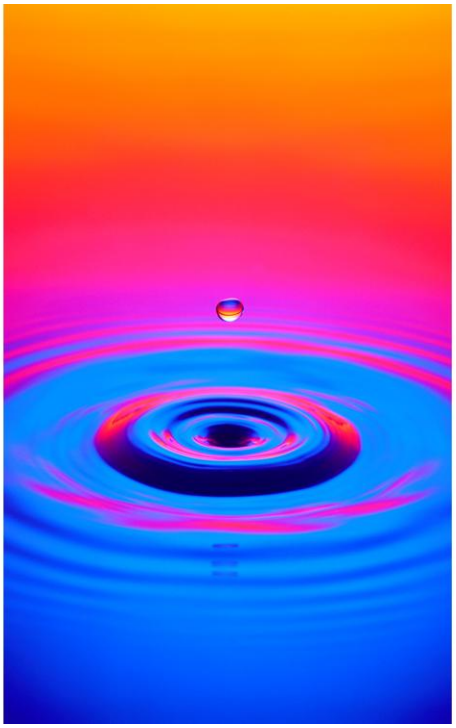
European Commission

Final Report

The opportunities to business of improving resource efficiency

Contract Ref. 070307/2011/610181/ETU/F.1




AMEC Environment & Infrastructure and Bio Intelligence Service

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Third-Party Disclaimer

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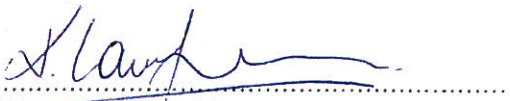

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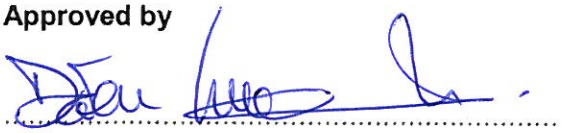

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AMEC Environment & Infrastructure
UK Limited & Bio Intelligence Service S.A.S

February 2013

Certificate No. FS 13881 Certificate No. EMS 69090

Executive Summary

This study forms part of the Commission's on-going analysis of the opportunities to be gained from improving resource efficiency and how best to help businesses realise the potential economic, as well as environmental and social benefit. The study has examined the main resource efficiency measures available to EU business using a top-down review of literature on resource efficiency[1] together with a bottom-up review of industry data and examples from case studies. Preliminary conclusions on measures were validated through limited industry consultation with EU-based businesses. The scope for businesses to improve resource efficiency has been assessed and the opportunity to business quantified through a business lens[2] as new estimates of direct economic benefits. This research provides a new economic perspective to complement other published studies, a better insight into the impact on businesses of policies and programmes on resource efficiency, and an understanding of the relative effectiveness of resource efficiency measures and of the measures which might best suit particular businesses or sectors of the economy. The study also highlights remaining gaps in knowledge and understanding so as to inform future efforts.

Economic opportunity to business from resource efficiency

This study identifies considerable economic opportunities for businesses in three example sectors (Food and Drink manufacturing, Fabricated Metal Products and Hospitality and Food Services) from implementing resource efficiency measures[3]. The **potential gross benefits**[4] from improving resource efficiency (based on the average benefit achieved by individual companies) are similar for all three example sectors, between 10% and 17% of turnover, with the value of economic benefits to each company from realising the opportunities from resource efficiency in the range €27,500 - €424,000 per annum, reflecting in part the different size of companies in these sectors. These estimates are based on businesses implementing all identified resource efficiency measures, which in effect would mean optimum efficiency in resource terms for all businesses across the EU-27. The gross benefits presented below exclude the corresponding investment costs.

STUDY SECTORS	Annual Benefit (EU-27) € billions	Average Annual Benefit (per company) € 000's / % avg. turnover
Food & Drink Manufacturing	64 – 118	424 (11%)
Fabricated Metal Products	44 – 82	164 (17%)
Hospitality and Food Services	18 – 43	27.5 (10%)

[1] Published sources up to and including October 2012 but with only limited coverage of the most recent material published between May and October 2012.

[2] The study perspective means only benefits that would be tangible to businesses implementing resource efficiency measures have been quantified (i.e. direct benefits). Wider environmental, social and other external benefits have been excluded from the economic calculations.

[3] The study boundary was countries within the EU-27 as the primary focus whilst ensuring best practices for non-EU countries were not ignored. The study focused only on measures that reduce waste generation, reduce water consumption and decrease material use for any given output. Energy saving measures are very important in resource efficiency terms but have been well studied to date; therefore energy was excluded from the scope of this study and results.

[4] Gross benefits have been presented here first as they provide a measure of the opportunity at a sectoral level. Net annual benefits (taking into account investment costs) to each company will be subject to factors such as access and terms of financing and so introduces a source of variance unrelated to the opportunity per se.

Scaling these estimates to all EU-27 businesses within the industrial sectors provides a 'theoretically possible' headline figure for the total gross benefits available to businesses from improving resource efficiency. These estimates are based on three scenarios illustrating firstly the total opportunity assuming businesses are all starting from a highly inefficient baseline; a second slightly lower level of opportunity (with a correspondingly higher level of potential uptake of measures) which is based on assuming only 9% of EU businesses have already optimised their resource efficiency; and a lowest level of potential uptake which assumes 55% of businesses have already optimised their resource efficiency. The evidence and data on exactly where the resource efficiency baseline lies for all EU-27 businesses in the industrial sectors is at present insufficient to provide more a precise estimate. The conclusion from this study is that the opportunity to businesses, across these three scenarios, lies in the range €466 billion to €914 billion.

GROSS BENEFITS - ALL INDUSTRY SECTORS[1]	**Annual Value**[2] **(millions EUR)**	**As % of turnover**		
		Average	Minimum[3]	Maximum[3]
TOTAL: Resource efficiency savings potential for European firms in industrial sectors **100% uptake** (average measure effects, average measure costs)				
Benefits	€ 995,826	14%	10%	17%
HIGH: Resource efficiency savings potential for European firms in industrial sectors **91% uptake** (average measure effects, average measure costs)				
Benefits	€ 914,023	12%	9%	16%
LOW: Resource efficiency savings potential for European firms in industrial sectors **45% uptake** (average measure effects, average measure costs)				
Benefits	€ 466,852	6%	4%	8%

Notes
(1) Figures exclude investment costs required to realise these benefits
(2) EU turnover € 7,329,008 (million) for industrial sectors assessed
(3) Minimum and maximum reflect differences between sector estimates which includes averaging in the calculations

Businesses will be concerned to understand the level of investment required to realise these economic opportunities and the range of time over which such investment may be allocated. Whilst it is acknowledged that actual net benefits will reflect the different nature and financing terms of the investment costs for individual firms, the gross benefits at an EU-27 level can be used to provide estimates of the **net benefits** for businesses using a broad assumption[5]. These estimates of net benefits are in the range €245 billion to €604 billion across the three uptake scenarios, representing an average of between 3% and 8% of annual turnover for all businesses within the industrial sectors as shown in the table below.

NET BENEFITS - ALL INDUSTRY SECTORS[1]	**Annual Value**[2] **(millions EUR)**	**As % of turnover**		
		Average	Minimum[3]	Maximum[3]
TOTAL: Resource efficiency savings potential for European firms in industrial sectors **100% uptake** (average measure effects, average measure costs)				
Benefits net of costs of measures	€ 604,290	8%	7%	11%
HIGH: Resource efficiency savings potential for European firms in industrial sectors **91% uptake** (average measure effects, average measure costs)				
Benefits net of costs of measures	€ 543,819	7%	6%	9%
LOW: Resource efficiency savings potential for European firms in industrial sectors **45% uptake** (average measure effects, average measure costs)				
Benefits net of costs of measures	€ 245,257	3%	2%	4%

Notes

[5] Costs required are based on broad bands and assumed to provide 10 years of benefit. Future costs are discounted at 10% (all in real terms).

(1) Figures include the investment costs discounted over 10 years
(2) EU turnover € 7,329,008 (million) for industrial sectors assessed
(3) Minimum and maximum reflect differences between sector estimates which includes averaging in the calculations

Benefits from improving resource efficiency will reoccur annually and give rise to a long term stream of benefits. However, investment costs will be incurred less often, sometimes only once, at the beginning of the periods, as is assumed here .

In addition to the timing of costs and benefits, the following are important when considering the estimates made in this report:

1. Estimates are highly influenced by the assumptions made on resource prices, material flows in the economy, the net effect of the measures and where businesses are starting from in respect of resource efficiency (recognising many have and are taking a number of measures already) – this report provides estimates within ranges to reflect these uncertainties;

2. Essential processes of averaging remove nuances in terms of the level of variation within and between sectors in terms of their potential opportunity; and

3. The quantification of the opportunity is based on implementation of all measures available to businesses to improve resource efficiency. However it is recognised that, given the constraints and limitations discussed in this report, businesses are highly unlikely to adopt all measures even if an economically robust business case could be developed. Instead they are likely to cherry pick those measures they believe to serve them best; the impact being an attenuation of the overall economic opportunity as some potential benefits remain unrealised.

Is also important to note that resource efficiency measures should always be considered in relation to the functionality of the products or the service provided, on a case-by-case basis. A reduction in material consumption might affect functionality, life span or the quality of products or services, and as a whole lead to more material being used. In this study, the potential benefits of resource efficiency measures have been calculated including only those measures that do not result in any significant trade-offs to other aspects of the life cycle of products or services.

Addressing the challenges facing business in improving resource efficiency

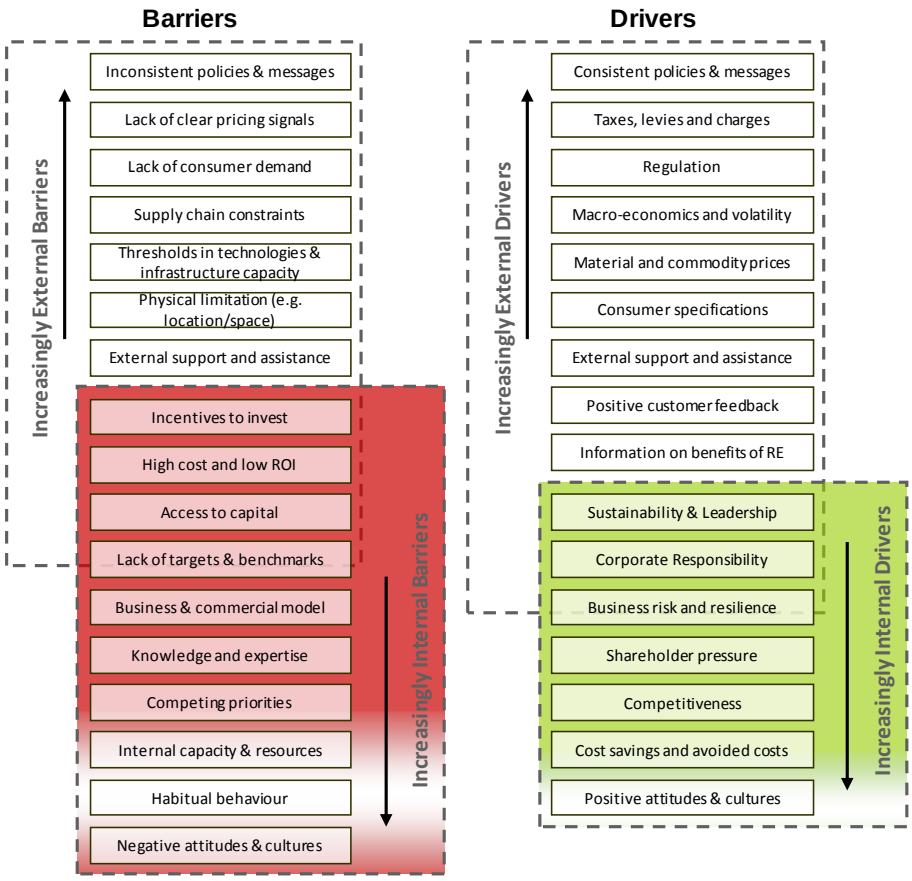
There is greater action on resource efficiency than ever before at the business level and the economic conditions within Europe[6] are applying pressure on companies to seek savings in production and material supply costs. Inefficiencies are being squeezed from commercial supply chains and businesses are undertaking internal examinations of production process efficiencies to capitalise on the 'quick wins' by reducing cost through reduced wastage and material usage.

However, the estimates for economic opportunity to businesses generated by this study could be interpreted as a being paradoxical – how is it that more action is being taken and yet such large financial opportunities exist? Why is it that businesses have somehow failed to capitalise on them? Even for the estimates of benefits net of costs, such estimates exist in a partial vacuum; they do not take into consideration the attenuating effect of the practical challenges and competing priorities within businesses[7] when taking action to become more resource efficient. The review of available evidence has highlighted the main challenges (barriers) as well as key drivers to becoming more resource efficient (see Figure 1).

[6] The EU economy shrank by more than 4% between 2008-09, Eurostat 2012.
[7] In a recent survey of around 400 businesses commissioned by edie, Temple Group and Sustainable Business showed the five competing priorities for business (in order of importance) to be: turnover, energy, waste, carbon and water.

The main drivers for EU businesses to improve their resource efficiency as identified in the research for this study are the rising price of commodities and key raw materials, supply-side partnerships and collaborative initiatives, competitiveness and potential bottom-line cost savings. Acting in an opposing manner, the key barriers are (a lack of) access to funding, market demand, knowledge and capability, and ability to implement cost-effective technological solutions which avoid lock-in. Overall, there is a range of challenging investment conditions given the macro-economic environment in Europe at present underpinned by reduced consumer demand.

Figure 1. Drivers and barriers to business becoming more resource efficient (Source: AMEC 2012)

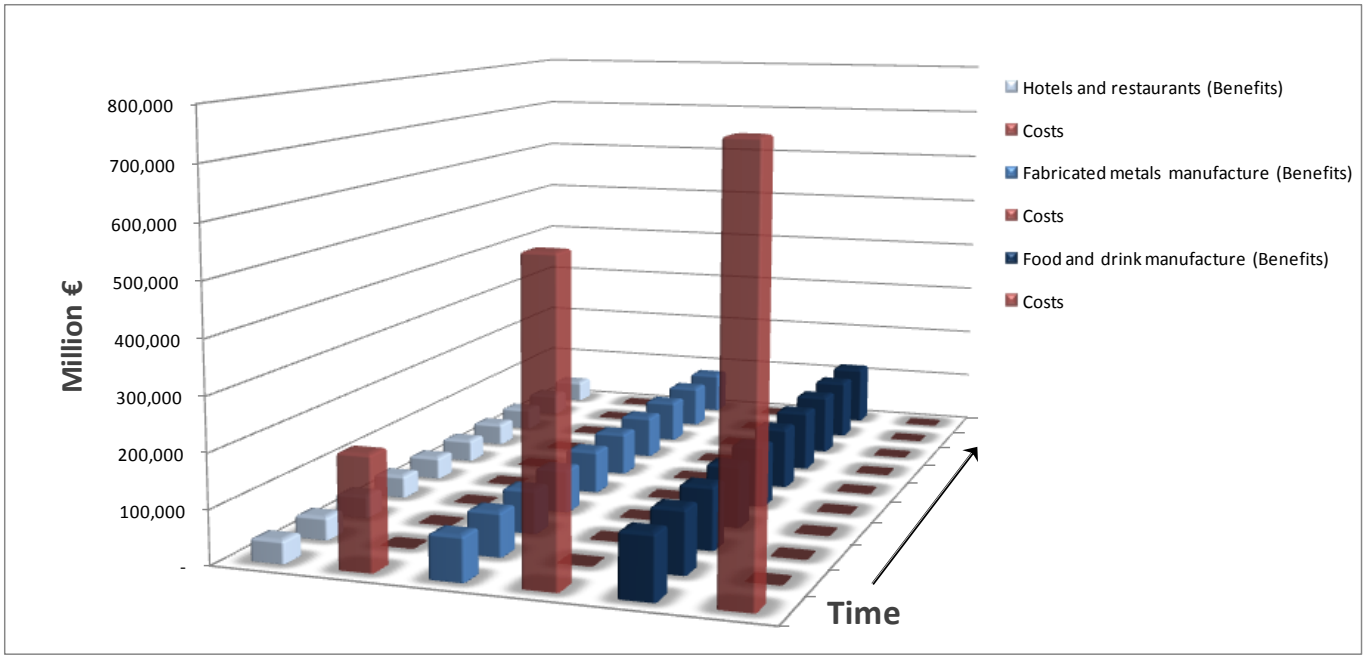


There are a number of instances where push and pull forces are exerted on business – examples include pricing signals, policies/messages and support and assistance. Such opposing forces could provide a structure on which to graft intervention opportunities to relieve the pressure and so help businesses move forward in terms of resource efficiency. Further and more complete examinations of the drivers and barriers, as well their influence in decision making for particular sectors could help policy makers to better understand where the most cost-effective investments lie.

The modelling for this study stops short of the level of sophistication necessary to quantify the effect of these and other micro-influencing factors. The research highlights such factors as having a considerable, though variable, influence on company-level decision making regarding the selection and uptake of resource efficiency measures. However, the nature of the factors, operating as they do at the firm level, necessitates quantification at the micro level – a complex piece of research even drawing together everything currently known and outside the scope of this study.

Financial barriers are key concerns of businesses. Underlying a range of commentary on investments to increase resource efficiency is the need for businesses to understand the level of investment relevant to resource efficiency measures and articulate it in terms which satisfy a potential lender. Although a business is likely to benefit over the long term, it must also justify expenditure on measures within a shorter financial horizon. To illustrate this, the graph in Figure 2 shows the allocation of costs and benefits over time for the three sectors focused on in this study. An upfront investment cost is offset by a stream of future benefits, with an overall financial gain to the company. This one-off cost in year one is one of the barriers for applying resource efficiency strategies – businesses need to finance such investment, which may in some cases be substantial compared to their turnover or free cash flows. If costs can instead be spread over a number of years, penetration of resource efficiency measures could probably be increased.

Figure 2. Resource efficiency investment costs and benefits over time for three key sectors (all measures)



The research here indicates that larger companies are responsible for a greater proportion of the overall benefit in the sector, but smaller companies gain comparatively more individually – this means smaller companies gain proportionally more from action on resource efficiency than larger organisations. However, not all opportunities are 'low hanging fruit'; many require investment and for small companies in particular, accessing finance may be difficult, resulting in an advantage, other things being equal, for larger companies. In surveys of companies, issues with a financial theme such as funding, grants, loans, investment capital and cash feature in the top three critical considerations in business decision making on resource efficiency measures. Where access to funding is constrained, for example by macro-economic conditions, it probable that action on resource efficiency will be abandoned, deferred or reduced. Furthermore, the challenging context for business includes a range of other pressures on companies costs. Those highlighted are: rising raw material prices; increased volatility; and the increasing internalisation of external costs in the supply of key resources. Additionally, competition in the market may restrict the ability of a business to pass all or part of these costs on to customers, meaning unrecoverable cost-base increases.

