of companies on their database such as recycling and reprocessors to third sector organisations.
Objectives	NISP is an industry-led business opportunity programme. The initiative brings together companies in separate industries and other organisations in a network to foster innovative strategies for a more sustainable resource use. The aim is to improve cross industry resource efficiency through the commercial trading of resources - such that one industries waste can be used as another's raw materials. NISP members are from all sectors and comprise companies of all sizes, including FTSE 100 multi-nationals and individual entrepreneurs. Small and medium size enterprises (SMEs) and micros make up over 90% of the membership. NISP works directly with businesses of all sizes and sectors. A programme advisory group, consisting of key industry representatives, assists each of the regional teams to ensure the programme is driven by genuine business requirements and that the strategic direction is relevant for each region. At a policy level it is aligned with key English Government objectives. Regional teams of dedicated industrial symbiosis practitioners work with businesses in the area to raise the profile of industrial symbiosis and to recruit members to the programme.
Type of behavioural change expected	The programme works by encouraging companies to adopt a collaborative approach in all aspects of their business so that resources can be recovered, reprocessed and reused elsewhere in the industrial network either by themselves or by other companies. This is achieved by holding seminars and other events, producing case studies of successful IS projects and other publications, and providing education about the subject. Over the last five years, NISP has developed a range of tools available for use by the regional practitioner teams. These include a diverse range of training materials and courses; a robust and proven framework for delivering NISP facilitated workshops and best practice sharing events. NISP also manages a national resource stream monitoring system and data analysis tool - Central Resource for Industrial Symbiosis Practitioners (CRISP). CRISP assists practitioners to identify current synergies and also provides a pipeline of potential synergies stretching out several years into the future, thus giving confidence for predicting future achievement. CRISP maps the data and informs regional planning by identifying material flows prevalent within a defined geographic area. It is used to calculate indicators, develop strategies and measures for improving the efficiency of material flows. CRISP helps practitioners to identify current synergy opportunities and also provides a pipeline of potential synergies. The business is expected to achieve resource savings through physical exchange of materials and expertise.

<table>
<tr><td>Level(s) of organisational change expected</td><td>As an initiative which promotes industrial ecology, NISP focuses mainly on the physical exchange of materials, energy, WRAP also have a Business Resource Efficiency programme which offers a wealth of support to SMEs via its Business Resource Efficiency Hub (www.wrap.org.uk/brehub) – learning how they can create and protect jobs by improving the way they use resources, and that reducing waste and using materials more efficiently could make their company more profitable.</td></tr>
<tr><td>Expected results and impacts (quantitative and qualitative)</td><td>NISP targets for 2011-14 – (all of these are on an annual basis)
462,000 tonnes biodegradable waste diverted from landfill
540,000 tonnes CO2 emissions avoided
£8.4 million cost savings direct to the businesses supported
£28.7 million sales growth for the recycling and reprocessing sector
252,000 tonnes of primary resource use avoided</td></tr>
<tr><td>Actual results [quantified]</td><td><table><tr><th>NISP achievements</th><th>2010-12</th><th>Lifetime Benefits</th></tr><tr><td>Reduction in primary resources used</td><td>3 million tonnes</td><td>Not available</td></tr><tr><td>Reduction of carbon dioxide emissions</td><td>1 million tonnes</td><td>2.6 million tonnes</td></tr><tr><td>Additional sales generated</td><td>£13.5 million</td><td>£20 million</td></tr><tr><td>Cost savings for businesses</td><td>£24 million</td><td>£70 million</td></tr><tr><td>Jobs saved</td><td>Not available</td><td>Not available</td></tr><tr><td>Waste diverted from landfill</td><td>870,000 tonnes</td><td>2.3 million tonnes</td></tr></table>
Lifetime benefits have been estimated based on evidence provided from recipients of NISP support who were interviewed years after that support to find out whether they had taken on-going action. While many of the synergies that NISP promotes result in only one-off action being taken, a substantial proportion do result in on-going action by the businesses involved to divert waste from landfill and for these synergies, lifetime benefits can be claimed

The NISP website provides several case studies on resource savings achieved through the initiative.</td></tr>
<tr><td>Strengths</td><td>NISP is the first national Industrial Ecology initiative in the world
The initiative brings together a broad range of industries, sectors and skills and creates new networking opportunities for its members
The membership was free – although from September 2012 a membership fee will be introduced – dependant on the size of the company.
Through NISP, reductions are achieved in the cost base of industry whilst simultaneously delivering environmental ‘goods’ such as diverting wastes from landfill and reducing CO2 emissions.</td></tr>
<tr><td>Drawbacks</td><td>While achieving its targets the programme needs to move higher up the waste hierarchy – while the essence of industrial symbiosis is that one company’s waste is anthers resource – often the synergies formed have the element of a reprocessor – so recycling rather than reuse.</td></tr>
<tr><td>Lessons learnt</td><td>An alternative to the current model of NISP is under study, which consists in a paying service for the companies that participate in the programme.</td></tr>
<tr><td>Contacts</td><td>Carl Nichols
Marcus Gover
WRAP
http://www.wrap.org.uk</td></tr>
<tr><td>Sources and references</td><td>NISP website: http://www.nisp.org.uk
WRAP website: http://www.wrap.org.uk</td></tr>
</table>

21 Global Reporting Initiative

Name	Global Reporting Initiative
Organisation	The GRI Guidelines are often used in conjunction with other relevant international initiatives, frameworks and guidance. GRI has global strategic partnerships with the Organization for Economic Cooperation and Development, the United Nations Environment program and the United Nations Global Compact. Its Framework enjoys synergies with the guidance of the International Finance Corporation, the International Organization for Standardization's ISO 26000, the United Nations Conference on Trade and Development, and the Earth Charter Initiative.
Year	Founded in Boston in 1997-on-going
Location	Now located in Amsterdam, The Netherlands
Type of information provision policy	GRI provides resources to simplify the sustainability reporting process. Services also include coaching and training, software certification, guidance for small and medium sized enterprises in beginning reporting, and certifying completed reports. GRI offers a number of services to support new and experienced reporters. GRI publications, grouped into different series, cover many of the most relevant issues in reporting. Reporting Resources includes standard templates and checklists for easier GRI reporting. Training and Workshops teach GRI reporting methods to beginners around the world. The Certified Software and Tools Program authorizes the new digital resources that are changing the reporting field. And reporting is not just for the world's biggest companies: GRI's support for Small to Medium Sized Enterprises and for Supply Chain companies helps to make sustainability reporting valuable for smaller businesses everywhere. GRI offers the Certified Training Program worldwide for all organizations that are interested in sustainability reporting and want to learn about it. The Program comprises of a number of GRI Certified Training Courses and Modules.
Funding	The Funding of the GRI comes mainly from from Organizational Stakeholders**,** GRI's core supporters**:** governments, foundations and international organizations**.** Corporate and governmental sponsorships, and revenues from GRI's products and services complement the total funding of GRI. In 2010-2011, the total income of GRI was of € 5.5 million and the operating expenses of € 5.3 million. In the period 2009-2010, the total income was of € 5.9 million and the operating expenses of € 5.7 million.
Scope	The Global Reporting Initiative (GRI) is a non-profit organization that promotes economic, environmental and social sustainability. GRI provides all companies and organizations with a comprehensive sustainability reporting framework that is widely used around the world. The GRI supports both SMEs and larger companies, and promotes greater sustainability practices in all sectors, with no distinction of resources. The Reporting Framework can be used by any organization, of any size, sector or location.
Objectives	ECONOMIC SUSTAINIBILITY: GRI works towards a sustainable global economy by providing organizational reporting guidance. A sustainable global economy should combine long term profitability with social justice and environmental care. This means that, for organizations, sustainability covers the key areas of economic, environmental, social and governance performance. GRI's Sustainability Reporting Framework enables all companies and organizations to measure and report their sustainability performance. By reporting transparently and with accountability, organizations can increase the trust that stakeholders have in them, and in the global economy. GRI is a network-based organization. A global network of some 30,000 people, many of them sustainability experts, contributes to its work. GRI's governance bodies and Secretariat act as a hub, coordinating the activity of its network partners. VISION: A sustainable global economy where organizations manage their economic, environmental, social and governance performance and impacts responsibly and report transparently. MISSION: To make sustainability reporting standard practice by providing guidance and support to organizations."
Type of behavioural change expected	Provides tools that enable reporting of sustainability measures taken within a company A sustainability report is an organizational report that gives information about economic, environmental, social and governance performance. For companies and organizations, sustainability – the capacity to endure, or be maintained – is based on performance in these four key areas.

	To produce a regular sustainability report, organizations set up a reporting cycle – a program of data collection, communication, and responses. This means that their sustainability performance is monitored on an ongoing basis. Data can be provided regularly to senior decision makers to shape company strategy and policy, and improve performance. GRI's Framework consists of the Sustainability Reporting Guidelines, Sector Supplements, National Annexes, and the Boundary and Technical Protocols. The Sustainability Reporting Guidelines are the foundation of GRI's Framework and are now in their third generation. The fourth generation of Guidelines – G4 – are currently in development and will be launched in May 2013. They feature sustainability disclosures that organizations can adopt flexibly and incrementally, enabling them to be transparent about their performance in key sustainability areas. A National Annex is a version of GRI's Guidelines tailored for local use and covering local issues. The Guidelines are augmented with contextual information that assists reporters to understand how they can tailor their report for a local audience. GRI has initiated the concept of National Annexes to address national and regional issues in GRI reporting. Published in 2011, the Technical Protocol - Applying the Report Content Principles provides process guidance on how to define the content of a sustainability report. This includes deciding on the scope of a report, the range of topics covered, each topic's relative reporting priority and level of coverage, and what to disclose in the report about the process for defining its content. GRI's sector guidance makes reporting more relevant and user-friendly for organizations in diverse industries.
Level(s) of organisational change expected	An effective sustainability reporting cycle should benefit all reporting organizations. Internal benefits for companies and organizations can include: - Increased understanding of risks and opportunities - Emphasizing the link between financial and non-financial performance - Influencing long term management strategy and policy, and business plans - Streamlining processes, reducing costs and improving efficiency - Benchmarking and assessing sustainability performance with respect to laws, norms, codes, performance standards, and voluntary initiatives - Avoiding being implicated in publicized environmental, social and governance failures - Comparing performance internally, and between organizations and sectors External benefits of sustainability reporting can include: - Mitigating - or reversing - negative environmental, social and governance impacts - Improving reputation and brand loyalty - Enabling external stakeholders to understand company's true value, and tangible and intangible assets - Demonstrating how the organization influences, and is influenced by, expectations about sustainable development
Expected results and impacts (quantitative and qualitative)	The aim was to create an accountability mechanism to ensure companies were following the Coalition for Environmentally Responsible Economies (CERES) Principles for responsible environmental conduct. Investors were the framework's original target audience.
Actual results [quantified]	3,642 Organizations involved, 9,077 Reports and 8,619 GRI Reports filled After G3 was launched, GRI expanded its strategy and Reporting Framework, and built powerful alliances. Formal partnerships were entered into with the United Nations Global Compact, the Organization for Economic Co-operation and Development, and others. A regional GRI presence was established with Focal Points, initially in Brazil and Australia and later in China, India and the USA. Sector-specific guidance was produced for diverse industries in the form of Sector Supplements (now called Sector Guidelines). Educational and research and development publications were produced, often in collaboration with academic institutions, global centers of excellence and other standard-setting bodies. GRI's services for its users and network expanded to include coaching and training, software certification, guidance for small and medium sized enterprises in beginning reporting, and certifying completed reports. GRI's outreach was strengthened by its biannual Amsterdam Conference on Sustainability and Transparency, beginning in 2006; the third conference in May 2010 attracted over 1,200 delegates from 77 countries.

Strengths	Sustainability is a topic of increasing interest for companies, and the GRI offers standardised guidelines to help companies develop their own reports in a transparent way. Investors are looking at sustainability data more than ever before, and GRI supports them in their quest for information by providing agreed metrics for sustainability reporting. The resources are available online as well as printed publications, and conferences and training sessions are organised for the interested organisations. This makes a wide range of services that the companies can choose and use as they need.
Drawbacks	More Environmental, Social and Governance reporting is needed in Brazil, Russia, India, China and in SMEs. Even in the most advanced economies, some sectors are not advanced in ESG reporting. Most ESG reporters are large companies, and it is imperative to incentivize SMEs to understand and report on their own ESG performance.
Lessons learnt	The reporting framework has been revised and upgraded continuously, adapting it to the needs of the companies. The next generation of the guidelines (G4) will boost the robustness of the integrated reporting framework, and will enable the analysis and assurance of integrated ESG reports.
Contacts	Lucy Goodchild Global Reporting Initiative http://www.globalreporting.org/
Sources and references	https://www.globalreporting.org/

22 ÖBU, Switzerland

Name	ÖBU – Network for Sustainable Business.
Organisation	ÖBU – Network for Sustainable Business.
Year	In 1989 in Switzerland in reaction to the student initiative of St. Gallen University (OIKOS). On-going
Location	Zurich, Switzerland
Type of information provision policy	Information via website, personal consultation/training
Funding	The network is funded trough annual membership fees, which depend on enterprises size. Further funding is assured through donations and grants, earnings of events and capital gains of own funds. It is open for new members but the admission of new applicants is based on the board of direction's decision. Admission generally presupposes previous engagement in sustainable issues. New members are recruited mostly by recommendations or their own observation of the network followed by asking them for participation.
Scope	Aids about 400 enterprises—usually nationally-based within Switzerland They vary in size and sector and range from small family owned business to global players.
Objectives	ÖBU advocates environmental, social and management issues. It aims to promote ecological consciousness and action in the Swiss economy and particularly in the top-management of enterprises. It sensitizes and motivates enterprises to use environmental changes as chances to boost innovation and competitiveness. The ÖBU programme does not have quantified objectives established for their activities.
Type of behavioural change expected	**Information is provided** on the website. It embraces documents regarding climate and energy, management systems, Eco-efficiency and effectiveness, communication and marketing, Corporate Social Responsibility and financial and policy issues. Every topic offers a small database were networks activities in this field as well as additional information can be downloaded. The ÖBU communication guideline assists especially SMEs with the set-up of own CSR reports. It is enriched with best practises, background information and links on the topic. The LCA Software guide supports enterprises to find adequate software for environmental accounting. The ÖBU environmental law checklist shows up instruments for the compliance with environmental law. Enterprises learn how to proof conformity with the complex requirements of ISO 14001 and EMAS by self-assessment. **Trainings** are conducted within workshops. For instance the workshop "Introduction in management systems for sustainable business" takes place every year. The tools presented are especially addressing newcomers, who want to establish a corresponding management system. **A General Meeting** takes place annually in form of the Forum OE. The conference is the central event for all members and representatives, with the presence of the companies CEOs. Presentations and discussions focus on visions and strategies regarding sustainable business management. The forum is the networks' main socializing event and offers an opportunity for exchange between members. In 2010 its topic was "Ready to turnabout!" thus the conference deals with instruments and parameters for the turn of businesses towards sustainability. The topic of the 2012 conference was "The business case of sufficiency", with a special focus on sufficiency opportunities for businesses. **The collaborating Online platform "Proofit"** was set up to promote the idea of sustainable business addressing the specific needs of SMEs. It summarizes motivating information, good practise and suggestions for sustainable improvements within its "Infothek" and provides the "Efficheck", a self-evaluating tool that measures SME's individual environmental engagement and makes results comparable to those of other companies of the same sector. Through governmental support Proofit and a "Club of Proofessors" can be offered free of charge. The latter consists of retired environmental- and energy-officers who work for the website in order to maintain quality and keep it up-to-date. They supervise Proofits work and act as ambassadors. **Meetings on specific topics** are set up to support enterprises' interaction on specific topics with representatives from science and public institutions. The ÖBU Business lunch and the "proofit apèro" are offered to present innovative enterprises. The target audience are decision makers from industry, politics, media as well as other interested people. ÖBU's events help to realize ideas coming from its members. The ÖBU structures a certain project, searches for an adequate platform, prepares a financial plan and organizes the project's realization. Non-members can take part in certain projects and workshops paying an extra charge. **The Website** presents the network with its objectives and achievements. **A Newsletter** is widely distributed. It informs about events and projects, about developments within the topics environment and sustainability and deals as central information medium for the whole

	Lobbying: The ÖBU encourages exchange between businesses, governmental administration, politicians, NGOs, the media and the general public in order to create a political framework that support enterprises' efforts towards sustainability. **Competition of best performance** is carried out with the help of the ÖBU award. Since 1999 it evaluates the quality of CSR reports of Swiss enterprises. The award appreciates enterprises efforts and fulfilments in combining their economic objectives with sustainable issues. The ÖBU awards three larger enterprises every second year. A separate award is handed out to SMEs. Reports are based on an assessment instrument and supported by of the University FHNW (Fachhochschule Nordwestschweiz). **Best practices** of enterprises' actions towards sustainability are collected within the Gallery OE. It embraces case studies from diverse members in all levels of companies' value chain and presents measures for economic, ecologic and social sustainability.
Level(s) of organisational change expected	The ÖBU programme aims to promote ecological consciousness in the top management of the enterprises, and provides them with the necessary information and tools. The general events organised are open to all the member companies, and provide generic information. If any specific point of interest is detected within the members, the necessary tools can be developed under request.
Expected results and impacts (quantitative and qualitative)	The ÖBU does not have quantitative objectives established, but the main goal of the programme is to make the economy more sustainable. Annually, a hotspot or main topic is selected, which will guide the events organised during the period.
Actual results [quantified]	No evaluation of the ÖBU programme has been carried out at the time of writing.
Strengths	The ÖBU programme has brought together a number of companies that collaborate in a network. The interest of the businesses in joining the network demonstrates the economic benefits of the actions taken.
Drawbacks	The mainstream organisations have not been sufficiently involved in the programme activities, and are reticent to change.
Lessons learnt	The participation of businesses in the organisation of events and the communication of the benefits of resource efficiency practices has demonstrated to be an effective approach. The ÖBU programme is based in a network of businesses that share experiences on resource efficiency.
Contacts	Gabi Hildesheimer ÖBU– Network for Sustainable Business http://www.oebu.ch/
Sources and references	http://www.oebu.ch/

23 Green Suppliers Network, USA

Name	Green Suppliers Network
Organisation	Partnership between: 1) U.S. Environmental Protection Agency (EPA) • The Green Suppliers Network is a component of the E3 Initiative (Economy, Energy, and Environment) supported by US EPA 2) U.S. Department of Commerce's National Institute of Standards and Technology's Manufacturing Extension Partnership (NIST MEP)
Year	On-going
Location	USA
Type of information provision policy	Website, company visits with assessments, training, and development of personalized plans of action Example of their services from website: *"Customized, hands-on assessments of production processes to reduce energy consumption, minimize carbon footprint, increase productivity, and drive innovation.* ▪ *The Green Suppliers Network review team conducts a technical review at the facility and trains staff on the Lean and Green Advantage. EPA is not involved in any onsite technical assistance.* ▪ *The team combines the expertise of the supplier's local Manufacturing Extension Partnership Center (a program within the Department of Commerce) with the expertise of the supplier's state environmental programs.* ▪ *Suppliers will receive a set of confidential recommendations that, when implemented, will result in production efficiencies, environmental improvements, and cost savings.* *During the Green Suppliers Network review, suppliers use value stream mapping techniques to identify sources of non-value-added time or materials, identify opportunities to increase efficiency, and develop a plan for implementing improvements. Value stream mapping serves as a critical tool during the review process and can reveal substantial opportunities to reduce costs, enhance production flow, save time, reduce inventory, and improve environmental performance."*
Funding	Joining the Green Suppliers Network is free, but the cost of a typical review varies depending on factors such as the depth and focus of technical reviews and the expertise of the local NIST MEP.
Scope	Focus on improving efficiency in all aspects of the industry (materials, waste, water, plastics, wood, energy, etc.)—varies from business to business as needed Sector : industry "Small and medium-sized manufacturers can join the Green Suppliers Network as a *Partner*, or a larger manufacturer can join as a *Corporate Champion* and nominate suppliers to participate. By joining, small to medium-sized companies commit to participating in an onsite lean and green technical review of a product or process line. Larger Corporate Champions commit to nominate companies from their supply chain that can benefit the greatest from participating in an onsite technical review. " Business leaders are targeted, but workers are trained directly by the Green Suppliers Network.
Objectives	"The Lean and Green Advantage: - See immediate results through hands-on training on the shop floor - Reduce overhead and manufacturing costs - Reduce environmental footprint - Improve supply chain relationships - Meet customer expectations and be better positioned in the green global marketplace"
Type of behavioural change expected	The programme works by offering a step-by-step guide to improve efficiency of workers (offers direct training to build competency of the workers) as well as process of production, and makes recommendations for more efficient technology. By partnering with the Green Suppliers Network, companies learn lean manufacturing techniques coupled with sound environmental strategies, which is called the *Lean and Green Advantage*. Make different recommendations based on the company, up to the company to implement themselves.

<table>
<tr><td>Level(s) of organisational change expected</td><td>Examples of resource efficiency measures available in case studies:
Selected examples from case studies:
Discovering ways to salvage wasted product (ex: capturing residual Listerine in extra bottles)
Stricter monitoring procedures at Whirlpool factories lead to 35 percent less wasted scrap metal—also involved an education process, whereby workers were better trained to recognize what was/was not useable material
Recommended new, energy efficient technology to Medegen Medicine Manufacturing Services, which, when implemented, eliminated 660 gallons of hydraulic oil waste/year
Advised more efficient ways of packaging at Medegen Medicine Manufacturing Services, which significantly reduced material waste</td></tr>
<tr><td>Expected results and impacts (quantitative and qualitative)</td><td>Partners
Achieve additional savings and efficiencies beyond traditional lean techniques by addressing energy efficiency and environmental performance.
Find customized solutions by identifying the root causes of waste and inefficiency.
Save money and increase capacity.
See immediate results through hands-on training on the shop floor.
Achieve additional savings and efficiencies beyond traditional lean techniques.
Stay competitive and profitable while reducing your impact on the environment.
Corporate Champions
Strengthen your suppliers' ability to respond to needs and improve the overall quality of your products.
Improve supply chain relationships.
Share your priorities and issues with suppliers.
Reduce your product's cumulative carbon footprint.
View aggregate supplier results that can be used to inform internal and external stakeholders about the environmental performance of your supply chain.”</td></tr>
<tr><td>Actual results [quantified]</td><td><table>
<tr><td>Annual Environmental Impact Savings Identified</td><td>$28,256,447 (€22,250,000)</td></tr>
<tr><td>Annual Cost Savings from Lean Opportunities Identified</td><td>$40,799,112 (€32,126,000)</td></tr>
<tr><td>Estimated One-Time Environmental Savings</td><td>$34,587,917 (€27,236,000)</td></tr>
<tr><td>Total Annual Potential Impact Identified</td><td>$103,643,476 (€80,060,000)</td></tr>
<tr><td colspan="2">Environmental Outcomes</td></tr>
<tr><td>Energy Conserved (kWh)</td><td>868,151,686</td></tr>
<tr><td>Water Conserved (gal)</td><td>98,868,199</td></tr>
<tr><td>Air Emissions Reduced (lbs)</td><td>7,334,121</td></tr>
<tr><td>Solid Waste Reduced (lbs)</td><td>31,242,894</td></tr>
<tr><td>Water Pollution Reduced (gal)</td><td>21,314,070</td></tr>
<tr><td>Hazardous Waste Reduction (lbs)</td><td>270,605</td></tr>
<tr><td>Toxic/Hazardous Chemical Use Reduction (lbs)</td><td>180,105</td></tr>
</table></td></tr>
<tr><td>Strengths</td><td>No evaluation has been communicated at the time of writing</td></tr>
<tr><td>Drawbacks</td><td>No evaluation has been communicated at the time of writing</td></tr>
<tr><td>Lessons learnt</td><td>No evaluation has been communicated at the time of writing</td></tr>
</table>

Contacts	Becky Cool Tom Murray U.S. Environmental Protection Agency (EPA)
Sources and references	http://www.epa.gov/greensuppliers/ http://www.greensuppliers.gov/about/faq.html

24 WasteCap Resource Solutions, USA

Name	WasteCap Resource Solutions, Inc.
Organisation	"WasteCap Resource Solutions was created using a successful model from other WasteCap organizations across the country in Massachusetts, Maine, New Hampshire, and Nebraska.
Year	In 1996, WasteCap Wisconsin began as a cooperative effort between the business community and the Wisconsin Department of Natural Resources and was funded with a grant from the Recycling Market Development Board. In January 1998, WasteCap Wisconsin became a private nonprofit 501(c)(3) organization. In 2009, WasteCap Wisconsin changed its name to WasteCap Resource Solutions" (http://www.wastecap.org)
Location	Madison and Milwaukee, Wisconsin, USA
Type of information provision policy	*"WasteCap Resource Solutions' new system, WasteCapTRACE, is a simple, powerful and effective online documentation program that tracks ongoing construction and demolition debris recycling and documents the results." (wastecap.org)* Also provide on-site assistance, offer construction and demolition waste recycling training
Funding	Funded in part by membership in the organization and donations.
Scope	-All solid waste materials -Work with companies involved in construction, demolition and renovation projects
Objectives	To provide waste reduction and recycling assistance for the benefit of business and the environment.
Type of behavioural change expected	**WasteCap Resource Solutions provides planning, technical and educational assistance, as well as monitors, measures, documents and publicizes results of waste management efforts during construction and demolition projects. Specifically, WasteCap can:** • **Provide draft** construction or demolition waste reuse and recycling specifications • **Write and review bids** for trash and recycling collection • Develop a construction or demolition **waste management plan** (required for LEED) • Help **obtain exemptions** from the WI DNR for recycling of wood, drywall, etc. • Provide **technical assistance**, market information, and research support • **Instruct and educate** contractor employees and subcontractors about their role in the program • **Conduct waste audits** and monitor program including interviewing job site crews, checking for mis-sorted materials in recycling and trash containers and correcting problems • **Ensure proper placement**, timing, and labelling of trash and recycling dumpsters • **Document construction waste management results** (required for LEED). Document and calculate the types and quantities by weight and volume of trash and recyclables as well as the financial impact of the program's implementation • **Share results**. Share the story and promote results internally to employees and externally • Complete a **final construction waste management evaluation and report** **C&D Recycling Training** Taught by WasteCap Resource Solutions Nationwide, owners are requiring construction waste recycling as part of sustainable building. Those who know how to meet this demand will be at a market advantage. This day-long training provides the skills to develop, manage, monitor, document and promote a successful recycling program for construction and demolition debris. Participants receive three year Accreditation in Construction Waste Recycling and training to obtain LEED construction waste management points. **Site Visits** WasteCap draws upon a network of volunteers to conduct waste assessments for businesses and provides a written report of recommendations. **Events** WasteCap partners with a variety of events to encourage business-to-business peer exchange about construction and demolition recycling. WasteCap also hosts an annual awards ceremony, the R3 Awards, to recognize excellence in commercial debris reduction, reuse and recycling in Wisconsin. » (See wastecap.org/services for more information)
Level(s) of organisational change expected	Process or product improvement- yes Product or service redesign- yes See above

Expected results and impacts (quantitative and qualitative)	**Vision:** To transform waste into resources. **Mission:** To provide waste reduction and recycling assistance for the benefit of business and the environment.
Actual results [quantified]	*"WasteCap Resource Solutions and its clients have diverted 638,915 tonnes of construction and demolition waste from landfills, which is 266 pounds per person in Wisconsin. An equivalent of 289,263 trees has been saved by recycling wood and cardboard. WasteCap Resource Solutions' construction and demolition projects are currently achieving an average 88% recycling rate."* (wastecap.org) Ex: **Columbia St. Marys Hospital – East Campus March 2004 – June 2006** Client: St. Mary's Hospital Contractor: Oscar J. Boldt Construction Results: This project met its 50% recycling goal; diverting about 95% of construction waste and saving over $200,000 (€157,000) in waste hauling costs. For a full list of past projects, visit http://www.wastecap.org/projects/past/ For a list of current projects, visit http://www.wastecap.org/projects/current/ For a list of testimonials, visit http://www.wastecap.org/projects/testimonials/
Strengths	No evaluation has been communicated at the time of writing
Drawbacks	No evaluation has been communicated at the time of writing
Lessons learnt	No evaluation has been communicated at the time of writing
Contacts	WasteCap Resource Solutions, Inc. www.wastecap.org
Sources and references	www.wastecap.org/ www.wastecapdirect.org www.wastecaptrace.org

Annex B: Sector Characterisation

February 2013
Doc Reg No. 31305 13070i1

1. Selection of the Sectors

1.1 Summary

This document details AMEC's and Bio Intelligence Services' proposal for detailed examination of a limited number of sectors within the above titled study following discussions and agreements at the interim meeting of the 7 June 2012.

Part of this study aimed to model the scope for EU businesses to improve their resource efficiency and understand, based on available evidence, the 'effect' from implementing or adopting measures to decrease their use of materials, water and generation of wastes. Focusing efforts on selected sectors is necessary given the time and resource constraints as well as the need to gain the necessary intimate understanding of businesses operating in specific sectors. To achieve this understanding the research team has completed a sector screening across wide range of sectors and detailed initial analysis on eight priority sectors according to the following criteria:

- High material resource intensities, high water consumption/demand, high volumes of waste generated;
- Sectors that are of significant size and importance within the EU-27; and
- Sectors where the evidence showed a higher potential for resource efficiency (including where early intervention could yield better outcomes such as quick wins and early cost savings).

Published literature, statistics and research has been examined in eight sectors to help prioritise which sectors are most suitable for taking forward. This document details, at the highest level, the outcomes from this research and presents a justification for more detailed examination of **three** sectors as part of the valuation and quantification task.

1.2 Summary of the sectors

Detailed initial analysis of eight sectors (see Table A1.1) has been completed to provide baseline information upon which a more informed judgement about which sectors were taken forward for quantification.

Table A1.1 Characterisation of the main sectors examined for selection

Sectors	Scope to improve through resource efficiency	Data availability, quality and completeness
Construction & demolition activities	**Fair** – the sector has already done a lot to improve but such improvement is unequally distributed. Supply chains are key to making the largest gains and yet there is evidence to show smaller firms could make substantial gains through simple on-site resource efficiency measures. Many of the largest opportunities lie in product design, process design and material specification; designing for efficiency during the manufacture and particularly the in-use and end-of-life phases.	**Good** – Data is readily available albeit is not of a consistent depth and reliability for all activities and Member States. There is some centralisation of data on resource efficiency however this is skewed to well-supported industry sub-sectors and specific to a few Member States. Given the size and diversity of the sector, it would be challenging to accurately establish benchmarks recognisable by all businesses operating in the sector. The accuracy of any forecast opportunities from improving resource efficiency is likely to be compromised as a result.