The research shows that a greater examination of the effect barriers have on business decisions both at the firm, activity and sectoral level would help policy makers target resource-efficiency support appropriately. Information on economic benefits from resource efficiency is patchy and occurs at different levels and although some sectors have good information, across the EU there is a relative lack of aggregated and comparable data at the sector level. Data on economic costs and benefits as well

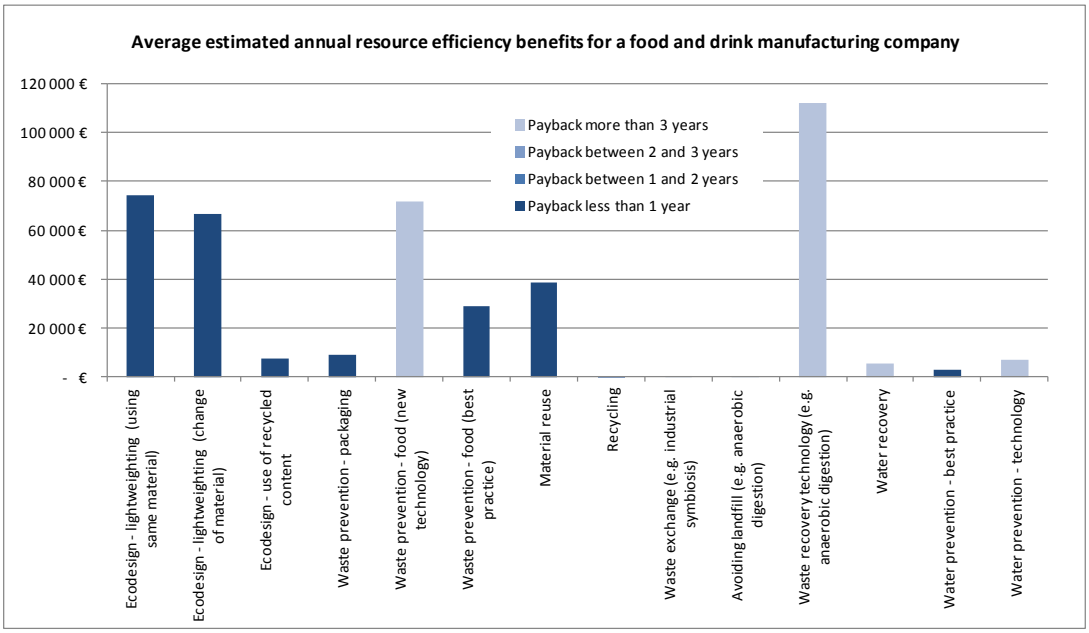
as on overcoming obvious challenges such as access to finance and technical knowhow could be significantly improved. Clear and obvious indicators would help businesses focus on collection of data on key metrics and the evidence suggests a common approach may be welcomed by businesses.

There is also anecdotal evidence from businesses that the often quoted 'economic potential' associated with increasing resource efficiency is somewhat improbable. This leads to a climate of scepticism within businesses and translates into inaction. Here the role of peer-to-peer networks, case studies and active advocacy targeted at the application, costs and benefits of specific measures for specific sectors or activities is particularly important. The assessment of policies and programmes here has shown that the European Commission, Member States and supporting organisations are already highly engaged in delivering this support. The overriding conclusion from the review of evidence is that existing instruments to improve resource efficiency are working and it will be a case of further refinement and tweaking to existing instruments rather than creating new ones. Such refinements will strengthen existing actions to help businesses firstly understand the level of opportunity, understand what measures are appropriate and how practically these might be implemented and gain confidence from others that action can genuinely deliver the purported benefits at the firm level.

Key measures by sector

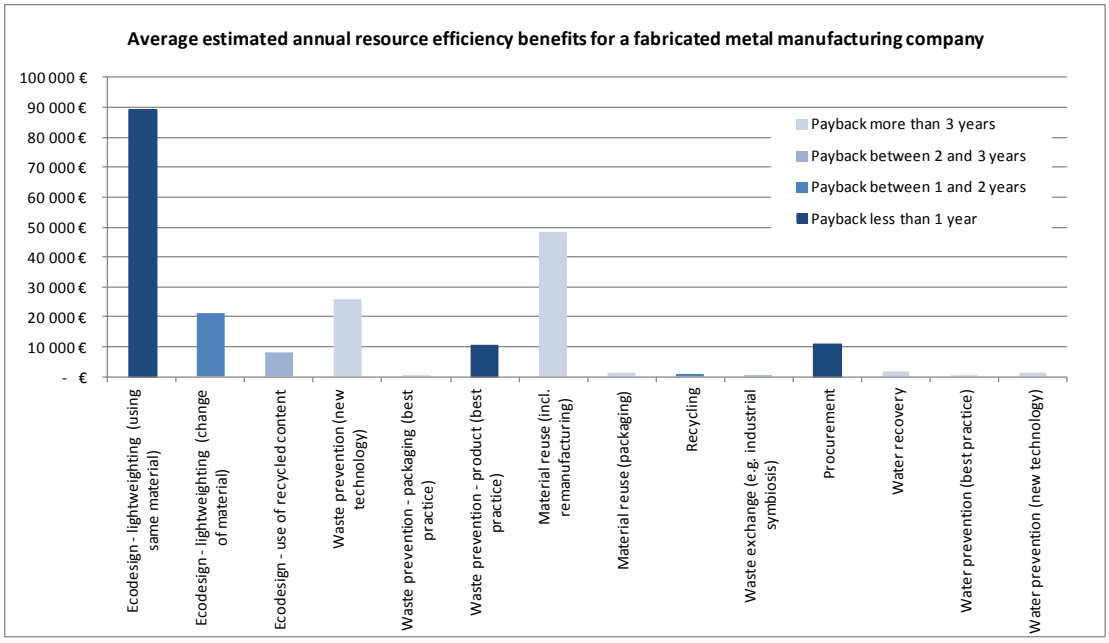
- **Food and Drink Manufacturing:** the resource efficiency opportunities in this sector result from redesign of packaging (lightweighting and choosing more resource efficient materials and designs), waste prevention of food (both installing new resource efficient technology and implementing 'soft' best practice), reuse of packaging and internal waste recovery and reuse. The packaging-related measures are relatively simple and often have a payback period of less than a year. Although presenting shortcomings for the functionality of the product (protecting the goods), measures such as lightweighting may affect the robustness of the packaging products and the reuse of packaging may be limited by specific requirements of hygiene or air tightness. The estimates here are based on what is feasible without compromising the original functionality of the packaging. The measures that involve investment in new technology for food processing and waste treatment have payback periods of two or more years. Waste prevention measures related to consumer food waste, such as portion size or sell-by-date do not fall within the scope of resource efficiency opportunities for businesses, and therefore have not been analysed;

- The food and drink sector has four measures which each represent 10% or more of the total benefit, summing to 76% of the total maximum potential benefit, with the greatest being onsite waste recovery technology;



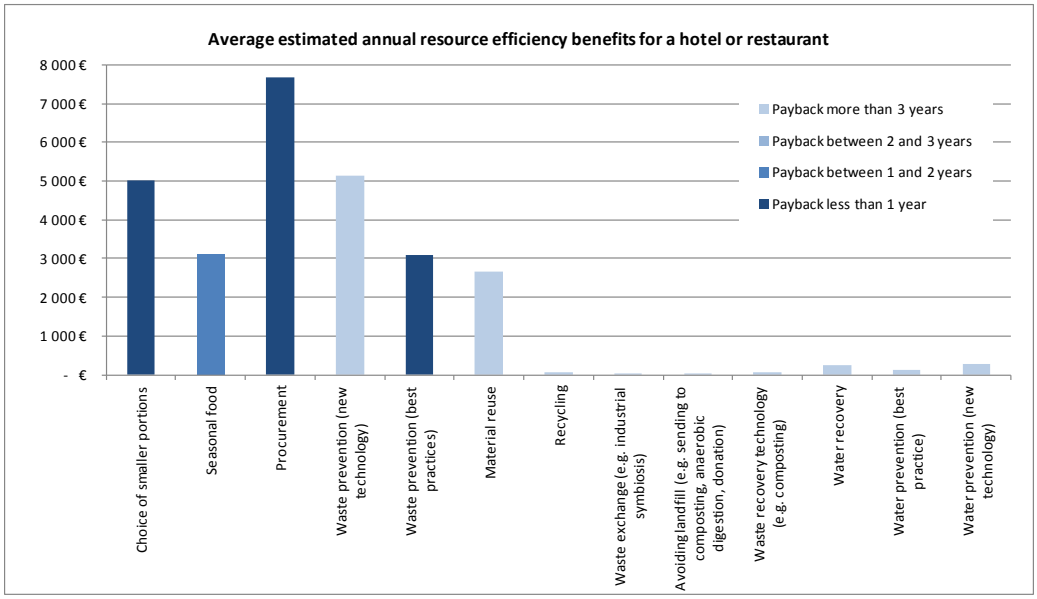
- **Fabricated Metal Products**: the main resource efficiency measures for a company manufacturing fabricated metal products are ecodesign (lightweighting), changing procurement practices, reusing materials in a closed loop system such as remanufacturing and waste prevention (using production processes that do not create waste). These measures result in a gross benefit of over €190,000 in reduced costs (15% of an average company's turnover). Ecodesign and best practices in waste prevention have payback periods of less than a year. Purchasing new production equipment and establishing a take-back or remanufacturing system requires high investments that would have a payback of three or more years and would likely need to be built into the normal business investment cycle. Recycling and scrap selling do not provide any significant additional benefits as the sector already recycles their materials quite efficiently;

- The top two measures account for over 60% of the total maximum potential benefit for the fabricated metal products sector. These are ecodesign (40%) and material reuse (22%). They reflect the main activities in the sector and use of materials. The third measure is waste prevention using new technology (12%). The potential of waste prevention depends on the specific metals and applications. Waste minimisation measures are relatively common among businesses, but some potential might be possible by optimising operating parameters such as tool wear, reduction of cuttings and rejects, or reduction of operating fluids and supplies. Material efficiency strategies related to collection and reuse of end-of-life products are considered under material reuse such as remanufacturing, but professional waste collection and treatment do not fall within the scope of resource efficiency for metal product manufacturers, and therefore have not been analysed;



- **Hospitality and Food Services (HaFS)**: an average hotel or restaurant in the EU could save just under €30,000 (annual gross benefit) if it adopted all the resource efficient measures available. This represents about 10% of a typical business' annual turnover. Most of the measures with the greatest benefits are no cost/low cost measures that could be paid back within one year, e.g. changing purchasing practices and implementing best practices for cleaning and cooking, adopting reduced and re-usable packaging and processing technologies that reduce wastage). Purchasing seasonal food can also provide significant cost savings; and

- The top three measures account for about 65% of the potential benefit - procurement (28%), waste prevention using new technology (19%) and smaller portions (18%).



Other relevant observations from the research

The environmental benefits of the material savings[8] were calculated (in terms of contribution to global warming) for the three example sectors to represent between 2-4% of total annual greenhouse gas (GHG) emissions in the EU. The main observations in respect of the three example sectors are:

- Minimising food waste provides the highest environmental impact savings potential in the Food and Drink manufacturing and HaFS sectors. The potential of measures addressing use of paper and board and plastic is also important in Food and Drink sector; and
- The Fabricated Metal Products sector has the highest environmental impact savings potential through measures which address use of iron and steel, glass, aluminium and plastics. The sector's use of wood and paper and board has significant impacts and savings in the 'land use' category of environmental impacts.

In addition to the financial and environmental benefits for companies, there are a range of other impacts from resource efficiency measures that may affect their trading environment. These include:

- Impacts on other companies upstream and downstream in the supply chain, most of which will result in overall material reductions;
- Rebalancing of the supply chain (e.g. take-back schemes, which illustrate a form of vertical integration);
- Substitution of materials by labour. Ecodesign is such an example where time spent designing is compensated by reductions in use of material;
- Attitudinal changes as promotion and adoption of resource efficiency measures at work may lead to consumers changing behaviour at home, potentially affecting markets for companies' products; and

[8] Calculated using Environmentally-weighted Material Consumption, which uses Life Cycle Inventory data to estimate the potential environmental impacts of different material flows. This crude calculation method provides only an indication of the potential environmental benefits, which will depend on the specific measures

- Development of an environment in which there is further improvement in the application of resource efficiency measures with society becoming 'more proficient in applying resource efficiency'.

Resilience of the results

The method to quantify the costs and benefits of resource efficiency is based on a number of assumptions. The two main assumptions were firstly that it is possible to quantify the impacts within an average EU company in each sector despite large variations and secondly this can be scaled up to estimate potential at an EU level. However, the approach allowed resource efficiency measures to be matched to resource consumption and waste generation at a company level and so highlighted the business context for decisions. In assessing just what these new estimates mean for business and how reliable they might be, the following important notes should be reflected upon:

- The estimates for the current amount of resource consumption at a sector level are analysed indirectly from a combination of sources and should be considered subject to potential error;
- The current consumption and waste generation levels calculated for an average EU company in this study are in reality less than an actual average EU company which has not already implemented any resource efficiency measures. This is because the economy wide consumption and waste statistics include a mixture of companies that have already implemented resource efficiency opportunities to their full potential;
- The estimates of resource efficiency potential costs and benefits are based on individual case studies, which may not be representative for an average company. Often only the most positive experiences of implementing resource efficiency measures are reported and this might overestimate the actual benefits;
- The investment costs of measures are based on the study team's best estimates taking into account the available (limited) evidence and cross-checked with industry experts. The results for net benefits are sensitive to these estimates;
- The prices for materials, water and waste management used in the valuation vary significantly across sectors and countries and averages are used. Price variation is next in importance after application of measures as a source of uncertainty in the headline estimates; and
- The uptake of measures (which in effect sets the baseline position of companies in respect to how efficient they currently are) required crude determination through the use of the Eurobarometer survey. Assumptions were made to match the estimates for uptake with the measures identified in this study and although the high and low estimates for uptake represent a wide range, the low estimate is thought to be conservative such that the potential at the EU level is not overestimated.

The main EU-27 estimates derived in this study, whilst subject to uncertainty, are not significantly divergent from comparable estimates. In its 'Resource Revolution' report, McKinsey Global Institute[9] presented large numbers regarding the potential opportunities from increased resource efficiency. It estimated that global savings could be $2.9 trillion[10] (€2.1 trillion) in 2030 if there is full capture of all the resource productivity potential and that 75% of these savings could come from just 15 key opportunities; however, the report also estimated that investments of over $1 trillion (€775 million) in the resource system will be required each year to meet the rising future resource demands. Oakdene Hollins estimated the savings opportunity to

[9] McKinsey Global Institute (2011) Resource Revolution: Meeting the world's energy, materials, food and water needs

[10] Rising to $3.7 trillion if carbon floor price was $30/t and environmentally harmful subsidies were removed.

business in the UK in the year 2009 as €63 billion[11]. In the Ellen MacArthur report on the opportunities from transition to a circular economy[12] detailed product level modelling estimates that the circular economy represents a net material cost saving opportunity of $340 to $380 billion (€246 - €295 million) per annum at EU level for a 'transition scenario' and $520 to $630 billion (€403 and €488 million) per annum for an 'advanced scenario', in both cases net of the materials used in reverse-cycle activities. The 'advanced scenario' results would equate to 19 to 23% of current total input costs or a recurrent 3 to 3.9% of 2010 EU GDP.

Information programmes that promote resource efficiency

As part of the analysis, over 100 initiatives that promote resource efficiency were identified (i.e. aimed at reducing resource consumption or best utilising resources in the production of goods or services) in 13 EU Member States and nine non-EU countries, managed by either public or private entities. These covered a number of economic sectors using different approaches, such as funding for research and development, knowledge transfer, direct consulting and auditing services, training workshops and, self-help tools and guides.

These information programmes are often based on the hypothesis that there is potential to improve business efficiency. Generally they provide support such that potential benefits can be realised. The results of these programmes are heterogeneous, but in general lead to resource (and hence cost) savings in businesses. Many of these programmes are run at regional level and the disparity of industries within Europe lead to a wide diversity of approaches in the design of the information programmes. In some cases, these information programmes are embedded within other framework programmes orientated to support businesses in a number of issues such as internationalisation, business models and management of other environmental aspects. Another approach is that of sectoral programmes targeted specifically to support SMEs on a specific issue. The diversity of examples and methods shows that there is valuable knowledge and experience in the EU industry, and multiple options can be valid for supporting resource efficiency in businesses. Resource efficiency programmes are not systematically applied throughout the EU, which leads to the conclusion that there is some scope for scaling up these types of initiatives.

Concluding remarks

Despite clear benefits, many European companies have failed to fully implement the changes needed to become more resource efficient. In general, business may be unaware of the potential, have other priorities or the financial incentive is not great enough. Although market conditions are currently challenging, this study shows that businesses seeking savings through adoption of resource efficient measures can benefit most by recognising the following key themes:

- Sectors have intrinsic characteristics. Some sectors have potential concentrated in only few areas, others need to focus on a wider mix;
- Measures need to be carefully chosen to realise financial benefits. The selection is more important than the level of investment and poorly chosen measures can have less of a positive benefit;
- The types of measures fall into two broad groups, those with a payback of a year or less, and those with a longer payback (greater than 3-5 years). There are fewer measures with an intermediate payback period;

[11] Scaled to EU-27 based on UK turnover ~€ 675 billion. Oakdene Hollins (2011). The further benefits of business resource efficiency: a research report completed for the Department of Environment, Food and Rural Affairs.

[12] Ellen MacArthur Foundation (2012) Towards the Circular Economy: Economic and business rationale for an accelerated transition.

- For business managers, attention should focus on time windows which are in the short and the longer term compared to the more typical medium term focus for decision making. For the shorter term the focus should be on embedding resource efficiency within daily and monthly management reviews. In the longer term, companies should prioritise resource efficiency considerations within their investment planning and strategy for company management;

- Many low-cost/no-cost measures provide substantial benefits and are relatively simple to implement;

- Financial benefits may be related to government policies. For example landfill taxes increase the benefits available from waste prevention at the company. Remaining informed of the policy agenda allows such savings to be prefigured and built into business plans;

- Waste within the supply chain is a particular challenge because preventing it can require investment and for businesses to introduce new processes – this means that many of the best resource efficiency opportunities cannot be realised in the low-cost/no-cost category and require a longer-term vision as well as a commitment to invest to achieve savings; and

- Engaging the supply chain as partners to meet waste prevention and resource efficiency targets (e.g. by setting targets and agreements on key resource and waste metrics), can be a catalyst for innovation throughout the supply chain.

If markets operated in a perfect world there would be no need for policy makers to intervene – there simply would be no market failures to redress; resource efficiency would be achieved automatically. The existing environment for business includes incentives for resource efficiency, such as increasing commodity prices, to which companies already respond without the need for intervention. The questions are how should policy makers such as the European Commission intervene, where is intervention most appropriate and which interventions are the most cost-effective?

This study identifies the two main types of public policy for helping business achieve resource efficiencies:

- Policies which have coherence with and cognisance of usual business processes and work within the existing structure of industrial organisation. They rely primarily on the response of companies to well-understood types of signals such as prices; and

- Policies which address areas that are not commonly tackled by companies due to lack of awareness, motivation or knowledge of benefits. Intervention of policy is needed to trigger business action in such cases.

More generally, policy makers may recognise that:

- Of the three resources of focus in the study, materials and waste are responsive to price signals, but water is relatively cheap in comparison and requires other policies for a change in company behaviour; and

- The focus on measures with paybacks of less than a year is very relevant to a business with taxable profits, as they provide a way of investing in the business, reducing tax liability (on the re-invested profits) while maintaining the same level of annual turnover. Information programs for financial advisers in contact with more than one company may benefit overall uptake of resource efficiency measures amongst EU businesses.

Overall, the study confirms the potential for resource efficiency to deliver economic benefits at the company level and environmental/social benefits for the wider community with the diversity of contexts and applications being a key overarching theme for all participants concerned with resource efficiency.

Contents

1. Introduction

Forty years since the publication of the Club of Rome's 'Limits to Growth[13]', which expressed a concern that there were likely to be limits to economic and population growth given the finite nature of the resources required to sustain such growth, resource efficiency as an environmental concept and a commercial strategy appears to be coming of age. There have been significant developments over the past decade in the field of resource efficiency, resource security and waste prevention. These include changes in policy to stimulate and drive forward more efficient design of products (ecodesign), reductions in the lifetime impact of goods and services, development of programmes and measures to prevent waste and examination of new business models that, if widely adopted, could recast the way policy makers, businesses and consumers interact, contract and transact. The Commission has led debate examining why we have seen market failures, and conducted research and evaluation on what new policies could redress these.

Amongst these fast-moving changes at the policy level, businesses within the European Union are still facing significant economic challenges as European governments wrestle with measures to rebalance their economies following one of the most severe financial shocks in recent history. Across all countries and sectors, businesses are under increasing pressure to find cost savings, do more with less and tap into new markets to maintain commercial viability and in an indirect way, social cohesion. Never before has 'being more efficient in our use of resources' as a commercial strategy and business model made more sense; indeed the concept of the 'circular economy' as the resource language of business leaders appears to be gaining traction, particularly when contextualised within business resilience and resource security strategies. Despite the obvious drivers and the wealth of literature and case studies on the benefits from being more efficient, businesses (particularly small and medium-sized companies, which make up the majority of all EU businesses) generally find themselves in a dilemma – realising benefits often requires investment and realising investment is becoming increasing challenging for many companies.