Sectors	Scope to improve through resource efficiency	Data availability, quality and completeness
Manufacturing of vehicles	**Fair** – larger organisations have already made big gains in resource efficiency and productivity. The sector is a large water and materials consumer. It does produce wastes (4M tonnes) but recycles a significant proportion of key materials. There are significant opportunities within the dense supplier networks and parts manufacturers. Amongst the larger players, few low-cost/no-cost measures are available, RE is innovation driven. Measure available to suppliers to the industry will be captured elsewhere (e.g. fabricated metal products).	**Good** – the sector, particularly the larger players have been engaged and well studied and there are some rich sources of bottom-up examples, particularly around in-house tooling and manufacture. The information has high degrees of transferability within the sector and to some other manufacturing sectors. Even if this sector is not examined, the information available should be harvested and considered in light of applications to other manufacturing sectors.
Manufacturing of fabricated metal products	**Good** – significant number of RE measures are available within a dense and diverse sector of primarily SMEs. Many barriers exist in the sector to implementing resource efficiency but bottom-up evidence shows significant gains can be made by low-cost/no-cost measures. Businesses diverse in character but there is transferability of measures and the decentralised nature of the information flows to the sector means opportunity to improve is larger than others. Some businesses moving in the right direction, but many focus on investing in end-of-pipe 'big ticket' initiatives and fail to take-up the simple measures to internally improve efficiency. Culture and attitude a big driver for change.	**Fair** – some good data available, particularly on the bottom-up case studies. The diversity of the sector creates a data consistency and comparability challenge. Lack of monitoring and reporting data generally on resource intensity and consumption at the SME level. Relies on pro-active employees in environmental roles to drive change and collect information. Trade organisations are fractured but a better and more reliable source of data and evidence on RE measures. Materials flow data likely to be challenging to accurately establish – sector well studied in some Member States (IT, DE, UK) but limited in others – scaling will require careful assumptions than should be verified.
Manufacturing of pulp & paper	**Challenging** – the sector has made substantial gains in energy and materials efficiency and is centralised and well supported by recycled raw material markets – recycled fibre use increased by 89% since 1990. Clear economic incentive for the industry to reduce raw material costs. Active trade body in reducing impacts and maintaining competitiveness – this means many measures already taken leaving few low-cost measures to be done.	**Very good** – evidence is clear on consumption and measures taken to reduce material and water intensities. Wastes recovered where possible and trade organisation CEPI has published a lot of detailed information. The sector is generally aware of the resources they are consuming and have strategies in place to manage them down.
Manufacturing of iron & steel	**Challenging** – the sector has made substantial gains in energy and materials efficiency. There are some less technologically-focused water reduction options but the big resource efficiency gains are in energy and will come from long-term investments into advanced steel-making technologies. Few quick wins left to make compared to other sectors.	**Good** – the sector has been well studies and opportunities quantified from different perspectives. Centralised and well represented, the sector is an engaged player in the RE debate. Processes are well defined and data can be standardised with less effort than other sector. Lack of low-cost/no cost measures the argument against.
Manufacturing of food & drink products	**Good** – the evidence demonstrate a lot of improvement in the sector but there remain substantial opportunities from increasing the efficiency of resource use – good supply chain opportunities too. The sector is well represented on the debate at an EU level and data on measures actually being implemented will help in the accuracy of opportunity scoping. There is a lack of clarity on what the sectors' top-runners are achieving and few BAT-standard metrics exist upon which a benchmark can be gauged.	**Fair** – some good data available, particularly on the bottom-up case studies. The diversity of the sector creates a data consistency and comparability challenge and the quality of some of the data needs to be verified. There is limited information on the attitudes and characteristics of the businesses themselves although trade organisations may have a better idea of their members' attitudes. Metrics are inconsistently applied in measuring. Could present a challenge?

Sectors	Scope to improve through resource efficiency	Data availability, quality and completeness
Information and communication technologies (ICT)	**Challenging** – ICT often seen as an enabling technology for other sectors in improve their productivity/efficiency. Within the sector, the focus is on material security, scarcity and recovery of high value elements. This has forced a downstream tackling through better recovery models and also upstream increasingly modular design for re-use, refurbishment or recovery. It has very high water and materials intensity metrics but there is limited EU-based ICT manufacturing, some assembly but opportunities here for improving resource efficiency are well driven already.	**Poor –** there is little bottom-up information other than a handful of published case studies. Recent engagement with key product manufacturers showed the issue to be high on the agenda but data and metrics collection/collation is at an early stage. It could be too soon to examine this sector in detail given the limited number of manufacturing firms publishing information. Main customer focus is on performance and carbon. Significant global opportunities exist but quantifying these based on current available information would be significantly challenging.
Accommodation and food services	**Good** – the nature (low-cost/no-cost) of the measures as well as the lack of progress across the sector creates significant opportunities. The sector has diverse ranges of businesses with SMEs making up 99%. Material impacts vary depending on the activity but water consumption is high and wastes are typically not prevented nor recovered effectively. Rising charges for commodities and waste collections, plus WFD requirements to apply the waste hierarchy creating strong signals for action on resource efficiency.	**Fair** – data will be a considerable challenge. The sector is well represented but a general lack of sector-level data along with the diversity of business types, models, markets and trading patterns will mean significant assumptions are likely and verifying these will be crucial. Low levels of data on possible uptake – some limited pockets of information in specific case studies exist. Data on the measures is better with clearer conclusions.

1.3 Selection of the sectors

Table A1.2 Justifications for proposed selection

Sectors	Rationale for inclusion/exclusion	Proposed action
Construction & demolition activities	• Economically important, large size, good coverage, diverse • Networked supply chain with good scope for RE improvements • Biggest opportunities on resource efficiency lie in the supply chain (e.g. designers, architects, specification controllers, product suppliers) • Simple measures on-site have a significant difference given the number of businesses and scale of the activities • High impact in terms of energy, materials and water intensity • Well represented by trade bodies with good data sources --- • Highly complex supply chains serving many different markets with different construction challenges/styles. • Has received a substantial amount of attention and focus regarding standards, impacts, resource use and measures to address more sustainable construction designs, processes and projects. • Accurate estimations of the scale of the opportunity (given the diversity) pose a real challenge to this study without expending significantly more effort that is practicable within the study constraints. • Sector lacks the necessary homogeneity to be able to make broad assumptions on the level of opportunities from resource efficiency that would be widely recognised and accepted by businesses in the sector. • Particularly exposed to the effects of macro-economic factors that would create specific challenges for analysis of the effect and further opportunity from further embedding resource efficiency. • Characterised by lots of unregulated small players with diverse attitudes and business models. • Significant opacity in the data from its supply chains would make accurate quantification extremely challenging.	**Exclude**

Sectors	Rationale for inclusion/exclusion	Proposed action
Manufacturing of vehicles	• Sector is of significance in terms of GVA and jobs. • Comparatively heterogeneous compared to others with similar processes and outputs between companies and countries - good base for scaling opportunity. • There are diverse and dense supplier networks (often SMEs) and the larger players have cascaded requirements for efficiency measures through to their suppliers (who in many cases have struggled to respond due to typical SME barriers). • The sector is a rich source of innovation in manufacturing and resource efficiency. • Dominated by relatively few large organisations that have already made gains in resource efficiency. --- • Information on production-line efficiency gains (bottom-up) is harder to source than end-of-life vehicles (a significant impact and one with specific EU legislation controlling it). • Many of the manufacturing-type resource efficiency measures could be transferred into other sectors.	**Data gathering only**
Manufacturing of fabricated metal products	• Sector is of a significant size and coverage is throughout the EU with top countries including DE, IT, ES, UK and CZ. • Less affected by external market factors although many SMEs face similar constraints, barriers and limitations to improving efficiency and attitudes may be an issue. • Characterised by small firms operating in defined markets. • Many production optimisation and process efficiency measures are available and evidence on uptake (whilst weak) suggests there is room for significant improvement across the board. • Geographic differences are less of an issue compared to, for example, construction. • Customers are driving down requirements to be more efficient and meet stricter environmental ambitions. • Sufficient process commonalities to mean that cross-transference assumptions could be made on the scope for improving resource efficiency. • A high user of raw materials as well as water and energy and a producer of significant waste – some hazardous. • Sector has achieved some gains but many remain to be made amongst the sector's smaller players. --- • Sector lacks a clear voice for RE initiatives – date gathering challenges. • Data is generally patchy, inconsistent metrics and dubious accuracy in some cases – case studies generally better reliability but lack details. • Level of support mixed – higher in some Member States (e.g. DE, UK) • Lots of smaller players with diverse attitudes and business models will make assumptions on up-take and scaling less certain. • Lack of heterogeneity in activities, markets, businesses structures and sizes although there are. • Access to finance and investment in the long-term challenging – focus is on low-cost/no-cost – but too many focus on end-of-pipe and technological solutions, failing to tackle the productivity issues internally through best practice and 'tweaks'. • All market players operate in a largely un-regulated environmental space (though it is increasing), which removes a key driver for environment impact reduction.	**Include**
Manufacturing of pulp & paper	• High water and material intensity. • High degree of similarity in processes – measures have high cross-transference within the sector but not to other sectors. • Very good availability of information. --- • The sector has already done a significant amount to address its resource efficiency and has been well supported. • Collection systems in place for fibre recycling across the EU – sector unlikely to benefit from low-cost RE measures – limited scope for improvements. • Sector sensitive to external market pressures creating difficulties accurately forecasting predicted take-up – many measures are significant investments subject to confidence around stable market conditions	**Exclude**

Sectors	Rationale for inclusion/exclusion	Proposed action
Manufacturing of iron & steel	• Significant GDP generator and cuts across many EU Member States. • Well represented at the trade body level and an engaged player in many policy debates at an EU level. Consultation with the industry, as well as harvesting relevant data would be straightforward compared to other sectors. --- • However, the research indicates the main opportunities are for reduction of energy – many of the simple quick wins on materials RE do not apply or have already been examined and in many cases implemented. • The sector is not a heavy user of water and although some measures have been identified, these are small in number and a lack of data on the effect of these measures (in reduction terms) would make economic valuation of the opportunity difficult to judge. • The industry is dominated by a few large players, many of whom have already embedded sustainability into their business models and activities. • It is a sector that is judged to have fewer low- cost/no-cost resource efficient measures with many of the opportunities lying in investment in new technologies. • The sector is also highly sensitive to macro-economic conditions which can create unstable investment conditions adding further complexity and uncertainty into any estimates of opportunity.	**Exclude**
Manufacturing of food & drink products	• Largest industrial manufacturing sector in the EU-27 in terms of turnover, value added and employment - over 2.7M businesses – good scaling. • Is dominated by SMEs. IT, FR, DE, ES and UK are the top five Member States. • Evidence shows high number of low-cost/no-cost measures and big impacts on efficiency when applied to the small and micro-level businesses • Agriculture a major supplier and impacts here are high – water, land use, biodiversity (monoculture etc…) • Well represented and engaged on the sustainability and resource management agenda – a number of initiatives already implemented (e.g. lean) • Data on a case-by-case basis good – less clear and consistent on a sectoral level. • Sector lags behind its global peers in terms of production value, labour productivity and investment in R&D. • High material, water and energy intensity and is present in all EU Member States. • Under pressure to increase its sustainability through public awareness, assurance and other retailer-led standards and campaigns • Good published bottom-up information on the simple materials, water and waste savings applicable to the industry. --- • Gathering comparable, accurate and transparent information across the wide range of activities in the manufacturing sector will be challenging – there is little on water consumption and inconsistency amongst waste data. • High levels of sectoral diversity and a lack of heterogeneity in • Much of the sector un-regulated, lacking some key drivers for change. • Influenced by commodities and agricultural produce price rises, but a good driver for increasing efficiency to improve productivity levels per unit input.	**Include**
Information and communication technologies (ICT)	• The sector is well organised and is progressive in messaging the positive gains in resource management it is making. • The ICT sector does help to enable greater resource efficiency in other sectors as well as have indicative opportunities from improving their own resources. • An interesting sector in RE terms – wide ranging impacts and likely to grow. • Consumer of significant quantities of high value metals/minerals and pure water – generates waste (some hazardous). --- • Much of the opportunity for greater efficiency lies in how the products are designed for using less and recovery at the end of life. • Energy consumption in-use is far more significant in environmental and resources terms than material or waste produced in manufacture. • The sector lacks the scale of others – much ICT manufacturing outside EU. • Data on resource consumption is limited or inconsistent – material flows in particular are not well covered. • Pricing the impact of using the rare earth and precious metals is not straightforward and it is not clear who could be consulted to gather the necessary information. • RE measures typically in response to material security and business resilience issues (e.g. access to critical materials) – limited environmental drivers.	**Exclude**

Sectors	Rationale for inclusion/exclusion	Proposed action
Accommodation and food services	• Huge economic significance with very high number of SMEs • EU-27 coverage with good evidence of measures to improve RE through adoption of best practice and low-cost measures. • Sector has done relatively little on RE – now starting to receive some limited support through international initiatives • Well represented at the EU-level by centralised trade organisation. • Scale of the opportunity as well as the nature higher than other sectors. • Lack of heterogeneity across the sector will create challenges in developing accurate up-take models – will require focus in specific areas. • Data availability low and inconsistent – many do not monitor or measure resource consumption for water and materials and waste is often treated (and similar in nature) as household would be.	**Include**

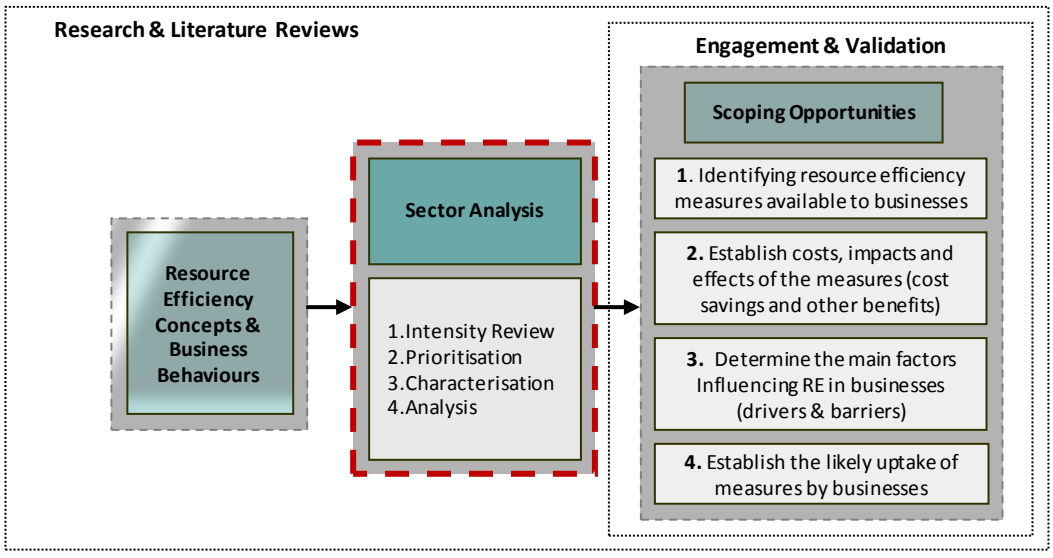
2. Analysis of the sectors

Drawing upon the results of the literature review and data analysis together with indications from other relevant sources of research, the various sectors have been examined having regard to their relative material resource intensities, water consumption and waste generation levels. Twelve sectors were initially reviewed and screened with more detailed evaluations conducted on eight sectors (Table A2.1).

Table A2.1 Selected sub-sectors for detailed analysis

Sectors	Sub-sectors
Manufacturing	Automotive, pulp & paper, primary metal production, metal fabrication, coating and casting, food and drink, textiles/clothing
Construction & Demolition	All construction and demolition activities including utilities, buildings and other infrastructure
Services	ICT, hospitality and food services (cafes, bars, restaurants, hotels, public canteens and contract catering)

Figure A2.1 Analytical framework for assessing the scope for business improvement in efficient use of resources



3. Research and Findings

3.1 Construction & Demolition

3.1.1 Sector Overview

Eurostat estimates that the construction sector across the EU27 in 2007 [1]:

- comprised 3.1 million construction enterprises,
- provided employment to 14.8 million persons (which was 12% of the non-financial business economy workforce),
- generated 1,665 €bn of turnover, and
- generated 562 €bn of value added (which was 9.3% of the non-financial business economy's total value added).

The NACE Rev1.1 categorisation splits the construction sector into five subsectors, as shown in table A3.1:

Table A3.1 Statistics for Construction Sub-Sectors in the EU-27 in 2007[2]

NACE Group name (NACE Rev1.1)	NACE Group	No. of enterprises (1,000)	No. of persons employed (1,000)	Turnover (€m)	Value added (€m)
General construction (building of complete constructions or parts thereof and civil engineering)	45.2	1,270	8,112	1,070,000	326,000
Building installation	45.3	759	3,483	325,000	125,000
Building completion	45.4	930	2,637	202,000	86,000
Site preparation	45.1	117	460	56,000	19,000
Renting of construction or demolition equipment with an operator	45.5	16	89	10,000	5,000
TOTAL for construction sector		3,090	14,793	1,665,000	562,000

The construction sector is made up of a high proportion of small enterprises, which mainly serve a local market, and relatively few large ones. Enterprises with fewer than 50 staff were responsible for employing 72% of the

[1] Eurostat, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Construction_sector_statistics

[2] Eurostat, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Structural_profile_of_construction_sector,_EU-27,_2007.PNG&filetimestamp=20100730133039

construction sector workforce in the EU-27 in 2006 (which compares to an average of 50% (2005) for the non-financial business economy), and for providing 65% of construction sector added value (compared to 40% in 2005 for the non financial business economy overall[3].

The economic performance indicator of value added is probably the most useful for measuring the performance of the construction sector as whole, because it allows aggregation and comparison across the very diverse range of activities and businesses carried out within the sector, such as building construction, civil engineering (including structures and underground utilities), refurbishment, demolition, site preparation (including excavation), and equipment rental. Other useful output indicators include project value – often measured in €/m^2.

3.1.2 Resource Efficiency Status

Waste Generated

2002 EC Regulation on Waste Statistics (2150/2002) requires data on the generation, recovery and disposal of waste every two years, beginning with the reference year 2004[4]. However a number of problems have beset the reporting of data on construction and demolition (C&D) waste, and probably the best recent study to address this is Management of Construction and Demolition Waste in the EU, (BIO, Arcadis & IEEP, 2011) [Ref 9][5].

The report examines data from ETC working paper – Present recycling levels of Municipal Waste and C&D Waste in the EU[6], which shows a total level of C&D waste for the EU27 of 866 Mt (2004), which is based on the Eurostat data. It uses the data to give figures for C&D waste per capita and C&D waste per unit of GVA for all EU27 member states – ranging from 0.05 to 5.9 t/capita and 0.02 to 5.02 kt/M€ (waste per unit of GVA is a waste intensity indicator – the inverse of waste productivity). The report examines the reasons for the wide discrepancies in these figures – some to do with the quality / completeness of reporting and some due to realities – both cultural (including the ratio of construction to demolition in each MS economy) and economic.

The report describes the problem of excavation waste, stating that some C&D waste statistics may include excavation waste and excavation can be up to 80% of the CD&E total for a country (e.g. France). The report makes various adjustments to correct for both under-collection of data and over-reporting through including excavation waste, done on a country-by-country basis, and concludes the following C&D waste figures for the EU-27 for 2005 – 461 Mt and 1.09 t/capita. It also states the ranges for these figures shown in Table 2.2, with the qualification that the quality and reliability of the data available do not allow for a more precise range to be established.

The report does not give any overall figure for waste intensity for the EU27. However since the population figures and the added value figures remain the same for each country (i.e. only the waste figures have been corrected), we

[3] Eurostat, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Construction_sector_statistics

[4] Eurostat, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Waste_statistics

[5] European Commission, DG Environment, Management of Construction and Demolition Waste in the EU, (BIO, Arcadis & IEEP), 2011 [ref 9]

[6] European Topic Centre on Resource and Waste Management, EU as a Recycling Society - Present Recycling Levels of Municipal Waste and C&D Waste in the EU, April 2009

would expect the final figure for waste intensity to relate to the EU member state range of 0.02 to 5.02 kt/M€ in the same way that the final figure for waste per capita of 1.09 t/capita relates to the EU member state range of 0.05 to 5.9 t/capita - i.e. the overall figure for waste intensity for the EU27 would be 1 kt/M€.

Table A3.2 Estimates of C&D and CD&E Waste Generated in the EU27 in 2005 ([7] except for waste intensity figure)

Type of waste, EU27, 2005	Total (range) (Mt/yr)	Waste intensity (kt/M€ of GVA) - estimated	Waste per capita (range) (t/capita)
C&D waste	461 (310-700)	1.0	1.09 (0.63-1.42)
CDE waste	(1,350-2,900)	n/a	(2.74-5.9)

Materials Used

A detailed body of material flow accounts exists for the EU27, maintained by Eurostat, to enable the material productivity of the EU and of the member states to be calculated and monitored. Material productivity on a whole economy basis is best defined as GDP/DMC[8].

Material flow accounts cover all primary materials flowing into and out of an economy and are divided into the main groups of fossil fuels, minerals and biomass. The minerals category is sub-divided into metal ores, construction minerals and industrial minerals. Material productivity for the EU construction sector should be defined as gross value added by the construction sector dived by material resources used by the construction sector. The best approximation to this available from the EU-level material flow accounts would be construction minerals used divided by GVA for the sector. However there are a number of issues with using this indicator to address business resource efficiency opportunities in the construction sector, notably the following.

- "Construction minerals" covers only raw materials such as aggregates, sand, gypsum. It does not cover all material inputs into construction including processed and manufactured products such as timber products, steel components, insulations, decorations, fit-out materials, etc;
- The processed materials, which are not accounted for in MFA statistics, have higher values than basic raw materials, and therefore the benefits of minimising their use through resource efficiency are much greater than for raw materials;
- Other sectors use "construction minerals" and the construction sector uses other raw materials such as "industrial minerals"; and
- Improvements in the material productivity in construction, as measured in this way, can arise from economy-level shifts that are not related to resource productivity at all, e.g. from material-intensive

[7] Ibid

[8] Where DMC is Domestic Material Consumption, defined as domestic extraction plus imports minus exports, and measures the annual amount of raw materials extracted in a national economy, plus all physical imports minus all physical exports.

construction, such as road-building, to higher added value construction such as refurbishment, building offices and even construction equipment rental. Disaggregating true resource productivity improvements from macro-economic shifts is impossible when looking at overall improvements in material productivity as a single indicator.

For most sectors the relationship between waste (an **output** that needs to be minimised) and materials use (an **input** that needs to be minimised) is very straightforward, by the simple principle of the mass balance:

- Materials in = product out + waste out.

Therefore for these sectors the approaches and measures for reducing waste generation (i.e. for improving waste productivity and waste efficiency) are the same as those for reducing material use (i.e. for improving material productivity and material efficiency). (Note that the same cannot be said for reducing waste to landfill, for example, as this is also promoted by increasing waste recovery, which has no direct impact on material use). Indeed for this reason Further Benefits of Business Resource Efficiency[9] includes materials productivity benefits under the heading of waste productivity.

However for the C&D sector the simple mass balance does not apply because of the presence of demolition waste, and the mass balance has to be modified to:

- Waste out = (materials in minus product out) + demolition waste.

This means in practice that to improve the resource efficiency of the C&D sector we need to consider construction and demolition separately. In terms of the metrics this is difficult as the C&D sector is treated as one, with economic, waste and material data available generally only for the C&D sector as a whole. This can be further complicated by the variable inclusion of excavation data as described above, which (in terms of waste) can dwarf the C&D figures.

The way ahead in assessing opportunities for improving materials productivity in construction is therefore probably to look at very specific sub-sectors such as house-building, retail development, road-building, and to define a specific basket of material inputs that can be readily monitored for each, such as aggregates, timber, steelwork, insulation, tiles and bricks, etc.

Water Used

Water productivity in construction needs to be clearly distinguished from the influence of construction practices (including design) on water efficiency in the built environment, i.e. in operational buildings and other built structures. The latter would seem to have far greater potential to improve the water productivity of the whole

[9] Oakdene Hollins, 2011, The Further Benefits of Business Resource Efficiency

economy than the former[10]. This is a completely different consideration when looking at water productivity as compared with materials or waste productivity for the C&D sector.

The main areas are use in concrete / cement manufacture, dust suppression, wheel-washing and equipment/vehicle cleaning, domestic-type uses for personnel hygiene and the testing and commissioning of pipework and process plant. Key measures to reduce water are therefore likely to be designing and specifying less water intensive materials and simple water minimisation measures through good site practices.

Eurostat has tables, by country, for abstracted water (surface water and ground water)[11] used by construction and for water supplied to construction from the public water supply[12]. For the former, amongst the EU27 the only credible data is for Belgium, Bulgaria, Germany, Hungary and the Netherlands (respectively 132, 400, 204, 224, and 484 Mm^3 in 2007). For the latter, amongst the EU27 the only credible data is for Spain (36Mm^3 in 2008). The only countries showing non-zero values for both abstracted and public-supply water are Bulgaria and the Netherlands, where the public supply use is respectively just 0.3% and 0.4% of the abstracted total.

This data contrasts strongly with UK data published by WRAP and the SFC[13] which estimates a UK water intensity figure of 148m^3 water per £million contractors output for 2008, of which just 1.3m^3/£m was abstracted water and the rest was mains water. Converting this intensity figure using total contractors' output figures in £m, also given in the report, yields a total figure for water usage in construction of 15.5 Mm^3, which can be viewed alongside the Eurostat data reported above although is unlikely to be directly comparable. The ONS in the UK[14] presents data for the water intensity indicator of the median mains water use during the construction process per £100,000 of project value (m3/£100k) and reports UK figures from 2005 (8.2 m3/£100k) to 2010 (6.3 m3/£100k). These figures for water intensity are clearly around half the value estimated in the WRAP and the SFC.

3.1.3 Summary of Resource Efficiency Indicators

As noted above, provided both the numerator (number on top) and denominator (number on the bottom) of resource efficiency indicators can be attributed correctly to the system they are describing (e.g. house-building, retail development, civil engineering, transport infrastructure) then a resource efficiency indicator will be most useful to an individual business if it relates as precisely as possible to the sub-sector and activities of the business. However for reasons of policy making and cross-comparison between sectors and within sectors, the most useful indicators overall will be those on a macro scale, as shown against "Best options" in Table 2.3 below.

[10] Unpublished study for WRAP by AMEC, PRO095-003 – Scoping study to compile estimates of the resource efficiency impacts of material and water use in the built environment, August 2010.

[11] Eurostat, extract from data set env_watq2

[12] Eurostat, extract from data set env_watq3

[13] WRAP and the SFC, 2011, An Action Plan for Reducing Water Usage on Construction Sites

[14] http://www.ons.gov.uk/ons/rel/construction/construction-statistics/no--11--2010-edition/chapter-16---key-performance-indicators-and-benchmarking.pdf

Table A3.3 Recommended Resource Efficiency Indicators for Use in the C&D Sector

Type of RE Indicator	Options	For waste	For materials	For water
Productivity	Possible numerators	GVA (in €)	GVA (in €)	GVA (in €)
	Possible denominators	Weight of: C&D waste generated, C&D waste landfilled, or demolition waste landfilled	DMC, or total weight of materials and products used by a sub-sector	Water used in C&D, water used in C&D plus embodied water, whole life water use of projects being built; also can choose between mains water, abstracted water and total water.
	Best option(s)	**GVA/C&D waste generated**	**GVA/DMC**	**GVA/total abstracted and mains water used in C&D**
Efficiency	Possible numerators	Project value (€), floor area built, length of road built, length of pipeline installed, etc.	As for possible numerators for Waste Efficiency to the left.	As for possible numerators for Waste Efficiency to the left.
	Possible denominators	As for possible denominators for Productivity above	As for possible denominators for Productivity above	As for possible denominators for Productivity above
	Best option(s)	**Project value/C&D waste generated**; others depending on sub-sector.	**Project value/DMC**; others depending on sub-sector.	**Project value/total abstracted and mains water used in C&D**; others depending on sub-sector.
Intensity	Possible numerators	As for possible denominators for Productivity above	As for possible denominators for Productivity above	As for possible denominators for Productivity above
	Possible denominators	As for possible numerators for Efficiency above	As for possible numerators for Efficiency above	As for possible numerators for Efficiency above
	Best option(s)	**C&D waste generated/GVA**; others depending on sub-sector.	**DMC/GVA**; others depending on sub-sector.	**Total abstracted and mains water used in C&D/GVA**; others depending on sub-sector.

3.1.4 Drivers and Barriers in C&D Resource Efficiency

One of the best recent summaries of drivers and barriers in C&D resource efficiency has been made by the Eco-Innovation Observatory[15]. This resulted from a 2011 business survey with 128 respondents and it divides drivers and barriers into the five factor categories of Economic and financial, Technological, Environmental, Socio-cultural, Regulatory and policy framework. It lists 15 drivers and 21 barriers under these headings. These are reproduced below in Tables A2.4 and A2.5.