The review of evidence suggests that for business leaders and companies across the spectrum of industry activities, resource efficiency is a priority; many are already doing a lot to address it and intend to continue to do more in the future. This study into the potential opportunities to business from improving their resource efficiency aims to complement recent estimates of the monetary size of the opportunity from becoming more resource efficient by quantifying it through a business lens – i.e. on direct benefits to business from improving their resource efficiency with a focus on materials, water and waste; energy is excluded from this analysis. The study has triangulated its core assumptions from three sources: cross-sector top-down literature, bottom-up case studies and benchmarking data and direct contact with a select group of industry representatives and environmental professionals.

1.1 Context

The European Commission published its Flagship Initiative for a Resource Efficient Europe under the Europe 2020 Strategy in January 2011. It establishes the importance of using all types of natural resources (and not just energy)

[13] Meadows (et al) (1972)

efficiently for the European economy and environment. The Initiative is expected to boost productivity, improve competitiveness, drive down costs, and secure growth and jobs for Europe.

The Flagship Initiative provides a framework for policy actions for the next decade, which will guide the Commission's efforts in many different policy areas. In particular all the relevant policies and actions related to production and consumption should take resource efficiency issues into account – in effect there needs to be better horizontal integration of resource efficiency across the policy landscape.

The adoption and communication of the Commission's Roadmap to a Resource Efficient Europe[14] outlined some of the key challenges facing Europe in becoming more resource efficient, using resources and wastes more effectively and addressing the barriers with the right policies and tools. Following its publication in September 2011, there have been several high profile reports examining, from different angles, the potential and opportunities that are available from collective action on becoming more efficient economies and societies[15].

More recently, we have seen the adoption of a European Parliament resolution on a resource efficient Europe, which sets out six priority areas for action on resource efficiency[16], the launch of the European Commission's Online Resource Efficiency Platform (OREP)[17], the membership of which includes high profile EU policy makers, and consultation on 'options for resource efficiency indicators', which are intended to underpin actions to achieve the ambitions set out in the 'Roadmap'. In December 2012, the European Commission published its 'Manifesto for a resource-efficient Europe[18]. Such actions signal a commitment on resource efficiency and set out the statement of intent to help engage business, industry and society, not only to better understand the problem but also to support in creation of the right conditions for a transition to a more circular and sustainable EU economy.

This study aims to put estimates (impacts, benefits and monies) behind the opportunities available to EU businesses from resource efficiency measures, to understand what has already been done and practically what more could be done to realise the opportunities that are theoretically available. Action on resource efficiency needs to be taken by different stakeholders within society and the push for more efficient and sustainable industries and economies must rely not only on policies that inspire action, but also evidence that helps businesses build robust cases for action, which in many businesses is not self evident. The results are expected to feed into the on-going development of policies within the area of Sustainable Consumption and Production, Resource Efficiency and the 7th Environmental Action Programme. The identification of where further research might be required and/or be beneficial will also help to inform policy development.

[14] COM(2011) 571 final

[15] Amongst others, McKinsey Global Institute (2011) Resource Revolution, Ellen MacArthur Foundation (2012) Towards the Circular Economy, World Economic Forum (2012) More with Less, Ecorys (2011) Competitiveness of the European Companies and Resource Efficiency, Oakdene Hollins (2011) Further Benefits of Business Resource Efficiency and Aldergate Group (2012) Resilience in the Round.

[16] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2012-0223+0+DOC+XML+V0//EN

[17] http://ec.europa.eu/environment/resource_efficiency/re_platform/index_en.htm

[18] http://europa.eu/rapid/press-release_MEMO-12-989_en.htm

1.2 Study aims and objectives

The study **aims** were to provide the Commission with:

- Insight into the nature of, and outcomes from, a range of information policies and programmes promoting resource efficiency and what these tell us about current inefficiency in resource use in the EU;
- An understanding of what resource efficiency measures are available to businesses to help become more resource efficient and which measures might best suit particular businesses or sectors of the economy based on evidence to date;
- A better insight into the potential monetary opportunity for businesses along the entire value chain and where the key intervention points for resource efficiency measures lie based on evidence gathered at the business as well as EU level; and
- What degree of cross-transference of the identified measures/opportunities might apply and how might these transferences be realised.

The **objectives** of this study were:

- To review a range of information policies within different Member States and other countries (public and private initiatives), assess the scope and effectiveness (including measured outcomes) and determine whether the evaluation of these policies and programmes can help inform the Commission about current inefficiency in resource use across the EU;
- Assess the scope for business to improve in their use of resources when viewed through the lens of businesses, taking into account the practicalities, challenges and uncertainties businesses face in adopting more efficient ways of procuring, using and consuming resources.; and
- Provide an estimate of the potential cost savings from resource efficiency gains in European businesses focusing only on water, waste and material inputs and for a selection of sub-sectors in manufacturing and services.

1.3 Scope of the study

The primary focus for **Part A** was the EU although it was recognised that evidence from information policies and programmes from countries outside the EU may be relevant and should be included. In all, reviews of over 100 different policies and programmes were conducted, with a more detailed comparative review and write-up of 24 different information provision initiatives. In setting out a framework for completing the analysis, the study team developed a set of criteria to allow comparative assessment, which included the following elements:

Table 1 Assessment criteria for information policies review

Name	Type of information provision policy	Type of behavioural change expected	Strengths
Organisation	Funding	Level(s) of organisational change expected	Drawbacks
Year	Scope	Expected results and impacts (quantitative and qualitative)	Lessons learnt
Location	Objectives	Actual results [quantified]	Contacts

For **Part B**, the scope of the study included an cross-sector examination of the scope for businesses to improve in the efficient use of resources, including a wide-ranging review of the available measures based on analysis of over 160 current publications and specific resource efficiency case studies as well as interaction and consultation with stakeholders from Member State authorities as well as leading industry companies. Given the wide range of measures available (and in many cases the sector or activity-specific application of certain measures), a rationalisation exercise was conducted to cluster measures to a manageable set covering the key broad measure categories available to business at this time.

The quantification of potential savings from resource efficiency included opportunities from efficiency improvements in material and water use as well as waste reductions but excluded energy, which has been studied in significant detail in other reports. The detailed analysis and monetisation of savings was made across the EU-27 for the hospitality and food service sector (HaFS), food and beverage manufacturing and fabrication of metal products.

The results were scaled to EU-27 (all sectors), based on bold assumptions, to provide an overall indicative opportunity in monetary terms from the likely improvements businesses could make in resource efficiency.

1.4 Using this report

1.4.1 Report structure

This study report is presented in two parts.

- **Part A** is an examination and analysis of information policies promoting resource efficiency – one of the fundamental requirements for business to become more resource efficient is to have the knowledge, skills and capability to change. Information policies, which include many of the main Member State government-funded programmes and interventions, are a key vehicle for delivering this advice, support and guidance. The Commission is interested in gaining a better understanding of what tangible outcomes a range of information policies and programmes have delivered; and

- **Part B** is an assessment of the measures available to business to become more resource efficient, an analysis of the scope for business to improve (i.e. what are the current inefficiencies and to what extent

could they be addressed) and a quantification of the potential savings from increasing resource efficiency.

In addition to the two main parts – which provide task-based methodologies, findings and concluding statements where appropriate – Chapter 2 provides background to the conceptual framework within which the study sits, namely resource efficiency, competitiveness and business behaviour.

1.4.2 Limitations

The analysis is founded on evidence where available but a number of assumptions have been used to scale the impacts across sectors, businesses and Member States. The use of such assumptions reflects underlying uncertainties in the analysis which has been addressed using sensitivities. The findings as presented in this report are subject to these assumptions and cannot be understood to be definitive or exact.

2. Study framework

There is no single definition of resource efficiency; it means different things to different people. Cost is a common language and whilst many smaller businesses may appear to fail to fully understand the resource efficiency concept, most if not all manage costs. Therefore, whilst the concepts of resource efficiency have been important elements to frame the assessment of the impacts of information policies and programmes and the scope for improvement and potential savings to be gained by businesses who seek to improve their resource efficiency; the context (i.e. how businesses understand these concepts and how they interpret them ahead of taking action) was equally important if the results were to be meaningful and recognisable when viewed through the lens of businesses themselves.

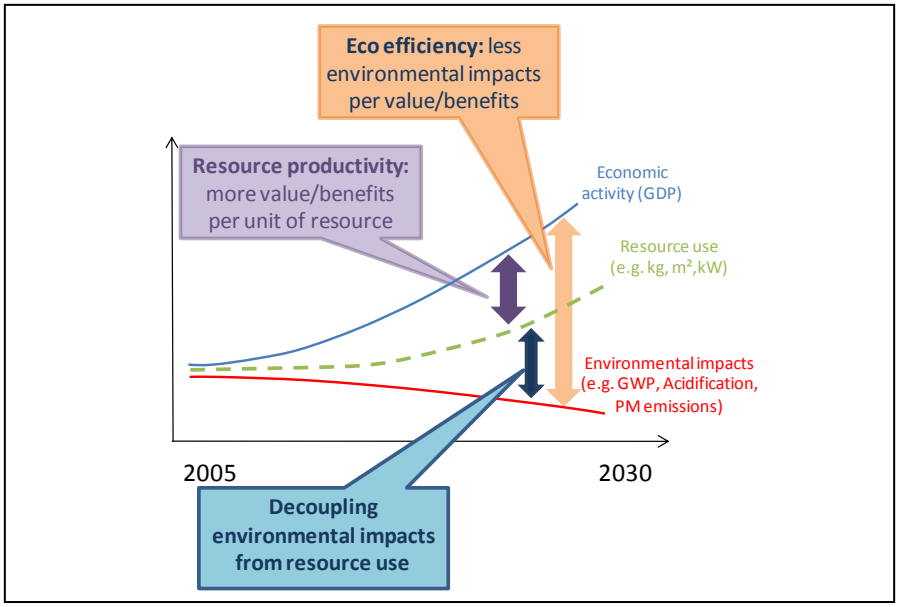
In setting a conceptual framework for this study to work within, the team drew upon a wealth of recently published strategies, reports and research as well as using professional judgement and feedback from businesses. For the purpose of this study, resource efficiency for businesses is understood in a twofold way: the cost savings from reduced use of resources or treatment of waste and wastewater; and the increase of revenue from improved products or selling used resources to others. Therefore, this study holds a double analysis: the amount of resource use and the economic impacts of resource efficiency opportunities for businesses. A simply analysis of the environmental impacts is also performed to give an idea of the broader benefits of business resource efficiency.

2.1 Concept of resource efficiency

Resource efficiency is not just concerned with the amount of resources consumed, but the use of natural resources in relation to the economic benefits and the environmental impacts. The EU's Resource Strategy has the dual objective of decoupling resource use from economic growth as well as decoupling environmental impacts from resource use. It should be noted that as efficiency is inherently based on the relationship of the inputs and outputs, the opportunities for resource efficiency can refer to any improvement that increases the benefits obtained per unit of resource use (i.e. resource productivity). Furthermore resource efficiency can also refer to any improvement that reduces the (life cycle) environmental impacts per unit of resource use.

Translating the concept of resource efficiency into real improvements in the EU economy and in individual businesses is however still a great challenge. Both public and private sectors have to work together to achieve the ambitious goal of a Resource Efficient Europe. The implementation of successful resource efficient practices in businesses throughout Europe is crucial to attain this goal. For companies, resource efficiency can reduce the costs of production and increase profits, commonly referred to as the 'win-win' scenario. When this is extended to the entire economy, resource efficiency can help to fuel economic growth while reducing the consumption of non-renewable materials and improving the supply security of key materials. This decoupling effect is depicted in Figure 1.

Figure 1: Resource productivity, eco efficiency and decoupling resource use from environmental impacts19



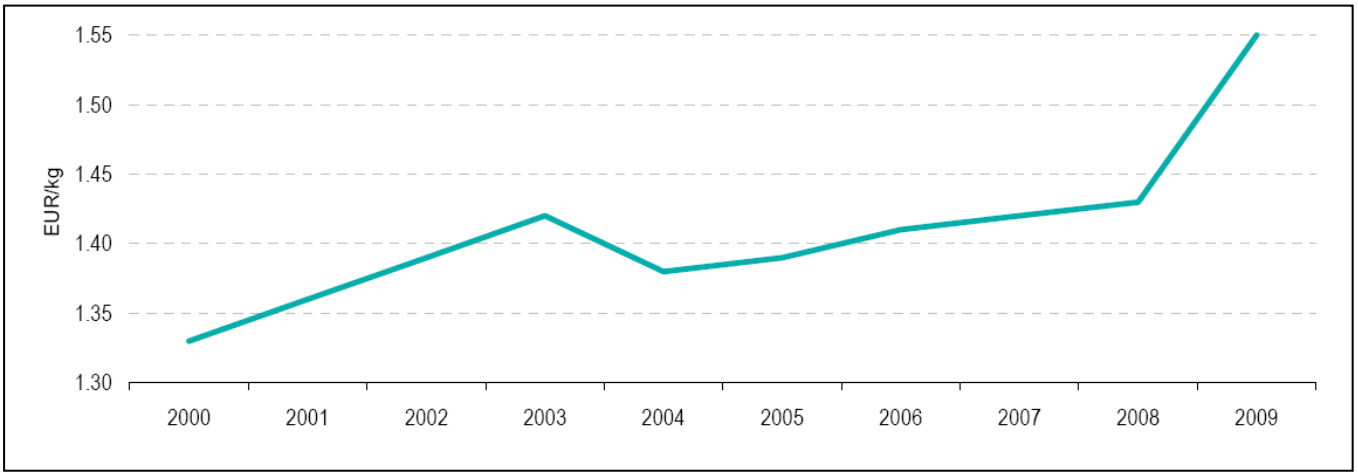
In examining whether resource efficiency as a concept is delivering decoupling, we must review the measurements of progress available to us at this time for the European economy as a whole. Resource productivity is defined as the ratio of the volume of gross domestic product (GDP) over domestic material consumption (DMC) and is typically expressed in €/kg. It is a metric for measuring the level of efficiency associated with resource consumption relative to the economic output (value) derived but is not a measure of resource efficiency itself. It is the leading indicator chosen to represent and measure the effectiveness of policy initiative set out in the Roadmap to a Resource Efficient Europe. It is therefore an important metric but not one directly used within this study. Businesses do not, as a rule, typically measure and monitor DMC on a company-wide basis and therefore data at the company level is too limited to be of use in such a wide-ranging study as this one. It is however important to recognise the linkage between the indicator and the concept of resource efficiency - one would expect to see increasing resource productivity with rising levels of resource efficiency amongst Europe's business communities.

Figures published by Eurostat show that resource productivity in the EU-27 economy increased from 1.33 € per kilogramme of DMC in 2000 to 1.55 €/kg in the year 2009. This corresponds to an average annual increase of about 1.6 %[20]. The average annual resource productivity growth rate was slightly above the volume growth rate of GDP (around 1.2 %) suggesting that decoupling of economic growth from resource consumption may be occurring. Figure 2 shows the resource productivity growth in the EU-27 over the period 2000-2009. The spike in resource productivity seen during 2008-09 is attributed to a huge slump in DMC brought on as a result of contraction in resource use amongst the material-intensive industries of the EU-27; in particular, construction activities shrunk creating a demand fall-off for key materials such as aggregates, steel and glass. The output (measured in GDP) during this contraction dipped but less so than DMC, further decoupling the two indicators.

[19] Based on the communication of the EC "Thematic strategy on the sustainable use of natural resources", COM(2005) 670

[20] Eurostat (2012) Statistics in focus 22/2012: EU's Resource Productivity on the increase

Figure 2. Resource Productivity EU-27 (GDP/DMC) 2000-2009 (EUR/kg).



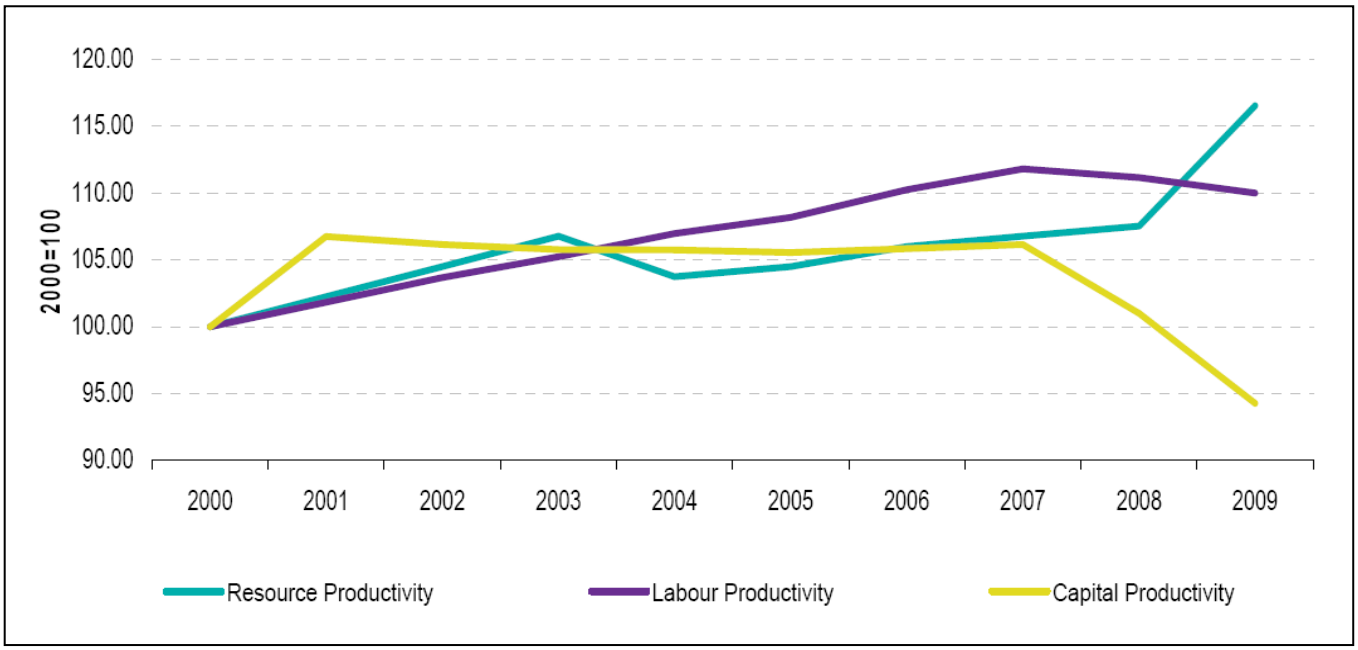
Source: Eurostat, 2012

At the business level, the economic conditions within Europe[21] are applying pressure on companies to seek savings in production and material supply costs; efficiencies are being squeezed out of commercial supply chains and businesses are undertaking internal examinations of production process efficiencies to capitalise on the 'quick wins' by reducing cost through reduced wastage and material usage. Some of these savings may be passed onto consumers as businesses fight competitively for consumers' attention but others will choose to build 'monetary cushions' or re-invest to realise further efficiencies. Businesses' reactions are not, in most cases, easily predictable or comparable.

Reviewing the Eurostat data shows that resource use, measured by DMC, decoupled from GDP growth as a result of a rising labour productivity and measures taken by businesses in the European economy to become more efficient. Comparison of the resource productivity, labour productivity and capital productivity trends (Figure 3) shows the effect of the economic crisis in 2008/09 was marked; labour productivity dips and capital productivity drops, implying that less GDP had been generated with roughly the same amount of fixed capital. That said, the economic conditions within Europe have meant that at the level of the organisation, businesses have survived by increasing their labour productivity. Whether this trend has continued into the present time remains to be analysed however the statistics do show that resource efficiency measures as a means to increase resource productivity remain a highly topical area for businesses to focus on in the coming years.

[21] The EU economy shrank by more than 4% between 2008-09, Eurostat 2012.

Figure 3. Resource Productivity over Labour Productivity and Capital Productivity, EU-27 - 2000-2009.