[15] Eco-Innovation Observatory, Resource-Efficient Construction - The Role of Eco-Innovation for the Construction Sector in Europe, 2011, www.wupperinst.org/uploads/tx.../EIO_WP4_ResEff_Constr_Report.pdf

Table A3.4 Drivers in Construction Resource Efficiency

Factor categories	Drivers
Economic and financial factors	Competition for innovative building components
	High price of building materials (as an incentive to search for substitutes)
Technological factors	Innovative technology development
	High research and development activity in the construction sector
Environmental factors	Scarcity of materials for energy and resource-efficient technologies
	Favourable geographical location (e.g. stable temperatures, ground composition)
Socio-cultural factors	Building planners skilled in sustainable construction (architects, engineers, etc.)
	Strong collaboration between research, experts and business in the sector
	High level of awareness of building/home owners
	Craft labour force skilled in sustainable construction (electricians, plumbers, etc.)
	High level of acceptance by building/home users
Regulatory and policy framework	Ambitious building regulations and standards
	Subsidies and programmes for sustainable construction
	Green public procurement
	Construction materials tax

Source: [16]

Table A3.5 Barriers in Construction Resource Efficiency

Factor categories	Barriers
Economic and financial factors	Building materials are too cheap
	Building materials are too expensive
	Limited access to venture capital & other sources of finance for innovative projects
	Price of materials for innovative technologies is too high
	Lack of competition for innovative building components
	Limited demand for eco-innovative buildings (user-investor dilemna)
	Refurbishing too expensive
Technological factors	Lack of innovative technology development
	Technological lock-ins (e.g. old energy infrastructures)
	Low research and development activity in the construction sector

[16] Ibid

Factor categories	Barriers
Environmental factors	Scarcity of materials for energy and resource-efficient technologies
	Unfavourable geographical location (e.g. limited sunlight, extreme temperatures)
Socio-cultural factors	Weak collaboration between research, experts and business in the sector
	Lack of knowledge/ training of craft labour force (electricians, plumbers etc.)
	Lack of knowledge/ training of building planners (architects, engineers etc.)
	Lack of awareness of building/home owners
	Lack of acceptance by building/home users
	Risk averse attitudes in the construction sector
Regulatory and policy framework	Lack of subsidies and programmes for sustainable construction
	Un-ambitious regulations and standards
	Monitoring and certification underdeveloped

Source: [17]

3.1.5 Current Practice in Resource Efficiency

Attitudes and Behaviours within Construction

- Gallup, 2011, Attitudes of European Entrepreneurs towards eco-innovation (ref 29); and
- Oakdene Hollins, Brook Lyndhurst and the Resource Recovery Forum, WR1403: Business Waste Prevention Evidence Review – L2m3 - Attitudes and Behaviours (ref 101).

Key Actions by Businesses and Trade Associations

The key European TAs are:

- European Construction Industry Federation, http://www.fiec.org/Content/Default.asp
- Council of European Producers of Materials for Construction, http://www.cepmc.org/en

Waste and Materials:

See Management of Construction and Demolition Waste in the EU, (BIO, Arcadis & IEEP), 2011 [ref 9].

Water

See: http://www.strategicforum.org.uk/water.shtml]

[17] Ibid

3.1.6 Resource Efficiency Opportunities

The opportunities for achieving resource efficiency improvements in C&D can be sub-divided into:

- design improvements,
- changes to input materials,
- improvements in C&D processes, and
- management of waste.

The main measures for achieving these resource efficiency opportunities are shown in Table A3.6.

Table A3.6 Summary of Resource Efficiency Improvement Measures for Construction and Demolition

Type of RE Opportunity	Waste	Materials	Water
Product design	Leaner design/eco-design, modular design (to reduce waste in construction), including design using standard sizes of components such as panels and fittings. Design for deconstruction/recycling. Design for longevity, e.g. new nuclear power stations designed for 60 years instead of 30 years.	Leaner design/eco-design; modular design: e.g. component lightweighting (through use of stronger/higher quality components such as reinforced concrete and higher performance insulation).	
Material input changes		Reduced material use through material substitution, e.g. higher performance coatings, adhesives, etc. Reduced virgin material use through re-use of timbers, fittings, decorations, etc; and re-use of whole buildings through refurbishment instead of demolition. Reduced virgin material use and increasing recycled content, e.g. use of recycled aggregates. Reduced packaging use, through eliminating packaging (e.g. brick and block delivery) and use of returnable transit packaging (RTP) such as returnable crates and pallets (e.g. Euro and CHEP pallets).	Reduced mains water use through use of collected rainwater / grey water for uses such as: concrete/cement making, dust suppression, equipment/vehicle cleaning and wheel-washing. Re-use of cement plant/vehicle wash water in the cement-making process. Substitution of abstracted (surface or ground) water for mains water.
Process design	Off-site fabrication to minimise material use and waste generation and to allow waste re-use and recycling in controlled factory environment Better planning and control of material use to minimise off-cuts. Avoiding over-ordering including through use of consolidation centres	Off-site fabrication to minimise material use and waste generation and to allow waste re-use and recycling in controlled factory environment Better planning and control of material use to minimise off-cuts. Avoiding over-ordering including through use of consolidation centres	More water-efficient manual and automatic equipment for dust suppression (including hose trigger controls), equipment/vehicle cleaning and wheel-washing, and domestic-type uses for personnel hygiene. Better planning, control and site design to reduce need for washing down.

Type of RE Opportunity	Waste	Materials	Water
Materials handling	Better handling and storage throughout, including raw materials, intermediates and finished products/installations/buildings.	Better handling and storage throughout, including raw materials, intermediates and finished products/installations/buildings.	
Waste management	Preparing for re-use, e.g. separation and handling of unused/damaged raw materials, including through the use of consolidation centres. Segregation for recycling, e.g. plasterboard and use of MRFs. Waste treatment/reprocessing to add value/reduce loss of value, e.g. sorting, crushing and grading demolition waste		Re-use or recycling (i.e. with treatment) of water used for applications such as equipment/vehicle cleaning and wheel-washing, and the testing and commissioning of pipework and process plant.

Sources: Various references including WRAP case studies, and the authors' experience.

3.1.7 Gaps, Challenges and Next Steps for the Study

Box 1 Summary of further research needed for final report (draft for discussion)

Main challenge is to evaluate what is current practice and differentiate that from best practice opportunities, in preparation for quantifying and costing those opportunities.

There is probably not much benefit from speaking to individual business representatives, as it would be too onerous to ensure a representative cross-section of the industry. Compared to sectors such as iron and steel C&D is very diverse with a large majority of small businesses. Also surveys have already been done and more would be gained by more in-depth literature research, and follow-up of individual reports for clarification and obtaining source data.

There may however be benefit in speaking to key stakeholders such as the two main European TAs, some of the large national TAs, and other organisations such as WRAP in the UK. There may also be sub-sector TAs at European and/or national level worth speaking to, particularly once a more detailed quantification reveals in which sub-sectors the main opportunities lie.

A key next step is to tie in the work on individual sectors, such as C&D, with the future work on quantifying the opportunities so that effort is most efficiently targeted. Feedback from the client will be helpful here too.

Key specific areas for more development are:

- How behavioural issues will affect realisation of resource efficiency opportunities (level of influence from constraining factors);
- Which are the best resource efficiency indicators both for policy makers / public support providers, and for individual businesses;
- Existing benchmarks against these indicators; and
- Level of theoretical vs. realistic resource efficiency opportunity opportunities (i.e. take-up rates).

3.2 Iron & Steel

3.2.1 Economic and resource consumption data

The European iron and steel sector, composed of 17,000 enterprises with 1.08 million employees, accounted for total turnover of approximately € 395 billion and 4.6% of manufacturing in the EU in 2006 (see Table A3.7). The EU steel industry is dominated by large, multinational companies such as Arcelor-Mittal (Luxembourg), Tata Steel Europe (UK), ThyssenKruup (German), US Steel (US) and Riva Group (Italian) with a world-wide network of production facilities and focus on high quality products, product innovation and value creation supported by research and development, efficiency and skilled manpower (Ecorys, 2008)[18]. There are also approximately 3,000 niche specialists, such as foundries which typically produce less than 5 million tonnes per annum and have a few production locations with smaller but specialised product portfolio. Together, the European iron and steel industry produced 172 million tonnes of crude steel in 2010, accounting for approximately 15% of world steel output (EUROFER, 2011)[19].

Table A3.7 Iron & steel sector: economic activity data

	Number of enterprises	Turnover	Number of employees	Value added (VA) at factor cost	Share of VA in manufacturing total	Crude steel production (2010)
EU-27	17,000	395 billion €	1,080,000	79.4 billion €	4.6%	172 million tonnes
Top 5 Member States	Italy Greece Germany United Kingdom Spain	Germany Italy France Spain United Kingdom	Germany Italy France Spain United Kingdom	Germany Italy France Spain United Kingdom	Luxembourg Slovakia Romania Finland Austria	Germany Italy Spain France United Kingdom

Eurostat (2012): structural business statistics for NACE 24 Manufacture of basic metals for year 2006[20]; EUROFER (2011).

In an integrated steelworks, water is used for direct and indirect cooling, gas cleaning, scale breaking and washing operations including waste gas cleaning with scrubbers. The water management primarily depends on local conditions, particularly on the availability of fresh water and on legal requirements. Because of costs for waste

[18] Ecorys (2008). Study on the competitiveness of the European steel sector. Published by European Commission, DG Enterprise and Industry. http://ec.europa.eu/enterprise/sectors/metals-minerals/files/final_report_steel_en.pdf

[19] EUROFER (2011). Annual Report 2010.

[20] Eurostat (2012) Structural business statistics (SBS) for industry and construction http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database

water treatment and availability of fresh water, water consumption has been constantly reduced since 1980 and measures to reduce water consumption such as extensive recirculation have been implemented (EC, 2012)[21].

According to the Best Available Techniques (BAT) Reference Document for Iron and Steel sector (EC, 2012), the sector is highly intensive in materials: an integrated steelworks producing 3 to 5 million tonnes of steel per year will handle 8 to 12 million tonnes of raw materials such as ores, pellets, scrap, coal, lime, limestone and additives as well as process residues such as by-products and wastes. In 2006, 357 million tonnes (Mt) of total inputs, including iron ore (35%), scrap (34%), coal (15%), lime, limestone and dolomite (9%), additives (5%) and fuels (1%), were processed to produce 206 Mt of crude steel (58% of total input) and 151 Mt of off-gases, process gases, and solid production residues (EC, 2012).

The Environmental Impact Database for SMEs reports that the iron and steel sector generated 24.1 million tonnes of waste in 2006 (Planet SA et al., 2010)[22].

3.2.2 Sector-specific drivers and barriers

Drivers

Costs of raw material (including iron ore and scrap metal) and energy constitute a large portion of the production costs of steel (20-40%), providing incentives for the European steel industry to make substantial resource efficiency improvements by applying a range of advanced techniques for materials and energy management (Ecorys, 2011)[23]. In the last few years, the incentive to increase resource efficiency accelerated as global competition in the steel industry increased significantly and pushed the costs of raw materials and energy to record levels (McKinsey) [24].

Furthermore, environmental legislation such as EU Emissions Trading Scheme, has forced steel manufacturers to adopt more environmentally friendly production methods and products. This is demonstrated in the significantly lower energy intensity values of the EU steel industry compared to the worldwide values[25].

All major players in the EU steel industry report that sustainability is one of the core corporate values and refer to a number of initiatives taken to increase energy, water and material efficiency.

[21] European Commission (2012) Best available techniques (BAT) reference document for iron and steel production. http://eippcb.jrc.es/reference/BREF/IS_Adopted_03_2012.pdf

[22] Planet SA and Danish Technological Institute (201) SMEs and the environment in the European Union. Published by European Commission, DG Enterprise and Industry. Waste data is from Environmental Impact Database for Small and Medium sized Companies (EIDSME), which estimated waste consumption per Member State and per sector for year 2006 http://web.me.com/kkalog/SMEENV/LinkedDocuments/EIDSME_sector_country.swf

[23] Ecorys (2011). Study on the competitiveness of the European Companies and Resource Efficiency. Published by European Commission, DG Enterprise and Industry

[24] McKinsey & Company (2011). Resource Revolution: Meeting the world's energy, materials, food, and water needs.

[25] The EU energy intensity is 17-23 GJ/tonne steel for basic oxygen furnace (BOF) and 3.5-4.5 GJ/t for electric arc furnace (EAF), whereas the global energy intensity is 20-31 GJ/t for BOF and 9.1-12.5 GJ/t for EAF (Ecorys, 2011)

Barriers

After 30 years of continuous reduction of energy use in production and resource efficiency improvement, the iron and steel industry has a relatively small set of options for further short-term improvements in resource efficiency (Ecorys, 2011). Breakthrough technologies such as ultra-low CO_2 steelmaking (ULCOS) programme are based on a completely different steelmaking process which would require a large financial investment, and investors today are deterred by the volatility in energy and output prices and by uncertainty over regulatory environment.

There is also lack of comprehensive data on water usage, material flow and waste generation in the steel industry, which makes it difficult to assess opportunities for efficiency improvements. General lack of knowledge and skills on water management technologies are also mentioned as barriers (ESTEP, 2011)[26]

3.2.3 Key actions on RE by business and/or trade associations

The European Steel Technology Platform (ESTEP) was established by the European steel industry to bring together industry, research centres, the European Commission and Member States to maintain the leadership of the European steel industry in the area of sustainable development[27]. Mainly through one of its industrial programmes, 'rational use of energy resources and residues management', ESTEP has led and funded research and development (R&D) programmes including the ULCOS, efficient recovery and utilisation of by-products and technologies for improving water and material efficiency. ESTEP is also strongly involved in public-private partnerships such as Sustainable Process Industry through Resource and Energy efficiency (SPIRE), Resource and Energy Efficiency Partnership (REP) and several European Innovation Partnerships (EIPs), namely Raw Materials Initiative (on sustainable supply of raw materials), Water Resource Imitative (on sustainable use of water) and Key Enabling Technologies (KETs). ESTEP has been also involved in some flagship initiatives launched by the European Commission such as Resource Efficient Europe, Industrial Policy and Innovation Union. The common objective of these public-private partnerships is to develop the technologies that will help the European iron and steel industry to develop solutions to improve resource and energy efficiency.

European Steel Association (EUROFER) is the main trade association for the iron and steel industry in the EU with steel companies and national steel federations as members it represents. It is actively involved in ESTEP and other aforementioned public-private partnerships. In response to the EU Roadmap for Resource Efficiency, EUROFER (2011) welcomed the emphasis on recycling, recyclability of materials and life cycle based decision making and suggested that technology-related measures based on Best Available Technologies or benchmarking are more applicable to manufacturing industries.

[26] ESTEP (2011). EIP Water Efficiency ESTEP Contribution. http://ec.europa.eu/environment/water/innovationpartnership/pdf/15_12_2011/ESTEP%20for%20EIP%20water.pdf

[27] http://cordis.europa.eu/estep/about_en.html

3.2.4 List of potential measures/technologies for improving resource efficiency

The European steel industry has made substantial efficiency improvements over the last decades on both energy reduction and dematerialising. However, there are still a number of measures which are still relevant for the sector in improving resource efficiency (see Table A3.8).

Table A3.8 Resource efficiency improvement measures in iron and steel sector

Water	Materials	Waste
Avoiding the use of potable water for production lines	Reducing coke consumption by directly injecting reducing agents such as pulverised coal, coke oven gas, oil and wastes individually or in combination.	Recirculation of waste gas and water
Increasing the number and/or capacity of water circulating systems when building new plants or modernising/revamping existing plants	Improving recovery rate from iron ore extraction	Recycling facilities to fully utilise iron-rich residues and by-products: blast furnace and basic oxygen furnace dust and sludge, electric arc furnace dusts
Using the water in cascades until single parameters reach their legal or technical limits	Increasing scrap recycling to maximum scrap utilisation: today 40% of crude steel produced in EU-27 is from scrap metal but this can increase to 50% in the next 20 years	Utilisation of by-products (blast furnace slag, steelmaking slag, electric arc furnace slag, tar and benzole) by steelmaking and downstream non-steelmaking facilities
Centralising the distribution of incoming fresh water	Coke dry quenching	
Using the water in other plants if only single parameters of the water are affected and further usage is possible	Recycling facilities to fully utilise iron-rich residues and by-products: dust processing at the grinding mills (“dry grinding”) and electric arc furnace	
Keeping treated and untreated waste water separated. By this measure it is possible to dispose of waste water in different ways at a reasonable cost		
Using rainwater whenever possible		
Coke dry quenching: saves water and generates steam for electricity generation		
Dry de-dusting: using air to de-dust instead of water		
Using waste heat for water treatment and sludge drying		

Sources: EC, 2012; McKinsey, 2011; The 2030 Water Resources Group (2009). Charting our water future: economic frameworks to inform decision-making.

3.2.5 Best practice / top runners

Water: extensive recirculation system can reuse 97% of water required in the integrated system (98% of which is needed for indirect and direct cooling) and result in water intake of about 3.16 m^3/t crude steel. This is compared to once-through system where water intake can range from 100 to 200 m^3/t crude steel (EC, 2012). ESTEP and the European Water Platform (WssTP) have organised exchanges of best practices for sustainable water management.

Waste & Material: best practices and top runners in waste and material management were not easily identifiable at this time. This issue will be addressed by direct consultation with the industry (see Box 2).

3.2.6 RE indicators—resource consumed per economic activity

There is a lack of a comprehensive and/or generally accepted approach to measuring resource efficiency at the company level as companies report consumption of different resources and many indicators used do not necessarily provide information on the "level of efficiency" of the firms (Ecorys, 2011). Possible indicators for the EU iron and steel sector include the following:

- Water: cubic meter of water consumed per GVA or per tonne of steel produced (m^3/€ or m^3/t steel);
- Material: direct material input (DMI)[28] per GVA or per tonne of steel produced (DMI/€ or DMI/t steel); and
- Waste: tonne of solid waste generated per GVA or per tonne of steel produced (t waste/€ or t waste/t steel).

3.2.7 Data gap analysis

Box 2	**Further research area through direct consultation with the Industry**

Research conducted to date on the resource efficiency in the iron and steel sector has indicated a number of issues that have not been explored in the existing literature. These include:

- How resource efficiency issues are viewed by the industry;
- Drivers and barriers in regard to what has been done to date and what might be important in the future;
- How behavioural issues affect resource efficiency challenges and opportunities;
- Which resource efficiency metrics may be used to identify top-runners in the industry;
- Best practices in regard to water, waste and material management;
- Attitude toward establishing industry best available technology (BAT) standards; and
- Level of theoretical vs realistic resource efficiency opportunity opportunities.

Project team plans to consult with industry players to further explore these issues. For the iron and steel sector, the potential industry contacts would be EUROFER (the EU iron and steel trade association) and ESTEP (the industry-led initiative on developing sustainable practices in iron and steel industry).

[28] UNESCAP (2009). Eco-efficiency Indicators: Measuring Resource-use Efficiency and the Impact of Economic Activities on the Environment.

3.3 Food & Drink Manufacturing

3.3.1 Economic and resource consumption data

The European food and drink sector[29], composed of 2.71 million enterprises with 17.85 million employees in manufacturing, trade and services of food and drinks, accounted for total turnover of approximately € 3.28 trillion in 2008 (see Table A3.7). The EU food and drink industry is the largest industrial manufacturing sector in the EU-27 in terms of turnover, value added and employment. The food and drink manufacturing sector is dominated by small and medium-sized enterprises (SMEs) which account for 48% of turnover and valued added, 63% of employment and 99% of companies (FoodDrinkEurope, 2012)[30]. In comparison, the food and drink retail markets are increasingly concentrated: in most EU countries, the market share of the top 3 retailers ranges from 30% to 50%, with a few countries with greater than 70% market share. The outlook for European food and drink industry is less promising as it lags behind its global peers in terms of production value, labour productivity and investment in R&D (FoodDrinkEurope, 2011)[31].

Table A3.9 Food & drink sector: economic activity data

	Number of enterprises	Turnover	Number of employees	Value added (VA) at factor cost	Main agricultural and food product output
EU-27	2.71 million	3.28 trillion €	17.85 million	551 billion €	296.1 mt cereals
					54.5 mt fresh vegetables
Top 5 Member States	Italy	France	United Kingdom	France	31.4 mt drinking milk
	Spain	Germany	Germany	United Kingdom	2.4 mt cream
	France	United Kingdom	Spain	Germany	7.9 mt bovines
	Germany	Italy	France	Spain	22.0 mt pigs
	United Kingdom	Spain	Italy	Italy	0.7 mt sheep
					11.7 mt poultry

Eurostat (2012): structural business statistics for food and drink manufacturing, trade and services sector for year 2008[32] and Eurostat (2011) Food: from farm to fork statistics[33].

Water is both a product and a main ingredient in food and drink manufacturing. Water is also used in many food-processing steps including washing, boiling, steaming, cooling and cleaning. As a result, the food and drink sector

[29] Food and drink sector includes manufacture of food products (NACE Rev.2 C10) and drinks (C11), whole sale of food, beverages and tobacco (G46.3), retail sale in non- and specialised stores with food, beverages or tobacco (G47.1 and 47.2) and food and beverage service activities (H56).

[30] FoodDrinkEurope (2012) Data and trends of the European food and drink industry 2011.

[31] FoodDrinkEurope (2011). Supporting the competitiveness of the European food and drink industry: FoodDrinkEurope competitiveness report 2011.

[32] Sector information is from Eurostat statistical business statistics: http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database

[33] http://epp.eurostat.ec.europa.eu/portal/page/portal/food/data/database

consumes a significant amount of water, both from direct abstraction and its use of the public water supply. However, available data on the sector's water use is incomplete[34] as the water consumption information between the various sub-sectors varies significantly from one region to another due to different natural conditions and economic and demographic structures (CIAA, 2007)[35]. According to available information in Eurostat (i.e. 14 Member States), the European food and drink processing industry consumed approximately 1.5 billion cubic meters of water, accounting for 2.0% of total water consumption in Europe in 2007[36]. Considering the unavailable information, the total water consumption in the sector is likely to be larger than 1.5 billion cubic meters of water.

Raw material for food and drink sector is largely agricultural produce: the EU food and drink industry purchases about 70% of the European agricultural produce (CIAA, 2007). Primary agricultural output includes, among others, products such as crops, animals ready for slaughter, or milk.

Statistical information on total amount of solid waste generated by food and drink industry is similarly incomprehensive as the inconsistency in waste categorisations at national level makes it difficult to compile comparable information for EU-27.The Environmental Impact Database for SMEs reports that the food and drink manufacturing sector generated 60.3 million tonnes of waste in 2006 (Planet SA et al., 2010)[37]. During the same year, manufacturer of food, drink and tobacco products generated 37.3 tonnes of animal and vegetal waste (excluding slurry and manure) (Bio Intelligence Services, 2010)[38].

3.3.2 Sector-specific drivers and barriers

Drivers

Rising prices of agricultural commodity due to international competition and scarcity as well as rising input costs (e.g. crude oil, gas, electricity, etc.) have made the resource efficiency a pressing issue for food and drink industry[39]. Increasing public awareness in sustainable food production and regulatory restrictions on food safety has also put the industry under pressure to survive and maintain its competitiveness.

[34] Eurostat compiles statistics on water use by supply category and user (http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/env_wat_esms.htm). However, information is only available for approximately 15 Member States for total supply and less number of Member States for sub-categories for supply and user.

[35] Confederation of the food and drink industries of the EU (CIAA) (2007). Managing environmental sustainability in the European food and drink industries.

[36] For two Member States of which water consumption statistics was not available for year 2007, values from 2006 or 2008 were used.

[37] Planet SA and Danish Technological Institute (2011) SMEs and the environment in the European Union. Published by European Commission, DG Enterprise and Industry. Waste data is from Environmental Impact Database for Small and Medium sized Companies (EIDSME), which estimated waste consumption per Member State and per sector for year 2006 http://web.me.com/kkalog/SMEENV/LinkedDocuments/EIDSME_sector_country.swf

[38] Bio Intelligence Services (2010). Preparatory study on food waste across EU-27.

[39] Ecorys (2011). Study on the competitiveness of European companies and resource efficiency: final report.

Technological innovation in food manufacturing, packaging and logistics has contributed to increased efficiency and efficacy of raw material use (EC, 2007)[40].

Barriers

Because the companies that make of the European food and drink sector are largely SMEs, limited access to financial resources for investing in resource efficiency measures as well as limited access to knowledge are considerable barriers to resource efficiency improvements (Ecorys, 2011). Often, companies assign resource management responsibility to a single individual with insufficient power or organisational support to implement waste reduction or lean production (Oakdene Hollins, 2011)[41].

Compliance requirements of certain regulatory standards such as the hygiene standards mean that the industry is not exactly incentivised to maximise water savings as there are technical limits and a certain level of fresh, clean water use is necessary. In many cases, metering and/or monitoring of resource consumption is often limited, which makes it challenging to apply good management practices.

For wholesale and retail food and drink sector, barriers to reducing food waste include supply chain inefficiencies, difficulties anticipating demand causing inefficient stock management, marketing strategies that incentivise consumers to purchase more food, marketing standards on aesthetic issues and packaging, high product specificity and temperature sensitivity of food products (Bio Intelligence Services, 2010). In food service sector, portion sizes bigger than consumers' needs, difficulty anticipating number of clients, negative attitudes toward the practice of taking leftovers home, low awareness of food waste and difficulty meeting preferences of clients are barriers to reducing food waste.

3.3.3 Key actions on RE by business and/or trade associations

The European food and drink sector is committed to resource efficiency for both reducing material, energy and water used for production and service but also the effects of its operation on the environment (CIAA, 2007). The industry established the European Food Sustainable Consumption and Production Round Table (SCP RT) in 2009 to promote a science-based, coherent approach to sustainable consumption and production in the food sector across Europe (Food SCP, 2012)[42]. One of the key objectives, establishing scientifically reliable and uniform methodologies for environmental assessment of the entire life cycle of food and drink products, is in line with the industry's ongoing effort to better track and manage resource consumption. FoodDrinkEurope, the industry's main trade association, is scheduled to launch environmental sustainability report and vision towards 2030 in June 2012[43].

[40] European Commission DG ENT (2007). Competitiveness of the European Food Industry An economic and legal assessment.

[41] Oakdene Hollins (2011). Opportunities for resource efficiency in the food and drink sector.

[42] European Food Sustainable Consumption and Production Round Table (2012). Presentation on the European Food Sustainable Consumption and Production Round Table.

[43] http://www.fooddrinkeurope.eu/event/2012-environmental-sustainability-report-vision-towards-2030/

In the UK, the Federation House Commitment (FHC) was launched in 2008 to support its members in the food and drink industry to reduce water usage within their company, and by doing so, contribute towards an overall sector-wide water reduction target of 20% by the year 2020 against a 2007 baseline (WRAP, 2011)[44]. The FHC signatories, representing 21% across the UK, have reduced water consumption (excluding water in product) by 11.9% between 2007 and 2010 to 1.75 cubic meter per tonne of product per annum.

3.3.4 List of potential measures/technologies for improving resource efficiency

The measures available to improve resource efficiency in regard to water, materials and waste for the European food and drink industry are listed below (see Table A3.8).

Table A3.10 Resource efficiency improvement measures in the food and drink manufacturing sector

Water	Materials	Waste
Reuse of greywater and rainwater harvesting	Use of by-products as fertilizers and animal feeds	Use of by-products as fertilizers and animal feeds
Water consumption monitoring	Use of by-products for bio-energy production	Use of by-products for bio-energy production
Modifying cleaning and housekeeping practices	Efficient packaging	Efficient packaging
Preventing water leakage	Just-in-time delivery	Just-in-time delivery
Staff training to raise awareness in water consumption		Reducing the volume and weight of packaging material to the required levels of safety and hygiene
Reduction and treatment of waste water		Reducing the use of single-trip packaging (e.g. stretch wrap and corrugated cardboard)

3.3.5 Best practice / top runners

Water: there are a number of cases studies which demonstrate improvement in water efficiency in food and drink manufacturing, however the literature search did not indicate a clear best practice in the sector. Project team will investigate best practice and top runners in water through direct consultation with the industry association (see Box 3).

Material and Waste: the European sugar industry has shown a 100% use of raw material. It processes 110 million tonnes of beet on yearly basis to produce 17.6 million tonnes of sugar (16%) (Ecorys 2011). The remaining components are re-used as follows: (1) water (75%) for beet washing; (2) molasses (3.5%) and beet pulp (5%) as animal feed; and (3) other material (0.5%) for incorporating into sugar factory lime.

[44] Waste and Resource Action Programme (WRAP) (2011). The Federation House Commitment: Reducing water use within the Food & Drink Industry. Progress Report 2011.

3.3.6 RE indicators—resource consumed per economic activity

Possible indicators for the EU food and drink sector include the following:

- Water: cubic meter of water consumed per GVA or tonne of product (m^3/€ or m^3/t product);
- Material: direct material input (DMI)[45] per GVA or tonne of product (DMI/€ or DMI/t product); and
- Waste: tonne of solid waste generated per GVA or tonne of product (t waste/€ or t waste/t product).

3.3.7 Data gap analysis

Water and material consumption statistics per MS across EU-27 is not available in Eurostat.

Box 3	**Further research area through direct consultation with the Industry**

Research conducted to date on the resource efficiency in the iron and steel sector has indicated a number of issues that have not been explored in the existing literature. These include:

- How resource efficiency issues are viewed by the industry;
- Drivers and barriers in regard to what has been done to date and what might be important in the future;
- How behavioural issues affect resource efficiency challenges and opportunities;
- Which resource efficiency metrics may be used to identify top-runners in the industry;
- Best practices in regard to water, waste and material management;
- Attitude toward establishing industry best available technology (BAT) standards; and
- Level of theoretical vs realistic resource efficiency opportunity opportunities.

Project team plans to consult with industry players to further explore these issues. For the iron and steel sector, the potential industry contacts would include FoodDrinkEurope.

[45] UNESCAP (2009). Eco-efficiency Indicators: Measuring Resource-use Efficiency and the Impact of Economic Activities on the Environment.

3.4 Fabricated Metal Products

3.4.1 Economic and resource consumption data

The European fabricated metal products sector which encompasses the manufacture of machinery and equipment, composed of 460,329 enterprises with 6.2 million employees, accounted for a total turnover of approximately € 912 billion in 2009 (See table A3.11). Machine manufacturing supplies the means of production for all parts of the economy. It is a very wide and diverse sector (EC, 2012)46. Among the member states the metal products manufacturing sector was largest in Germany generating ¼ of the EU added-value total in 2006 (EuroStat, 2009)47. The sector is dominated by SMEs who contributed 78.3% of the value-add in 2006 and has a distinct reliance on intra EU trade at 74% of production the figure much higher than 67.6% the average for other industrial products (Eurostat, 2009).

Table A3.111 Fabricated Metal Products: economic activity data

	Number of enterprises	Turnover	Number of employees	Value added at factor cost
	units	*millions of €*	*units*	*millions of €*
EU-27	460,329	912,340	6.2 Million	286,723
Top 5 Member States	Germany Spain Italy UK Czech Republic	Germany Spain France Italy UK	Germany Spain France Italy UK	Germany Spain France Italy UK

Eurostat (2012): structural business statistics NACE 25 and 28 manufacturing of fabricated metal products and Machinery and equipment sectors for year 2009.