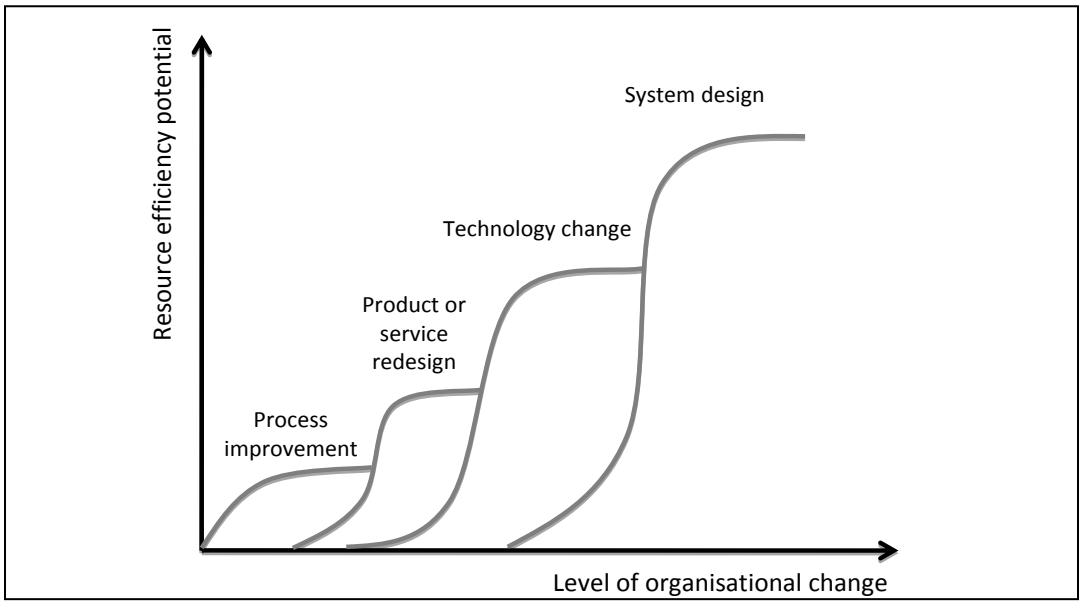


Source: Eurostat 2012

One way to better understand the how businesses conceptualise resource efficiency would be to consider resource efficiency at different levels of the company (see Figure 4). **Process improvements** typically require the least of companies to introduce and implement, but the resource efficiency potential of these improvements are also limited. The **redesign** of a product or service allows the entire life cycle to be taken into consideration. This includes not only processes within the company but also involves suppliers and other stakeholders in the value chain of the product or service. Shifting to a significantly more **resource efficient process or product technology** typically requires more investment and knowledge to implement, but it can also result in considerable resource savings. Finally, a **system perspective** allows companies to completely restructure their processes and offerings in a way that can achieve the greatest resource efficiency potentials. Placing these four descriptors of efficiency gains into measures that business might recognise provides examples of different levels of organisational change that include:

- Process improvement: e.g. duplex printing, recycling water, introducing better process controls;
- Product or service redesign: e.g. using less resources, material substitution, ecodesign, e.g. reducing the volume of packaging per product;
- Technology change: e.g. electronic invoicing, heat pumps instead of gas heaters, replacement production process, more efficient equipment; and
- System design: offering the product as a service, take-back and remanufacturing.

Figure 4. The scope for resource efficiency in relation to change in the business' organisation[22]

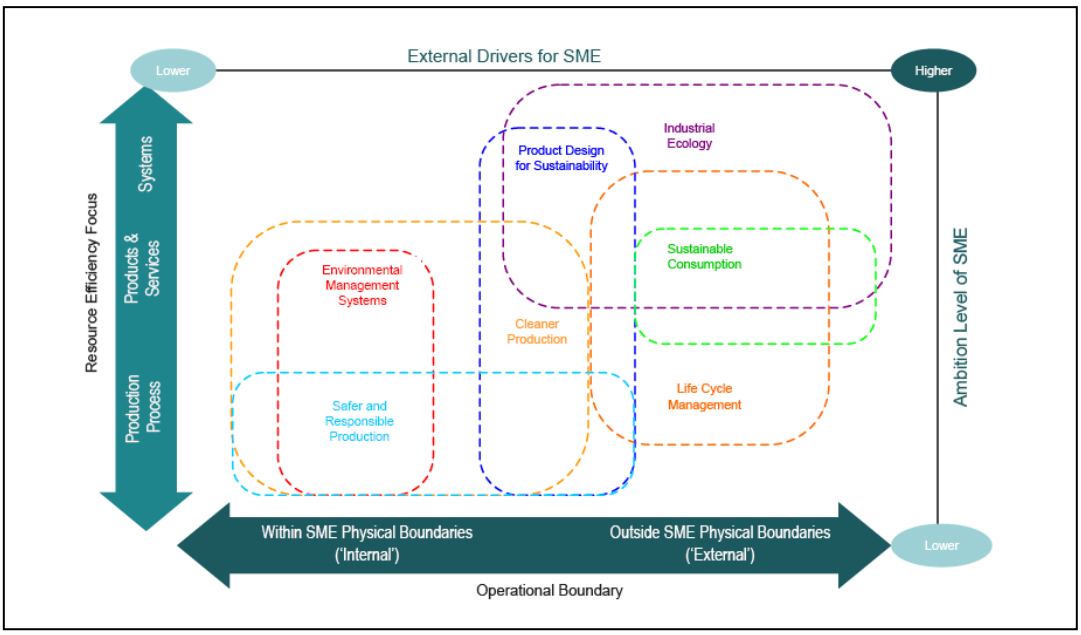


Building on some of the principles set out in Figure 4, another way to conceptualise resource efficiency relevant to businesses and in particular SMEs has been presented in a recent UNEP report[23], which maps the concepts according to their key focus (e.g. improving production processes, services and/or systems) offset against whether they are within or outside the boundaries of the SMEs operational environment (Figure 5). From research conducted by both AMEC and Bio Intelligence Service over several years and in different sectors, the conclusion is that businesses conceptualise resource efficiency in very different ways depending on a range of factors, including human factors such as knowledge, training and business ethos (the tone and direction of a business set by its leadership). Equally, research suggests that particularly amongst SMEs, there is no single area in a business that resource efficiency covers; rather it is a set of distributed skills and practices that are covered by different areas of business management. This can lead to more prevalent tactical behaviours in business as opposed to strategic ones; even businesses who are concerned about managing resources may not be focusing on the right resource efficiency actions that have the greatest positive impact, particularly if they are locked in to what they are already doing. Even though there will be awareness of resource cost changes and active management of wastes and by-products, the research suggests more needs to be done to help business embed the concept of resource efficiency using common vocabulary to ensure action is less reactive and more pro-active.

[22] Based on Brezet (1998) Sustainable product innovation, *3rd International Conference 'Towards Sustainable Product Design'*, London, UK

[23] UNEP (2012) The business case for resource efficiency through innovative business models in SMEs, Project report #2 (UNEP/Wuppertal Institute Collaborating Centre on Sustainable Consumption and Production)

Figure 5. Resource efficiency concepts relevant to SMEs (source UNEP)



However resource efficiency is conceptualised, using resources more efficiently makes good business sense on a number of levels (economic, social and environmental) and it is widely acknowledged that a transition to more resource efficient industrial models cannot be driven by policy and regulatory measures alone. In choosing how resource efficiency is conceptualised from the perspective of business, this study takes account of the evidence that suggests businesses have different barriers and drivers acting upon them, they perceive resource efficiency differently and will have various external factors exerting force upon them; a good example here being supply chain initiatives, where a dominant purchaser cascades efficiency down through the supply chain by way of setting objectives, standards and targets for its suppliers to meet. If the right messages and targets are set, along with sufficient support and incentive, this can be an effective mechanism for improving resource efficiency by uptake of specific measures. This study does not therefore seek to set out a new conceptual framework for business resource efficiency, rather it recognises that increased resource efficiency stems from a series of actions (measures) taken on a number of levels by individuals and businesses, which lead to lower overall costs per unit output and wider environmental, societal and economic benefits. It is the effect of these measures as well as the likely level of uptake amongst less efficient businesses that is a key part of this study.

2.2 Business resource efficiency

Taking account of obvious differences between businesses and the goods and services they provide, materials intensity and waste generated, there is a wide body of evidence to suggest that some businesses and sectors are using resources more efficiently and some less so. This inequality between businesses, where a comparison can be made, suggests that there is potential for most businesses to improve, and some more than others. This inequality between businesses and sectors represents the 'opportunity' from improving resource efficiency. Indeed, the wider the disparity in 'efficiency level' amongst businesses within a sector, the greater the scope for improvement. This

study has examined this 'gap' to better understand what the potential may be to improve resource efficiency amongst businesses and what size of opportunity could be expected from taking action.

Businesses already implement a diverse range of resource efficient practices[24]. Constantly increasing productivity is an inherent part of all businesses. The reduction of material consumption often implies cost savings and therefore is a common activity in companies, as shown in a study carried out by The Gallup Organisation for the Eurobarometer[25]. The results of this survey showed that nine in ten companies introduced at least one change in their organisation during the last five years to reduce material costs, such as purchase or development of efficient technologies or implementation of recycling practices; however, as some recent studies show, there is still some significant room for improvement. Oakdene Hollins estimated the savings opportunity to business in the UK in the year 2009 as €63 (£55) bn and 90 Mt CO_2 equivalents[26]. A study carried out by Urban Mines[27] calculated the potential savings for business in the UK based on surveys, providing examples of resource efficiency in different sectors and sampling enterprises of different sizes. The results showed that certain sectors (environmental technologies, construction, chemicals and food & drink) had a higher potential of cost savings from reduction of resource consumption and some sectors (energy, power and utilities) had lower cost savings and higher capital investment.

In their 'Resource Revolution' report, McKinsey Global Institute[28] presented some very large around the potential opportunities from increased resource efficiency. It estimated that savings could be $2.9 trillion[29] (€2.1 trillion) in 2030 if there is full capture of all the resource productivity potential and that 75% of these savings could come from just 15 key opportunities; however, the report also estimated that investments of over $1 trillion (€775 million) in the resource system will be required each year to meet the rising future resource demands. Much of this investment will need to come from businesses themselves and this is a significant ask of businesses given the continuing economic pressures, resource price volatility and of global trading uncertainties brought on by the economic crisis of 2007/08. In the report on the opportunities from transition to a circular economy[30] (a concept associated closely to resource efficiency as many businesses would recognise it) detailed product level modelling estimates that the circular economy represents a net material cost saving opportunity of $340 to $380 billion (€246 - €295 million) per annum at EU level for a 'transition scenario' and $520 to $630 billion (€403 and €488 million) per annum for an 'advanced scenario', in both cases net of the materials used in reverse-cycle activities. The latter would equate to 19 to 23% of current total input costs or a recurrent 3 to 3.9% of 2010 EU GDP. Such estimates

[24] Urban Mines (2010). Practical resource efficiency savings – Case studies. Study commissioned by BIS

[25] Gallup (2011). Attitudes of European Entrepreneurs towards eco-innovation. A survey requested by Directorate-General Environment and coordinated by Directorate-General Communication

[26] Oakdene Hollins (2011). The further benefits of business resource efficiency. A research report completed for the Department of Environment, Food and Rural Affairs.

[27] Urban Mines (2010). Potential for resource efficiency savings for businesses. Study commissioned by BIS

[28] McKinsey Global Institute (2011) Resource Revolution: Meeting the world's energy, materials, food and water needs

[29] Rising to $3.7 trillion if carbon floor price was $30/t and environmentally harmful subsidies were removed

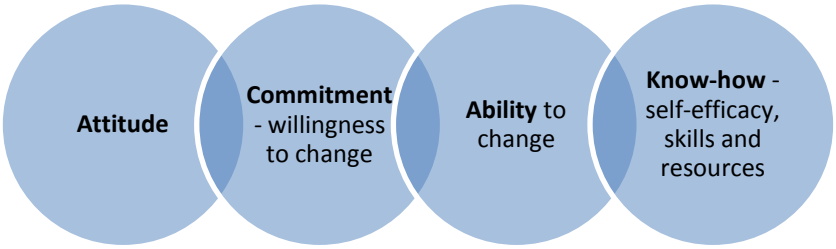
[30] Ellen MacArthur Foundation (2012) Towards the Circular Economy: Economic and business rationale for an accelerated transition

demonstrate that increasing resource productivity, whether by targeted resource efficiency measures or new models for doing business, represents a massive opportunity for businesses in the EU.

Realising these opportunities will not be an easy task. The barriers for businesses to implement the measures necessary to capitalise on the full potential of resource efficiency may be due to lack of information and knowledge of alternative technologies, materials or practices. In particular companies do not seem to have a clear view of the benefits that resource efficiency can provide to them[31] and often view resources as fixed inputs over which they perceive to have limited control. Among SMEs, resource efficiency practices are perceived to be costly to implement with little direct benefits flowing back to the business[32]. Information policies or programmes focused on enhancing the knowledge on resource efficiency in businesses could be quite cost-effective and indeed have been a cornerstone of policies that seek to intervene in the market to generate additional efficiencies within businesses. The current examples of specific policies or programmes that explicitly tackle resource efficiency are limited, but a number of countries have put in place strategies with a wider scope (economy, sustainable development, sustainable consumption and production action plans, plans and strategies on raw materials, climate change, etc) that include references to resource efficiency[33].

It could be suggested that the scope for improving resource efficiency, in its pure form, would be a measure of the gains that could be made should all barriers and failures be removed, leaving businesses able to achieve a theoretical 'maximum efficiency'. The scope as we understand it however is far more complex, being a series of interplaying factors within a business that determine an organisation's 'capability' to become more efficient provided that the opportunity is there; and in many cases it is, as measured by the disparity in resource efficiency between businesses. The capability of a business to improve relies on a number of factors, including:

Figure 6. Key factors in businesses becoming more resource efficient[34]



It is not only necessary for businesses to have the attitude, but also the commitment, ability and knowledge to change. When any of these four factors fails, the barriers to improve become insurmountable. These issues are

[31] Ecorys (2011) Study on the competitiveness of the European Companies and Resource Efficiency. Study commissioned by the Directorate General-Enterprise and Industry of the European Commission.

[32] Danish Technological Institute (2010). SMEs and the environment in the European Union. Study prepared for the European Commission, DG Enterprise and Industry.

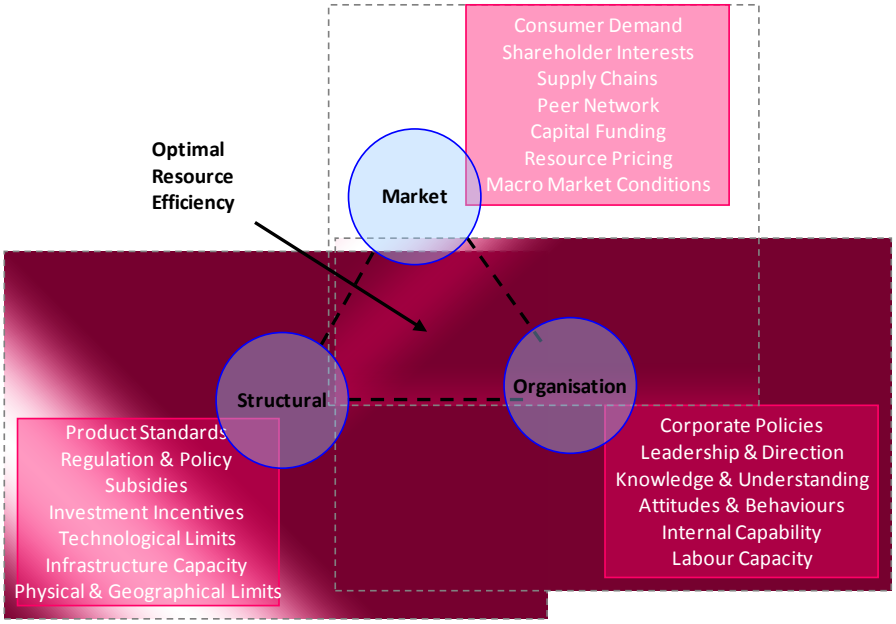
[33] EEA (2011). Resource Efficiency in Europe. Policies and approaches in 31 EEA member and cooperating countries.

[34] Source: AMEC, 2011

more visible in SMEs, for which changes imply great efforts; the average investment in resource efficiency amongst the smallest businesses is around 9% of turnover compared to 0.3% for the largest businesses[35]. Despite the higher levels of initial investment, the smallest companies are most likely to see the greatest return on their investment with savings of 11% of turnover compared to 0.4% of turnover in the largest companies. The failure that may lie behind many smaller companies being unwilling to invest in resource efficiency might be a lack of accessible capital and also limited knowledge about the potential benefits from that investment. Here information policies and programmes can be an effective way of communicating with smaller organisations along with funds to help catalyse the necessary changes.

This however is over-simplifying the decision-making construct for businesses on resource efficiency; in reality there are a great many factors that must be evaluated in making investment decisions (even relatively small ones), some of which are set out in a diagrammatic framework in Figure 7.

Figure 7. Framework of selected key factors in business resource efficiency decision-making[36]



Balancing such interconnectivities is a real challenge within a business and one that can create paralysing inaction on resource efficiency, especially when operational day-to-day demands are factored in. Optimal resource efficiency would seem to rely on all factors being balanced in decision making and yet such practical challenges often means movement towards greater business resource efficiency is compromised.

In its draft report of 2012[37], UNEP highlighted several conclusions relating to the challenges associated with businesses becoming more efficient. Internal challenges for resource efficiency and safer production were reported

[35] EIO (2011) Closing The Eco-Innovation Gap: An economic opportunity for business

[36] Source: AMEC 2012

as being diverse, but the main challenges were *inadequate skills and knowledge* (resources), *perception of high costs* associated with resource efficiency measures (understanding and perception), *difficulties with evaluation* of environmental aspects and impacts of a company (implementation), and *resistance to change* (culture). The key external challenges to the uptake of resource efficiency highlighted through the survey were *uncertainty about the effective economic benefits* of available methods and tools (economic), *high costs associated with verification and certification, lack of awareness of economic benefits* in connection with environmental compliance (institutional), and *lack of support* (e.g. tailored information, networking, suitable consultants and tools).

Policy makers can and have been taking action to help business improve its resource efficiency by arming it with relevant information and helping identify the quick-wins where small investments in simple measures can yield rapid returns and create the initial momentum required. This study recognises that more could be done and there is sufficient appetite within European institutions to do more; it seeks to convey conclusions not only on how successful policies and programmes have been to date but also what the level of opportunity to business might be if there was greater uptake of measures to improve resource efficiency cross-sectorally.

[37] UNEP (2012) Overcoming SME Challenges – Resource Efficiency Strategy Guidebook for Intermediary Organisations Supporting SMEs (UNEP/Wuppertal Institute Collaborating Centre on Sustainable Consumption and Production (CSCP)) Final Draft, March 2012.

PART A

Analysis of information policies promoting resource efficiency

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3. Information-based and awareness-raising initiatives

Information provision and awareness raising initiatives promoting resource efficiency aim at providing targeted information to influence the behaviour of key actors in the supply chain. It is often assumed that when individuals or organisations make poor choices regarding the use of resources, it is due to misinformation or lack of information. Individuals and organisations rarely search out, read or properly digest all of the information available to them when making a decision. The type, complexity and amount of information provided, as well as the way it is communicated, all have a significant impact on the likelihood of people understanding and ultimately acting upon the information. In a world where information is highly accessible and individuals have to quickly process a lot of information, getting the attention of individuals and organisations can be difficult. Furthermore, although information policies may be effective in informing the key actors of how to act, the main challenge is actually putting the knowledge into practice.

It is therefore important to first get the attention of the target group, and then provide them with information that they can easily process and act upon. Examples of information policy tools that promote resource efficiency in businesses include awareness raising campaigns; websites; printed materials; free audits; corporate reporting; certifications; education programmes; capacity building; knowledge transfer networks; and, training of personnel (see Figure A1, where the information-based tools are in the green ellipse). Other information policy tools not specifically focused on providing information to businesses themselves, but to their customers can also be used to promote resource efficiency. Environmental labels or funding schemes, which require businesses or customers to act in a more resource efficient manner, can therefore also be seen as information policies that promote resource efficiency.

Resource efficiency can be achieved through different approaches, these can include behaviour changes on the production floor regarding waste treatment; the reduction of materials specified in products during design; implementing a new resource efficient technology; or even creating a new business model built around resource efficiency. As a result of this wide diversity of approaches, the nature of the information programmes and their agents are also broad. Public institutions, international agencies, industry associations or private foundations can develop information programmes to promote resource efficiency. These may choose to focus on specific business sectors or on specific issues depending on their objectives.

This chapter investigates existing information-based initiatives that promote resource efficiency in businesses. An analysis of the effectiveness and cost-benefit of various types of initiatives across the EU and elsewhere is provided. This will determine the state of resource efficiency in businesses in the EU, as well as provide ideas for how to best design information-based resource efficiency programmes.

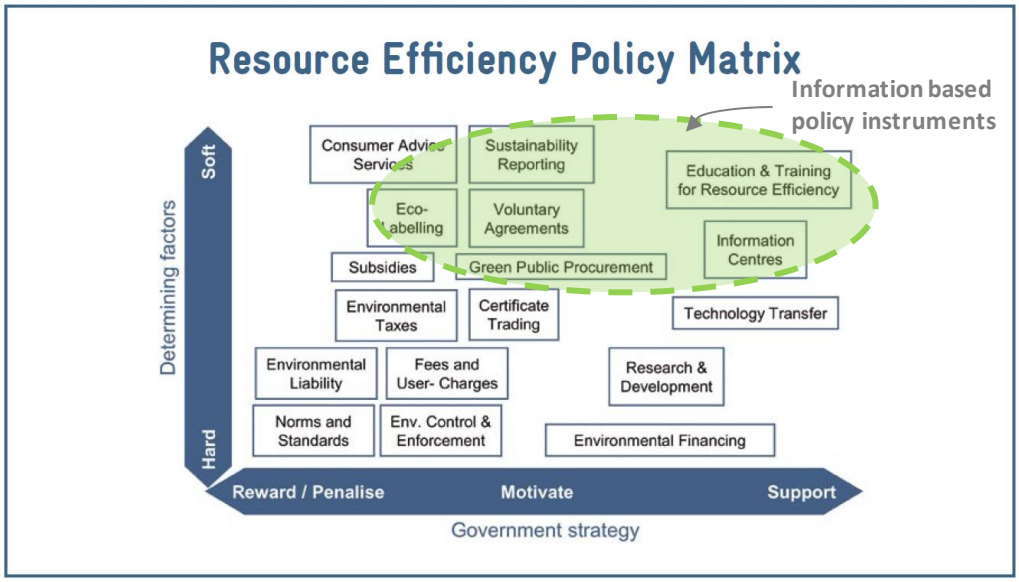


Figure A1 A matrix showing the broad scope of resource efficiency information policies[38]

3.1 Methodology

The identification of initiatives aimed at improving the resource efficiency (limited to materials, waste and water) of business was based on a literature review[39] and desktop search. This was supplemented by asking persons working in the area whether they knew of any other initiatives which would be worth investigating. As there is no clear definition of what an information-based policy tool is, a broad interpretation was used in the initial search. There is not always a clear distinction between regulatory, economic, research and educational, cooperation and informational instruments. For example, free auditing and consulting services were considered as information based initiatives, even though this could also be seen as a subsidy.

[38] UNEP/Wuppertal Institute Collaborating Centre on Sustainable Consumption and Production (CSCP) (2006) Policy Instruments for Resource Efficiency. Towards Sustainable Consumption and Production.

[39] Selected key relevant reports on resource efficiency initiatives:

- AEAT (2007) A Review of International Approaches to Waste Prevention and Minimisation. Construction Resources Waste Platform. Study commissioned by Defra / BREW.
- UNEP/Wuppertal Institute Collaborating Centre on Sustainable Consumption and Production (CSCP) (2006) Policy Instruments for Resource Efficiency. Towards Sustainable Consumption and Production.
- AEA (2009) Business Resource Efficiency. Report to the Sustainable Development Research Network
- Umweltbundesamt (2010) Development of scientific and technical foundations for a national waste prevention programme.
- WBCSD and IUCN (2010) Water for business. Initiatives guiding sustainable water management in the private sector.
- COWI (2011) Economic analysis of resource efficiency policies. Study commissioned for the European Commission, DG Environment.
- TemaNord (2011) Assessment of initiatives to prevent waste from building and construction sectors. Study commissioned by the Nordic council of Ministers.
- UNEP/Wuppertal Institute Collaborating Centre on Sustainable Consumption and Production (CSCP) (2006) Policy Instruments for Resource Efficiency. Towards Sustainable Consumption and Production.

The first search resulted in over 100 potentially relevant initiatives covering 13 Member States and 9 non-EU countries. Only programmes that clearly aimed to reduce resource consumption or best utilise resources in the production of goods or services were identified. Voluntary environmental schemes, such as ecolabels, green (public) procurement and environmental management systems, where companies have to fulfil a specific set of criteria, were also considered as information based programmes that can promote business resource efficiency. A wide range of these types of programmes exist at EU level. Figure A2 provides an overview of EU initiatives that directly or indirectly promote resource efficiency in businesses.

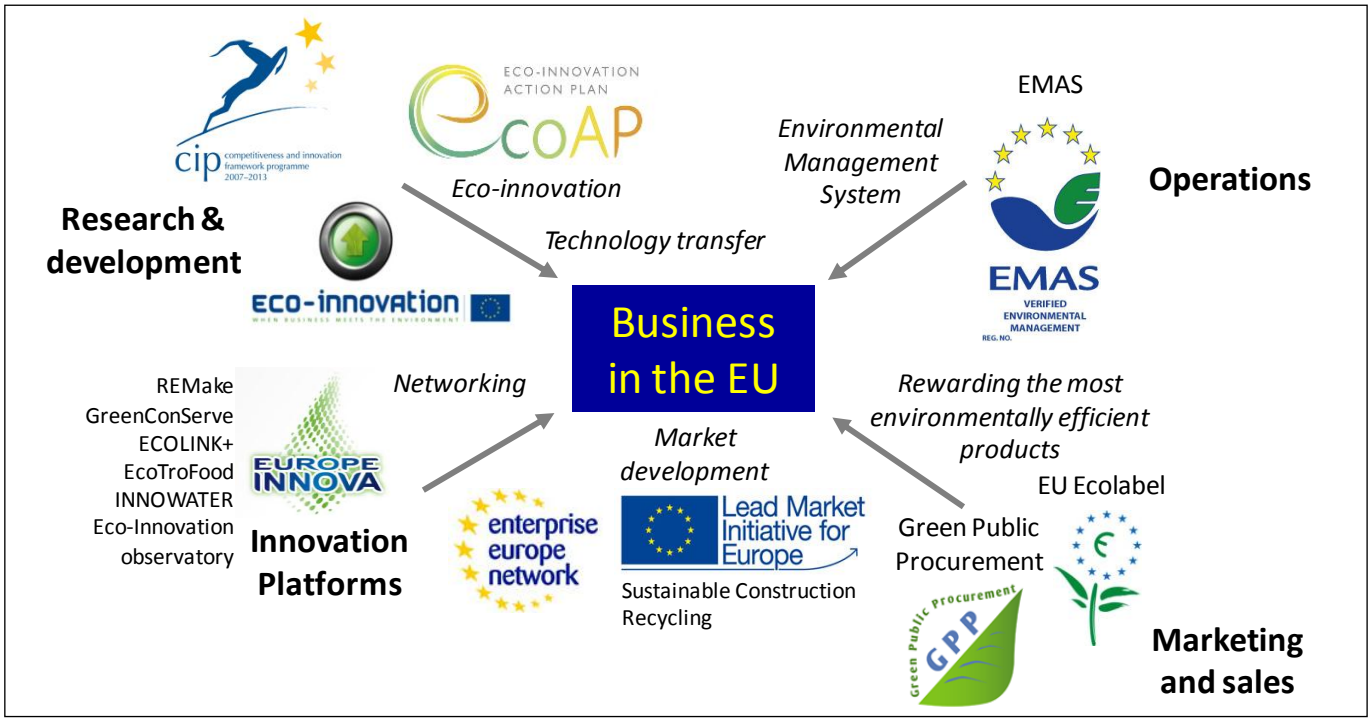


Figure A2 An overview of existing programmes in the EU related to promoting resource efficiency in businesses

Other funding programmes such as the Seventh Framework Programme for Research and Technological Development (FP7), LIFE programme and the INTERREG programme also indirectly support businesses in developing and implementing resource efficient technologies but as the sustenance is limited to funding for research and networking activities across countries, these are not analysed further.

Ecolabels

Ecolabels are voluntary certification schemes that guarantee compliance of a product or service based on specific (high) environmental standards. This can include criteria such as sustainably sourced materials, a certain amount of recycled content is used in the product, or limits on wastewater emissions. The idea behind ecolabels is that companies that manufacture products (or deliver services) more efficiently and with less environmental impacts are able to distinguish themselves on the market. The consumers who are concerned about environmental issues are then able to easily identify the best environmental performing products and choose ecolabelled products over others on the market. This competitive advantage is what motivates companies to use ecolabels. There are a wide range of

ecolabels currently on the market covering both public schemes (e.g. EU Ecolabel, the Blue Angel/Blauer Engel, Nordic Swan) and private schemes (e.g. Marine Stewardship Council, Programme for the Endorsement of Forest Certification (PEFC), Cradle-to-Cradle)[40]. The manners in which ecolabels are managed and monitored vary considerably. Some schemes have strict certification procedures and regular systematic checks, whilst others are less stringent.[41] A few schemes offer services to companies to help them achieve certification through ecodesign or production process improvement. Although ecolabelled products are supposed to represent the best environmentally performing products on the market, the certification criteria for some schemes are not always sufficiently updated. For these schemes, once companies have obtained the label, they are not motivated to continuously improve their processes and products. In general for ecolabels, there is little tracking of resource efficiency performance in companies. Besides increased sales, there is very little quantitative data on the economic benefits of ecolabels[42]; therefore it has not been possible to determine the resource efficiency pay-back for such programmes. In the context of this study, the EU Ecolabel and Eco-Emballages (the Green Dot Scheme in France) were selected to represent information based ecolabel programmes.

Green (Public) Procurement

Green (Public) Procurement includes guidelines or criteria which take into account environmental issues when tendering for goods or services. Often the criteria for green procurement are based on ecolabel criteria.[43] Similar to ecolabels, suppliers that fulfil green procurement criteria are awarded for their efforts to reduce environmental impacts. Public authorities are currently leading when it comes to setting environmental criteria for products and services. The EU and a number of Member States have developed their own Green Public Procurement Schemes. Private firms have been following suite. In the context of opportunities to business of improving resource efficiency, Green Procurement motivates companies to produce more resource efficient products (similar to ecolabels). In addition, Green Procurement is also an approach to business procurement that can potentially reduce a company's resource use and costs. In the search of information based programmes that improve companies' resource efficiency, multiple (public and private) initiatives were identified that provide Green Procurement training to companies. Like ecolabels, these programmes rarely track the resource efficiency and cost savings of the companies systematically, so it was only possible to gather anecdotal evidence. This so far has shown that there is no major difference in costs of 'green' products, except in the case where operating costs are significant (e.g. energy and water using products). Here Green Procurement can lead to significant savings in companies. Only one Green Procurement programme was selected for further investigation in this study: Green Suppliers Network (USA).

[40] World Resources Institute (WRI) and Big Room, Inc. (2010) Global Ecolabel Monitor. Towards Transparency.

[41] Duke University, Nicholas Institute for Environmental Policy Solutions (2010) An Overview of Ecolabels and Sustainability Certifications in the Global Marketplace.

[42] AEAT (2004) The direct and indirect benefits of the European Ecolabel. Final Report produced for DG Environment at the European Commission

[43] AEA (2010) Assessment and Comparison of National Green and Sustainable Public Procurement Criteria and Underlying Schemes. Report to the European Commission, DG Environment.

Environmental Management Systems (EMS)

Environmental Management Systems (EMS) are management tools that help businesses track their environmental (including resource use) performance, which allows them to continuously improve their resource efficiency. A typical EMS follows a Plan-Do-Check-Act process cycle and when implemented in an organisation becomes part of its business processes and strategic management. The international standard for EMS is ISO 14001. The EU encourages EMS through its Eco-Management and Audit Scheme (EMAS). Businesses certified under EMAS must have third party verification and make publicly available the environmental impact and performance of their organisation. The estimated average costs of implementing EMAS for an organisation is €48,000 the first year and €26,000 annually for subsequent years.[44] The annual costs of EMAS are typically off-set by quantified energy and resource savings (up to ten times the annual costs, although high efficiency gains are unlikely to be repeatable year after year). Besides efficiency savings, widely acknowledged benefits to businesses are reduced negative incidents, market access, improved relations with stakeholders and regulatory relief. A recent Defra study showed that two thirds of SMEs attributed an increase of their sales (average increase of sales value of £14,961 per £ million turnover) to the implementation of a certified EMS.[45] The average cost savings over two years cited in the study was £4,875 per £ million turnover, suggesting a payback period of 3 months. There are several public programmes and private companies that assist businesses in implementing EMS. In this study, EMAS and the Global Reporting Initiative were selected to represent EMS/reporting programmes that improve resource efficiency in companies.

Other information-based initiatives

The remainder of the initiatives identified involve organisations that provide various kinds of tools, information, training and consulting services. Some gather these services under a single programme or resource efficiency agency, while others build upon a network of organisations. Besides offering case studies, best practice guides, tools and a wide range of services, some of the initiatives encourage businesses to commit to voluntary agreements and achieve certain resource efficiency targets. Awareness raising is an important aspect of many of the initiatives, as many of the initiatives organise campaigns, conferences and workshops to promote resource efficiency in businesses.

An initial screening of the identified initiatives was performed to select the most relevant for further investigation. The screening was based on the following criteria:

1. whether sufficient information could be gathered to determine the effectiveness of the initiative
2. a broad variety of different types of initiatives would be investigated (e.g. types of policy tools, sectors, resource type, countries, etc.)
3. innovative (and successful) approaches to promote resource efficiency in businesses

[44] Milieu & Risk and Policy Analysis (2009) Study on the Costs and Benefits of EMAS to Registered Organisations. Prepared for the European Commission, DG Environment.

[45] WYG Environment and Energy (2012) An Evidence-based Study into the Benefits of EMSs for SMEs. Prepared for Defra, UK.

The screening resulted in a short-list of 23 initiatives, which was shared with the European Commission for feedback. Each of the short-listed initiatives was then examined in detail using a common template for gathering information (see TableA1). Contact persons for each initiative were identified and contacted to verify the gathered information and provide additional (and/or missing) information. The common template allowed the initiatives to be analysed in a consistent manner so that the effectiveness of different information programmes could be compared, e.g. the level of success of the programme itself and the benefits for businesses participating in the programme. The individual strengths and weaknesses, and lessons learned were also determined for each programme.

Table A1 Template for gathering information on the resource efficiency initiative

Name	*Name of the information programme*
Organisation	*Name of the organisation behind the programme/initiator*
Year	*When did the programme start, end, on-going?*
Location	*Country or region the initiative operates*
Type of information provision policy	*Type of information provided? E.g. website, brochures, training, workshops, seminars, company visits, etc.*
Funding	*The costs of developing and running the programme (direct funding/subsidies to companies should not be included)*
Scope	*Which resources are targeted? E.g. materials, waste, water, plastics, wood, etc.* *Which sector? E.g. industry, agriculture, construction, services, etc.* *Which companies? E.g. SMEs, big companies, etc.* *Who in the company? E.g. production managers, procurers, business leaders, etc.*
Objectives	*What did the programme set out to do? E.g. save water, save costs, improve market potential, etc.*
Type of behavioural change expected	*How does the programme work? E.g. building competencies internally, motivating/inspiring business leaders, concrete tools and calculators, competitions, follow-up, etc.* *What was the rationale for how resource efficiency could be achieved through the information/services were provided?* *How was the business expected to achieve resource savings? E.g. training all of its employees, providing recycling bins, change internal processes, implementing ecodesign, installing wastewater plants, providing new services, joining industrial symbiosis, etc.*
Level(s) of organisational change expected	*What kind or resource efficiency measure was encouraged? Provide concrete examples, e.g. improved recycling, installing water efficient taps, minimise packaging, etc.* - Process or product improvement - Product or service redesign - Technology change - System design
Expected results and impacts (quantitative and qualitative)	*What did the organisation expect from the programme before it was implemented?*
Actual results [quantified]	*What did the programme actually achieve?* *How successful were they? Provide case studies, ex-post assessment reports, etc.*
Strengths	*Why was the programme successful? E.g. responded well to business needs, there was a follow-up, competent experts, etc.* *What was it good at?*

Drawbacks	*What did the programme not achieve (compare the expect results with actual results)?* *Why was it not able to achieve this?* *What was missing for the programme to be more successful?*
Lessons learnt	*What knowledge did the organisation behind the programme learn?* *What would they recommend, if they were to improve the programme?* *What did the participating businesses learn from the programme?*
Contacts	
Sources and references	

3.2 Overview of information-based initiatives promoting resource efficiency

A broad selection of information-based initiatives that promote resource efficiency in businesses was investigated further. The selection represents a diversity of information-based programmes in terms of:

- **Geographical scope**: international, EU, national, regional, etc.
- **Resources targeted**: all resources (including energy), materials, waste, water, etc.
- **Companies/Sectors targeted**: all sectors, specific sectors, SMEs, etc.
- **Type of initiative / services provided**: website and publications (e.g. case studies, best practice guides); information centres / points of contact; campaigns and awareness raising; tools and calculators; events, seminars and workshops; forums and networking; knowledge sharing; training sessions; awards; voluntary agreements; labels and certification schemes, onsite visits and audits; consulting services; mentoring; benchmarking; action plans and improvement potential reports, etc.

Table provides an overview of the information-based initiatives that were investigated in more detail. The factsheets for each initiative can be found in the complimentary report containing the Annexes.

Table A2 List of information-based programmes that were investigated further

No.	Name	Organisation	Country	Resources targeted	Companies / Sectors targeted	Type of initiative / services provided	Payback / Economic results
1	Eco-Management and Audit Scheme (EMAS)	European Commission	EU	All	All	Website and publications (including training materials) Events, conferences and seminars in several Member States Helpdesk for enquiries	For small enterprises payback is on average just over 2 years For medium and large enterprises payback can be as little as two months and up to €100,000 to €400,000 annual energy and resource savings.
2	EU Ecolabel	European Commission	EU	All	Different product categories	Website and publications (including factsheets per product category) Events, conferences and seminars in several Member States Helpdesk for enquiries at EU level and national contact points Annual Communication Award among licence holders	The scheme is estimated to cost €3.4 million to operate (2004 figure)
3	European Water Stewardship (EWS)	European Water Partnership	EU	Water	All	Partnership Standard Inspection and certification Communication Guidelines Website and publications	
4	WIN (Wirtschaftsinitiative Nachhaltigkeit - *Sustainable Business Initiative*)	Styrian Federal Province Government, the Styrian Economic Chamber and the Styrian Business Promotion Agency	Styria, Austria	All	Target SMEs	Website and publications including best practice guides and case studies Regional information events and training seminars Subsidised on-site 'checks': Sustainability Check, Management Check and Eco Check	About €2.8 million of financial support for consulting projects (from 2003 to 2011) caused €30.1 million of investment for improvement measures in the

No.	Name	Organisation	Country	Resources targeted	Companies / Sectors targeted	Type of initiative / services provided	Payback / Economic results
						Financial support for consulting services offered by external experts: Holistic sustainable development Implementation of EMS Resource efficiency and waste management	companies
5	Mambo and Eco-Efficiency Scan Programme	OVAM	Belgium	All	All manufacturing companies	Tools and calculations: Eco-efficiency Scan MAMBO (waste)	Case study evidence, per resource efficiency measure savings between €2000 and €27,000 (based on total costs of waste)
6	Material Efficiency Audit Tools	Motiva	Finland	Energy Materials Waste Water	All	On-site auditing Analysis tools	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%.
7	Eco-Emballages	Eco-Emballages	France	Packaging materials (paper, cardboard, plastic, glass, metal)	Packaging	Awareness raising campaigns on sorting and recycling Ecodesign training sessions with a focus on packaging minimisation Packaging audits Partnerships with engineering schools that lead company projects to minimise packaging	Packaging audits result in an average increase of turnover of 0.4%. Student partnerships deliver packaging reduction of 10-20%.