The fabricated metal products industry undertakes a number of high energy intensity activities and energy costs accounted for 4.4% of purchases of goods and services in 2006 (Eurostat, 2009).

46 European Commission – Trade machinery and electrical appliance http://ec.europa.eu/trade/creating-opportunities/economic-sectors/industrial-goods/machinery/

47 Sector information is from Eurostat statistical business statistics: http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database

Water usage in the fabricated metal products industry is high; it is used for cooling, degreasing, rinsing, cleaning and washing operations. Water management efficiencies vary across the EU, industry data suggests efficiencies are low apart from where regulatory or financial constraints are in place (EC, 2006)48

Raw materials for the fabricated metal products sector are dependent on imports at competitive prices meaning that companies need to look for alternative sources of raw material inputs or undertake resource efficiency activities more pro-actively than in other sectors, there are additional supply constraints influenced by high demand from India and China (EcoStat, 2009). A number of the input materials for fabricated metal products are listed by the EU as critical in terms of resource security and this is likely to have considerable implications for resource efficiency in the sector in the future49. Despite this industry data suggests low material efficiencies except where financial factors (such as for gold, silver) or environmental regulatory pressures (such as for cadmium) are paramount (EC, 2006).

The fabricated metal products sector produced 88,982,941 tonnes of waste in 2006 (Planet SA, 2011)50. There is a lack of comprehensive data on waste generated due to the segmented nature of the sector.

3.4.2 Sector-specific drivers and barriers

Drivers

The escalating cost of raw materials and energy is a problem for the sector and constitutes a large proportion of the production cost for the sector. This is compounded by a dependence on imports of materials at competitive prices and increasing supply constraints influenced by high demand in India and China, meaning that companies need to look for alternative sources of raw material inputs or apply a range of resource efficiency techniques to reduce usage of energy and materials in the future (EcoStat, 2009).

Furthermore, technological innovations in manufacturing processes have led to considerable opportunities for resource efficiency and value chain optimisation across the sector which companies are beginning to adopt; this is however slowed by the comparatively large SME numbers within the sector who are constrained by financial commitments (REMake, 2012).

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[48] European Commission (2006). Best Available Techniques (BAT) reference document for surface treatment of metals and plastics. http://eippcb.jrc.es/reference/BREF/stm_bref_0806.pdf

[49] (DEFRA, 2012) – Resource Security action plan: making the most of valuable materials

http://www.defra.gov.uk/publications/files/pb13719-resource-security-action-plan.pdf

[50] Planet SA and Danish Technological Institute (2011).SMEs and the environment in the European Union. Published by European Commission, DG Environment and Industry. Waste data is from Environmental Impact Database for Small and medium sized companies) EIDSME), which estimated waste consumption per member State and per sector for the year 2006. http://web.me.com/kkalog/SMEENV/LinkedDocuments/EIDSME_sector_country.swf

The increasing amount of environmental regulation in the sector has forced many businesses including SMEs to increasingly consider resource efficiency measures, this legislatory burden is only likely to continue and encourage further adoption of resource efficiency measures in the future (REMake, 2012.)

Many companies operating in the fabricated metal products sector namely the machinery and equipment field are driven by a diverse and demanding client base such as the food and drink industry and renewable technologies markets this is having an impact in encouraging better downstream resource efficiency techniques as part of customers sustainable supply chain initiatives (Germany Trade and Invest, 2012)[51].

Barriers

Because the majority of companies that make up the European fabricated metals are SMEs, limited access to financial resources for investing in resource efficiency measures as well as limited access to knowledge are considerable barriers to resource efficiency improvements (REMake, 2012). The complex nature of compliance and regulatory requirements on the industry are often difficult for the SMEs involved in the sector to manage and they are not incentivised to maximise resource efficiency (REMake, 2012).

The sector is also impacted by the varied customer base which can all place conflicting demands in terms of cost vs. environmental management on upstream suppliers (EcoStat, 2009). The sector is part of diverse and interwoven economic network up and downstream and as such is very disjointed in its approach to best practice in terms of resource efficiency. It does also mean that the sector has direct and indirect consequences on many other parts of economy (European business Facts and Figures EUROSTAT, 2009).

The report identified a lack of comprehensive data on resource efficiency across the sector this could be due to the diverse nature of the sector, dominance of SMEs and lack of open innovation and benchmarking activity.

3.4.3 Key actions on RE by business and/or trade associations

The fabricated metal products industry including machinery and equipment is a very fragmented sector across EU-27 as such each of its component fields has their own trade associations. This means that unlike other sectors there is no one resource efficiency solution that can be implemented across the sector as a whole. The European Commission recognises the gaps in understanding resource efficiency in the manufacturing holistically across the EU-27 and as such has implemented research programmes such as REMake and Factories for the future to encourage resource efficiency measures across manufacturing organisations in the Member States, including those engaged in fabricated metal products.

Those member states with large numbers of companies engaged in the sector have their own trade associations and supporting bodies that represent the sector. In Germany, for example, DEMEA have been tasked by the Federal Ministry of Economics and Technology with informing manufacturers about the importance of resource and material efficiency.

[51] Germany trade and Invest (2012). The Machinery & Equipment Industry in Germany http://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Industry-overviews/industry-overview-machinery-equipment.pdf

3.4.4 List of potential measures/technologies for improving resource efficiency

List of resource efficiency improvement measures relevant to the fabricated metal products sector (see Table A3.8).

Table A3.112 Resource efficiency improvement measures in fabricated metal Products sector

Water	Materials	Waste
Reuse of grey water and rainwater harvesting	Reduction in production of scrap and off cuts via monitoring of material losses while optimising production	Increase levels of onsite recycling at the end of the process and use of waste treatment measures along the production line
Water consumption monitoring via centralised meter and use of sub meters	Reduction in material losses during production via better management and visualisation	Re-use of by products as part of production process or in other products
Modifying cleaning and housekeeping practices e.g.:	Production design and application of life cycle thinking to reduce overall material usage in products	Consideration of BAT when looking at investing in new technologies and machinery onsite
Preventing water leakage by measuring and monitor water consumption to identify leaks and losses.	Just-in-time delivery to clients and	Install onsite waste management plans
Staff training to raise awareness in water consumption	Adjustment of component parts to reduce overall material usage	
Reduction and treatment of waste water	Communication up and down supply chain to encourage value chain optimisation	
Water treatment measures along production line to allow for water re-use as part of production process,	Applying techniques to reduce off -cuts during punching and cutting	
Implementation of planned maintenance of water system	Staff training to increase quality control and reduce losses and apply LEAN techniques and continual process improvement	
Application of water saving rinsing techniques	Use of metratronic solutions i.e. substitution of purely mechanical functionalities by electro technical and software technical solutions) in your product design	
	Encourage a culture of transparency and communication to encourage staff innovation in measures to reduce material inefficiencies	

Sources: REMAKE, 2012 http://www.ecomanufacturing.eu/sat.html

3.4.5 Best practice / top runners

Water: best practices and top runners in water were not easily identifiable at this time. This issue will be addressed by direct consultation with the industry (see box 2).

Material and Waste: There are a number of case studies undertake as part of research projects such as REMake that demonstrate resource efficiency in practice as part of the sector however the literature search did not indicate a clear best practice methodology for the sector. This issue will be addressed by direct consultation with the industry (see box 2).

3.4.6 RE indicators—resource consumed per economic activity

There is a lack of comprehensive and/or generally accepted approach to measuring resource efficiency across the fabricated metal products sector. Possible indicators for the EU fabricated metal products sector include the following:

- Water: cubic meter of water consumed per GVA or tonne of product (m^3/€ or m^3/t product);
- Material: direct material input (DMI)[52] per GVA or tonne of product (DMI/€ or DMI/t product); and
- Waste: tonne of solid waste generated per GVA or tonne of product (t waste/€ or t waste/t product).

3.4.7 Data gap analysis

Water and material consumption statistics per MS across EU-27 is not available in Eurostat.

Box 4	**Further research area through direct consultation with the Industry**

Research conducted to date on the resource efficiency in the Fabricated metal products sector has indicated a number of issues that have not been explored in great depth in the existing literature. These include:

- How resource efficiency issues are viewed by the industry namely SMEs;
- Drivers and barriers in regard to what has been done to date and what might be important in the future;
- How behavioural issues affect resource efficiency challenges and opportunities;
- Which resource efficiency metrics may be used to identify top-runners in the industry;
- Best practices in regard to water, waste and material management;
- Attitude toward establishing industry best available technology (BAT) standards; and
- Level of theoretical vs. realistic resource efficiency opportunity opportunities.

Project team plans to consult with industry players to further explore these issues.

3.5 Pulp & Paper Manufacture

3.5.1 Economic and resource consumption data

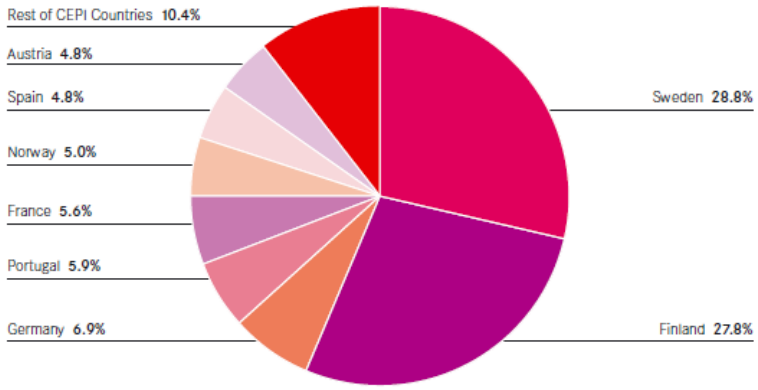
In 2010, Europe's paper and pulp industry had a turnover of €80.6 billion and produced almost 100 million tonnes of paper and paperboard and 12.7 million tonnes of pulp. 683 companies were active employing 998 paper mills. Since 1991 paper production has increased by 46% while use of recycled fibres has increased by 89%.

Paper and pulp is a major consumer of raw materials. In 2010, 50% of the industry's costs were in purchase of fibres and 18% were in energy. Biomass feedstocks are used both as fibre in the final product but also as a source of energy with the paper and pulp industry consuming over a quarter of all the biomass energy consumed in Europe. Water abstracted, over 90% from sources on the surface was 4,000 million cubic metres, though only 312 million cubic metres was consumed, with the remainder returned to source.

There is a clear economic incentive for the industry to reduce materials use to reduce input costs.

In the upstream industry, the EU pulp industry is dominated by Scandinavian countries, responsible for around 60% of CEPI countries production. This is due to their proximity to wood resources, the main raw material of pulp production. Overall, these and other EU member states have access to forest resources which are of major importance as a raw material for the industry.

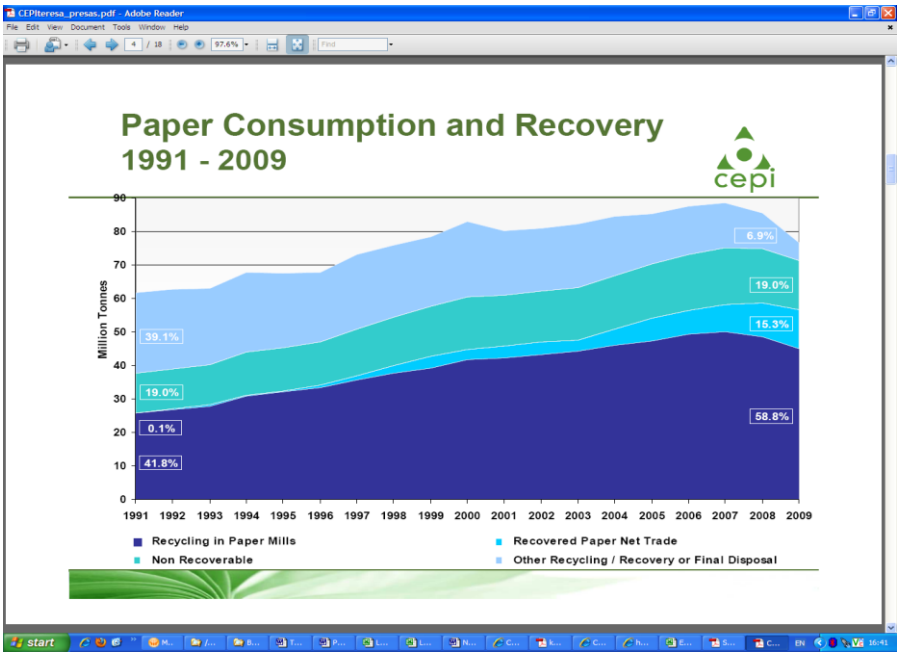
Figure 1 Pulp production by CEPI country in 2008



Source: CEPI 2009

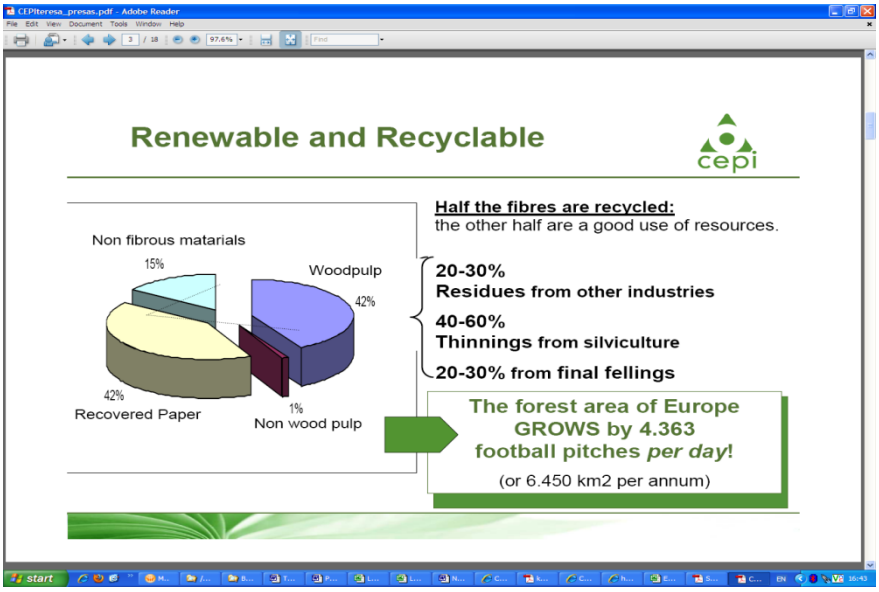
Europe is net importer of pulp, with a ratio imports/exports close to 4. However, the ratio has decreased in the period 2004-2008. The main pulp export partners are Asian countries (62.6% of total exports), followed by other European countries. The main importer of pulp to European CEPI countries is Latin America (55.3%) followed by North America (34.9%). Imports from Latin America have increased steadily since 2004, while imports from North America have decreased significantly.

Downstream, the paper and pulp industry currently relies on recycled materials as a major feedstock. The following graph shows the importance of recycled materials as well as the impact on the industry from the recession. Currently the downturn from 2008 provides the conditions for very strong competition between producers anxious to retain market share to cover costs of capital in mills.



Source CEPI

The following provides a breakdown of sources of the renewable and recyclable part of the feedstock.



Source CEPI

Overall, the stock of wood is increasing in Europe and only 60% of annual growth is currently used. Without taking into account other considerations, there is oversupply of raw materials, which further increases the competitive pressures on manufacturers.

European manufacturers predominantly use European supplies and 80% of the wood used by comes is sourced within manufacturers' member states.

The industry structure of the sector reflects the benefits of economies of scale in manufacture. While the size of a mill enables needs to be of a certain size to achieve this there are further benefits of size as the complexity of impacts upstream and downstream increase. A larger firm can dedicate staff to address specific issues dedicated to address specific issues and generally better provide a management organisation for complexity. The sector is heterogeneous as regards size of the production mills, but shows a trend of increasing size of mills in the last ten years. Larger size mills are located in Sweden, Finland and Norway (BREF, 2001).

Figure 2- Number of pulp mills by volume

Source: CEPI 2009

The industry has an active trade body (CEPI) which provides statistic sources on the industry and promotes understanding between participants of the benefits of technology and the impacts of policy and legislation. As such the industry has moved quickly to maximise the benefits of resource improvements where these lead to cost advantages in response to competition in worldwide markets. It has also contributed to the understanding of policy implications for current patterns of use and the industry is recognised as being relatively aware of resource efficiency measures.

A wider perspective of paper demand and use would cover aspects relating to the demand for paper as well as the factors in its supply. As the volume of paper is large, similarly large savings would be available from changes in behaviour which reduce its overall consumption. The 'paperless office' is not a concept that is recognised as necessarily desirable or achievable and other aspects of electronics have increased rather than reduced paper and board consumptions, such as the rise in internet retailing with its corresponding need for packaging. A recent report on the relationship between ICT and paper concluded that the environmental implications from substituting paper with ICT are not easily discerned.

The paper and pulp industry also illustrates the issue of agency in managing resources. Paper is widely used across many sectors, the party responsible for recycling changes through the stages of its use and reuse. Equally, the benefits of recycling need to be allocated to the actors in the chain. In simple terms, when paper is used in a

company, is its recycling opportunity applicable to that industry or to the paper and pulp industry which created the product in the first place?

3.5.2 Sector-specific drivers and barriers

Overall, the industry is like other commodity industries is being susceptible to impacts from a range of factors in world markets, and in small movements in prices making large differences to profits. Such factors include the global recession as well as environmental policies in local markets and policies affecting trading partners for example in other jurisdictions. Both drivers and barriers reflect these international and national pressures.

Drivers

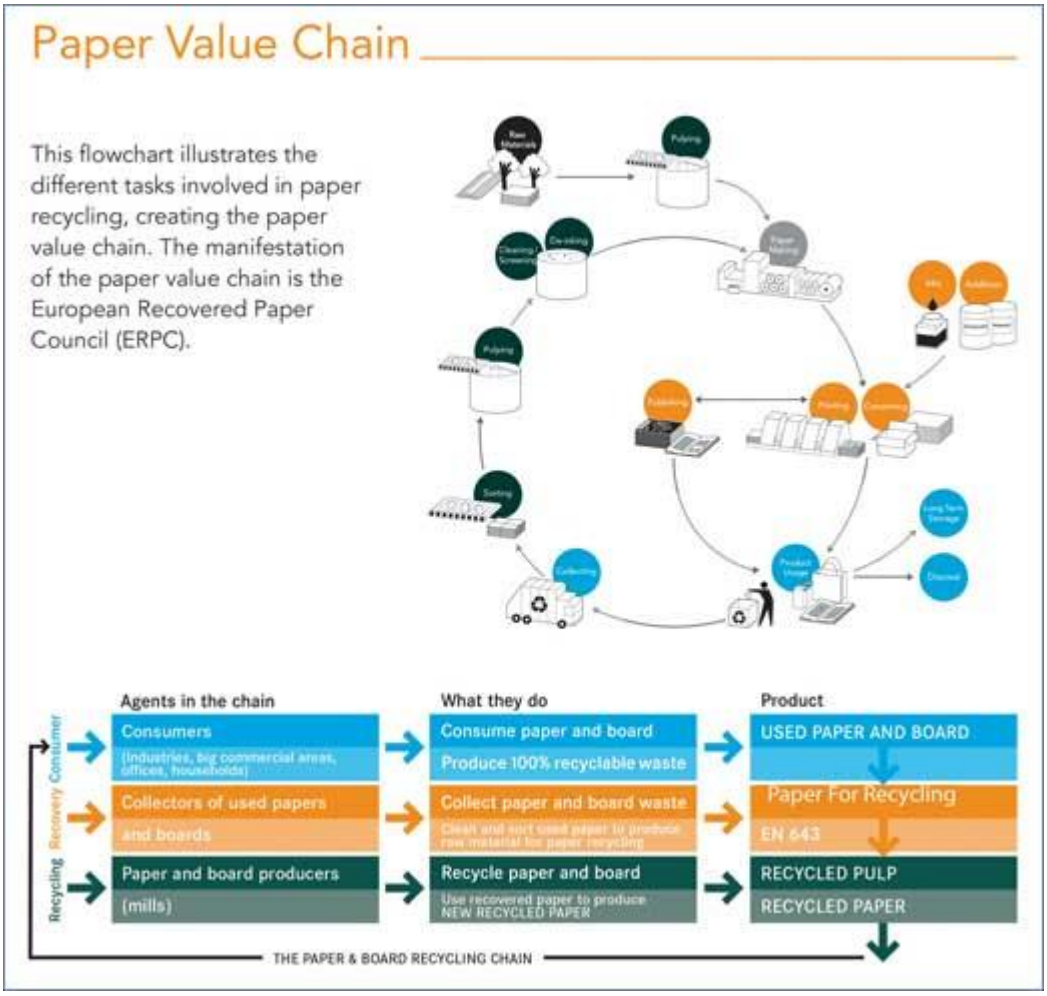
- **Increased demand in emerging markets** leading to pressures on materials, including recycled materials. China lacks sources of virgin fibres;
- **Increased demand for environmentally sustainable sources of fibre** forest products are used in industries which, in responding to environmental and other drivers, are applying new technology to access the basic raw fibre material in the paper and pulp feedstock. One example is the textiles industry;
- **Competitive distortions in global markets** due to unfair trade policies (restrictions and duties from China, India and Russia) raising prices and reducing worldwide supplies;
- **Mandatory EU targets for renewable energy** - this specific energy policy bears directly on the volumes of raw material resource. While the paper and pulp industry currently recycles a large proportion of its feedstock, there is a direct threat to this recycled source as it is also a source of biomass for renewable energy production;
- **National regulations restricting access to land** so restricting virgin supplies;
- **Import duties (e.g. on ethanol)** restricting access to world markets; and
- **Contamination in recycled feedstocks** which require separate collection and management throughout the recyclate supply chain.

Barriers

- **Uncertainty in energy markets** - The energy requirements of paper production mean that companies are affected both by energy policies and by demand and supply in overall energy markets. Uncertainty in both policy and markets is cited as a barrier to increased levels of resource efficient behaviour;
- **Uncertainty in Markets related directly to energy** - These include emissions markets where the Paper and pulp industry may benefit from generation of renewable energy, but in which prices are currently low compared to expectations; and
- **Recovery rates for recycled paper are relatively high** - This leaves little additional room for accessing a new source through collection processes focused specifically on paper. More general collection systems such as kerbside collection systems, collection points, and corporate waste collection will increase overall recycling rates will provide possible small increases in feedstocks.

3.5.3 Key actions on RE by business and/or trade associations

According to CEPI, the industry's aim is not just to grow the volume of recycling, but to increase the added value throughout the cycle of material flows.



In this context, the use of paper as a biomass feedstock is of lower value than its reuse as a source of fibre for paper manufacture.

This 'Paper Value Chain' provides an example of a conceptually-led approach which links to fundamental aims such as development of the 'circular economy' and the separation of economic growth from resource use. The industry has experience of presenting issues within such overarching frameworks including most recently the developing context for resource efficiency. More specific actions taken by the industry may often be placed within such frameworks, which also help minimise possible overlap and conflict between different actions. For example, a European Recovered Paper Identification scheme was established in 2009 to improve the monitoring of paper in the supply chain for recyclate.

Member states typically recycle a large proportion of their paper. Levels of 72% for paper packaging waste were achieved in 2009, the highest anywhere in the world, and the European Declaration on Paper Recycling targets a 70% recycling rate target overall in 2015.

Waste Watch, an awareness raising organisation in the UK estimate that a tonne of recycled paper saves at least 30,000 litres of water as well as 3-4MWh of energy. CO2 savings and water savings are also noted by the Waste and Resource Action Programme (WRAP).

The industry, though its trade association, has provided information on resource consumption incentives and other environmentally-focused policies. To illustrate the degree of communication between industry members, a completely revised Good Manufacturing Practice was published by CEPI in 2010 was taken up by 50% of the European packaging sectors by April 2011 11 months after its launch.

CEPI has also supported the development of underlying methodological tools including carbon footprint measuring framework ('Ten toes'), a framework for transport emissions, a water profile and preparation of water footprint. To support innovation, including a large proportion of expenditure under EC R&D programmes, it published the Innovation Trends Report in 2010 providing insight into the product and process developments in the forest based sector.

Certification programmes in related industries, such as Forest Certification programmes are also important to the industry, ensuring that feedstocks are managed appropriately.

3.5.4 List of potential measures/technologies for improving resource efficiency

In general terms, the paper and pulp industry is aware of the level of resources it consumes and can be assumed to act to continue to improve production processes and factors in the supply chain as, due to the scale of materials use, resource efficiency improvements frequently reduce costs.

Paper can be recycled up to six times before the fibres become too short for reuse. Technologies that could increase the number of cycles for fibre reuse would deliver immediate benefits. These technologies include nano-technologies as well as more basic industrial processes for treating raw materials. The industry looks to build on its research into nano-technologies related to paper and pulp production from the 1970s. Improvements here allow quality improvements which decrease materials and energy use. Recently, nanotechnologies allow new applications such as the integration of devices into the basic product. Nanotechnology application to paper production could lead to large commercial benefits and is an area of commercial confidentiality.

Mechanical pulping, lignoboost and biomass gasification are examples of more basic processes which are also expected to lead to improvements in resource efficiency.

The paper industry has the opportunity to extend its association with low carbon products as its materials can be produced through low carbon routes, for example by using transport running on low carbon fuels.

3.5.5 Best practice / top runners

To have a major impact, improvements in resource efficiency need to be taken up by individual companies. Potential improvements are often applicable industry-wide as there is a similarity in production processes (as with production of commoditised products generally). In the paper and pulp sector, the implementation of best practices therefore depends on R&D at industry level and then their application at individual company or plant level.

Portuel Soporel is an example of the good practice in the application of an approach leading to resource efficiency benefits at the company level. It produces 1.55 millions tonnes of paper and 1.34m tonnes of pulp annually and was the second best performing Portuguese company in terms of environmental impact.

Its corporate targets include:

- More use of renewable energy;
- Decrease consumption of fossil fuels;
- Increase recycling;
- Reduce CO2 emissions; and
- Improve waste management.

One incentive addresses the start of the production process. The company owns and uses woodland with trees which are specifically suited to paper production and to the generation of biomass energy. The cost and resources for the same quality of paper is thereby reduced.

A second incentive, the launch of a specific product ('Navigator hybrid') illustrates an example of a second generation approach to recycling. If the first generation of recycling is to reuse a material, a second generation is to ensure that as well as being reused, it is of sufficient quality. This product sets a standard for a balance of new and recycled fibres and thereby avoids the problems of poor quality which result from use of 100% recycled fibres. Such incentives not only ensure a market but address potential reputational impacts for the products produced by the company but for all recycled products.

Other practices which have been identified as in use more widely across Europe include:

- Supplier screening (e.g. based on Forest certification);
- Introducing stricter controls on materials;
- Investment in fuel reduction at plants;
- Investment in wind energy;
- Use of wastewater sludge as renewable energy (through Anaerobic Digestion).
- Reusing water from production processes; and
- Installing new biological treatment at plants.

Overall, the industry aims to achieve a high level of resource reuse. For example 94% of water used is returned to its source and 90% of newspapers and corrugated products are made from recycled fibre.

In respect of waste, industry residues to landfill have fallen 53% from 32kg/tonne of finished product to 15kg/tonne over the last decade.

The relative benefits of different processes for improvement are continuously under review and are encapsulated in the BREF, the latest draft of which was produced earlier this year (2012) and is currently under consultation.

3.5.6 RE indicators—resource consumed per economic activity

Indicators have been the subject of enquiry at CEPI. In general, as paper and pulp is a manufacturing process, the indicators that relate to throughput are appropriate to industry and facility comparisons For example, the following might be used:

- Water: cubic meter of water consumed per GVA or tonne of product (m^3/€ or m^3/t product);
- Material: direct material input (DMI)[53] per GVA or tonne of product (DMI/€ or DMI/t product); and
- Waste: tonne of solid waste generated per GVA or tonne of product (t waste/€ or t waste/t product).

3.5.7 Data gap analysis

Water use statistics are available for a minority of countries from Eurostat though these include Sweden and Norway which are major paper and pulp producers and hence major water users. Consumptive and non-consumptive water uses are not distinguished.

The level of materials use is available in aggregate and probably for some individual cases through the trade association which seeks to understand and promote resource efficiency savings.

References

CEPI

McKinsey&Poryr report on the impact of biomass markets on the paper and pulp industry.

[53] UNESCAP (2009). Eco-efficiency Indicators: Measuring Resource-use Efficiency and the Impact of Economic Activities on the Environment.

3.6 Information and Communication Technology

3.6.1 Economic and resource consumption data

Table A3.13 ICT sector: economic activity data

	Number of enterprises	Turnover	Number of employees	Value added (VA) at factor cost	Top 5 Sub-Segments ranked by turnover
EU-27	646, 000	€1,122bn	4.63 million	€460 bn	Telecommunications Computer programming, consultancy and related activities Manufacture of communication equipment Manufacture of electronic components and boards Information service activities
Top 5 Member States	United Kingdom Italy Germany France Poland	United Kingdom Germany France Italy Spain	United Kingdom Germany France Italy Spain	United Kingdom Germany France Italy Spain	

Eurostat (2012): structural business statistics for ICT[54].

The overall ICT sector has a turnover for the EU27 member states of €1,122bn including both manufacture and services.

The section of the European industry responsible manufacturing electronic components - the electronics industry - accounts for 217 billion Euro in 2009 which is ca. 19% of the €1,115 billion global production of electronic equipment. The mentioned global production value is equally divided between mass market product categories (PCs, mobile phones, game consoles, etc.) and professional electronic equipment.

Europe's role in mass market Study on the Competitiveness of the European Companies and Resource Efficiency 97 electronic production has diminished substantially since the crisis of 2001 to represent only 11% of the world output in 2009 but, with a share of 28%, it has a far more important position in professional electronic equipment production. But Europe's electronics industry is losing market share to competing regions.

"The environmental footprint of the electronics industry is considered rather significant. An example which illustrates this footprint is a 2-gram 32MB memory chip. The production of that electronic device requires as much as 1.200 grams of fossil fuels, 72 grams of chemicals and 32.000 grams of water."

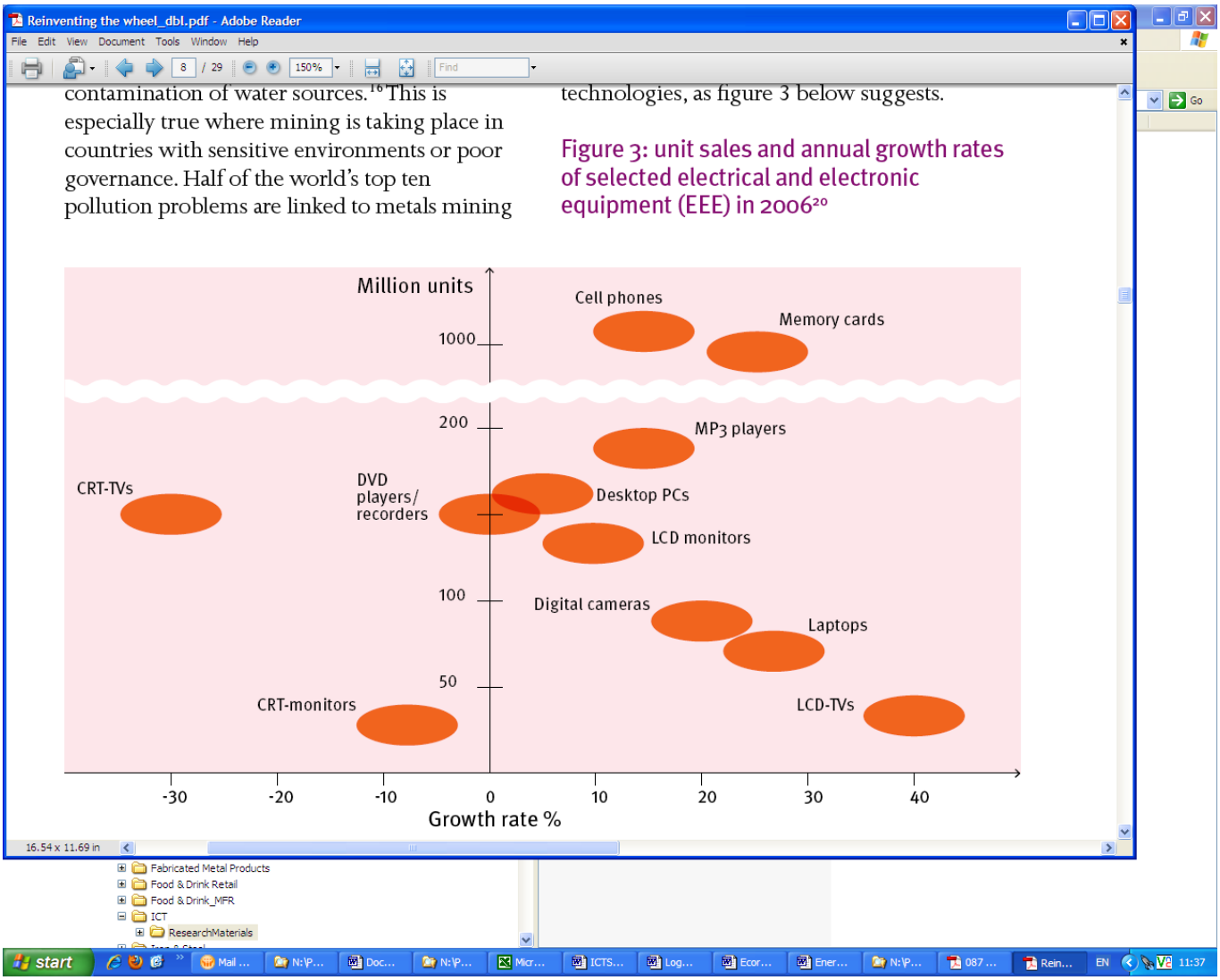
With this backdrop in respect of its manufacturing activities alone, ICT encompasses a wide range of processes and activities. It includes:

- equipment: computing, storage, networking, telecommunications, media, biomedical, etc;

[54] http://epp.eurostat.ec.europa.eu/portal/page/portal/food/data/database

- edge gear: PCs, printers, faxes, telephones, mobile devices, televisions, radios, SOHO modems/routers, etc;
- facilities: data centers, equipment rooms, telephone switching centers (COs), engineering cores, research labs, network and television operating centers (NOCs & TOCs), call centers (emergency response, customer service, etc.), media studios, grid control centers, etc;
- connectivity: local, metropolitan, and wide area networks (LANs, MANs, & WANs), broadcast infrastructures, telephony networks, etc; and
- behaviour: of ICT practioners and ICT users.

A key feature of ICT is the growth rate. The issues associated with resources use are increasing rapidly and there are therefore exponential gains to be made in treating resource issues earlier through establishing good recycling programmes before or as part of increases in mass production.



ICT is often seen as an enabler of efficiency improvements in other sectors. Resource consumption for the provision of ICT may act to reduce resource consumption in other industries. ICT is also one of the converging technologies, increasingly overlapping with nano-technology and biotechnology. Overall there is a blurring of boundaries making measurement difficult further complicated by changes over time.

The main focus of Research and Development in the ICT industry is energy. VDMA launched a study in 2009 to indicate the share of the engineering industry towards an energy efficient industry. One of the main results is that only 40% of possible energy savings are realized.

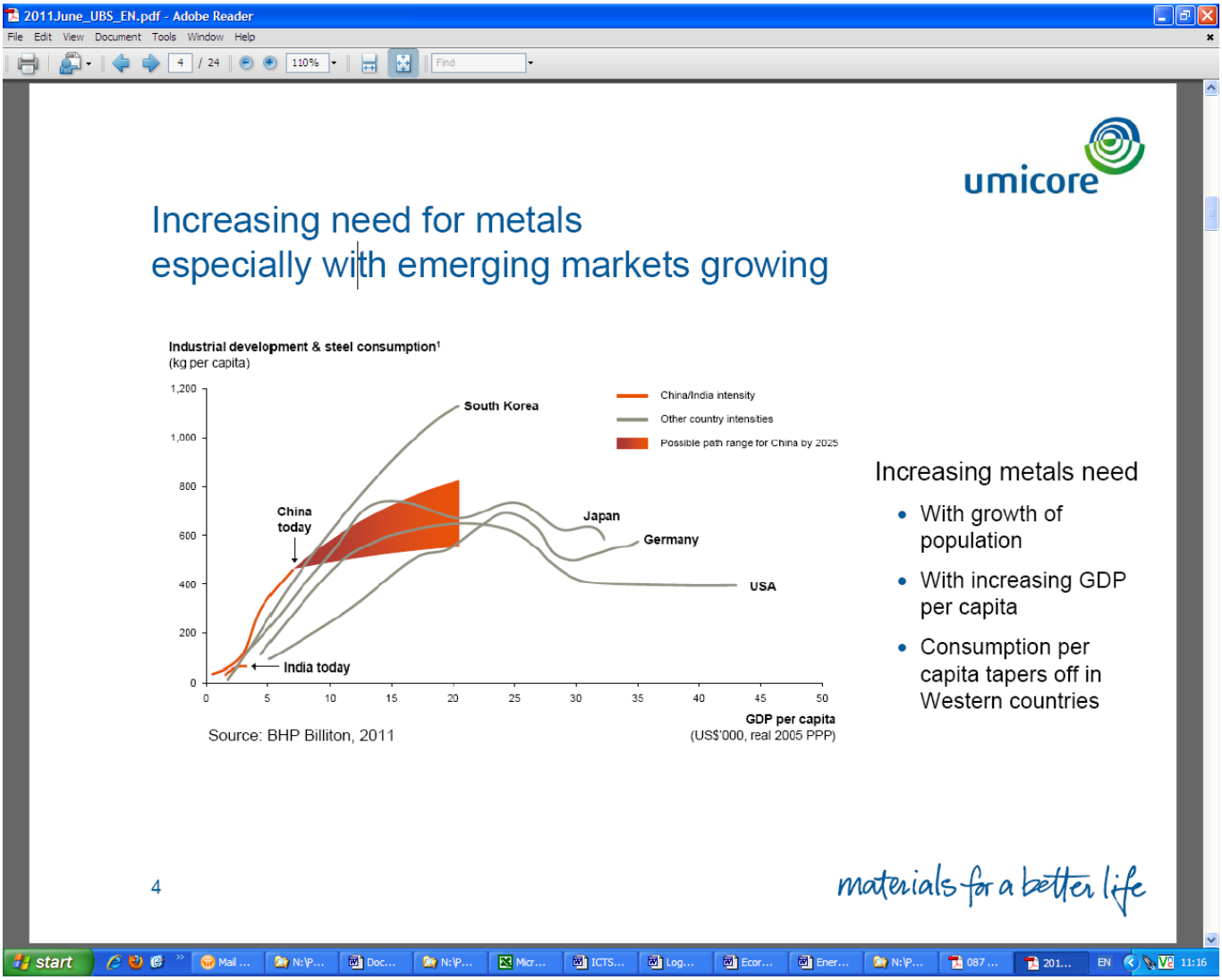
Of the $250 billion spent globally each year powering computers, about 85% of that energy was simply wasted idling. Computers and related equipment have been blamed for causing as much global warming as the airline industry, Pat Gelsinger, senior vice president for Intel's digital enterprise group, recently told the press. REF 305

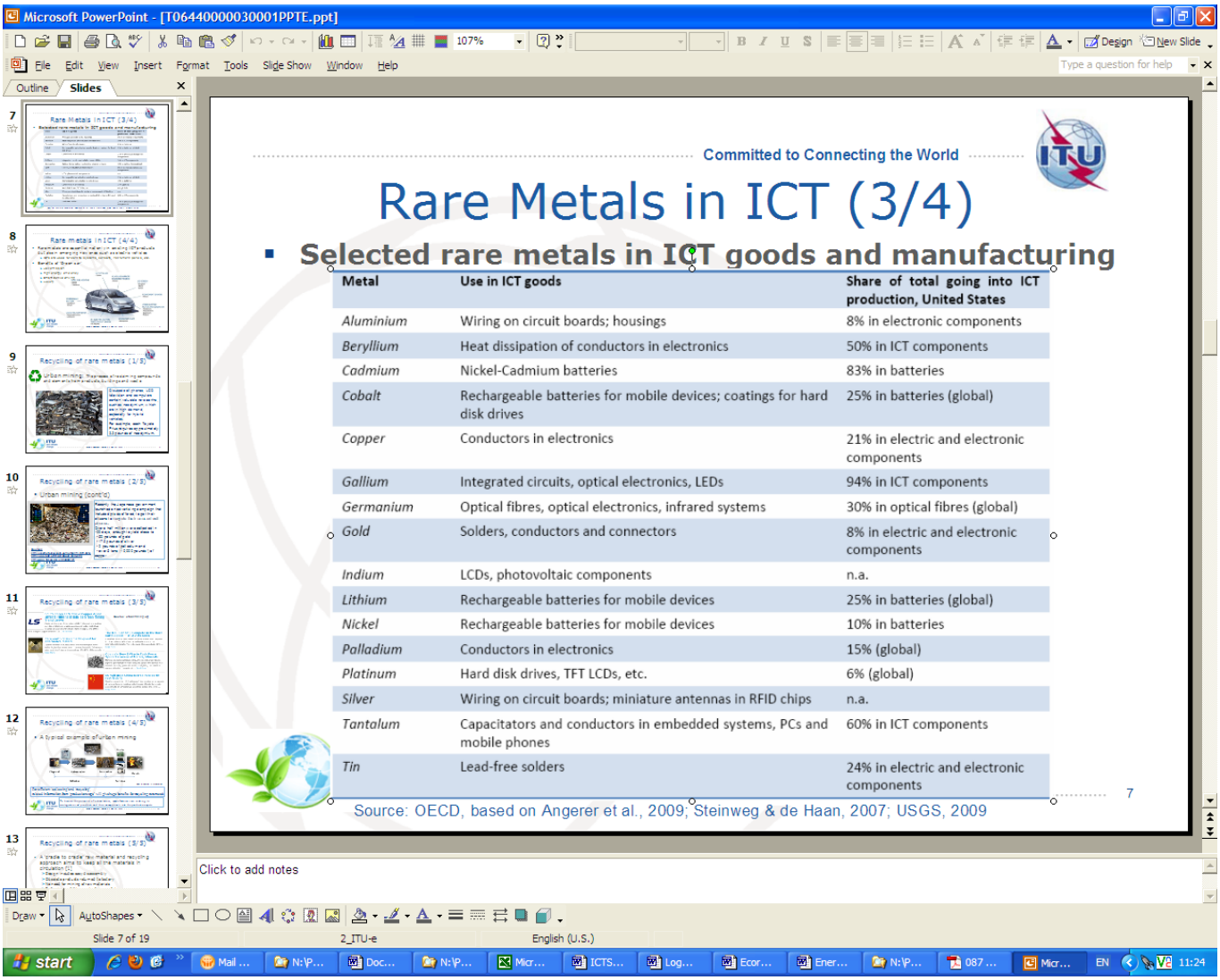
There are specific schemes related directly to the goal of reducing energy consumption. The Climate Savers Computing Initiative has the goal of reducing computer energy use by 50% by 2010.

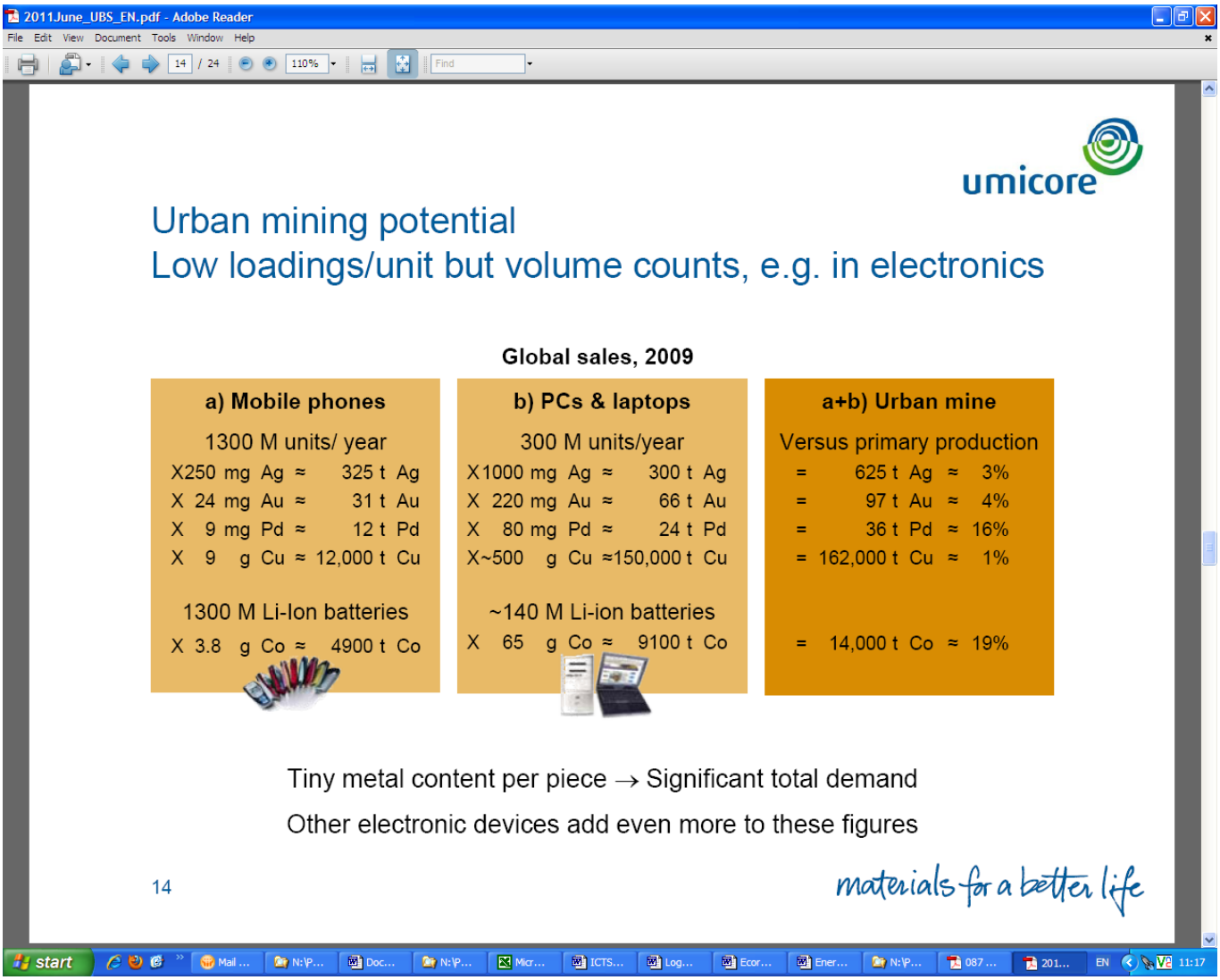
Water use in ICT is primarily related to energy use and cooling the predominant application. The major step for resource efficiency with respect to water is understood to be achieved through a focus on energy use and hence the majority of resource efficiency work related to energy is assumed also to result in benefits in terms of water use. There is increasingly a specific focus on water use independent of its relationship with energy use, however these are relative small volumes compared to its use in cooling.

Although small in volume the highest priority in the use of materials in ICT is related to the use of rarer metals including the so-called ‘rare earths’. The background to resource use is growth worldwide in demand for metals, of

which 'technology metals' form a steady proportion.







As regards waste, electronics are filled with potentially noxious elements such as mercury, lead, and polyvinyl chloride. Furthermore most computers are outdated within a year or two, making high tech products a disposable class by themselves from this perspective. How to stop toxic ingredients leaching into the air and water, and recycle those parts that can be salvaged has been an ongoing problem for the industry with substantial legacy issue related to the previous disposal of electronic equipment.

3.6.2 Sector-specific drivers and barriers

Drivers

- The visibility to a wide public of the resources consumed by computers;
- The increasing scarcity of specific resources, particularly rare earths

- Increasing demand for and penetration of an electronic infrastructure.

Barriers

The core barriers for the electronics industry can be summarised as follows:

- Missing market penetration of efficient technologies;
- The missing of a legal framework with binding high recovery quotas (for industrial waste and municipal waste) and charge fees for some waste fractions;
- Lack of information or access to capital (especially for SMEs);
- Missing public awareness.

A suitable regulatory measure in this context would be to increase controls on illegal exports to reduce the amount of WEEE leaving the EU declared as used equipment. A consequent application of the EU's Green and Sustainable Procurement Programs could be seen as a suitable market based instrument across all member states that would find the strong support of the electronics industry.

Specific barriers related to the reuse of rare metals have been identified as follows:

- **Difficulty pricing environmental impacts of materials.** Any attempt at pricing the environmental impacts of raw materials is complicated by the very different relationships between the availability and extraction costs of different materials associated;
- **No guarantee of better environmental outcomes.** Any substitute materials may not necessarily result in outcomes with less environmental impact;
- **Low priority given to better circulation and efficiency.** Greater recycling, and better resource efficiency appear low down the list of recent strategies to address resource scarcity. For example, from the point of view of the EU Raw Materials Initiative, which has dominated the debate about metals, resource efficiency and recycling are given lower priority than negotiating better terms of trade and opening up new sources of material; and
- **Lack of information.** Developing a resource efficiency or recycling strategy is hampered by the lack of information about material flows.

3.6.3 Key actions on RE by business and/or trade associations

Green ICT focuses on comprehensive sustainability and applies to in-house as well as out-sourced ICT equipment, facilities, and services and part of an approach used in public institutions and private businesses.

WEEE Directive.

Improving collection rates and incentives for recovery is flagged up by many commentators as crucial to ensuring better recycling rates, as no amount of recycling technology can improve secondary use if the rate of product recovery is low. The most substantial existing policy instruments that bear on collection and recycling of metals (in

other words, seek to drive recycling beyond what would otherwise be achieved by the market place) are four EU directives covering: waste electrical and electronic equipment (WEEE), end of life vehicles (ELV), packaging and batteries.

3.6.4 List of potential measures/technologies for improving resource efficiency

The focus on materials use is related to the potential scarcity and value in recovery of rare metals.

The following slide indicates the range of potential measures that might help in managing these resources.

There has also been an interest in establishing more complete approaches which enable easier recycling. For example, through better design.

Recycling targets that focus on specific materials and their quality, rather than simply on tonnages would help for specific metals and enable the treatment of different materials according to their diverse properties and their diverse uses. At present the generic weight-based targets of the WEEE Directive drive recovery of the high volume metals rather than the more dispersed, specialist ones, which are often of greater economic and environmental interest.

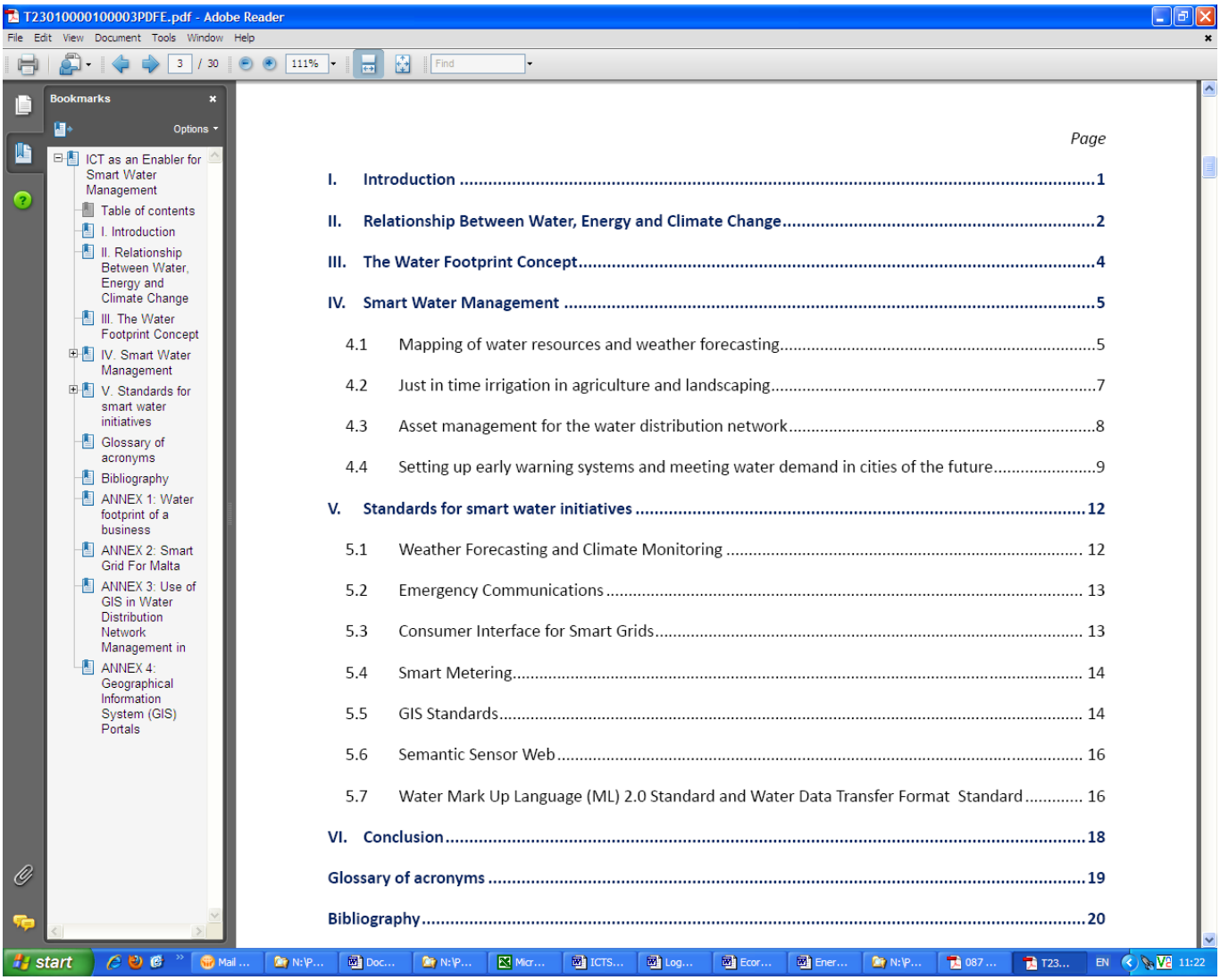
Other research is focusing on the perspective of the manufacturing process, rather than a particular material or group of materials. For example, the SRC/SEMATECH Engineering Research Center for Environmentally Benign Semiconductor Manufacturing is a "multi-university research center leading the way to environmentally friendly semiconductor manufacturing." In a recent interview, Farhang Shadman, who directs the engineering research center, observed "One manufacturing plant uses anywhere between two to four million gallons of very, very pure water, we call it ultra-pure water, per day, and that, on the average, is roughly equivalent to the water usage of a city of maybe 40 or 50,000 people.

3.6.5 Best practice / top runners

In datacentres, Google has a facility in Belgium where the water filtration system uses 100% recycled water. The ability to use recycled water was one of the reasons for choosing this site. Dirty water from an industrial canal enters the system and runs through a number of treatment steps, including large tanks that are filled with a fine sand to filter out small particles. At the end of the process, the water is completely clear and, although not suitable for drinking, it is clean enough for environmentally friendly and highly efficient cooling.

To that end, Dell has scheduled an announcement Thursday about its "environmentally-responsible product recovery and recycling program" and the results of a survey detailing just what happens to its computers at the end of their lives. In June it announced its intention to become "the greenest" tech company. That's a distinction that many will vie for -- and that competition is as important as the drive toward the next faster microchip. Ref 306

An example of the use of ICT as an application is provided through a incentive called ‘smart water’ illustrated through the steps described in the following programme:



3.6.6 RE indicators—resource consumed per economic activity

The indicators for ICT are wide, reflecting the different roles and processes involved in ICT provision. There are corresponding difficulties in establishing overall measures representative of the wide sector. There are also specific difficulties which are frequently related to the scope of the ICT and the activity it is associated with. These are fundamentally due to the use of ICT as an enabling technology in other industries.

For example, The Green Grid replied as follows to an issue of methodology for the treatment of water in a recent interview:

> How should the question of direct water use versus that embodied in a facility's energy consumption be handled? The Green Grid told me, "This is a topic the Green grid is putting the finishing touches on, but the current preferred direction is as follows: The Water Usage Effectiveness (WUE) metric will come in two forms, a facility only form which will be used for day-to-day operations and site optimization around water usage and a source-based WUE to aid in design questions and site selection that will capture the embodied water in the energy as well. (The description of the metric is at http://www.thegreengrid.org/~/media/WhitePapers/WUE)

3.6.7 Data gap analysis

The main issue in data use and collection in the treatment of the different activities under the heading of ICT. These may require very different data sources depending on the activity and may require different ancillary data. Where ICT is measured as contributing in an overall scheme, such as smart water, the technology it supplants should also be considered in the metric.

3.7 Accommodation and Food Service

3.7.1 Economic and resource consumption data

The European accommodation and food service sector[55], composed of approximately 1.70 million enterprises with 7.98 million employees in providing short-term accommodation and complete meals and drinks for immediate consumption, accounted for total turnover of approximately € 461 billion in 2008 (see Table A3.7). The sector can be divided into three sub-sectors—(1) hotels and other short-stay accommodations; (2) restaurants, bars and cafes; and (3) catering and canteens—which are differently affected by certain factors (EC, 2009)[56]. Hotels and restaurant sub sectors are closely connected to tourism and dominated by micro and small enterprises, whereas catering and canteens are typically run by larger firms and barely linked to tourism. The sector accounts for high proportions of non-financial business economy employment, especially in southern Member States and United Kingdom, although part-time employment is significantly higher than in both the total service economy and the total economy (Eurostat, 2009)[57].

Table A3.134 Accommodation and food service sector: economic activity data

	Number of enterprises	Turnover	Number of employees	Value added (VA) at factor cost	Key indicators for the sector	
EU-27	1.70 million	461 billion €	7.98 million	194 billion €	201,168	Hotels (and similar establishments)
Top 5 Member States	Italy	United Kingdom	United Kingdom	United Kingdom	5.77 million	Bedrooms
	Spain	France	Germany	France	1.53 trillion	Nights spent
	France	Italy	Spain	Spain	1.4 million	Enterprises in restaurants, bars and catering
	Germany	Spain	Italy	Italy		
	United Kingdom	Germany	France	Germany		

Eurostat (2012): structural business statistics for accommodation and food service sector for year 2008[58]
Eurostat (2012). Hotel and accommodation statistics and Eurostat (2012) Restaurants, bars and catering statistics for key indicators for year 2007[59].

[55] Accommodation and food service sector includes accommodation (NACE Rev.2 I55) and food and beverage service activities (I56).

[56] European Commission, DG Employment (2009). Hotels and restaurants sectors. Comprehensive sectoral analysis of emerging competences and economic activities in the European Union.

[57] Eurostat (2009) More than 9 million persons employed in the hotels and restaurants sector in the EU - Issue number 101/2009.

[58] Sector information is from Eurostat statistical business statistics: http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database

[59] Eurostat (2012). Hotel and accommodation statistics – NACE Rev 1.1 and Eurostat (2012) Restaurants, bars and catering statistics – NACE Rev. 1.1 http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Hotel_and_accommodation_statistics

Water consumption by the accommodation and food service sector is not well documented by statistics (Eurostat, 2009)[60]. Compared to other key water-consuming sectors such as agriculture, water consumption by this sector is relatively low (Ecologic, 2007)[61]. However, the projected growth of the sector suggests that the sector's water consumption is likely to increase over time. In addition, water consumption by a tourist is higher than that of a resident: a European tourist consumes around 300 litres per day compared with a European resident consumption of 100 - 200 litres per day, possibly due to maintenance of grounds and pools, daily room cleaning and laundry, intensive kitchen activities and a 'pleasure approach' to showers and baths (EC, 2012)[62]

Raw material consumption for accommodation and food service sector is relatively small. Raw material required for constructing infrastructure for this sector is considered under the construction sector's raw material consumption. Food services sector relies on purchasing agricultural produce, but most will be purchased from food and beverage suppliers.

Tourism sector is responsible for a small share of waste generation within Europe, contributing to the 6.7% of total waste generation that arises from the wider services sector in the EU-27 (EEA, 2010)[63]. The Environmental Impact Database for SMEs reports that the accommodation and food services sector generated 17.0 million tonnes of waste in 2006 (Planet SA et al., 2010)[64]. Similar to water consumption, tourist may generate up to twice as much solid waste per capita as local residents (EC, 2012). Waste from accommodation has similar characteristics to mixed household waste, although the sector is a major contributor to packaging waste (Eurostat, 2010)[65].