No.	Name	Organisation	Country	Resources targeted	Companies / Sectors targeted	Type of initiative / services provided	Payback / Economic results
8	Deutsche Materialeffizienz-agentur (demea)	Deutsche Materialeffizienz-agentur / the German Materials Efficiency Agency was created at the initiative of the Federal Ministry of Economics and Technology	Germany	Materials Waste	SMEs	Website and publications (including a newsletter and database of good practices) Online tool for the self- assessment of the potential material savings Conferences and workshops Annual German Material Efficiency Award Funding for consultation services to identify savings potential	Based on the examination of over 1,000 analyses the potential savings were estimated at €215,000 per year per company. This is translated to an annual increase of profits by 1.8%.
9	Netzwerk Ressourceneffizienz	Ministry for Environment and Federal Environment Agency	Germany	Metal industry Plastics producing industry Green office computing New building technologies Electric cars Large scale energy production projects	All	A website as information platform Conferences Good Practice examples Network activities Newsletters Organisation of common activities and initiatives: dialogue processes, pilot projects or training Company-based workshops Information on financing possibilities Organisation of local and regional events	
10	Effizienznetz Rheinland-Pfalz (EffNet)	Effizienznetz Rheinland-Pfalz (EffNet)	Rheinland-Pfalz, Germany	All	All, with focus on SMEs and some specific sectors	Website and publications Events to promote resource efficiency Web- based benchmarking tool “BUDA” Advice on funding opportunities	The estimated saving potential for 46 companies was estimated at €2.5 million per year, with an investment of €12.4 million (payback time 5 years)

No.	Name	Organisation	Country	Resources targeted	Companies / Sectors targeted	Type of initiative / services provided	Payback / Economic results
11	Effizienz-Agentur NRW	Effizienz-Agentur North Rhine-Westphalia	North Rhine-Westphalia, Germany	Material Waste Water Energy	Manufacturing SMEs	Website and publications (including success stories) Information forums Consulting services to achieve resource efficiency improvements using the Eco-Efficiency and PIUS Check Resource efficiency and ecodesign tools Knowledge transfer Assists companies in the application process for funding	Investment of over €36 million has resulted in the saving of factory supplies of approximately €10.4 million per year (payback time 3.5 years)
12	"Prevent and Save" Packaging Waste Prevention Programme (PWPP)	Repak and EPA (Ireland)	Ireland	Packaging materials and waste	All	Website and publications Seminars Packaging survey Training	
13	Money Back Through the Window (Ablakon Bedobott Pénz)	KÖVET Association for Sustainable Economies	Hungary	All	Fisheries and forestry, mining and quarrying, manufacturing, electricity and water supply, construction, the commercial sector, hotels and restaurants, transport logistics, real estate others (56 case studies from companies representing 25% of the country's industrial output	Website and publications including case studies Annual conference and workshops Annual 'Environmental Savings Awards'	Cases are organised by their payback times: For the cases where no investment was required, the average savings was €134,000 For cases, where payback is one year, the average savings was €180,000 For cases, where payback is more than three years, the average savings was €400,000

No.	Name	Organisation	Country	Resources targeted	Companies / Sectors targeted	Type of initiative / services provided	Payback / Economic results
14	Eco-efficiency programme	IHOBE	Basque region, Spain	All	All	Technical tools related to environmental information, practical guides, case studies and best practices Workshops, expert courses and training on-demand Free audits and plans for resource savings Assistance with implementation of environmental management systems, ecodesign, ecolabelling, green purchasing	Ecodesign cost is €5 - €10 per tonnes of CO_2 eq. saved (no evaluation performed at the time of this study)
15	On Course for Zero Waste	Zero Waste Scotland	Scotland, UK	All	SMEs in all sectors	Online training	
16	Hackefors Model	Altea AB	Sweden	All	All	Joint EMS certification Individual consultation (costs shared between members) General meetings	
17	Courtauld Commitment	Waste and Resources Action Programme (WRAP)	UK	Food packaging Food waste	Food and drink supply chain (suppliers, manufacturers, retailers)	Voluntary agreement to reduce packaging, food and drink waste, and packaging waste Involving the leading retailers, brand owners, manufacturers, suppliers and industry organisations WRAP's key account managers assist companies to develop implementation plans	The agreed targets are estimated to be cost-efficient (high level of food waste and packaging savings that are also cost reductions)
18	Envirowise	Formerly under the Business Resource Efficiency and Waste (BREW) Programme, now under the Waste and Resources Action Programme (WRAP)	UK	Materials Waste Water	All (20% of total target market has used Envirowise's services)	Point of contact for free advice on resource efficiency Website and publications including best practice guides and case studies Resource efficiency calculators and tools Seminars, exhibitions and practical workshops Free onsite visits and recommendations	Saving of £38 for business for every £1 invested by Government

No.	Name	Organisation	Country	Resources targeted	Companies / Sectors targeted	Type of initiative / services provided	Payback / Economic results
19	ENWORKS	ENWORKS	North West of England, UK	Energy Materials Water Waste	All (mostly manufacturing and service sectors)	On-site assistance and technical support Online tools: best practices database, information resources, etc. Knowledge transfer through events	For every £1 invested by the UK, £10 of bottom-line savings is generated for North West businesses
20	National Industrial Symbiosis Programme (NISP)	National Industrial Symbiosis Programme (NISP) now under the Waste and Resources Action Programme (WRAP), funded by Defra	UK	All	All	Website and publications (including a newsletter) Extensive database with case studies Regional information events and training seminars Facilitated workshops and best practice sharing events Resource stream monitoring system and data analysis tool to identify potential synergies for resource exchange in defined geographical areas	The net Total Economic Value Added (TEVA) ranges from £1,470m to £2,450m (€1,800m to €3,000m), representing an investment multiplier of between 53.2 and 88.6.
21	Global Reporting Initiative (GRI)	Global Reporting Initiative (GRI)	International	All	All	Guidelines for sustainability reporting Online resources Coaching and training Certification of software, tools and reports	
22	ÖBU	Swiss Association and centre of competence for eco-conscious Business Management	Switzerland	All	All	Website Personal consultation Training	

No.	Name	Organisation	Country	Resources targeted	Companies / Sectors targeted	Type of initiative / services provided	Payback / Economic results
23	Green Suppliers Network	Partnership between the U.S. Environmental Protection Agency and the U.S. Department of Commerce's National Institute of Standards and Technology's Manufacturing Extension Partnership (NIST MEP)	USA	All	All industry sectors	Website Company visits with assessments Training Development of personalized plans of action	The total annual potential impact identified is of $103,643,476 (€80 million)
24	WasteCap Resource Solutions	WasteCap Resource Solutions, Inc	Wisconsin, USA	Solid waste materials	Construction, demolition and renovation projects	Online documentation programme On-site assistance Construction and demolition waste recycling training	

3.3 Analysis of information-based initiatives

The review of the selected initiatives shows that there are a multitude of different approaches to supporting businesses in improving their resource efficiency. Besides the geographical coverage and the resources, sectors and/or companies targeted, the information-based initiatives vary according to:

- How the initiative is organised;
- The 'mechanism' that the initiative applies to promote resource efficiency (i.e. the underlying approach that is used to act encourage businesses to improve their resource efficiency);
- The media or manner of communication or knowledge sharing that is used;
- The frequency and duration of involvement with businesses; and
- How the initiative is financed.

Table A3 provides an overview of the different variations identified for conceiving an information based programme for promoting resource efficiency. Each of the options have their advantages and disadvantages, e.g. regular onsite audits with experience experts would probably achieve significant resource efficiency improvements rapidly, but would also be relatively costly to implement and maintain. The different variations shown in the table are not comprehensive and neither is each option independent. Often, information based programmes apply a multitude of complementary options to best encourage businesses to improve their resource efficiency.

Table A3 Typology of information-based initiatives promoting resource efficiency

	Variations of information-based initiatives							
Geographical coverage	International	EU	National	Regional	Local			
Resources in focus	All	Several resources (e.g. materials and waste)	Specific resources (e.g. food waste)					
Type of resource efficiency measure	Process or product improvement	Process, product or service redesign	Technology change	System change/redesign				
Sectors targeted	All	Selected sectors	Individual sectors					
Companies targeted	All	SMEs	Other					
Organisation	Information centre	Network	Partnership	External experts	Scheme			
Mechanism	Discover *(e.g. providing information)*	Engage *(e.g. awareness raising,*	Educate *(e.g. training)*	Diagnose *(e.g. audits, checks)*	Enable *(e.g. tools, contact to experts,*	Exemplify *(e.g. awards, labels)*	Assist *(e.g. consulting, mentoring,*	Monitor *(e.g. reporting)*

	Variations of information-based initiatives							
		commitment, networks)			*access to funding)*		*access to funding)*	
Communication form	Face to face (direct personal contact)	Group (e.g. seminar)	Helpdesk (telephone and email)	Publications	Website	Other		
Duration of engagement	Constant	Constant for a limit time period	Punctual (e.g. annual)	Once				
Financing	Free (paid by public funds)	Subsidised (part of the costs are paid by the company)	Membership	Voluntary	Company pays full costs	Other		

As there is not sufficient information of the pay-off or pay-back time for all of the initiatives, it has not been possible to determine which type, design or structure of an information-based programme would be the most cost effective. Nonetheless, it is possible to derive some useful findings that can support the design of a successful information-based programme to promote resource efficiency in businesses. The analysis of initiatives supported the following findings:

3.3.1 Cost-effectiveness of information based programmes

Some of the initiatives actively track the effectiveness and performance of the programme (as well as the savings achieved in businesses), but in most cases this is done irregularly (e.g. for case studies) or simply not done at all. Among the programmes investigated, the main benefit for businesses was energy and resource efficiency savings. Depending on the company and the type of measure, annual savings could range from a few thousand Euros to a million Euros. The calculated savings depend to a large extent on the actual costs of resources and waste treatment. Commodity prices for materials can vary significantly. When prices are high, the cost savings from resource efficiency will be correspondingly higher. Likewise water and waste management is priced/taxed differently across Europe, which means that the same economic benefits cannot be expected from the same measures or resource savings. Nonetheless, the majority of the measures would require no investment or could be paid back within a year. Although these are significant savings, it was mentioned that it was unlikely that high efficiency gains could be repeatable year after year.

Besides cost savings, an increase in sales and market opportunities could be attributed to some of the programmes, such as EU Ecolabel, EMAS and sustainability reporting (GRI). Several programmes also stated that business achieved other benefits such as improved company and brand image, lower regulatory compliance costs, better staff recruitment and retention, but these are more difficult to quantify.

Estimates for the cost effectiveness of the public funded programmes in the UK range from €10 to €38 of business savings for every € invested by the government.

3.3.2 Organisation of the initiative

One of the main strengths of WRAP and its range of programmes is that it offers a 'one stop shop' or central contact point for businesses that can cover a wide range of needs. Businesses from any sector and size can receive help on a broad variety of resources and issues. To provide more flexibility, some programmes offer a broad range of expertise by working with partner organisations and contacts to independently approved specialists and consultants, e.g. ENWORKS and WIN. This is also one way of supporting local networks and companies. It can also help ensure that the advice given is independent and practical. Eco-Emballages even proposes businesses to partner with engineering students that specialise in packaging design to help them reduce packaging waste. The organisation of the initiatives is often linked to the needs of the businesses targeted (personalised advice, online tools, etc) and the available funding. Some of the programmes analysed (e.g. NISP, Öbu, Ihobe) promote the creation of business networks and the implication of companies with experience on resource efficiency in the organisation of workshops and training seminars.

3.3.3 Mechanism for change

Providing targeted information to influence businesses to improve their resource efficiency is common amongst the information based initiatives investigated. This can be done in various ways to encourage companies to act. For some companies, it might be sufficient to educate and engage personnel to get them started, whilst other companies might require more support with their internal processes using tools and expert advice. Several of the initiatives provide support with 'softer skills' which can embed behavioural change across the organisation. Deeper relationships at both managerial and operational levels were seen as important in, for example, the Courtauld Commitment. In general, commitments either in the form of (voluntary) agreements or monitoring progress is thought to be effective in ensuring results are achieved. Here a balance must be found so that the burden of reporting is not too great on businesses. Another effective approach to engage businesses in resource efficiency is to quantify the financial and environmental savings and frame them in business terms.

Awards, labels and certification schemes can also motivate businesses to improve their resource efficiency, but here the 'mechanism' is reverse in the sense that businesses have to first demonstrate that they are resource efficient. Businesses that choose to fulfil certain criteria or do exceptionally well with regards to resource efficiency can enjoy additional marketing benefits and recognition on the market.

3.3.4 Communication form

Direct face-to-face interaction is seen to be the most convincing manner to engage businesses in resource efficiency, but meeting with peers in non-competitive environments (e.g. NISP) was also mentioned as an effective way of sharing knowledge. In order to lower costs, some initiatives provide on-site visits, training and workshops with several companies at a time. For some businesses and individuals, where time and convenience is an issue, online training and self-help diagnostic tools were preferred.

An important aspect of the manner in which information is provided is that it is clearly structured. Some individuals and businesses are overwhelmed with too much information, especially if it is not presented in a clear way responding to their specific needs. Personal interaction is better suited to provide support and solutions catered

for individual needs. Publications and online resources are most effective when the information is concise with more detailed information clearly signposted.

With voluntary agreements, awards, labels and certification schemes, the communication is not just between the business and the organisation behind the initiative, but includes a wider audience of the supply chain and customers.

3.3.5 Duration of engagement

Information based programmes were most effective when they were able to embed resource efficiency into companies as part of their daily operations and business processes. Regular contact with businesses could help ensure this and could also allow the programme to track resource efficiency progress in a formal or informal manner (e.g. the Courtauld Commitment, Global Reporting Initiative). For some companies, a single visit or series of visits were seen as sufficient to initiate a pilot project for resource efficiency before it became an integrated part of the organisation.

It was also mentioned that it took time for information programmes to build up a reputation for being able to achieve actual cost and resource savings. A certain amount of time is needed for a programme to establish itself and demonstrate its value. Successful programmes that had existed for some time experienced companies that would return to update or develop their resource efficiency competencies. Short lived programmes are not considered to be very effective in engaging businesses.

3.3.6 Financing

Most of the programmes are provided as free services so that costs are not a barrier to engage businesses. Often the only costs are the businesses' own time spent. Programmes could be fully funded or partly funded with the possibility of businesses to apply for individual funding. In some cases, the fact that services were provided for free could be perceived by businesses as low value or even implying a catch, e.g. costs would come later, or the advice would be totally independent.

Membership fees could be a way of sharing costs (e.g. Hackefors Model in Sweden) and ensuring companies commit more (e.g. Eco-Emballages). Öbu in Switzerland is an example of programme running exclusively on membership fees. Although most of the programmes investigated in this study are initiated by public authorities, there are several examples of consulting companies offering resource efficiency services on purely private business terms (see TableA4). According to a Eurobarometer survey[46], 43% of SMEs in the EU report that they receive external support in relation to their environmental actions. Most of these receive advice and other non-financial assistance from private consulting and audit companies (12%) and similar assistance from business associations (10%). Very few SMEs appear to receive direct financial support, with 5% receiving private funding from a bank or investment company, 4% public funding and 3% private funding from friends and relatives.

[46] TNS Political & Social (2012) SMEs, Resource Efficiency and Green Markets. At the request of the European Commission. Eurobarometer 342.

Table A4 Examples of resource efficiency related services offered by private consulting firms

Consulting firm	Examples of services offered
Deloitte http://www.deloitte.com/view/en_GX/global/services/sustainability-and-climate-change/index.htm	Resources management: - Water management - Minerals - Land use Sustainable operations and supply chain: - Developing Key Performance Indicators for Sustainability - Green Lean Six Sigma - Sustainable cost management - Green warehousing - Sustainability reporting and sustainable business performance management - Automation of sustainability reporting
McKinsey http://www.mckinsey.com/Client_Service/Sustainability	Sustainability and resource productivity: - Green Operations (supply circle management, production, product design, recycling and reuse) - Clean Technologies (identifying opportunities for investment, designing operational improvement programs, exploring implications for existing business models) - Sustainable Enterprise (sustainability strategies, green growth, managing for sustainability) - Water & Waste (develop water management programs, optimise industrial operations, capture the potential of waste services provision, revolutionise products and systems)
KPMG http://www.kpmg.com/Global/en/WhatWeDo/Special-Interests/climate-change-sustainability-services/Pages/Default.aspx	- Sustainability supply chain services (strategic analysis, diagnostics, benchmarking and supplier assessment, business case development, implementation support, performance monitoring) - Sustainability performance improvement services
PriceWaterhouseCoopers http://www.pwc.com/gx/en/sustainability/index.jhtml	- Strategy - Monitoring and reporting - Performance management - Governance and organisation
Ernst and Young http://www.ey.com/GL/en/Services/Specialty-Services/Climate-Change-and-Sustainability-Services	- Climate change and sustainability services - Supply chain (product lifecycle management, sustainable procurement review) - Corporate responsibility reporting advisory
Boston Consulting Group https://www.bcg.com/expertise_impact/capabilities/operations/default.aspx	Operations: - Cost efficiency and asset optimization - Lean - Sourcing and procurement - Supply chain management
Bain & Company http://www.bain.com/consulting-services/performance-improvement/index.aspx	Performance Improvement: - Performance Improvement Diagnostic - Business Process Redesign - Lean Six Sigma - Sustained cost transformations - Supply Chain Management - Procurement
Accenture http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Sustainability-Services-Brochure.pdf	- Sustainability strategy (innovation and new businesses) - Operational Excellence (Sustainability performance management, green six sigma, sustainable supply chain, sustainable talent, organization and learning) - Emissions Management (water and waste management services) - Sustainable Infrastructure (waste, water and recycling solutions)

This wide offer of support services related to resource efficiency from public and private entities illustrates the growing interest of companies in improving their environmental performance in general and their resource efficiency in particular. Most of the public programmes provide a variety of support services to companies on resource efficiency in general, but with a slight focus on the early stages of the process (e.g. awareness raising,

access to knowledge, support to action, etc). Private consultants, however, take action mostly in later stages of the process, once the decision of change has already been taken. In this sense, it can be said that this variety of services are not competitors but complementary, and respond to the different needs of companies regarding resource efficiency strategies for their businesses.

4. Possibility to scale up resource efficiency programmes

The analyses of information-based programmes that promote resource efficiency in businesses provide ideas for how to successfully design and implement similar programmes at EU level. The lessons learnt from these programmes can be seen as suggestions for good practice, and any new initiatives should build upon, strengthen and complement the existing programmes.

4.1 Existing initiatives at EU level that promote resource efficiency

The most relevant initiative at EU level on resource efficiency for businesses is perhaps REMake[47], a Europe INNOVA[48] project financed by the Competitiveness and Innovation Framework Programme[49] (CIP) with the objective of supporting recycling and resource efficiency strategies in SMEs by means of consulting tools such as self-assessment tools, training modules and database information systems. Although the scope of this project is not wide enough to cover all industrial sectors and material flows throughout the EU, its aim is to test methods and tools to overcome a number of barriers to eco-innovation, such as access to knowledge, lack of innovation skills, etc. The organisation of the REMake partnership is similar to that of some of the information programmes analysed (e.g. WIN, Motiva, Ihobe), in which support from external experts is fully or partially funded by the programme organisation. The 'Innovation Voucher' in REMake is a new funding scheme currently being tested by the public innovation agencies demea (Germany), OSEO (France), Innovhub Milan (Italy), DII Navarra and CICI Valencia (Spain) and WRAP (UK). The Innovation Voucher allows manufacturing SMEs to access technical, business and innovation support, in the field of recycling and resource efficiency. Based on the experiences gathered from REMake, there seems to be a potential to extend the partnership to all EU Member States and use the experience of national resource efficiency centres and networks to support the creation of similar entities in Member States that do not currently have them.