3.7.2 Sector-specific drivers and barriers

Drivers

Rising food prices, input costs (e.g. crude oil, gas, electricity, etc.) and waste disposal costs (i.e. escalating landfill and incineration taxes) have made the resource efficiency a pressing issue for accommodation and food service industry. Increasing public awareness in and consumer demand for sustainable lodging and food has also put the industry under pressure to survive and maintain its competitiveness.

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http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Restaurants,_bars_and_catering_statistics

[60] Eurostat (2009). MEDSTAT II: 'Water and Tourism' pilot study.

[61] Ecologic (2007). EU water saving potential. Report for DG ENV. ENV.D.2/ETU/2007/0001r

[62] European Commission (2012). Reference document on best environmental management practice in the tourism sector. Final draft. June 2012.

[63] EEA (2010). European Environment, State and Outlook 2010. Copenhagen.

[64] Planet SA and Danish Technological Institute (2011) SMEs and the environment in the European Union. Published by European Commission, DG Enterprise and Industry. Waste data is from Environmental Impact Database for Small and Medium sized Companies (EIDSME), which estimated waste consumption per Member State and per sector for year 2006 http://web.me.com/kkalog/SMEENV/LinkedDocuments/EIDSME_sector_country.swf

[65] Eurostat (2010). Environmental statistics and accounts in Europe – 2010 edition. Luxembourg.

There are also various EU and local waste management regulations that require businesses in accommodation and food services sector. The Waste Framework Directive (2008/98/EC) is an important driving force in preventing and minimising waste.

Barriers

Because SMEs dominate accommodation and food service industry in the EU (with the exception for catering services), limited access to financial resources for investing in resource efficiency measures as well as limited access to knowledge are considerable barriers to resource efficiency improvements.

In food service sector, portion sizes bigger than consumers' needs, difficulty anticipating number of clients, negative attitudes toward the practice of taking leftovers home, low awareness of food waste and difficulty meeting preferences of clients are barriers to reducing food waste (Bio Intelligence Services, 2010)[66]. A survey of UK hospitality business by WRAP (2011)[67] found that, where businesses are doing their best to recycle everything possible, they may need more information about the best environmental option for different methods of disposal, especially for food waste.

3.7.3 Key actions on RE by business and/or trade associations

HOTREC is a trade association representing hotel, restaurant and café industry in Europe. HOTREC is working to produce a catalogue of best practices in the hospitality sector and supporting good environmental practices provided that the investment required to put them in place can be recovered and result in profits in the medium and long term (2011)[68]. It is also favourable to the voluntary use of eco labels for tourist accommodation services.

3.7.4 List of potential measures/technologies for improving resource efficiency

The measures available to improve resource efficiency in regard to water, materials and waste for the European accommodation and food service industry are listed below (see Table A3.8).

[66] Bio Intelligence Services (2010). Preparatory study on food waste across EU-27.

[67] WRAP (2011). Opportunities for contract changes in recycling collection in the hospitality sector.

[68] HOTREC (2011). HOTREC position paper on sustainability. 28 October 2011. http://www.hotrec.eu/policy-issues/sustainability.aspx

Table A3.15 Resource efficiency improvement measures in accommodation and food service sector

Water	Waste
Water consumption monitoring (for both facility management staff and individual consumers)	Developing waste inventory to identify prevention and minimisation opportunities
Installation of water saving devices for taps, toilets, pools, green areas, etc.	Efficient ordering and storage
Staff training and provision of guest/consumer information to encourage lower water consumption	Local sourcing and packaging return / selection of low packaging products
Preventing water leakage and monitoring leak 'hotspots'	Efficient bathroom toiletries and housekeeping
Implementation of bedclothes and towel reuse schemes to reduce laundry volumes	Provision of low impact drinking water and efficient food provision
Green procurement of efficient washing machines	Waste sorting and recycling
Installation of rainwater/greywater collection and internal/external distribution system	Wastewater treatment: collection, pre-treatment and biological treatment,
Eco-certification schemes	

Sources:

3.7.5 Best practice / top runners

The European Commission has a reference document for the best environmental management practices (BEMP) for the tourism sector under the revised Community Eco-Management and Audit Scheme (EMAS) Article 46.1(EC, 2012). The document provides description of best environmental management practice and environmental performance indicators and, where appropriate, benchmarks for excellence and rating systems identifying performance levels. The use of the reference document is voluntary but the EMAS organisations are encouraged to use them for setting up their environmental management system.

3.7.6 RE indicators—resource consumed per economic activity

Possible indicators for the European accommodation and food service sector include the following:

- Water: cubic meter of water consumed per guest-night (m^3/guest-night), quantity of wastewater/rainwater used per year (m^3/year);
- Raw material: direct material input (DMI)[69] per GVA (DMI/€); and
- Waste: tonne of solid waste generated per GVA (t waste/€), the proportion of waste that is sorted and sent for recycling (percentage mass of total waste), the quantity of unsorted waste sent for disposal (kg per guest-night).

[69] UNESCAP (2009). Eco-efficiency Indicators: Measuring Resource-use Efficiency and the Impact of Economic Activities on the Environment.

3.7.7 Data gap analysis

Water and material consumption statistics per MS across EU-27 is not available in Eurostat.

Box 5	**Further research area through direct consultation with the Industry**

Research conducted to date on the resource efficiency in the accommodation and food service sector has indicated a number of issues that have not been explored in the existing literature. These include:

- How resource efficiency issues are viewed by the industry;
- Drivers and barriers in regard to what has been done to date and what might be important in the future;
- How behavioural issues affect resource efficiency challenges and opportunities;
- Which resource efficiency metrics may be used to identify top-runners in the industry;
- Best practices in regard to water, waste and material management;
- Attitude toward establishing industry best available technology (BAT) standards; and
- Level of theoretical vs realistic resource efficiency opportunity opportunities.

Project team plans to consult with industry players to further explore these issues. Potential industry contacts would include HOTREC and some key catering service companies such as Sodexo.

3.8 Automotive

3.8.1 Economic and resource consumption data

The European automotive industry is often regarded as a major engine for the European economy (Ecorys, 2011)[70]. The European manufacture of motor vehicle and trailers sector composed of 19,698 enterprises with 2.2million employees and indirectly supports about 10 million jobs in other industries (EC, 2012). The health of the sector affects over 8% of the EU active workforce (EC, 2012). The sector accounted for total turnover of €625billion in 2009 (See table A3.16). The EU automotive industry exported €132 billion pounds worth of goods in 2010 and the EU share of global automobile production sat at 25% [71]. In 2010 the Member State producing the most vehicles was Germany with 5,905,985 vehicles, making it the third largest producer in the world (ACEA, 2010)[72]. The sector is dominated by sixteen key businesses including brands such and BMW, Fiat, General Motors and Toyota.

Table A3.146 Manufacture of Motor Vehicles: economic activity data

	Number of enterprises	Turnover	Number of employees	Value added at factor cost
	units	*millions of €*	*units*	*millions of €*
European Union (27 countries)	19,698	625,000	2,200,000	99,000
Top 5 Member States	Germany Spain France Italy United Kingdom	Germany Spain France Italy United Kingdom	Germany Spain France Italy United Kingdom	Germany Spain France Italy United Kingdom

Eurostat (2012): structural business statistics NACE 29 manufacturing of motor vehicles, trailers and semi-trailers sector for year 2009[73].

[70] Ecorys (2011). Study of competitiveness of European Companies and resource efficiency

http://ec.europa.eu/.../resource-efficiency-and-competitiveness-draft-final-report_en.doc

[71] European Commission Trade – Automotive

http://ec.europa.eu/trade/creating-opportunities/economic-sectors/industrial-goods/automotive/

[72] ACEA (2010) Motor vehicle production in Europe by country

http://www.acea.be/images/uploads/files/20111011_Production_EU27_1105_III_MV.pdf

[73] Sector information is from Eurostat statistical business statistics: http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database

For the motor vehicle and trailer manufacturing sector the water consumption information varied between one region to another due to different natural conditions, economic and demographic structures. According to available information in Eurostat* (i.e. 24 Member States), the European manufacture of motor vehicle industry consumed approximately 25.8 billion cubic meters of water in Europe in 2007 (Eurostat, 2012)[74]. Considering the unavailable information, the total water consumption in the sector is likely to be even greater.

**Eurostat compiles statistics on water use by supply category and user (http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/env_wat_esms.htm). However, information is only available for approximately 24 Member States for total supply and less number of Member States for sub-categories for supply and user.*

Raw material inputs and resource security is a key issue for the industry sector and it is likely there are considerable raw material inputs to the manufacture of motor vehicles, however at this juncture data on raw materials inputs to product could not be identified in the literature.

The Manufacture of motor vehicles sector produced 4,416,101 million tonnes of waste in 2006 (Planet SA, 2011). The waste produced in the sector is keenly affected by the End of Life Vehicles (ELV) Directive and overall recycling and recover rates are high. The figures for reuse and recycling rate of ELVs by Member State based on 2010 data for the year 2008 makes clear that the recovery rate of end of life vehicles is the highest in Germany (89,2 %) whereas it is lowest in Ireland (75,88%) (Ecorys, 2011).

3.8.2 Sector-specific drivers and barriers

Drivers

The competition within the automotive sector is becoming much more intense and the pressures on the car industry in the competitive global market are many and varied the improvement of resource efficiency and production life cycle plays an important role to address these pressures. (Ecorys, 2011). Pressure on the main players, driven by the pursuit of competitive advantage, means that resource efficiency measures are implemented more readily than in other sectors, with the major 16 taking a 'top-down' approach to implementing initiatives throughout their the supply chains.

There is stringent environmental legislation and standards in place that impacts the manufacture of motor vehicles and trailers; this is reflected in the positive uptake of resource efficiency measures. Increasingly strict environmental regulations require the continuous reduction of the environmental impact attributed to wastewater, waste and production-induced emissions. The pressure to reduce the impact on natural resources stems more from environmental legislation and the expectations of society than of cost reduction aspects (Ecorys, 2011).

European recycling legislation, such as the ELV directive (End of Life Vehicles) which was adopted in September 2000, and the concern over the security of material supply are major drivers for recycling and reducing waste in the

[74] *Eurostat compiles statistics on water use by supply category and user (http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/env_wat_esms.htm). However, information is only available for approximately 15 Member States for total supply and less number of Member States for sub-categories for supply and user*

industry (Ecorys, 2011). This sector is unusual in that although complex legal drivers such as REACH and the IPPC Directive are in place the sector takes a pro-active approach to resource efficiency due to consumer pressure. In already established markets, such as North America and Western Europe, the trend goes towards leaner, greener mobility (Ecorys, 2011).

Resource security is a key issue for the industry sector as highlighted by the ACEA in their positing statement in relation to the Commission's Initiatives on Raw Materials. The sector representatives ACEA suggest artificial resources scarcity in other world regions due to economic policy initiatives leads to significant risks for the European Automobile Industry; access to raw materials under competitive conditions is fundamental. Lack of assured supply means that manufacturers are increasingly looking to secure supply be resource efficient use or resources, lease models and recycling activities.

Barriers

The industry consider there to be a lack of definition in terms of 'resource efficiency', suggesting it is essential to develop a consensus among all stakeholders when considering which resources are to be addressed by the EC´s initiatives, and what is meant by resource efficiency as highlighted by ACEA in their positing statement in relation to the Commission's Initiatives on Raw Materials. The EU motor vehicle manufacturers would like see further discussion to elaborate on an adequate concept of ´resource efficiency' that encompasses environmental, economic and dependency issues. Until this happens and consensus is reached resource efficiency measures are likely to stall when they clash with other drivers such as economic success and lead to a resource dependency.

The barriers for further resource efficiency improvements are manifold as the industry relies on a number of upstream industries, often whom are SMEs which have to also increase their resource efficiency, despite being pushed by vehicle manufacturers to do undertake environmental measures it is often financially unfeasible for such organizations to undertake comprehensive resource efficiency activities and keep up with the level of eco-innovation desired by their large scale client and their customers (REMake, 2011)75.

3.8.3 Key actions on RE by business and/or trade associations

ACEA (Association des Constructeurs Européens d'Automobiles) represents the 16 major EU car, bus and truck manufacturers, accounting for around 95% of EU automotive production. The ACEA takes a lead in encouraging, monitoring and providing benchmarking among the EU manufacturers when it comes to managing resource efficiency, they provide access to member resource efficiency projects and data through their on-line site. The ACEA also represent the interests of their members with the European Commission in relation to resource efficiency suggesting 'The European Automobile Industry, a key player of the European industry, wishes to

[75] REMake (2012)

http://www.ecomanufacturing.eu/1728.html

contribute to the ongoing political discussion on access to raw materials and resource efficiency in a constructive manner'76.

The automotive industry is highly engaged in technological research which is also aiming at reducing CO2 emissions and building more sustainable and resource efficient cars (Ecorys, 2011). The European automotive industry is a driver for eco- innovation in Europe. Research and development is conducted into safer, cleaner vehicles as well as improving manufacturing processes, logistics and mobility management. According to the ACEA the automotive industry is Europe's largest private investor in R&D (Ecorys, 2011). The clean technologies and more efficient environmental processes developed in this sector are likely to be applicable in other sectors looking to make resource efficiency improvements in the future. A willingness in this sector to undertake open innovation and benchmarking activities also means that standardisation and best practice are more openly shared and more easily disseminated.

3.8.4 List of potential measures/technologies for improving resource efficiency

The measures available to improve resource efficiency in regard to water, materials and waste for the European Manufacture of motor vehicles sector are listed below (see Table A3.8).

Table A3.37 Resource efficiency improvement measures in motor manufacturing sector

Water	Materials	Waste
Reuse of grey water and rainwater harvesting	Use of by-products as fertilizers and animal feeds	Increased levels of onsite recycling at end of process and along supply chain
Water consumption monitoring via centralised meters and use of sub meters	Use of by-products for bio-energy production	Re-use of waste products as part of production process or in partnership with other organisations
Modifying cleaning and housekeeping practices	Efficient packaging	More Efficient packaging techniques
Preventing water leakage	Just-in-time delivery	Designing out of waste using eco-design techniques and applying life cycle methodologies
Staff training to raise awareness in water consumption	Improvement of combustion engines for efficiency;	Reducing the volume and weight of packaging material to the required levels of safety and hygiene
Reduction and treatment of waste water	Optimisation of vehicles	
Water recovery techniques along the production chain.	Application of lease models	Reduce steel waste by return from press shop to supplier for reuse
Application of water saving techniques during rinsing, bathing and cooling processes.	Decreased dependency on critical and restricted materials	Consideration of BAT reference documents to identify opportunities for savings

[76] ACEA (2011). ACEA position on Resource efficiency

http://www.acea.be/images/uploads/files/20110323_ACEA_position_Resource_efficiency.pdf

Water	Materials	Waste
	Application of circular models and lease models Reduction in materials losses during production	

Sources: (REMake, 2012) (Ecorys, 2011) (ACEA, 2012)

3.8.5 Best practice / top runners

Water:

BMW have actively undertaken a number of water saving initiatives. BMW has already reached the 100% mark at its engine plant in Steyr in Austria which generates zero litres of process wastewater. A closed water cycle and complex filter systems ensure not a single drop is wasted (Ecorys, 2011). The example of BMW shows that, at least in some areas such as water recycling, the maximum efficiency has been achieved already (Ecorys, 2011).

Material and Waste:

The BMW Group is regarded as a front-runner amongst European car manufacturers with respect to resource efficiency (Ecorys, 2011) (Sustainable Value research, 2009)[77]. The company aims to reduce the amount of resources consumed and emissions produced per vehicle by 30% from 2006 levels by year 2012. Fiat also undertake a number of resource efficiency measures, Fiat plays a leading role in the recycling field as 95% of the groups cars are recoverable by weight. Furthermore Fiat initiated a major project that focused on recovering energy from residual materials generated by the end-of-life vehicle recycling process (Ecorys, 2011).

3.8.6 RE indicators—resource consumed per economic activity

Possible indicators for the EU motor vehicle manufacturing sector include the following:

- Water: cubic meter of water consumed per GVA or tonne of product (m^3/€ or m^3/t product);
- Material: direct material input (DMI)[78] per GVA or tonne of product (DMI/€ or DMI/t product); and
- Waste: tonne of solid waste generated per GVA or tonne of product (t waste/€ or t waste/t product).

[77] Sustainable value in automobile manufacturing (2009) Sustainable value research Ltd http://www.sustainablevalue.com/downloads/sustainablevalueinautomobilemanufacturing.pdf

3.8.7 Data gap analysis

Box 6	**Further research area through direct consultation with the Industry**

Research conducted to date on the resource efficiency in the motor vehicle manufacturing sector has indicated a number of issues have not been explored in the existing literature. However there are still areas for consideration during consultation these include:

- Details information on raw material inputs into production
- How resource efficiency issues are viewed by the industry holistically;
- Drivers and barriers in regard to what might be important in the future;
- The relationship between material security issues and resource efficiency
- How behavioural issues affect resource efficiency challenges and opportunities;
- Which resource efficiency metrics may be used to identify top-runners in the industry;
- Best practices in regard to water, waste and material management
- Influence of 'upstream' business on uptake of resource efficiency measures across supply chain
- Level of theoretical vs. realistic resource efficiency opportunity opportunities.

Project team plans to consult with industry players to further explore these issues. For the manufacture of motor vehicle sector, the potential industry contacts would include the ACEA.

Annex C: Data on materials and water consumption and waste generation for the key sectors

Current material consumption

The main material inputs together with the main resource type for the manufacture of food and drinks, fabricated metal products, except machinery and equipment, and hotels and restaurants sector are provided in the table below along with their corresponding ESA95 CPA's:

Table 15: Main CPA's and corresponding material inputs and resource types for different industry sectors

Industry type	Main CPA's	Material input	Resource type
Manufacture of food products and beverages	Products of agriculture, hunting and related services	Food	Food
	Fish and other fishing products; services incidental of fishing		
	Pulp, paper and paper products	Packaging	Paper and board
	Rubber and plastic products		Plastic
	Other non-metallic mineral products	Packaging	Glass
Manufacture of fabricated metal products, except machinery and equipment	Basic metals	Metals	Iron and steel
			Aluminium
			Copper
	Fabricated metal products, except machinery and equipment		Other non-ferrous metals
Hotels and restaurants	Fish and other fishing products; services incidental of fishing	Food	Food
	Food products and beverages		

The ESA95 statistics provide the share of material inputs in terms of their monetary value. In this study it is assumed that the share of monetary value of these material inputs is the same as the share of their amounts in tonnes. Using the ESA95 statistics and the Domestic Material Input (DMI) values for the different material types, the amount of total material input for different sectors can be calculated. The DMI values most relevant for the manufacture of food and drinks, fabricated metal products, except machinery and equipment, and hotels and restaurants sector are presented in the table below:

Table 16: The quantity of DMI's of most relevant resource types for the EU-27 economy

Resource type	Domestic Material Inputs (DMI) (in '000 tonnes) in 2009[79]
Iron and steel	279,672
Aluminium	29,500
Copper	68,651
Other non-ferrous metals	51,394
Food	871,880

Material consumption in the manufacture of food and drink

The estimate of total material input to the manufacture of food and drinks sector is presented in the table below:

Table 17: The quantity of main material inputs to the food and drinks sector calculated based on the ESA95 statistics

Resource group	Resource type	Value (in million Euros)	% share of value	Quantity (in 000' tonnes)
Biomass	Food	168,221	66%	577,788
Biomass	Paper and board	12,916	10%	9,649
Fossil fuel	Plastic	12,895	6%	2,992
Mineral	Glass	5,895	3%	1,031

Statistics from industry associations and other sources have been used to complement and fill data gaps in the current levels of material consumption of the above sector as presented below:

Table 18: The quantity of main material inputs to the food and drinks sector as reported by sources

Source	Material input	Resource type	Quantity (in million tonnes)
EUROPEN[80] 2006 data	Packaging	Plastics	14.9
		Paper and board	31.8
		Metal	4.9
		Glass	16.6
		Wood	12.9
PlasticsEurope[81] (2011)		Plastics	18.5
CEPI[82] (2011)		Paper and board	36.2
APEAL[83] (2009 data)		Metal	3.6
FEVE[84] (2011)		Glass	20.8
Food Cycle Study[85]	Food	Food	517
PRODCOM (2009 data)		Food	909

[79] Eurostat Material flow accounts [env_ac_mfa], 2009

[80] European Organization for Packaging and the Environment (EUROPEN). www.europen.be/

[81] European trade association of companies involved in the European plastics manufacturing chain (39.4% of 47 million tonnes of plastic are used for packaging)

[82] CEPI European Pulp and Paper Industry (consumption of case materials and other packaging)

[83] Association of European Producers of Steel for Packaging

[84] FEVE is the European Federation of glass packaging and glass tableware makers. Source: http://www.feve.org/images/stories/AProd-2011/1production-country-2011.jpg

[85] A forthcoming (likely be published in 2012) DG ENV study carried out by BIO Intelligence Service on "Assessment of Resource Efficiency in the Food Cycle".

The following observations are made about the reliability of ESA95 statistics for the material input quantities to the food and drinks sectors based on the comparison of data presented in the Table 17 and Table 18:

- Food: the food use in this sector calculated based on ESA95 statistics is consistent (around 12% difference) with the figures reported under the Food Cycle Study;
- Paper and board: is used for packaging in this sector. The values calculated based on ESA95 statistics are significantly lower (~65% less) than the figures reported by EUROPEN. It must however be noted that paper and board quantities reported by EUROPEN also include their use for the packaging of other products (such as electronic items, etc) than food and drinks. Therefore the EUROPEN figures only illustrate a theoretical (but unlikely) maximum possible use of paper and board in the food and drinks sector. Based on ESA95 and EUROPEN figures and assuming that 50% of all the paper and board destined for packaging in EU is used for food and drinks packaging[86], the total paper and board input to the this sector should be around 9.7-16 million tonnes;
- Plastics: like paper and board, plastics are also mainly used for packaging in this sector. The values calculated based on ESA95 statistics is significantly lower than the figures reported by EUROPEN and PlasticsEurope. It must however be noted that plastics quantities reported by both EUROPEN and PlasticsEurope also include their use for the packaging of other products (such as electronic items, etc) than food and drinks. Therefore the EUROPEN and PlasticsEurope figures only serves indicative purpose about maximum possible use of plastics in the food and drinks sector. Based on EUROPEN and PlasticsEurope figures and assuming that 50% of all the plastic destined for packaging in EU is used for food and drinks packaging, the total plastics input to the this sector should be in range of 7.5-9.2 million tonnes;
- Glass: The values calculated based on ESA95 statistics is only 5% of those reported by FEVE. It must be noted that the FEVE figures also include the glass used for tableware but the share of this market is less than 4% of the overall EU glass market. Therefore, assuming that around 95% of figures reported by FEVE correspond to the use of glass for food and beverage packaging, it is safe to say that the total glass input to this sector should be around 20 million tonnes; and
- Manufacturing of food products and beverages also requires chemicals for cleaning and lubrication of equipment. As no data could be found 25% more than what is reported for chemical wastes for the sector is used as an estimate.

[86] European Commission (2006) Reference Document on Best Available Techniques in the Food, Drink and Milk Industries: *In the UK, the FDM sector is responsible for using over 50 % of the total yearly packaging (4 - 5 million tonnes per year). On average, packaging represents 13 % of the UK sector's production costs.*

Based on the above analysis, the table below summarises the best estimate of the project team concerning the material input to the food and drinks sector:

Table 19: Summary of best estimates concerning the material input to the food and drinks sector

Material input	Resource type	Quantity (in million tonnes)			Reliability of estimated quantities
		Low estimate	High estimate	Best estimate	
Packaging	Plastics	7.5	9.3	**8.4**	Moderate
	Paper and board	9.7	15.9	**12.8**	Moderate
	Glass	15.8	19.8	**17.8**	Moderate
	Metal	1.8	2.5	**3.7**	Low
	Wood	6.5	6.5	**6.5**	Low
Food	Food	517	909	**713**	Moderate
Chemicals	Cleaning	2.4	2.4	**2.4**	Low

Material consumption in the manufacture of fabricated metals

The estimate of total material input to the manufacture of fabricated metal products, except machinery and equipment sector is presented in the table below:

Table 20: The quantity of main material inputs to the manufacture of fabricated metal products, except machinery and equipment sector calculated based on the ESA95 statistics

Resource group	Resource type	Value (in million Euros)	% share of value per resource	Quantity (in 000' tonnes) - Based on MFA Domestic Input
Metals	Iron and steel	**159,658**	22%	61,172
	Aluminium			6,452
	Copper			15,016
	Other non-ferrous metals			11,241

Statistics from industry associations and other sources have been used to complement and fill data gaps in the current levels of material consumption of the above sector as presented below:

Table 21: The quantity of main material inputs to the manufacture of fabricated metal products, except machinery and equipment sector as reported by sources other than ESA95 statistics

Source	Material input	Resource type	Quantity (in million tonnes)
EUROFER[87]	Metals	Iron and steel	206
World Steel Association (2010 data)		Steel (crude steel equivalents)	160.1
		Steel (finished steel products)	147.3
EAA[88]		Aluminium	12.5
European Copper Institute[89]		Copper	3.3
ECORYS[90]		Other non-ferrous metals	3.4

Following observations are made about the reliability of ESA95 statistics for the material input quantities to the manufacture of fabricated metal products, except machinery and equipment sector based on the comparison of data presented in the Table 20 and Table 21:

- Iron and steel: is mainly used for manufacture of automotive, tubes, domestic appliances, tubes and in construction and shipyards in this sector. The values calculated based on ESA95 statistics is significantly lower (more than 70%) than the figures reported by EUROFER. It is not known exactly how much steel is used in the fabricated metals manufacturing industry. According to Eurostat NACE codes, fabricated metal products do not include vehicles, machinery and equipment, but it could include basic metal parts that are used in these industries. The fabricated metal products sector does include metal structures used in construction but not basic rolled and formed steel sheets, bars, tubes, pipes and wires, which are part of the basic metal manufacturing sector. It is therefore assumed that the amount of metal used in the fabricated metals industry is all metal except that used for transportation, tubes, machinery and equipment, approx. 5%;
- Aluminium: is mainly used for packaging and in the buildings and transport in this sector. The values calculated based on ESA95 statistics is significantly lower (more than 45%) than the figures reported by EAA. It is reported by EAA that around 37% of all aluminium in EU is used for transport and 14% for engineering. Therefore it is assumed that the remaining 49% aluminium in EU is used for fabricated metal products (except machinery and equipment) sector. Based on ESA95 statistics and EAA figures, the total aluminium input to the this sector should be around 6.1 million tonnes;
- It is assumed that 50% of copper and other non-ferrous metals are used in the manufacturing of fabricated metals; and
- The fabricated metals industry also uses chemicals (lubricants, cleaners, surface treatment) as well as cardboard and wood packaging. Data on the use of chemicals or packaging for this sector could not be

[87] EUROFER is the European Steel Association representing 100% of steel production in EU. http://www.eurofer.org/eurofer/Publications/pdf/2011-AnnualReport.pdf
[88] European Aluminium Association, http://www.alueurope.eu/about-aluminium/facts-and-figures/
[89] European Copper Institute (2012) 2011 Annual Report
[90] ECORYS (2011) Competitiveness of the EU Non-ferrous Metals Industries. FWC Sector Competitiveness Studies. Study for the European Commission, DG

found, so it was assumed that the use of chemicals is 25% more than the amount of chemicals sent to waste by the industry. It is assumed that 0.5% of industrial wood is used for packaging and 5% of the total cardboard packaging output is used in this industry.

Based on the above analysis, the table below summarises the best estimate of the project team concerning the material input to the fabricated metal products (except machinery and equipment) sector:

Table 22: Summary of best estimate concerning the material input to the fabricated metal products (except machinery and equipment) sector

Material input	Resource type	Quantity (in million tonnes)	Reliability of estimated quantities
Metals	Iron and steel	92 – 100	Low
	Aluminium	6.3 - 7.9	Low
	Copper	1.7	Low
	Other non-ferrous metals	1.7	Low
Chemicals	Chemicals	4.2	Low
Packaging	Wood	1.5	Low
	Paper and cardboard	1.8	Low

Material consumption in the hotels and restaurants sector

The estimate of total material input to the hotels and restaurants sector is presented in the table below:

Table 23: The quantity of main material inputs to the hotels and restaurants sector calculated based on the ESA95 statistics

Resource group	Resource type	Value (in million Euros)	% share of value per resource	Quantity (in 000' tonnes)
Biomass	Food	**104 383**	29%	249 078

As there is very little data on the quantities of resource use of the hotel and restaurant sector, it is assumed that the same share of packaging is used as the food and drink processing industry (about 7%). The share of packaging materials is based on a WRAP study of waste from the hospitality sector in the UK:

Table 24: The quantity of main material inputs to the hotels and restaurants sector as reported by sources other than ESA95 statistics

Source	Material input	Resource type	Share of food packaging waste	Quantity (in million tonnes)
WRAP[91]	Packaging	Plastics	19%	3.0
		Paper and board	42%	7.0
		Metal	5%	0.8
		Glass	27%	4.5
		Wood	5%	1.0

Restaurants and hotels also consume cleaning liquids, paper napkins and textiles (table clothes, aprons, uniforms, etc.). The estimate for material consumption of chemicals and textiles is based on the waste generation amounts of chemical and textile wastes, respectively. Paper napkins and other sanitary paper are assumed to be 25% of total EU consumption of sanitary paper.

Table 25: Summary of best estimate concerning the material input to the hotels and restaurants sector

Material input	Resource type	Quantity (in million tonnes)	Reliability of estimated quantities
Packaging	Plastics	3.0	Low
	Paper and board	7.0	Low
	Glass	4.5	Low
	Metal	0.8 (0.5 is steel, rest is aluminium)	Low
	Wood	1.0	Low
Food	Food	(low estimate s 61 - 82) 71.5	Low
Chemicals	Cleaning	0.8	Low
Sanitary paper	Napkins	1.7	Low
Textiles	Textiles	0.06	Low

Current waste generation

Eurostat provides comprehensive waste statistics by industry sector and waste stream for the years 2004, 2006, 2008 and 2010. The waste streams were related to the material categories to ensure consistency in the calculations. Assumptions were used to determine the amount and type of materials in metallic wastes, discarded equipment, vehicles, batteries, animal and vegetal wastes, mixed ordinary wastes and mineral wastes.

[91] WRAP (2011) The Composition of Waste Disposed of by the UK Hospitality Industry.

Table 26: Generation of total waste in 2010 for major waste streams[92]

WASTE/NACE_R2	Total - All NACE activities	Manufacture of food products; beverages and tobacco products	Manufacture of basic metals and fabricated metal products, except machinery and equipment	Services (except wholesale of waste and scrap)
Total Waste	**2282.3**	**48.6**	**66.8**	**128.0**
Chemical and medical wastes	60.8	2.3	6.5	7.0
Recyclable wastes	211.5	3.7	14.8	42.5
- Metallic wastes	*88.3*	*0.4*	*13.7*	*12.6*
- Glass wastes	*9.2*	*0.6*	*0.1*	*2.7*
- Paper and cardboard wastes	*38.6*	*1.5*	*0.4*	*18.1*
- Plastic wastes	*12.8*	*0.7*	*0.2*	*2.9*
- Wood wastes	*56.5*	*0.4*	*0.4*	*4.1*
Animal and mixed food waste; vegetal wastes	66.1	28.2	0.1	10.2
- Animal and mixed food waste	*32.9*	*12.7*	*0.1*	*5.4*
Mixed ordinary wastes	147.8	4.8	4.3	37.0

Table 27: Generation of hazardous waste in 2010[93]

WASTE/NACE_R2	Total - All NACE activities	Manufacture of food products; beverages and tobacco products	Manufacture of basic metals and fabricated metal products, except machinery and equipment	Services (except wholesale of waste and scrap)
Total Hazardous waste	**96.4**	**0.7**	**9.6**	**11.1**
Chemical and medical wastes	32.7	0.6	5.3	4.9

Table 28: Generation of non-hazardous and hazardous waste according to EIDSME[94]

WASTE/NACE_R2	Total	Manufacture of food products; beverages and tobacco products	Manufacture fabricated metal products, except machinery and equipment	Hotels and restaurants
Non-hazardous waste	2431.7	59.4	81.8	17.0
Hazardous waste	76.8	0.7	7.9	1.9

[92] Eurostat : Generation of waste [env_wasgen]
[93] Eurostat : Generation of waste [env_wasgen]
[94] Environmental Impact Database for SMEs (EIDSME database)

Waste generation in manufacture of food and drink

Table 29: Summary of best estimates concerning the waste generation of the food and drink sector

Waste stream	Resource type	Quantity (in million tonnes)	Reliability of estimated quantities
Packaging[95]	Plastics	1.0	Low
	Paper and board	2.0	Low
	Glass	1.0	Low
	Metal	0.5	Low
	Wood	0.5	Low
Chemicals[95]	Chemicals	1.9	Low
Food[96]	Food	34.8	Moderate

Waste generation in manufacture of fabricated metals

The waste statistics provide data for manufacture of basic metals and fabricated metal products together. It was estimate the share is roughly 50% each.

Table 30: Summary of best estimate concerning the waste generation of the fabricated metal products (except machinery and equipment) sector[97]

Waste stream	Resource type	Quantity (in million tonnes)	Reliability of estimated quantities
Metals	Iron and steel	7.1	Low
	Aluminium	0.4	Low
	Copper	0.2	Low
	Other non-ferrous metals	0.2	Low
Chemicals	Chemicals	3.3	Low
Packaging	Wood	0.3	Low
	Paper and cardboard	0.5	Low

Waste generation in the hotels and restaurants sector

The Eurostat does not specify the waste generation statistics for the hotel and restaurant sector. Instead assumptions were made based on the total waste generation of the service industry. It was assumed that hotels and restaurants were responsible for 10% of all non-food waste generated by the service sector (except for metals only 1% of the total service sector's metal related wastes). The food waste estimated was taken from BIO's food waste study.

[95] Eurostat, waste generation data, 2008. Estimates based on metallic, glass, paper and cardboard, plastic and wood waste as well as estimates of shares from mixed ordinary waste

[96] BIO Intelligence Service (2010) Preparatory study on food waste. Study for the European Commission, DG Environment.

[97] Based on Eurostat, waste generation data for 2008

Table 31: Summary of best estimate concerning the waste generation of the hotels and restaurants sector[98]

Waste stream	Resource type	Quantity (in million tonnes)	Reliability of estimated quantities
Plastics	Plastics	1.0	Low
Paper and board	Paper and board	3.2	Low
Glass	Glass	0.8	Low
Metal	Metal	0.2 (0.12 is steel, 0.08 is aluminium)	Low
Wood	Wood	0.5	Low
Food[99]	Food	12.3	Low
Chemicals	Cleaning	0.8	Low
Textiles	Textiles	0.06	Low

Current water consumption

Eurostat provides some data on water consumption (e.g. gross abstraction, public water supply, self supply[100]) and wastewater on Member State level, but the dataset has many gaps and is not updated for all Member States. There is a breakdown to some industry sectors as well as a sub-category of water used for cooling purposes. The latest available data for each Member State was used. For Member States where data was not available an EU average based on the production value of the sector was used to estimate water consumption. Assumptions were used to determine the amount of water and wastewater to fit the industry sectors considered in this study.

Although significant amounts of water are used for cooling purposes in industry, this was not taken into account due to lacking data. The water statistics do not provide specific information for fabricated metals or for restaurants and hotels. For fabricated metals, it was assumed that the water consumption corresponded to half of the 'other manufacturing industry'. Likewise the water consumption of hotels and restaurants were estimated to be half of the water consumption of all services.

[98] Based on Eurostat, waste generation data for 2008
[99] BIO Intelligence Service (2010) Preparatory study on food waste. Study for the European Commission, DG Environment.
[100] Based on Eurostat, Water use by supply category and user [env_watq3]

Table 32: Summary of best estimates concerning water use[101]

Sector	Supply	Quantity (in million m^3)		Reliability of estimated quantities
Total supply	Public water supply	36,367	226,743	Low
	Self supply	190,376		Low
Total manufacturing industries	Public water supply	4,322	30,481	Low
	Self supply	26,159		Low
Food processing industry	Public water supply	1,244	3,487	Low
	Self supply	2,243		Low
Other manufacturing industry[102]	Public water supply	823	2,283	Low
	Self supply	1,460		Low
Services	Total water abstracted by services		2,235	Low
				Low

Eurostat also has some data on the generation of wastewater. No specific information on wastewater for fabricated metals was available and therefore it was assumed that the amount was similar to the manufacturing of motor vehicles and transport equipment. It was also assumed that most of the wastewater from restaurants and hotels is discharged to urban wastewater treatment and therefore there are no additional costs for restaurants and hotels for wastewater treatments.

Table 33: Summary of best estimates concerning wastewater[103]

Sector	Quantity (in million m^3)	Reliability of estimated quantities
Total manufacturing industries	15,068	Low
Food processing industry	1,372	Low
Basic metals	3,227	Low
Motor vehicles and transport equipment	224	Low

[101] Based on Eurostat, Water use by supply category and user [env_watq3]
[102] Excluding food processing, basic metals, motor vehicles and transport equipment, textiles, paper and paper products, chemicals, refined petroleum industries,
[103] Based on Eurostat, generation and discharge of wastewater [env_watq7]

Annex D: Potential of resource efficiency measures

Resource efficiency measures

Each type of resource efficiency measure was characterised based on the following dimensions

- Decreasing inputs with same output (substitution and efficiency);
  - Resource savings (costs saved from reduced purchase)
- **Increasing output with same input** (dematerialisation, effectiveness);
  - Increase revenue or other cost benefits (e.g. less costs for transport)
- **Minimising waste and losses** (efficiency and closing the life cycle loops); and
  - Resource savings (costs saved from reduced waste treatment)
- Average cost of the measure.

The potential for each of the above dimensions was estimated for each type of resource efficiency measure based on the gathered case studies. The main types of measures identified in literature were:

Resource efficient business models such as product leasing, remanufacturing and product/service-systems (PSS) are strategic implementation of one or several of the above listed measures. Product leasing and remanufacturing is material reuse extended to the value chain supported with ecodesign measures that extend product life. A PSS such as a Chemical Management System (CMS) is from a purchaser's perspective a redefinition of procurement criteria. From a supplier's perspective this corresponds to waste prevention and material reuse.

Ecodesign

Ecodesign is the integration of environmental aspects into product design with the aim of improving the environmental performance of the product throughout its whole life cycle[104]. Ecodesign involves an analysis of the environmental impacts of the entire life cycle of an existing product (or service) to determine what are major impacts and possible improvement options. Various types of Life Cycle Assessment (LCA) tools can be used, varying from very simplified methods to elaborate standardised methods. Typically all major environmental impacts are considered in ecodesign including those related to material consumption, waste generation and water use. Although ecodesign adds additional complexity to design processes (designers already have to balance the trade-offs between functionality, costs, quality and other product related issues), ecodesign has shown that it can help designers to identify more innovative solutions that reduce costs, improve the value and be more resource efficient. This is because designers get a better understanding of the product and each of the life cycle phases when performing LCA. In this way, ecodesign helps companies identify the 'hotspots' in a product's life cycle where most environmental impacts occur. This helps designers identify design changes that could lead to the less

[104] Ecodesign Directive (2009/125/EC)

consumption of materials and less generation of waste as well as actually making the product more desirable on the market and commend higher prices.

Contribution of ecodesign to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
Product lightweighting (using the same types of material)	Reduces the amount of materials used per product	Can increase the market value of the product (e.g. products with improved environmental performance can commend higher prices on the market) Can reduce production and transport costs (e.g. products will less volume or weight are cheaper to transport)	Less waste is generated when less material is used	Decrease in weight for packaging between 2000 and 2008[105]: • Liquid bottle: -14% • Soup can: -11% • Plastic drink bottle: -7% • Metal drink can: -7% • Glass beer bottle: -46% Apple[106]: • 27 inch (new version) iMac uses 25% less material compared to 15 inch (old version) iMac • 21.5 inch (new version) iMac uses 50% less material compared to 15 inch (old version) iMac
Material substitution (changing the type of materials used)	Can reduce the amount of materials used per product	Can increase the market value of the product (e.g. products with no hazardous substances can commend higher prices on the market) Can reduce production and transport costs (e.g. products will less volume or weight are cheaper to transport)		• Decrease in weight of a beer bottle from 260 g (glass bottle) to 38 g (plastic bottle)[107] • PVC-free office furniture[108]
Use of recycled content		Reduced material costs as recycled material is often cheaper than virgin material		Boots (UK) introduced 30% recycled plastic content into the bottles for its 'Ingredients' range of toiletries
Improve product durability by making it durable, repairable and upgradeable, e.g. design for longevity	This can be a benefit for companies that have more service-oriented business models such as remanufacturing, product/service-systems, etc. Benefits included as part of material reuse.			
Improving the (environmental) performance of products		Although this can increase the cost of the product, it can increase the market value of the product (e.g. products with improved environmental performance can commend higher prices on the market). Benefit already included in other ecodesign measures		Ecolabelled products

Comments

[105] EUROPEN; Packaging and Packaging Waste Statistics 1998 – 2006

[106] www.apple.com/environment/reports/

[107] www.carlsbergdanmark.dk/omol/AtVide/Emballager/Pages/Flasker.aspx

[108] Steelcase, http://www.oecd.org/env/resourceproductivityandwaste/46324389.pdf

- Although ecodesign can also be used to reduce water consumption for businesses, this is only the cases for products that contain water. The reduction of water tends to be more production-oriented and therefore the benefits are accounted for under water minimisation.

Costs

- An LCA can cost anything from €400 (simple assessment) – 50,000 (in-depth assessment), but typically €2000 - €10,000 per product[109]. Ecodesign training for a product development team costs around €3,000 - €10,000 (1-3 days)[110]. Simplified LCAs and help from resource efficiency centres could mean that ecodesign could be implemented in a company with a minimum of investment. Once a company has performed an ecodesign project, the costs of conducting other ecodesign projects are greatly reduced as the competency is already in-house;
- Ecodesign leads to material (cost) savings as well as avoided waste management costs; and
- Ecodesign has the potential to also reduce other production and transport costs, or even increase the sales of the product through higher market value.

Procurement

Best practices in procurement can help businesses save materials and money. Besides being able to negotiate on prices, purchasers can help ensure that suppliers provide their products and services in a resource efficient manner. This could be by setting procurement criteria for equipment that must be efficient in use, e.g. a photocopying machine that can has duplex printing functions, or process equipment that uses less water, or that is more durable, e.g. the product lasts longer or can be repaired or upgraded. Businesses can even decide to outsource secondary activities that can be performed more efficiently by other suppliers, e.g. cleaning, printing, chemical management, etc. By considering the life cycle costs of products, purchasers can identify the most resource efficient options for certain types of products.

Sustainable procurement can lead to the less consumption of materials and less generation of waste as well as saving internal costs.

[109] Own estimates together with:

- OECD (2009) Global Forum on Trade and Climate Change, Paris, 9 and 10 June 2009, Counting Carbon in the Market Place
- B Corporation (2008) B Resource Guide: Conducting a Life Cycle Assessment (LCA) www.bcorporation.net/resources/bcorp/documents/B%20Resources%20-%20Conducting%20a%20Life%20Cycle%20Assessment%20(LCA).pdf

[110] Own estimates

Contribution of procurement to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
Resource efficient product criteria	Reduces the amount of materials or water consumed by equipment (e.g. duplex printer, water saving taps) Increases the use of supplies and equipment (e.g. by buying more durable products) so that less supplies and equipment needs to be purchased	Can reduce production costs	Less waste is generated when less material is used	• Ecolabel • Trials have shown that catering outlets can cut their napkin consumption by at least 25 per cent by switching to the Tork interfold napkin dispenser.[111] • By optimising purchasing in terms of fitting steel lengths and by introducing quality criteria for the inspection of incoming goods, as much as 9% of steel could be saved for a steel manufacturer[112] • Only buying produce that is in season or reduced food purchasing
Outsourcing	Can reduce the amount of materials used per product	Can reduce production costs	Less waste is generated when less material is used	• Chemical Management Services seems to be able to reduce 30% of the wastes of spent solvents, acid, alkaline or saline wastes, used oils, spent chemical catalysts, chemical preparation and chemical deposits and residues[113]

Comments

- Some of the measures are already accounted for elsewhere, e.g. waste prevention and water minimisation

Costs

- Best practice training for a purchaser costs around €1,000 - €3,000 (1-3 days)[114]. Some organisations provide training for free. Procurement training is a low cost measure, but working with suppliers and

[111] http://www.sca.com/en/items/external-links/brand-sites/tork-uk/

[112] Greenovate! Europe (2012) Guide to resource efficiency in manufacturing. Experiences from improving resource efficiency in manufacturing companies. Europe INNOVA, Eco-Innovation, REMake.

[113] Own estimate based on various sources:

- CMS Forum website, www.cmsforum.org
- COWI (2008) Promoting Innovative Business Models with Environmental Benefits. Study commissioned by the European Commission, DG Environment.
- US EPA (2009) "Green Servicizing" for a More Sustainable US Economy: Key concepts, tools and analyses to inform policy engagement.

[114] Own estimates

developing procurement criteria and contracts can take additional efforts (up to several person days work). Additional investment costs for more resource efficient equipment is accounted for elsewhere;

- Ecodesign leads to material (cost) savings as well as avoided waste management costs; and
- Sustainable procurement leads to material (cost) savings as well as avoided waste management costs.

Waste prevention

Waste prevention are measures taken before a substance, material or product has become waste that reduce[115]:

(a) the quantity of waste;

(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.

In the context of businesses, waste prevention measures cover a wide range of different type of measures. From a quantitative point of view, waste prevention can be achieved by optimising production processes that create waste or by reusing materials and equipment. From a qualitative point of view, waste prevention is achieved by reducing environmentally harmful waste, in particular hazardous and/or toxic substances. Both the quantitative and qualitative perspectives of waste prevention lead to reduced waste management costs for companies and can even reduce the amount of resources needed.

There are two basic strategies to achieve waste prevention: using technology and equipment that is more resource efficient (a so-called 'hard measure'), or implementing more resource efficient practices in existing processes and equipment (so-called 'soft measures'). A 'hard' waste prevention measure could be installing new production equipment that uses less lubricants or water; is able to extract more meat, juice or oil from agricultural products; or, produces more components with less scrap metal. These types of measures typically require a capital investment. 'Soft' waste prevention measures comprise a broad variety of best management practices such as systematic measurement and monitoring of resource flows; better housekeeping and inventory management; awareness-raising; training; target-setting; behavioural change and leadership. These types of measures are typically low or no cost measures for companies and can be as simple as setting the duplex printing function as default on photocopying machines. Typically companies make use of both hard and soft waste prevention strategies, but for the sake of this study they are distinct measures as they have different cost implications. Lean production (or lean manufacturing) is an example of a combination of waste prevention measures.

Waste prevention can lead to less generation of waste (and thereby saving waste management costs) as well as decreasing the inputs to businesses.

[115] This definition is consistent with the Waste Framework Directive (2008/98/EC)

Contribution of waste prevention to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
New efficient technology	Less material is needed		Less waste is generated	• Ginsters (UK) installed new meat mincers that halved the original 4% meat loss[116] • Installing a more efficient refinery reduced material use by 5%[117] • Installing an anerobic digester
Process optimisation	Less material is needed		Less waste is generated	• Optimising operating parameters, e.g. minimising tool wear • Reduction of cuttings and rejects • Reduction of operating fluids and supplies • Improved storage and logistics
Soft measures (including training, measurement and tracking, best practice, behaviour change)	Less material is needed		Less waste is generated	• Environmental Management Systems such as EMAS ○ Cost savings of 2%-10% from a more efficient use of resources[118] • Reducing laundry detergent consumption through environmental programmes and training[119]

Comments

- Some of the measures are already accounted for elsewhere, e.g. waste prevention and water minimisation;
- In the context of this study, a distinction is made between waste prevention and product design measures that lead to resource efficiency. Ecodesign can be seen as a possible waste prevention measure, but in order not to double-count the resource efficiency opportunities, a clear distinction is made;
- Furthermore, waste prevention in the form of reuse of materials and equipment internally in a company or supply chain (e.g. reusable containers and packaging) is accounted for under material reuse; and
- Finally, waste prevention in the form of selling by-products of production is accounted under waste exchange.

[116] Envirowise case study: http://www.fhc2020.co.uk/fhc/cms/assets/Uploads/CS823final1.pdf
[117] Reference 10,3
[118] Milieu and RPA (2009) Study on the Costs and Benefits of EMAS to Registered Organisations. Study for the European Commission, DG Environment.
[119] Reference 11,3

Costs

- *Hard waste prevention measures*: purchasing and installing new technology that is more resource efficient typically involves high capital costs, which can range from €1000 (e.g. a duplex printer, more accurate dosing nozzles) to €500,000 (e.g. new machinery) [120];
- *Soft waste prevention measures*: best practice training costs around €1,000 - €3,000 (1-3 days)[121]. Some organisations provide training for free. Although training is a relatively low cost measure, implementing best practices require additional efforts for both management and employees. This could involve up to several person days work as well as costs to supporting tools such as environment management system software; and the development and production of brochures, posters and signs to raise awareness;
- The costs of EMAS registration is estimated to be on average €48,131 for the first year and €25,943 annually (for small enterprises (between 10 and 49 employees) €38,164 for the first year and €21,695 annually)[122]. EMAS registration involves significant administrative burden and audits;
- Process optimisation are categorised as simple changes that can be made by businesses and costs. The direct cost estimate in this study excludes the R&D and manpower costs required to understand where and how the process needs optimising. Real-world business costs may be substantially higher; and
- Waste prevention leads to material (cost) savings as well as avoided waste management costs.

Recycling, donations, waste recovery and composting

There are several alternatives for waste that are more resource efficient than disposal. Instead of sending waste to the landfill, companies can implement measure to better recycle or recover waste through treatments such as composting and anaerobic digestion. Common for all these measures is that they can lead to less waste management costs for companies. Although these measures have wider economic and environmental benefits for the economy, they do not directly benefit the companies that implement them.

Contribution of recycling to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
Recycling			Less waste is sent to landfill	• Mars' Slough site currently reuses and recycles over 90% of its site waste.[123]
Donation			Less waste is sent to landfill	• Donation of office furniture and computers to charities
Waste recovery			Less waste is sent to landfill	• Biowaste (e.g. food waste) can be anerobically digested to produce biogas and fertilisers
Composting			Less waste is sent to landfill	• Food waste is processed to high quality compost[124]

[120] Source of data Eco Observatory with supporting evidence from BIS (2010) findings
[121] Own estimates
[122] Milieu and RPA (2009) Study on the Costs and Benefits of EMAS to Registered Organisations. Study for the European Commission, DG Environment.
[123] Reference 13,3
[124] National Industrial Symbiosis Programme (2009) The pathway to a low carbon sustainable economy.

Comments

- Internal recycling and waste recovery is accounted for under waste prevention using resource efficient technology and equipment

Costs

- It is a relatively low cost measure to avoid that any waste is sent to landfill. This typically involves some training and possibly simple equipment for the sorting, segregation and storage of waste. We estimate these costs to be in the range of €500 - €5,000; and
- Onsite energy recovery from waste requires significant capital investment. There are two types of Anaerobic Digesters[125]:
    - **Farm-fed systems**
        - Scale is typically 100 kW to 1 MW
        - Capital cost is typically £500k to £2.5 million (k€620 - €3 million)
        - Annual income is typically £120k to £1.2 million (k€150 - €1.5 million)
    - **Waste-fed systems**
        - Scale is typically 1 MW to 2.5 MW
        - Capital cost is typically £5 - 10 million (€6.2 – 12.4 million)
        - Annual income is typically £2 - 4 million (€2.5 – 5 million)
- Recycling leads to waste management savings, which are the avoided landfill fees as well as additional revenue from selling recycled material;
- Donations lead to waste management savings, which are the avoided landfill fees.;
- Waste recovery (off-site) leads to waste management savings, which are the avoided landfill fees minus the costs of sending waste to waste recovery. Waste recovery (on-site) leads to waste management savings, which are the avoided landfill fees as well as additional revenue from the energy generated; and
- Composting leads to waste management savings, which are the avoided landfill fees minus the costs of sending waste to composting.

Waste exchange

An alternative to sending waste to be treated by waste management services, companies can find other companies that can use their by-products and waste as resources for their production. This can be achieved by business networking such as in industrial symbiosis, but could also be as simple as identifying local companies that would

[125] Lucy Hopwood, NNFCC (2011). http://www.sari-energy.org/PageFiles/What_We_Do/activities/worldbiofuelsmarkets/Presentations/BiogasUtilityDeveloperForum/Lucy_Hopwood.pdf

value a company's by-products or wastes. Besides avoiding waste management costs, this may even be a means for companies to generate revenue.

Contribution of recycling to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
Selling scrap		Extra revenue from selling waste	Less waste has to be treated	
Selling by-products		Extra revenue from selling by-products	Less waste has to be treated	• Meat and bone meal processed from animal by-products can be used as fuel in cement kilns[126]
Industrial symbiosis		Can generate extra revenue	Less waste has to be treated	• Waste foundry sand is reused to manufacture concrete blocks, bricks and associated products[127]

Costs

- Although, this measure might not be applicable to all businesses, it is a relatively low cost measure to establish agreements with other companies or organisations that could use a company's wastes or by-products. This typically involves some time identifying potential companies or organisations and possibly simple equipment for the sorting, segregation and storage of waste. We estimate these costs to be in the range of €1000 - €10,000. Some countries already have industrial symbiosis programmes that facilitate the establishment of these types of industrial networks; and

- Waste exchange leads to waste management savings, which are the avoided landfill fees as well as the potential additional revenue from the sold waste.

Material reuse

A specific type of waste prevention measure is to reuse materials and equipment internally in companies. This could be done by reusing durable packaging instead of disposal packaging to transport components between production sites. Material reuse could even be the basis of a resource efficient business model such as remanufacturing. Remanufacturing involves the reprocessing of used products to a state that is comparable to a new product. Material reuse and remanufacturing can lead to less consumption of materials and less generation of waste as well as saving material and waste management costs.

[126] National Industrial Symbiosis Programme (2009) The pathway to a low carbon sustainable economy.
[127] National Industrial Symbiosis Programme (2009) The pathway to a low carbon sustainable economy.

Contribution of waste prevention to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
Material reuse (internally)	Less material is needed		Less waste is generated compared to disposable packaging, pallets, trays, etc. Possibly increase in cleaning (water and detergents)	• Vitsoe uses wooden stillages to handle high value aluminium parts. The stillages are kept in a closed loop returning to suppliers in the otherwise empty trucks to be reused.[128]
Reusable (refillable) packaging	Less material is needed if the packaging is returned to the manufacturer. Increase in cleaning (water and chemicals)		Waste reduction does not occur on site, but with consumers. Waste could actually increase with damaged reusable packaging returned.	
Remanufacturing	Less material is needed		Less waste is generated	• Caterpillar Remanufactured parts and components provide same-as-new performance and reliability at fraction-of-new costs[129]

Comments

- Internal recycling and waste recovery is accounted for under waste prevention using resource efficient technology and equipment; and
- Materials that are reused externally are accounted for under donations or waste exchange

Costs

- A material reuse system must be developed, tested and implemented in order to work. The costs will vary by sector and extent of the system, e.g. direct reuse of transit packaging is relatively simple to implement, while a remanufacturing business would require significant investments and the establishment of a take-back system and reprocessing equipment. We estimate these costs to be in the range of €5000 - €50,000; and
- Material reuse (internal) leads to material (cost) savings as well as avoided waste management costs.

Water minimisation

Similar to waste prevention, water minimisation focuses on measures that reduce water consumption and wastewater generation. As with waste prevention these measures can involve new efficient technology and equipment as well as softer measures such as water flow analysis, leak detection, metering, awareness raising and training. Water minimisation can lead to less consumption of water as well as saving water treatment costs.

[128] https://www.vitsoe.com/eu/about/ethos

[129] - Caterpillar – equipment rental and remanufactured products www.cat.com/cda/layout?m=94942&x=7

Contribution of water minimisation to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
New efficient technology	Less water is needed		Less wastewater is generated	• More energy efficient equipment that requires less cooling water
Process optimisation	Less water is needed		Less wastewater is generated	• Optimising operating parameters, e.g. cleaning and washing processes are optimised
Soft measures (including training, measurement and tracking, best practice, behaviour change)	Less water is needed		Less wastewater is generated	• Environmental Management Systems such as EMAS • Water saving programmes and increasing employee awareness can save 10-35% water consumption[130]

Costs

- *Hard waste prevention measures*: purchasing and installing new technology that is more water efficient typically involves high capital costs, which can range from €1000 (e.g. water saving taps) to €1,000,000 (e.g. new process equipment) [131];
- *Soft waste prevention measures*: water analysis and leak detection costs around €1,000 - €3,000 (1-3 days)[132]. Some organisations provide this service for free. Although this is a relatively low cost measure, implementing best practices require additional efforts for both management and employees. This could involve up to several person days work as well as costs to supporting tools such as environment management system software; and the development and production of brochures, posters and signs to raise awareness. We estimate these costs to be in the range of €1,000 - €5,000;
- Process optimisation are categorised as simple changes that can be made by businesses and costs. The direct cost estimate in this study excludes the R&D and manpower costs required to understand where and how the process needs optimising. Real-world business costs may be substantially higher; and
- Water minimisation leads to water (cost) savings as well as avoided water treatment costs.

Water recovery

Similar to material reuse and internal material recycling, water reuse and recycling are measures where businesses can reduce their waste consumption as well as save on wastewater treatment costs. These include the reuse of cooling water or the reuse of grey water for processes that do not require clean drinking water, e.g. flushing toilets or landscape irrigation. If large amounts of water are used in production process, it might be a good investment for a company to treat the water themselves and then recycle the clean water in their processes.

[130] Reference 11,3
[131] Source of data Eco Observatory with supporting evidence from BIS (2010) findings
[132] Own estimates

Contribution of water recovery to resource efficiency	Decreasing inputs	Increasing output	Minimising waste	Examples
Reuse internally without treatment	Less water is needed		Less wastewater is generated	• Installing a reuse system
Clean internally (requires wastewater treatment equipment) and recycle	Less water is needed		Less wastewater is generated	• By installing a sludge-dryer system a coating company could reduce the amount of water in their sludge and reuse what was recovered[133]

Costs

- Water recovery measures require the installation of pipes to recirculate the water. This can be a modest investment if the water can be reused directly without treatment. If the water does need to be treated this requires purchasing and installing water filtration and treatment equipment, which can be a substantial capital investment. We estimate these costs to be in the range of €5,000 - €50,000.
- Water recovery leads to water (cost) savings as well as avoided water treatment costs.

3.8.8 Differences in measures in the different industry

	Measure	Manufacturing of food and drink	Manufacturing of fabricated metals	Hotels and restaurants
Design	Ecodesign (using same materials efficiently)	Packaging only	Product and packaging	• Smaller portion size • Hotels: Sustainable buildings? smaller rooms?
	Ecodesign (using more efficient materials)	Packaging only	Product (to a certain extent, otherwise it may no longer be a metal product) and packaging	• Using seasonal (and local) produce • Sustainable buildings?
	Ecodesign (increasing recycled content)	Packaging only	Product (metals already use high amounts of recycled content) and packaging	• Using disposable consumables such as recycled paper products?
	Ecodesign (increasing product life)	Reusable packaging Preserving product shelf life?	Product mostly Reusable packaging?	• Offering doggy bags?
Procurement	Resource efficient procurement	Materials, components and supplies for products, packaging and production processes (stock control, elimination of over-ordering, seasonal / local foods)	Materials, components and supplies for products, packaging and production processes	• Materials, components and supplies for products, packaging and production processes (stock control, elimination of over-ordering, seasonal / local foods)

[133] Greenovate! Europe (2012) Guide to resource efficiency in manufacturing. Experiences from improving resource efficiency in manufacturing companies. Europe INNOVA, Eco-Innovation, REMake.