The Enterprise Europe Network[50] (EEN) is a European Commission programme aimed at supporting SMEs in technology transfer, finding business partners and accessing EU funding. EEN supports sharing best practices and opportunities, which includes environmental aspects and projects. It functions with a network of local branches such as chambers of commerce, public agencies, etc., that provide support to SMEs on all the services offered by the EEN. In parallel, the Eco-innovation initiative of the European Commission helps companies to close the gap between research and commercialisation with the programme *"First application and market replication"*[51]. This funding programme is focused on bridging the gap between research and innovation (e.g. prototypes, test and

[47] http://www.ecomanufacturing.eu/

[48] http://www.europe-innova.eu/

[49] http://ec.europa.eu/cip/

[50] http://portal.enterprise-europe-network.ec.europa.eu/

[51] http://ec.europa.eu/environment/eco-innovation

verification of emerging technologies). Other initiatives not specifically related to resource efficiency but with a certain level of success at EU level are the Eco-Innovation Observatory[52], the Intelligent Energy - Europe programme[53] and the European Platform on Life Cycle Assessment (LCA)[54]. The Eco-Innovation Observatory aims to gather information on eco-innovation (including resource efficiency) activities and progress in the EU and Member States. The European Platform on LCA is hosted by the Directorate-General Joint Research Centre (JRC) of the European Commission and aims to improve credibility, acceptance and practice of LCA in businesses and public authorities. Part of this is the European Life Cycle Database and the International Reference Life Cycle Data System (ILCD), which both provide resources for businesses for performing LCAs including databases of life cycle inventory (LCI) data In a similar way, the JRC maintains the Reference Documents on Best Available Techniques (BREFs) – part of the framework of the Industrial Emissions Directive (IED). These documents gather the latest developments in environmental technologies for a number of industrial sectors, which helps Member States define the operating permits of installations affected by the IED Directive. BREFs can also be used by companies as a source of inspiration and benchmark of the environmental performance of their operations.

The Intelligent Energy - Europe programme funds research and development cooperation projects on energy efficiency, which results are made publicly available. This helps promoting energy efficiency, and renewable energy sources in the EU industry and transport.

The European environmental certification schemes (EU Ecolabel for products and EMAS for companies) have already been analysed in the previous section, and are examples of information programmes that can include resource efficiency criteria. Similarly, Green Public Procurement is tackled by the European Commission under the Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan. Common GPP criteria have been developed and national GPP action plans have been promoted in the EU Member States. For the EU Ecolabel, EMAS and GPP the European Commission maintains three respective Helpdesks[55] or information centres, which helps solve questions that may arise in the industry and eventually organise workshops or seminars. These Helpdesks are examples of free information services that promote and help businesses reduce the environmental footprint of their products or activities and increase their competitiveness.

4.2 Gaps identified at EU level

The two most recurrent services provided by the information programmes at regional level analysed in the previous section are knowledge generation and transfer (e.g. workshops, trainings, online resources, case studies, newsletters, etc) and assistance by experts (e.g. site visits, audits, expert advice, etc).

[52] http://www.eco-innovation.eu/

[53] http://ec.europa.eu/energy/intelligent/index_en.htm

[54] http://lct.jrc.ec.europa.eu/

55 Helpdesks for EU Ecolabel, EMAS and GPP:

- http://ec.europa.eu/environment/ecolabel/helpdesk.html
- http://ec.europa.eu/environment/emas/tools/contacts/helpdesk_en.htm
- http://ec.europa.eu/environment/gpp/helpdesk.htm

The generation of knowledge on resource efficiency is partially tackled within broader funding programmes such as the Seventh Framework Programme (FP7)[56] or CIP. Although FP7 and CIP help companies to become more resource efficient, the competencies and experiences tend to only benefit the participants involved. Knowledge from these projects could be made more applicable and accessible to a broader range of businesses to increase the uptake of resource efficiency measures and technologies. The "First application and market replication" programme under the Eco-innovation initiative covers partially this need by supporting the transfer of innovative technologies from research to market. This programme, however, does not affect the dissemination of the technologies, the sole beneficiaries of the support being the companies that develop the innovative solutions. This is somehow a similar issue to that of FP7 and CIP programmes: the knowledge generated is kept within the companies that participate in such programmes but the entire EU economy does not benefit as such of these innovations. The survey performed in this study (see section 8.3) confirmed that businesses rarely seek information on improving their resource efficiency on government and publicly funded websites. The Intelligent Energy – Europe programme supports the use and dissemination of EU knowledge of energy efficiency, but it is limited to energy. The EU could either extend the programme to include other resources, or consider establishing similar programmes focused on specific resources such as materials, water and waste.

Tailored technical, business and innovation support to SMEs are already part of the REMake partnership, but this is only a pilot project accessible only in a limited number of countries and companies. Such direct support is most effective through national or regional initiatives, but the EU could help in establishing initiatives in all Member States and regions through a knowledge sharing network. This is partially tackled by the Europe Enterprise Network (EEN), which provides a number of services to support technology transfer and spread best practices by using a network of local and regional agents in the different Member States. Although EEN does offer services for the environmental technology sector, it does not have a focus on resource efficiency that can be applied broadly across sectors. The specific general resource efficiency efforts in this area could be somehow improved. There exist also other similar services at EU level such as the European Small Business Portal[57], Your Europe-Business[58] portal or the IPR Helpdesk[59]. Such one-stop shop services are useful for business in a way that one single service (e.g. helpdesk) can provide information about available services, funding, information programmes, etc. This structure has been also used by some national and regional programmes (e.g. WRAP, Ihobe). A specific helpdesk or branch within the EEN dedicated to support resource efficiency in SMEs might make the service more visible for companies and have effects on both awareness raising and support to action. Furthermore, a close cooperation between national and regional public agencies (e.g. WRAP, demea, OVAM) and the EEN could help to better reply to businesses' needs and to avoid duplication of the work and services provided.

[56] http://ec.europa.eu/research/fp7/

[57] http://ec.europa.eu/small-business/

[58] http://europa.eu/youreurope/business/

[59] http://www.iprhelpdesk.eu/home

4.3 Possibilities of initiatives and actions at EU and national level to promote resource efficiency

As explained in the previous section, there are three key aspects in the promotion of resource efficiency in businesses at EU level:

- Generation of knowledge;
- Transfer of knowledge; and,
- Support to act and implement.

These three aspects can be undertaken in different ways, but should be coordinated with the previous work and the existing structures. The generation of knowledge for how businesses can become more resource efficient is already well established on the EU level through initiatives such as research, development and innovation programmes, best reference documents and life cycle inventory databases. The potential for improvement is more on the transfer of this knowledge and support to put the knowledge into practice. The EU could make a lot of this information more accessible through easily understandable websites, online training programmes (e.g. like Zero Waste Scotland's On Course for Zero Waste) and simple tools that companies could use directly (e.g. OVAM's MAMBO tool).

At present, DG JRC's ILCD project and the European Platform on Life Cycle Assessment are expected to support life cycle thinking and assessment in businesses. It is not clear to what extent businesses benefit from these initiatives, but the uptake of life cycle assessment and ecodesign could be further supported with the potential implementation of Product Environmental Footprinting (PEF)[60]. PEF aims to put forward a common methodology for quantifying and communicating the environmental impacts of products in the EU. This is expected to provide a more fair comparison of products based on their environmental performance, but also help companies and supply chains to communicate on how to increase their resource efficiency. In parallel, the Organisation Environmental Footprint (OEF)[61] will provide a harmonised calculation methodology to determine a company's environmental performance, which could be used to identify and reward the most resource efficient companies.

The EU could support a network of national and regional resource efficiency centres, or alternatively, establish a programme similar to Intelligent Energy - Europe (IEE). The benefit of national and regional centres is that they are closer to the local industries and their needs. This would ensure a broader uptake of resource efficiency measures. At present only a limited selection of EU companies participate in public R&D programmes, and they are typically businesses that already are motivated to increase their resource efficiency. An EU network of resource efficiency centres could help Member States establish their own national and regional centres and share a variety of tools, experts and online resources – as was tried out with REMake. Such a network could perhaps function as part of the EEN or be organised directly with national and regional business support centres. An EU network of resource efficiency centres could be established by the European Commission and the existing national public

[60] http://ec.europa.eu/environment/eussd/product_footprint.htm

[61] http://ec.europa.eu/environment/eussd/corporate_footprint.htm

agencies, in a way that the existing work and experience can be shared effectively and put into service for companies throughout the EU. During the interviews carried out for the analysis of existing information programmes, only a limited number of programme representatives recognised cooperation with other programmes or initiatives at EU level or in other Member States. A number of initiatives have been identified that have already developed important work on resource efficiency with companies, and the share of these experiences could help to broaden the companies and sectors participating in them.

Most of the information programmes analysed above operate at national or regional level. The positive results of many of them lead to the conclusion that these kind of services can be cost effective, can reduce the use of resources and improve the performance of businesses. The application of these programmes at small scale allows the offer of personalised services to businesses and a better knowledge of the particular situation of the local industry. In fact, a number of information programmes are, or have been, designed based on the needs expressed by companies.

This aspect of specificity of the programmes and services might somehow prevent the direct translation of some programmes into other geographical areas within the EU. Nevertheless, the basic approach and lessons learnt from the existing information programmes can be seen as proof of the potential benefits of resource efficiency for businesses, and the importance of the role that public administrations have in achieving these benefits. These services are not widely offered throughout the EU, which shows some room for improvement for the EU industry, provided that they are replicated at national or regional level.

5. Summary of findings

There exists a broad range of public and private information based programmes that support businesses in improving their resource efficiency. These can take the form of direct consulting and auditing services, or through training workshops, and self-help tools and guides. Voluntary schemes such as ecolabels and environmental management systems (e.g. EMAS) have proven to also be effective ways of promoting resource efficiency.

Resource efficiency savings are in general the main benefit of these programmes. Depending on the company and the type of measure, annual savings range from a few thousand Euros to a million Euros. The majority of the measures would require no investment or could be paid back within a year. The degree of savings depends to a large extent on the actual costs of resources and waste treatment, which can vary with commodity prices, and water and waste management taxes. This means that the economic benefits vary from the same measures across Europe and over time. Although many of the savings achieved are significant savings, it is unlikely that high efficiency gains could be repeatable year after year. Other benefits to business have also been attributed to the programmes such as improved company and brand image, lower regulatory compliance costs, better staff recruitment and retention. Estimates for the cost effectiveness of the public funded programmes in the UK range from €10 to €38 of business savings for every € invested by the government.

Although not investigated in detail, a range of resource efficiency improvement services offered by major (private) consulting companies were identified, indicating that there is a significant potential for business to improve their performance.

The analysis of information programmes promoting resource efficiency resulted in a typology of the services and approaches currently used. Together with the best practices and lessons learned gathered, this could support the design and implementation of other resource efficiency information programmes at either national or EU level. A wider application of programmes that builds on best practices would appear to be cost-effective.

PART B

Determination of the scope for business improvement in the efficient use of resources and quantification of the potential savings from uptake of further resource efficiency measures

6. Identifying the scope for businesses to improve in their efficient use of resources

6.1 Task overview

This task was concerned with seeking 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 was necessary given the time and resource constraints as well as the need to gain the necessary intimate understanding of businesses operating in specific sectors. The main research questions posed were as follows:

- **Where are businesses starting from?** This required the establishment of the 'baseline point' in efficiency terms – for the purposes of this study, defined as inefficient use of resources (i.e. more could be done). For comparison purposes, this baseline could be cross-referenced to an efficiency level that industry would recognise as 'standard practice'. The research sought to better understand, for selected sectors, definitions around levels of efficiency as well as what business might perceive to be efficient/inefficient practice, which varies by company, sector and country;

- **What resource efficiency 'measures' are available to businesses?** Recognising the impracticalities of trying to understand and catalogue measures at the greatest level of granularity (i.e. thousands of measures), this task was focused on researching typical measures (either individual or clusters often implemented together) to arrive at a framework of measures (see Table B3) that would be broadly applicable (and recognised as such by industry) in the sectors being examined. Research was conducted using top-down and bottom-up methods as well as direct surveys to triangulate the effect of the measures (i.e. the cost savings and other benefits), the typical cost ranges to businesses of implementing the measures and likely payback in the sectors examined;

- **What are the theoretical opportunities from improved resource efficiency?** This required the establishment of a theoretical 'optimum efficiency', a hypothetical operating environment where businesses are operating on minimum inputs (in resource terms) for maximum outputs (in value terms). For the purposes of the study, this was defined as optimum use of resources (i.e. it was unlikely given constraining market, environmental, technological and economic factors that businesses could do more to improve further). For comparison purposes, this optimum point could be cross-referenced to an efficiency level that industry would recognise as being 'best practice' and currently being achieved only by sector 'top-runners'; and

- **What scope is there for businesses to capitalise on the opportunities?** This task concentrated on the examination of the realistic extent to which it is believed businesses can achieve greater resource efficiency as set out graphically in Figure B1. This must be made having regard to some of the constraints and limiting factors (drivers and barriers) identified through the research. It is one of the most complex and difficult areas to assess; the literature reported significant variability in drivers/barriers[62], market failures, investment levels and research and development expenditure, innovation and business attitudes and well as business models, behaviours, attitudes and principles.

[62] The study has sought to understand and express the barriers from the view of business, based upon the capability, both real and perceived, of businesses to move from a less efficient model of operation to one that is more efficient.

Through triangulation of literature and data sources, using research and direct consultation, an effect was derived (in terms of material and water savings and waste reduction) for each measure and an assessment of the likely uptake by industries in the sectors examined was made. Given the lack of available information of likely uptake, the final figures were primarily informed through limited direct surveys and published surveys of European businesses[63].

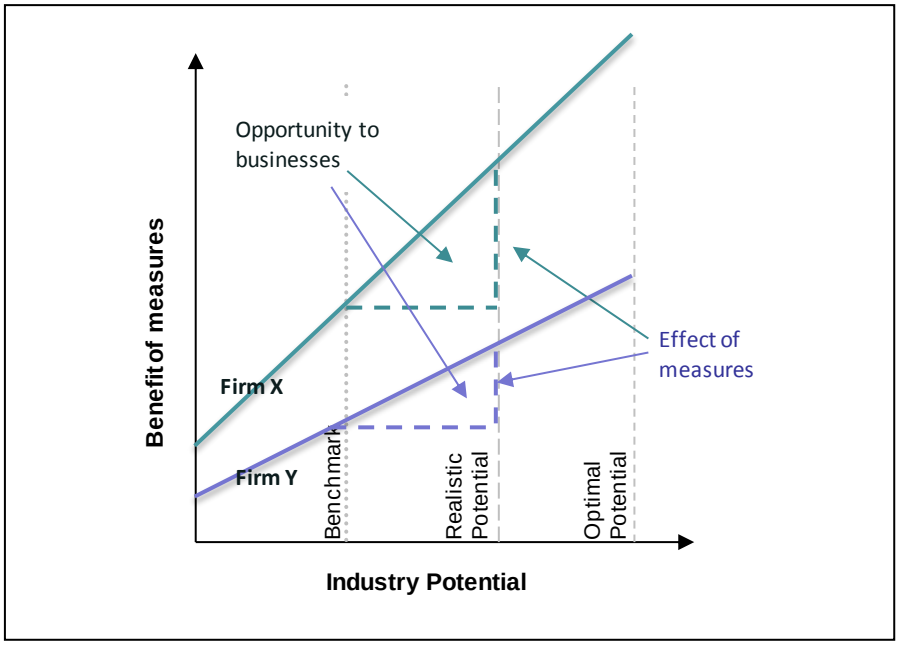


Figure B1 Conceptual model of the opportunities to business from resource efficiency

The objective of the task was to arrive at a plausible grouping of specific measures that could be adopted by businesses together with a conclusion as to what effect those measures would have in terms of reducing resource consumption and water usage per unit output and preventing, or where not practicable, re-using and/or recycling wastes generated. The outputs from this task are used as feed-in data to the quantification of the size of the opportunity.

6.2 Scope

Key elements to note about the scope of the task are:

- The focus is on those sectors that are considered to be resource intensive as informed by current knowledge and the literature reviews;
- The focus of the assessment of measures is concerned only with savings of materials and water and reduction of waste – energy is specifically excluded;
- The focus is on internal business efficiency rather than inclusion of the wider economic and environmental benefits;

[63] Flash Eurobarometer 342 (2012) SMEs, Resource Efficiency and Green Markets (TNS Political & Social)

- The scope of the resource efficiency measures being examined (with sub-groups therein), to include:
    - **Horizontal measures**: non-technology based '*soft measures*' that have applicability across businesses and sectors and are typically implemented as complimentary to more concrete eco-design, efficient technology, process and service-system measures.
    - **Specific measures**: these are described as '*hard measures*' more typical of the ecodesign, process optimisation and technology based solutions to eliminate, reduce or facilitate greater reuse of materials, water, by-products and wastes. Some measures are broadly applicable across a range of sectors and some are sector-specific.
- Estimation of the benefits (e.g. cost savings) that individual measures confer to any business implementing them has been triangulated from an assessment of published literature, the professional expertise of the consultants (AMEC and Bio Intelligence Services) and the results of a small survey of business and industries in the chosen sectors. The benefits are given as those directly conferred on the business – external benefits such as wider social, environmental and economic benefits are excluded from the estimates;
- Estimation of the costs of measures has been made based on data gathered from individual and sectoral case studies as well as from a selection of published sources with cross-checks made by the consultants – exact costs have not been fully verified by the study team and therefore can only be taken as estimates that may be applicable across a broad range of businesses within the chosen sectors;
- The assessment of the opportunity more widely has been assessed based on likely uptake (i.e. implementation by those businesses that at present are operating less than optimally in resource terms). The estimates have been derived from Eurobarometer survey results adapted to take account of influencing factors in uptake (i.e. those that the business can control – resource capacity, knowledge, financial aspects, investment and behaviours), but exclude external factors from the scope: regulatory, market conditions, finance availability, etc.
- Extrapolation of the scope of opportunities between businesses in the same sector and read-across to other sectors acknowledges the variances across the EU – these include, *inter alia*: markets they serve (clients/customers), supply chains, local conditions, specific regulations, access to finance, technologies and investment – but there is a limit to the extent the feed-in data for the quantification could factor all the variables into the estimates.

6.3 Methodology

6.3.1 Analytical framework

Assessing the scope for businesses to improve in their efficient use of resources required a wide-ranging literature review as well as targeted reviews of specific case studies. Given the scale of the challenge (the vast numbers of different businesses in different sectors and operating in different Member States), the study was forced to focus on several sectors following a review of the material, water and waste intensities of key sectors. In classifying the measures available to business to become more resource efficient, the study built on the framework set out by Brezet[21] by compartmentalising measures into types of change expected within a business as a result of improvements in resource efficiency broadly clustered by sector into measures of relevance to businesses operating

in the sectors chosen. Measures have been researched from a wide range of texts and case studies and rationalised into clusters (definitions) to create a more workable model with which to quantify the benefits to business. B2 sets out the analytical framework of this part of the study.