	Measure	Manufacturing of food and drink	Manufacturing of fabricated metals	Hotels and restaurants
Production	Waste prevention (resource efficient technology)	Product and packaging	Product and packaging	• Cooking, washing • Cleaning, dispensers instead of soap bars/bottles
	Waste prevention (optimisation and soft measures)	Product and packaging	Product and packaging	• Cooking, washing • Hotel cleaning, e.g. towels
	Material reuse (internally)	Packaging only	Packaging Products - remanufacturing	• No disposable tablewear • Reuse of towels
Waste	Avoiding landfill (recycling and waste recovery)	Recycling of packaging waste, waste recovery of food waste	Recycling or donation of all waste	• All waste • Food waste: donation, waste recovery, composting • Recyclable material: recycling
	Waste exchange (selling by-products and waste as resources)	Food waste as biofuel Packaging waste	Product and packaging waste	• Food waste as biofuel • Packaging waste
Water	Water minimisation (water efficient technology)	Food products and food processing Washing of reusable packaging	Cleaning and coating processes	• Cooking, washing, cleaning • Water saving devices
	Water minimisation (optimisation and soft measures)	Production processes	Production processes	• Cooking, washing, cleaning
	Water recovery and reuse	Production processes incl cooling	Production processes incl cooling	• Toilets and landscape irrigation

3.8.9 Estimates for reduction potential from EIDSME

Overall potential reduction in percent according to EIDSME[134]

WASTE/NACE_R2	Total	Manufacture of food products; beverages and tobacco products	Manufacture of basic metals and fabricated metal products, except machinery and equipment	Hotels and restaurants
Non-hazardous waste	-35%	-67%	-59%	0%
Hazardous waste	-47%	-74%	-65%	-7%

[134] Environmental Impact Database for SMEs (EIDSME database)

Example measures in the food and drink manufacturing sector selected from the research

Measures	**Maximum potential for resource savings** (% of amount used)		**Maximum potential for increase in revenue** (% of revenue)		**Maximum potential for minimising** waste (% of waste)		**Cost of measure**		**Comments and additional information**
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
Ecodesign - lightweighting (using same material) - packaging[135]	-5%	-20%	0%	3%	0%	-10%	5000	50000	A petfoods company lowered the sides of its cardboard transit trays, without loss of strength. This action reduced wastage and resulted in a 49 % reduction in the use of corrugated card and ink. In a preserves and peanut butter factory, a packing line study identified that static electricity associated with the sleeve film affected the availability of the automated tamper-proofing sleeve machine. By increasing the film thickness by 20 am, the machine speed could be maintained at 250 jars per minute and stoppages reduced by 40 %. Savings in film waste alone equated to GBP 25000/yr. (BREF (2006) FDM)
				Reduced transport costs and increased revenue		*Less waste is generated when less material is used*[136]			
Ecodesign - lightweighting (change of material) – packaging	0%	-20%	0%	3%			5000	50000	

[135] WRAP: http://www.wrap.org.uk/sites/files/wrap/Packaging%20research%20listing%2C%2025%20Aug%202011_0.pdf

[136] BREF (2006) Food, Drink and Milk Industries:

- 4.2.12.1 Selection of packaging materials: Decreased consumption of non-renewable materials and reduced waste generation.
- 4.2.12.2 Optimisation of packaging design – to reduce the quantity: Reduction in consumption of materials for packaging and reduced waste both at the installation and at the place of unpacking.

Measures	Maximum potential for **resource savings** (% of amount used)		Maximum potential for increase in **revenue** (% of revenue)		Maximum potential for **minimising** waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
Ecodesign - use of recycled content – packaging[137]			0%	-5%			2500	10000	
				Reduced material costs as recycled material is often cheaper than virgin material[138]					
Waste prevention - packaging	-1%	-5%			-4%	-20%	1 000	10 000	Poorly designed and operated packing lines cause many companies to lose as much as 4 % of their product and packaging. (BREF (2006) FDM)
	Dairy Produce Packers Ltd (DPP) Country: UK Measure: Introduced a waste minimisation strategy, resulting in less packaging being used of incoming goods waste minimisation - a saving of £3 700/year from reduced packaging on								Optimising packing line efficiency Waste minimisation by optimising packing line speed

[137] http://www.incpen.org/pages/pv.asp?p=ipen217

[138] http://www.letsrecycle.com/prices

Measures	Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
	incoming goods. 30% reduction in the quantity of cardboard used to package incoming goods.								
Waste prevention - food (new technology) [139]	-5%	-10%			-15%	-30%	50 000	1000 000	
					Use a waste management team Use of this technique by an example petfood installation led to a 50 % reduction in waste Abrasion peeling has a significantly higher product loss than flash steam peeling, 25 % loss compared to 8 – 15 % loss If fruit and vegetables are treated with enzymes during juice manufacturing, less waste is produced. Apple juice without enzyme (8-18% waste), with enzyme (10-25%)		Pinch analysis costs (EUR) Consultancy fees for the pinch analysis 32,000 In-house staff costs for the pinch analysis 16,000 Implementation of the pinch analysis recommendations 3,066,000 (BREF (2006) FDM)		

[139] Source of data Eco Observatory with supporting evidence from BIS (2010) findings; F&D Mfr has substantially higher technological investment costs, typical sector investment value €429k

Measures	Maximum potential for **resource savings** (% of amount used)		Maximum potential for increase in **revenue** (% of revenue)		Maximum potential for **minimising** waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
Waste prevention - food (best practice) [B]	-1%	-5%			-5%	-10%	1 000	25 000	4.1.7.1 Apply production planning, to minimise associated waste production and cleaning frequencies 4.1.7.2 Receive materials in bulk 4.1.7.3 Minimise storage times for perishable materials 4.1.7.4 Transport solid materials dry 4.1.7.5 Use a waste management team *Use of this technique by an example petfood installation led to a 50 % reduction in waste over an 8 month period, which was then maintained. The environmental impact was significantly reduced, together with very significant cost reductions by reducing the loss and waste of raw materials.* *4.1.7.6 Segregation* of outputs, to optimise use, re-use, recovery, recycling and disposal (and minimise water use and waste water contamination) 4.1.7.7 Use of by-products, co-products and residues as animal feed 4.1.7.8 Segregation of water streams to optimise re-use and treatment 4.1.7.11 Good housekeeping 4.1.8 Process control techniques 4.1.8.2 Control flow or level, by dedicated measurement of pressure *In the example brewery, the process modifications cost GBP 9500 (1999), but the associated reduction in beer losses and waste water charges worth GBP 800000/year, meant the payback period was 5 days.* *The example vegetable processing company saved over GBP 15000/year through reduced water costs, waste water charges and operator time. The payback period was a few months.* 4.1.8.4 Flow measurement and control 4.1.8.5 Analytical measurement *The dairy reports an estimated 15 % saving on detergent for each CIP unit; reduced amounts of water and detergent discharged for waste water treatment; reduced downtime of equipment and*

Measures	Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
									optimised quantity of detergent used for each cleaning cycle. 4.1.8.6 Use automated water start/stop controls 4.1.8.7 Use of control devices 4.1.8.8 Use of water nozzles (BREF (2006) FDM)
Material reuse – packaging [A]	-5%	-20%			-20%	-30%	5 000	500 000	Segregation of packaging materials to optimise use, re-use, recovery, recycling and disposal
							The new approach required an initial six-figure investment in crates; however, the company is already achieving commercial payback as a result of reuse against the cost of buying carton board. The change has reduced the use of corrugated cardboard by 112 tonnes each year http://www.wrap.org.uk/sites/files/wrap/Information%20Sheet%20apetito%20final%20June%202010.pdf		Conversion to refilling of glass containers in small scale, local manufacturing facilities would incur high capital costs of over £15 million per production line. The conversion of local, small scale, one-way glass bottling plants to refillables is the least cost option at circa £2 million to £3 million per production line. http://www.wrap.org.uk/sites/files/wrap/Refillable%20glass%20beverage%20systems%20-%20FINAL1.pdf
Recycling - packaging					-10%	-40%	500	2000	Waste management costs for recycling are integrated. This represents the costs of finding a firm to pick up the waste, buying dedicated bins and installing
					Average rate of recycling is around 60% Best recycling rate is Denmark and Belgium at around 80%.				Assuming all packaging waste is potentially avoidable or recyclable. Ecodesign -10% Waste prevention -20% Material reuse -30% Recycling -40% Total -100%
Waste exchange (e.g. industrial			0%	100%	0%	-20%		3000	This represents the costs of finding a firm to pick

Measures	Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
symbiosis) – food [c]							1000		up (and possible pay for) the waste, buying dedicated bins and installing
			Waste becomes a revenue. Only for waste.						
Avoiding landfill (e.g. sending to composting, anaerobic digestion) – food					0%	-20%	500	2 000	Assuming all packaging waste is potentially avoidable or recyclable. Waste prevention (best practice) -10% Waste prevention (technology) -30% Exchange -20% Avoid landfill -20% Waste recovery -20% Total -100% Waste management costs for sending to AD are integrated. This represents the costs of finding a firm to pick up the waste, buying dedicated bins and installing
Waste recovery technology (e.g. biogas, composting) - food			-30%	-60%	-10%	-20%	500 000	3000 000	
									Farm-fed systems *•Scale is typically 100 kW to 1 MW* *•Capital cost is typically £500k to £2.5 million (k€620 - €3 million)* *•Annual income is typically £120k to £1.2 million (k€150 - €1.5 million)* *Waste-fed systems* *•Scale is typically 1 MW to 2.5 MW* *•Capital cost is typically £5 - 10 million (€6.2 – 12.4 million)* *•Annual income is typically £2 - 4 million (€2.5 – 5 million)*
Water recovery	-10%	-30%			-10%	-30%	10 000	500 000	*4.1.7.6 Segregation* of outputs, to optimise use, re-use, recovery, recycling and disposal (and minimise water use and waste water contamination) *Water recycling and re-use have reportedly reduced water consumption by 19%, i.e. 165000 m3/yr.* (BREF (2006) FDM)
							The commercial value of the		4.2.7 Slaughterhouse waste treatment

Measures	Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
							biomass produced was estimated at GBP 50 per tonne. With equipment costs of GBP 350000 (1996 prices), the net cost savings of over GBP 130000 per year led to a payback time of 2.7 years.		4.2.7.1 Microbiological treatment of slaughterhouse waste
Water prevention - best practice	-5%	-15%			-5%	-15%	500	5 000	4.1.4 Dedicated metering of water consumption *At one site, a comparison of actual water consumption with recommended values led to a reduction in consumption of 13 %. Consequently, the volume of waste water, which would have had to be treated was also reduced.* 4.1.7 Removal of running water hoses and the repair of dripping taps and toilets *If a slaughterhouse has 50 water supply positions, including wash hand basins etc., with dripping taps and 10 toilets with running water, the extra water consumption can easily amount to 5000 - 6000 m3 annually. This is equivalent to DKK 75000 - 90000 (2001) running straight into the sewer.* *4.1.8 Use of pressure cleaning throughout the installation* *A 75 % reduction in water consumption can be achieved. Consequently, the volume of waste water to be treated is also reduced.* . *The direct economic benefit depends on the price of the water. An investment of EUR 50 - 250 per nozzle is necessary. If the existing pumps and water pipes are not fit for the desired pressure, then their replacement will increase the investment costs.* (BREF (2005) Slaughterhouses)

Measures	Maximum potential for **resource savings** (% of amount used)		Maximum potential for increase in **revenue** (% of revenue)		Maximum potential for **minimising** waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
							In the case study installation, in 1999 the flow-meters cost GBP 200 - 300 each. Modifying the pipework and installing 20 meters cost a total of GBP 30000. This led to a reduction of around GBP 23000/yr in the company's water and effluent bill.		Burton's food" (UK), which carried out a water investigation in 2008, through a detailed sub-metering of water usage, and resulted in the identification of possible savings of 73,000 cubic meters of water, and the reduction of 42% in water used per tonne of product. (Source: Food and Drink Federation - UK, Our Five Fold Environmental Ambition - Progress report 2009):
Water prevention - technology	-15%	-35%			-15%	-35%	50 000	500 000	4.1.8.7 Use of control devices *At the chicken processing installation, the introduction of flow regulators cost less than GBP 1000 and resulted in water savings worth over GBP 10000/yr.* *At the fish processing installation, the 40 % reduction in water use saved GBP 2500/yr and gave a payback period of 5 weeks.* 4.1.8.8 Use of water nozzles *In white fish filleting, water consumption can be reduced by up to 90 % by installing nozzles and sprinkling the water in one or two seconds out of every three. In the sorting of herring and mackerel, a 50 – 65 % reduction in water consumption can be achieved by regulating the nozzle sizes so that they only supply the necessary amount of water.* (BREF (2006) FDM)
	The SME Brewery sector				R&R ice cream in the UK				In industry the introduction of technical measures

Measures	Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
	%	%	%	%	%	%	€ per company	€ per company	
	has equally shown involvement in technology investment. An example of that is Brewery Liefmans in Belgium which installed a cooling tower to cool and recuperate water, thus saving water rather than draining it to the purification installation after cooling. This investment resulted into 20% savings of water consumption (CIAA, ibid.)				has invested in water efficiency by installing an effluent plant which uses ultra filtration and reverse osmosis technologies, thus reducing discharges to 50% and allowing costs savings of around £100,000. In addition, recycled water used of washing and cleaning processes will substantially reduce water consumption, thus saving the company another £19,000. (Source: Food and Drink Federation - UK, Our Five Fold Environmental Ambition - Progress report 2009)				such as changes in processes leading to reduced water demand, higher recycling rates and the use of rainwater could lead to savings of 15 – 90% with a global estimate of 43% of current water abstraction (BIO (2009) Water Standards)

Table Notes:

[A] Material re-use in the food and beverage sector is focused primarily on direct re-use of items such as re-usable transit and process packaging. No evidence of direct re-use of food grade materials although much can be prevented and/or recycled through other measures. By-products and usable resources produced as part of the food manufacturing process (e.g. coffee grounds) can be used as substitute fuels.

[B] Process optimisation measures are those categorised as simple changes that can be made by businesses (e.g. preventing waste, automatic controls) and costs exclude the R&D and manpower costs required to understand where and how the process needs optimising. Therefore real-world business costs may be substantially higher than the direct cost estimate here.

[C] Waste exchanges will not be applicable for all businesses in the food manufacturing sector and the level of uptake will vary depending on the type of waste and sector.

Beverage Industry Environmental Roundtable (2011) Water Use Benchmarking in the Beverage Industry. Trends and Observations 2011.

http://bieroundtable.com/files/BIER%20Benchmarking%20Publication%202012.pdf

Product group	Change in water use ratio
Carbonated soft drink	-7%
Bottled water	< 1%
Beer	-10%
Winery	+31%

Example measures in the fabricated metals manufacturing sector selected from the research

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
Ecodesign - lightweighting (using same material)	Product	-5%	-10%	0%	10%	0%	-5%	5000	50 000	
		Aubineau Constructeur, re-design of a refrigerated truck. 16% reduction of material weight. (REMake)		*Reduced transport costs and increased revenue (improved product)*		*Less waste is generated when less material is used*				Eco-products Directory:Beer cans: This design reduces aluminum consumption by about 9% compared with the conventional model
Ecodesign - lightweighting (change of material)	Product	0%	-5%	0%	2%			5 000	50 000	
		By using ecodesign a high performance tool manufacturer could achieve 20% reduction in mass and a 50% reduction in materials and chemicals use.								
Ecodesign - use of recycled content	Product			0%	-5%			5 000	25 000	
				Reduced material costs as recycled material is often cheaper than virgin material[140]						

[140] http://www.letsrecycle.com/prices

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
Waste prevention (new technology)	Product	-5%	-10%			-10%	-20%	75 000	100 000	
Waste prevention - packaging (best practice)	Packaging	0%	-5%			-5%	-20%	1 000	10 000	
Waste prevention - product (best practice)	Product	-1%	-5%			-5%	-10%	1 000	10 000	
Material reuse (incl. remanufacturing)	Product	-10%	-40%			-20%	-30%	10 000	1 000 000	
Material reuse (packaging)	Packaging	-5%	-20%			-20%	-30%	5 000	25 000	
Recycling	Product					-5%	-10%	500	2 000	Waste management costs for recycling are integrated. This represents the costs of finding a firm to pick up the waste, buying dedicated bins and installing
Waste exchange (e.g. industrial symbiosis)	Waste			0%	100%	0%	-10%	1 000	3 000	This represents the costs of finding a firm to pick up (and possible pay for) the waste, buying dedicated bins and installing
Procurement	Product	-1%	-5%			0%	-10%	1 000	10 000	
		By optimising purchasing in terms of fitting steel lengths and by introducing quality criteria of incoming goods as much as 9% of steel could be saved. (REMake)								

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
Water recovery	Process	-10%	-50%			-10%	-50%	10 000	500 000	
						By installing a sludge-dryer system an organic coating company in Spain could half the amount of water in their sludge and reuse what was recovered. (REMake)				
Water prevention (best practice)	Training	-5%	-15%			-5%	-15%	500	5 000	4.1.4 Process line optimisation Optimised line: 2951 m3 water usage per year, a saving of 74% Water consumption in one case has been reduced over seven years by 83 %, from 263636 m3 to 31818 m3 per year by installing about 70 water meters (usually 20 – 30 mm). 4.4.5.3 Rinsing stages using recycled water Reduction of water consumption up to 40 %.

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		Comments and additional information
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
Water prevention (new technology)	Technology	-15%	-35%			-15%	-35%	50 000	1 000 000	In industry the introduction of technical measures such as changes in processes leading to reduced water demand, higher recycling rates and the use of rainwater could lead to savings of 15 – 90% with a global estimate of 43% of current water abstraction (BIO (2009) Water Standards)

According to REMake: average material savings in the manufacturing processes reached 6.7%. Up to 9% of input (for investments with payback less than a year). Best available technologies reaching up to 20% of total abiotic resource consumption.

Example measures in hotels and restaurants selected from the research

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
Choice of smaller portion	Food	-6%	-10%	0%	0%	0%	-20%	-	1 000	
						One pub-restaurant in Tipperary, Ireland, reduced the amount of food waste generated by over one-third through reducing portion sizes (Irish EPA, 2008) (BREF Tourism)				
Seasonal food	Food			0%	-10%			-	10 000	Costs to cover training
					Decrease in costs					
Procurement	Food, products and packaging	-5%	-10%	0%	0%	-10%	-20%	1 000	10 000	
						Pre-prepared food, e.g. peeled potatoes, chopped onions, etc. bulk packaging				
Waste prevention (new technology)	Cleaning, cooking, washing	-1%	-9%			-10%	-20%	5 000	50 000	
Waste prevention (best practices)	Cleaning, cooking, washing	-1%	-5%			-5%	-10%	1 000	5000	
		Efficient cleaning: application of best practice techniques can reduce chemical consumption by at least 50 %				Accommodation premises savings Figure 6.4 demonstrates the magnitude of waste avoidance achieved by				implementation of waste prevention measures could easily lead to a reduction in waste-incurred environmental impact

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
		(BREF tourism).				a single average performing 189-room hotel. A 30 % reduction in total (sorted plus unsorted) waste generated per guest-night over a period of five years translated into a reduction of 35.7 tonnes per year of waste sent for disposal. (BREF Tourism)				of 30 % to 50 % for average hotels and other accommodation. The Scandic Hotel group found that only 15 % of individual soaps and shampoos provided to guests were used. Following the installation of soap and shampoo dispensers and associated bulk buying, (Scandic Hotels reduced waste volume by 40 %, (BREF Tourism)
Material reuse	Products and packaging	-10%	-20%			-20%	-30%	5 000	25 000	
Recycling	Products and packaging					-10%	-20%	500	2000	Waste management costs for recycling are integrated. This represents the costs of finding a firm to pick up the waste, buying dedicated bins and installing
						Hilton Slussen in Stockholm sorts waste into 26 different bins. Introduction of a sorting and recycling scheme in 1997 reduced the 125 tonnes per month sent to				

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
						landfill by 76% (BREF Tourism)				
Waste exchange (e.g. industrial symbiosis)	Food			0%	100%	0%	-10%	1 000	3 000	This represents the costs of finding a firm to pick up (and possible pay for)the waste, buying dedicated bins and installing
				Waste becomes a revenue. Only for waste.						
Avoiding landfill (e.g. sending to composting, anaerobic digestion)	Food					0%	-20%	500	2 000	Waste management costs for sending to AD are integrated. This represents the costs of finding a firm to pick up the waste, buying dedicated bins and installing
Onsite waste recovery technology (e.g. composting)	Food					-10%	-20%	5 000	25 000	
				In the case of The Savoy, organic waste is sent to a combined heat and power plant (fluidised bubbling bed reactor) to generate heat and electricity (see Figure 8.12). The electricity generated from the hotel's waste is sufficient to supply 10 % of the hotel's rooms.						Table 8.9: Calculation of annual savings and payback period for installation of an automated composting unit: €22000,payback 9 years

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
Water recovery	Process	-10%	-30%			-10%	-30%	1 000	50 000	
		A rainwater recycling system installed in the 250-room ETAP city-centre hotel in Birmingham, UK, saves up to 780 m3 of potable water per year (5 % to 10 % of consumption). This saving equates to about 6 % of best practice water consumption for this size of hotel (after implementation of all other water efficiency measures). NH Campo de Gibraltar hotel substitutes 20 % potable water with filtered and treated greywater from showers, used to flush toilets.				Reusing rinse water in washer-extractor machines can reduce water consumption by between 30 % and 40 %, heating energy consumption by up to 45 %, and detergent consumption by up to 30 % (EC, 2007; Smith et al., 2009).				EC (2009) estimate that water recycling can reduce water consumption by an additional 10 %, after a 40 % reduction in water consumption achievable from implementation of water efficiency measures.
Water prevention (best practice)	Training	-5%	-15%			-5%	-15%	500	5 000	
						Scandic Hotel with EMAS reduced -25% of water between 1996 and 2010. (BREF Tourism)				Water inefficient hotels can typically reduce water consumption by over 50 % A survey of eight hotels in Bulgaria

		Maximum potential for resource savings (% of amount used)		Maximum potential for increase in revenue (% of revenue)		Maximum potential for minimising waste (% of waste)		Cost of measure		
		Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	
		%	%	%	%	%	%	€ per company	€ per company	
										found that leakage accounted for between 32 % and 68 % of water consumption (EC, 2009) (BREF Tourism)
Water prevention (new technology)	Technology	-15%	-35%			-15%	-35%	5 000	50 000	The tourism sector could reduce its consumption by a max of 80 – 90%. (BIO (2009) Water Standards)
						Selection of an efficient and appropriately sized dishwasher can reduce water and energy consumption for dish washing by over 50 %,				In terms of total water savings in guest areas, installing low-flow showers throughout all guest rooms can achieve the greatest total savings, reducing typical guest water consumption by almost 10 % (Figure 5.3). This is followed by replacing bathroom taps (reduces total water consumption by approximately 5 %) and toilets (reduces total water consumption by approximately 3.5 %).

Resource prices

	Basic (raw) material			Processed material			Final material			Recycled material		
	Low estimate	High estimate	Average	Low estimate	High estimate	Average	Low estimate	High estimate	Average	Low estimate	High estimate	Average
Resource	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne
Iron and steel				955	1078	1019	1631	2184	1974	0	211	106
Aluminium				2468	2890	2669	3229	3591	3413	505	1021	763
Copper				3050	4761	3659	5223	6849	6099	3147	5023	4186
Other non-ferrous metals				3893	4747	4385	8559	9357	8898	2189	4498	3657
Glass				1383	1567	1450	2594	3104	2833	8	32	20
Plastic						300			400	73	282	178
Chemicals (and other hazardous substances)						1500			2000	30	120	60
Paper and board				860	937	895	1401	1526	1470	0	141	70
Wood				340	391	370	1348	1603	1477	8	42	25
Food	225	1216	876	248	1338	964	272	1472	1060	0	60	30
	Avoided food costs (SRA,2010) This is equivalent to EUR 530 per tonne waste avoided. (BREF Tourism)		WRAP Hospitality: avoided cost of purchasing food (£1,708 a tonne);								Used kitchen oil generates a small income when collected for biodiesel production. Clients of the 'Oilsense' system described above receive a payment of EUR 0.30 per litre, (BREF Tourism)	
Other biomass			500			750			100	0	60	30
Other waste			500			750			100			10
Water	1.64	2.17	1.77									
	water supply and disposal price of EUR 2.50 per m3 water price of EUR 2.73/m3 (BREF Tourism)											

Waste treatment

	Recycling			Landfill			Composting			Energy recovery		
	Low estimate	High estimate	Average	Low estimate	High estimate	Average	Low estimate	High estimate	Average	Low estimate	High estimate	Average
Resource	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne	€ per tonne
Iron and steel				0	211	**106**						
Aluminium				505	1021	**763**						
Copper				3147	5023	**4186**						
Other non-ferrous metals				2189	4498	**3657**						
Glass				8	32	**20**						
Plastic				73	282	**178**						
Chemicals (and other hazardous substances)				30	120	**60**						
Paper and board				0	141	**70**						
Wood				8	42	**25**						
Food				0	60	**30**						
				Most European countries impose a landfill levy that is increasing every year. In Ireland, the landfill levy was EUR 50 per tonne in 2011, rising to EUR 75 per tonne in 2012. In the UK, the landfill tax was EUR 65 per tonne in 2011, rising to EUR 100 per tonne in 2014, and these incurred charges are further subject to Value Added Tax. Collection and transport fees are charged in addition to such levies, so that total cost of waste disposal to landfill is typically in the region of EUR 100 to EUR 150 per tonne (BREF Tourism)						Sending organic waste for anaerobic digestion is comparable in price to sending it for landfill or incineration (SRA, 2010), but it will become cheaper as landfill charges increase. For the Swiss plant mentioned above, a gate fee of approximately EUR 70 per tonne plus transport costs of between 15 and 45 EUR per tonne are paid by the waste generators, including hotels and restaurants. This is lower than Swiss incineration costs of 110 to 150 EUR per tonne. WRAP Hospitality: If diverted from landfill to AD, savings (£11 cheaper per tonnes) avoided cost of haulage (£15 a tonne		

				WRAP Hospitality: diverting food waste to AD could result in the following cost savings: an additional haulage cost of £10 a tonne + avoided cost of landfill disposal of £21 a tonne						for waste going to landfill or £25 for waste going to AD); avoided cost of disposal (£78 a tonne for waste going to landfill or £57 a tonne for waste going to AD); Used kitchen oil generates a small income when collected for biodiesel production. Clients of the 'Oilsense' system described above receive a payment of EUR 0.30 per litre, (BREF Tourism)		
Other biomass				0	60	**30**						
Other waste						**100**						
Wastewater												**1.43**
										equating to EUR 0.68 per m3. Fees charged to users of the sewage network are EUR 1.16 per m3, one of the lowest in Germany (typical range EUR 1 to 3 per m3 (BREF Tourism)		

Annex E: Pricing estimates

Resource and waste management cost estimates

The estimates for cost of purchasing resources and waste management costs were derived from a variety of sources.

Table 34: Average price of some commodities[141]

Average €/tonne	May 2012
Cold rolled steel	703
Aluminium 99.5%	1565
Copper, grade A	6172
Zinc	1507
Nickel	13261
Wood pulp	630
Wood	287
Wheat	207
Maize	210
Barley	185
Rice	479
Sugar	462
Sunflower oil	1126
Bananas	747
Oranges	591
Beef	3212
Poultry	1628
Pork	1364
Salmon	3900

[141] http://www.indexmundi.com/commodities/

Table 35: Average price of recycled material in the EU[142]

Average €/tonne	2007	2008	2009	2010	2011
Glass	42.8	48.3	48.0	47.9	45.7
Paper	118.6	121.1	87.0	142.4	163.3
Plastic	364.9	341.7	254.6	298.0	325.0

The cost estimates for waste management includes the transport and haulage costs.

[142] http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/waste_related_topics/material_prices_recyclates

Table 3: Average resource cost estimates (€ per tonne) depending on production stage

€ per tonne	Basic (raw) material			Processed material			Final material/product			Recycled material		
Resource	Low estimate	High estimate	Best estimate	Low estimate	High estimate	Best estimate	Low estimate	High estimate	Best estimate	Low estimate	High estimate	Best estimate
Iron and steel	584	713	**647**	955	1078	**1019**	1631	2184	**1974**	100	500	**500**
Aluminium	281	1500	**1500**	2468	2890	**2669**	3229	3591	**3413**	505	1021	**763**
Copper	2818	4497	**2000**	3050	4761	**3659**	5223	6849	**6099**	3147	5023	**4186**
Other non-ferrous metals	1959	4026	**3273**	3893	4747	**4385**	8559	9357	**8898**	2189	4498	**3657**
Construction minerals (cement, masonry, etc.)	10	12	**11**									**100**
Aggregates	7	8	**7**									**50**
Asphalt												**50**
Glass	353	385	**368**	1383	1567	**1450**	2594	3104	**2833**	8	32	**20**
Plastic			**200**			**300**			**400**	73	282	**178**
Chemicals (and other hazardous substances)			**1000**			**1500**			**2000**			
Paper and board	540	652	**591**	860	937	**895**	1401	1526	**1470**	0	141	**70**
Wood	132	231	**190**	340	391	**370**	1348	1603	**1477**	8	42	**25**
Food	225	1216	**400**	248	2120[143]	**1500**	272	2120[143]	**2000**	0	60	**30**
Other biomass			**500**			**750**			**100**	0	60	**30**
Other waste			**500**			**750**			**100**			**10**
€ per m3												
Water	1.64	2.17	**1.77**									

Table 4: Average waste management cost estimates (€ per tonne)

[143] WRAP (2011) The Composition of Waste Disposed of by the UK Hospitality Industry. Cost savings were estimated based on £1708 (€2120) per tonne of purchased food.

€ per tonne	Landfill[144]			Composting			Energy recovery			Water treatment		
Waste stream	**Low estimate**	**High estimate**	**Average**	**Low estimate**	**High estimate**	**Average**	**Low estimate**	**High estimate**	**Average**	**Low estimate**	**High estimate**	**Average**
Iron and steel	20	100	**60**									
Aluminium	20	100	**60**									
Copper	20	100	**60**									
Other non-ferrous metals	20	100	**60**									
Construction minerals (cement, masonry, etc.)			**60**									
Aggregates			**60**									
Asphalt			**60**									
Glass	20	100	**60**									
Plastic	20	100	**60**						**40**			
Chemicals (and other hazardous substances)	20	248	**150**						**40**			
Paper and board	20	141	**60**			**40**			**40**			
Wood	20	100	**60**			**40**			**40**			
Food	20	100	**60**			**40**			**40**			
Other biomass	20	100	**60**			**40**			**40**			
Other waste			**100**						**40**			
€ per m3												
Water										**1.00**	**3.00**	**1.43**

[144] ETC/SCP (2012) Overview of landfill taxes in Europe. *"The majority of countries have a tax level for the most common waste types of EUR 30 per ton or higher, however many countries are already increasing their tax level so that it is already or will soon be between EUR 50 and EUR 70 per ton of waste."*