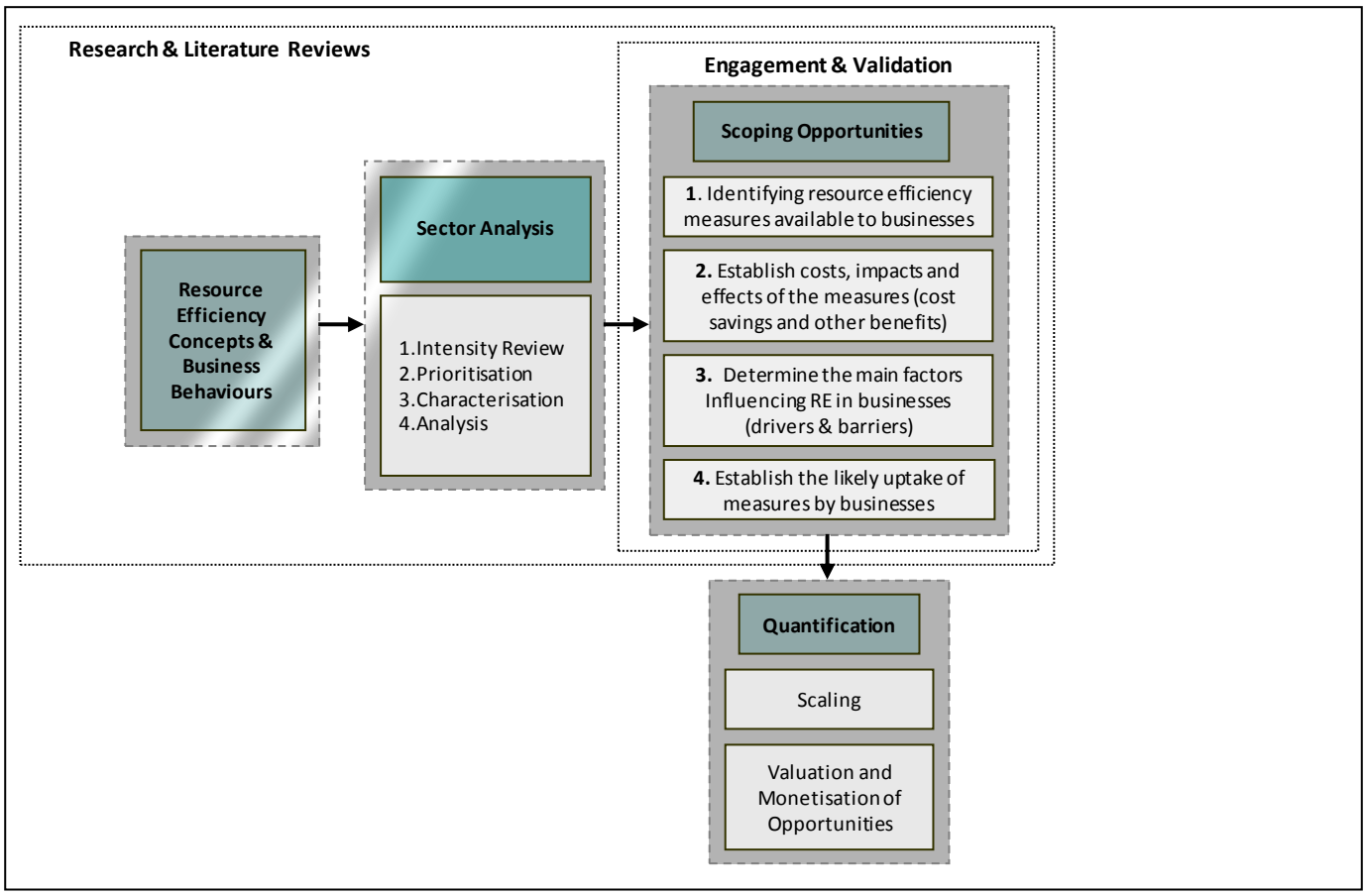


Figure B2 Analytical framework

6.3.2 Study literature review

In identifying suitable sources of information and data to feed into this study, over 200 published reports, case studies, industry profiles and other relevant research materials were reviewed and catalogued. The detailed information was captured in a two, tabulated datasets, the outputs from which were more usable assays of data, which have been integrated into the methodology and development of the quantified estimates. Specific outputs from this research include lists of drivers and barriers, key failures on business uptake and detailed information on the benefits businesses have realised through uptake of specific resource efficiency measures.

Many of the publications (particularly high profile ones published in the last two years) contain interesting and relevant material but at a level that is too aggregated to be of use in establishing the opportunities from a bottom-up perspective. Many of the reports focus on energy which, whilst a significant opportunity in terms of resource efficiency, is not the focus for this study. The research done by the study team confirms the spread of information on resource efficiency measures, the costs and benefits of those measures is concentrated at the macro-level (i.e. the EU or global perspective) and at the micro-level (reported through case studies on specific businesses). There is a

relative lack of data at the meso-level, i.e. disaggregated sufficiently to provide understanding on the functioning of different elements of the sectors under study without being too specific to a single entity. This is one of the first findings of the study.

6.3.3 Sector analysis

Given the need to set boundaries for the study, a review of the available information and data was conducted to establish the material intensities of various sectors with the aim of selecting those sectors. The study relied on previous published sources of information[64] rather than seek to generate new data on the material, water and waste intensities of various industrial sectors.

The objective of this component of the study was to better understand the character of the sectors in respect of the concept of resource efficiency; information that would be used later to guide the study team as to the barriers and constraints facing businesses and help determine the upper and lower boundary of potential uptake values to be used in quantifying the costs and benefits. The work focused on a review of selected sectors with a view to prioritising those which hold the greatest interest in the context of this study (i.e. those which pose higher levels of potential opportunity to improve) and examining the characteristics of the sectors in greater detail. This analysis was also used to arrive at a more informed outcome on how businesses in the sectors view resource efficiency, how they are impacted by drivers and barriers, what they are doing or have done already in improving resource efficiency and therefore what scale of opportunities remain 'untapped'.

Building on the foundations of the literature search and information gathered in development of Part A of this study, the sector analysis drew information from a number of academic and government-sponsored research reports and publications from trade associations and individual companies and was completed according to the following framework:

- Focus firstly on recent publications, which take account of the on-going developments in eco-innovation and resource efficiency measures; and
- Focus on the EU (but not discounting valuable examples from non-EU countries).

To establish which sectors would be taken forward for more detailed analysis, a set of selection criteria were applied as follows:

- 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).

[64] Including TNO (2011) report for DG JRC IPTS: Analysis of the future application of product policy instruments in the EU

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 selected (Table B1) for further, more detailed study into specific resource efficiency measures applied and the effect those measures have had.

Table B1 Selected sub-sectors for intensity analysis

Sectors	Sub-sectors
Manufacturing	Chemicals sector, 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, food and drink (hospitality and contract catering), facilities management (services and building maintenance, refurbishment and repairs) and product retail

Each of the sectors was reviewed in greater detail relying on published reports as well as sector-level water and waste data extracted from Eurostat[65]. This top-down review of the sectors was intended to act as a counterpoint to the study's bottom-up resource efficiency measures analysis, which used case studies, data and industrial survey results. The sector analysis sought to gather information and detail on the following areas:

Table B2 Key elements being sought in analysis and characterisation of the selected sectors

1.	Economic activity data relevant to the sector and its supply chain and sector characteristics in regards to size, scope and diversity
2.	Resource consumption in the sector
3.	How resource efficiency is viewed by sector: insights into behavioural issues of business organisations (motivators, constrainers, influencers, facilitators)*
4.	Sector-specific drivers and barriers
5.	Key actions on resource efficiency by business and/or trade associations
6.	List of potential measures/technologies for improving resource efficiency
7.	Identify the effect of implementing resource efficiency best practice and defining 'baseline' and 'best practice' conditions
8.	RE indicators (metrics) for resource consumed per economic activity

* This topic was explored largely based on consultation with industry and businesses

Following initial reviews, efforts were focused on those sectors where the evidence suggested substantial scope exists to improve resource efficiency and the availability, quality, completeness and reliability of existing data. At this point, four sectors were cut-off from further analysis: chemicals, textile manufacture, facilities management

[65] http://epp.eurostat.ec.europa.eu/portal/page/portal/environment/data/main_tables

and product retail. Eight sectors were then examined in further detail with the aim of selecting three sub-sectors from manufacturing and services sector for quantification. A summary of the information used in the evaluation of these sectors together with summary justifications for the selection of the three sectors for quantification is presented in more detail in Annex B. These three sectors were:

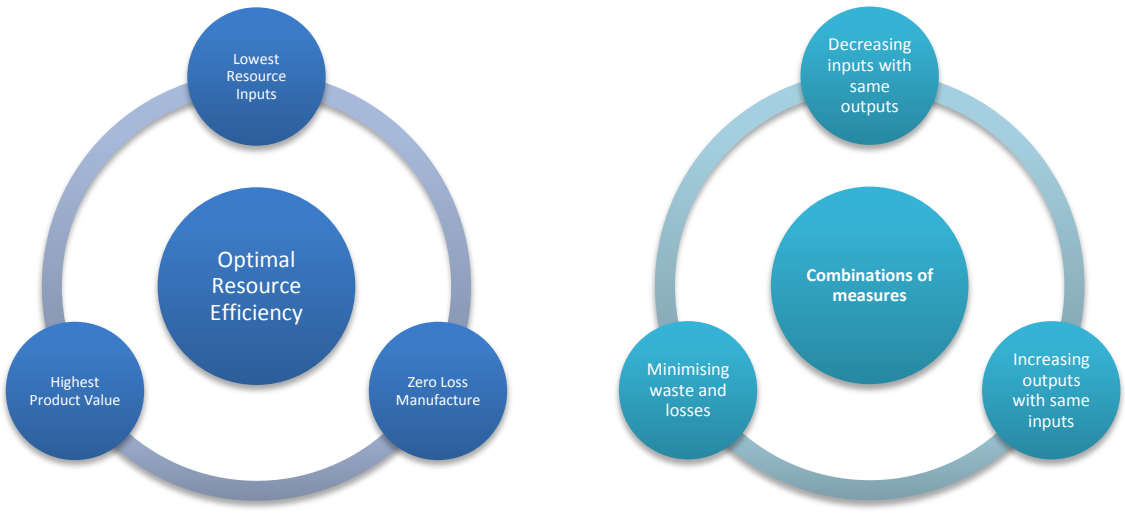
- Manufacture of fabricated metal products (limited data focus on automotive);
- Manufacture of food and beverage products; and
- Hospitality and food services (HaFS).

6.3.4 Assessment of resource efficiency measures

The objective of this element of the study was to identify typical measures, assess their relative costs, benefits, pay-back periods, general applicability (within and between sectors) and identify what evidence there is to suggest that the theoretical opportunity from implementing them could be realised across a range of businesses.

In assessing measures to become more resource efficient, it was first necessary to define resource efficiency/inefficiency, which depends on the system perspective but may be conceptualised as shown in Figure B3. In terms of measures to improve resource efficiency, **decreasing inputs with same output** (substitution and efficiency) typically can be characterised by *resource savings (costs saved from reduced input purchases*, **increasing output with same input** (dematerialisation, optimisation and effectiveness) can be characterised by *increase revenue or other cost benefits (e.g. higher item value, less costs for transport, processing and manufacturing)* and **minimising waste and losses** (efficiency, improved waste management and closing the life cycle loops) characterised by *decreasing waste volumes and re-use of industrial by-products*. In reality, resource efficiency is often improved by a combination of one or more measures. These characterisations were later used in scoping the opportunities and potential savings from further implementation by EU businesses.

Figure B3 Key elements of optimal resource efficiency and measures to improve it



This study has approached the identification and analysis of resource efficiency measures from both the top-down (using published sources that are typically broad in context and nature) and directly from case studies or published material at the firm-level (i.e. real-world examples of measures being implemented and the effects seen). Examination of measures at this more detailed level helped in understanding why certain measures were applied. In researching measures, the following information was gathered where available:

- Company name and country where the measure was implemented:
- Measure description;
- Net impact of the measure (primarily on water, material and waste);
- Cost data (company turnover, cost and savings of implementing the measure); and
- Barriers and notes on potential cross-sector applicability and further uptake of the measure.

Over 150 individual measures targeted at making businesses more resource efficient (excluding energy) were identified through the research work. Although it is acknowledged that there are likely to be thousands of variations on the typical types of measures used by businesses, to aid the aims of scoping opportunities, the list was rationalised into one of six categories and around 14 main measure types (see Table B3):

- **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. 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 consumption of materials and less generation of waste as well as actually making the product more desirable on the market and thereby able to command higher prices. Nevertheless, while LCA is a good tool, is not perfect for all the situations: some possible impacts of products or services are neglected (e.g. social aspects or not adequately covered (e.g. toxicity);

- **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;

- **Waste prevention** are measures taken before a substance, material or product has become waste that reduce:

  (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, for example, 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 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 seen as 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;

- There are several **alternatives for waste** that are more resource efficient than disposal. Instead of sending waste to the landfill, companies can implement measures 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;

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

- 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;

- 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;

- 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; and

- **Horizontal measures** can be categorised as those that typically are described as 'soft' measures such as better housekeeping, stock and damage control, improved monitoring and measurement, increased training, knowledge and awareness and company management, leadership. Characteristic of horizontal measures is the fact that they are primarily human in nature, internal to a company and often require some form of behaviour change or adaptation to realise a benefit or saving. Some horizontal measures may be implemented in isolation (e.g. better stock management and handling procedures to reduce wastage) but the actual benefits are difficult to quantify across different businesses, processes and sectors. Where the evidence was available to suggest that primarily behavioural measures would make resource savings or bring benefits to a company in their own right, these have been incorporated into the modelling work. However, this study has viewed these as being primarily complimentary to the 'hard' measures described above and as such it is likely a company seeking to be more efficient would undertake these measures as well as other ones.

Table B3 Breakdown of measure groupings from the literature and case studies review

Category	Measures	Examples	Decreasing inputs with same output	Increasing output with same input	Minimising waste and losses
Design	Ecodesign (using same materials efficiently)	Product lightweighting (e.g. glass and metal packaging) Product modification Product optimisation Product redesign	X Uses less materials	(x) Can increase revenue and/or decrease other costs	(x) Can reduce waste
	Ecodesign (using more efficient materials)	Materials substitution (e.g. cheaper, stronger, lighter) Bio-based surface coatings, adhesives and compounds	(x) Can use less materials or can use more resource efficient materials (not necessarily less)	(x) Can increase revenue and/or decrease other costs	(x) Can reduce waste
	Ecodesign (increasing recycled content)		-	(x) Can increase decrease material costs	-
	Ecodesign (increasing product life)	Green design (e.g. modularisation/design-for-deconstruction)	(x) Can use less materials, if less products are produced	(x) Can increase revenue and/or decrease other costs, if extended producer responsibility	(x) Can reduce waste, if less products are produced

Category	Measures	Examples	Decreasing inputs with same output	Increasing output with same input	Minimising waste and losses
Procurement	Resource efficient procurement	Materials handling & storage practices (reduced wastage) Materials selection (type, supplier, source) Switching Suppliers Efficiency-focused procurement (product standards	X Can use less materials	X Reduces costs of materials, components and equipment	(x) Can reduce waste, if less materials are used
Production	Waste prevention (resource efficient technology)	Replacement of production process with cleaner alternative Equipment replacement (e.g. increased efficiency and BAT) Process redesign (e.g. eco-design)	X Uses less materials	-	X Reduces waste
	Waste prevention (optimisation and soft measures)	Lean Production (lean thinking) Simple waste minimisation (e.g. waste sorting) Improved process control Process modification Process optimisation (tweaks and upgrades)	X Uses less materials	-	X Reduces waste
	Material reuse (internally)	Closed-loop service models (e.g. product leasing) Product refurbishment & remanufacturing Circular economy industrial models	X Uses less materials	-	X Reduces waste
Waste	Avoiding landfill (recycling and waste recovery)	Sorting and recycling waste			X Reduces waste management costs
	Waste exchange (selling by-products and waste as resources)	Recycling of by-products (industrial symbiosis		(x) Can increase revenue	X Reduces waste management costs
Water	Water minimisation (water efficient technology)	Simple water minimisation (e.g. low-flush WC / toilet hogs)	X Uses less water	-	X Produces less water
	Water minimisation (optimisation and soft measures)		X Uses less water	-	X Produces less water
	Water recovery and reuse	Increased Recycling (wastewater) Bio-based waste and water treatment Internal reuse (materials/water)	X Uses less water	-	X Produces less water

Category	Measures	Examples	Decreasing inputs with same output	Increasing output with same input	Minimising waste and losses
Horizontal measures		Behavioural adaptation and awareness Leadership and positive environmental messaging Knowledge and training Tools and training Monitoring and measurement of efficiency Better housekeeping and stock/inventory accountancy Product damage and wastage control	*Complements all of the measures above*	*Complements all of the measures above*	*Complements all of the measures above*

Table Notes

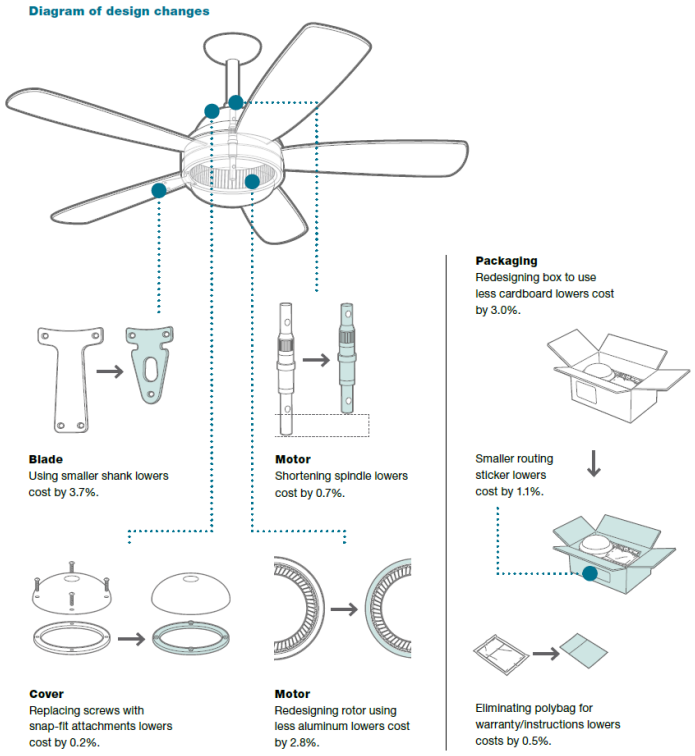
X – this resource efficiency measure contributes to achieving the desired outcome

(x) – this resource efficiency measures has the potential to achieve the desired effect depending on the specific application, processes and business sector

Resource efficient business models (i.e. system design level) 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.

Although some variation in the completeness of the data obtained from the measures review was noted, the majority is not detailed. The review concluded that available information can provide a good description of the particular measures applied and an overview of the direct effect it has on the business, albeit not at a highly detailed level in all cases – quite often the literature simply quotes "*company F saved €4,500 per annum through implementation of a filtration device to enable water to be filter and re-used for non-food contact applications such as outdoor wash downs*". Whilst such information tells us about the measure, its application and broad savings achieved, there is quite a leap required to understand wider application, payback and from what point the company actually started from (particularly as many of the case studies quoted a % saving).

Figure B4 Example of how ecodesign can save materials and costs[66]



Further rationalisation of the measures created a useable framework for the quantification of the opportunities to business in the chosen sectors - see example set out in Table B4.

Table B4 Example measures in the food and drink manufacturing sector selected from the research

	Uptake		Maximum potential for resource savings		Maximum potential for increase in revenue or reduction of costs		Maximum potential for minimising waste		Cost of measure	
	% of companies in the EU		% of amount used		% of revenue / % of production costs		% of waste		€ per company	
Measures	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate
Ecodesign - lightweighting (using same material) - packaging	11%	57%	-5%	-20%	0%	*(increased sales and/ or reduced costs)* 3%	0%	-10%	5,000	50,000
Ecodesign - lightweighting (change of material) – packaging	11%	57%	0%	-20%	0%	*(increased sales and/ or reduced costs)* 3%			5,000	50,000
Ecodesign - use of recycled content – packaging	11%	57%			0%	*(reduced material costs)* -5%			2,500	10,000

[66] McKinsey Quarterly (2012) Designing products for value. McKinsey & Company. October 2012.

	Uptake		Maximum potential for resource savings		Maximum potential for increase in revenue or reduction of costs		Maximum potential for minimising waste		Cost of measure	
	% of companies in the EU		% of amount used		% of revenue / % of production costs		% of waste		€ per company	
Waste prevention - packaging	9%	62%	-1%	-5%			-4%	-20%	1,000	10,000
Waste prevention - food (new technology) [67]	9%	62%	-5%	-10%			-15%	-30%	50,000	500,000
Waste prevention - food (best practice) [B]	9%	62%	-1%	-5%			-5%	-10%	1,000	10,000
Material reuse – packaging [A]	9%	62%	-5%	-20%			-20%	-30%	5,000	25,000
Recycling - packaging	12%	61%					-10%	-40%	500	2,000
Waste exchange (e.g. industrial symbiosis) – food [C]	1%	24%			0%	*(additional revenue)* 100%	0%	-20%	1,000	3,000
Avoiding landfill (e.g. sending to composting, anaerobic digestion) - food	9%	62%					-10%	-20%	500	2,000
Waste recovery technology (e.g. biogas, composting) - food	1%	24%			*(reduced energy costs)* - 30%	*(reduced energy costs)* - 60%	-10%	-20%	500,000	3000,000
Water recovery	8%	50%	-10%	-30%			-10%	-30%	10,000	500,000
Water prevention - best practice	8%	50%	-5%	-15%			-5%	-15%	500	5,000
Water prevention - technology	8%	50%	-15%	-35%			-15%	-35%	50,000	500,000

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.

A key part of the study terms of reference was that the opportunities to business be quantified into those low-cost/no-cost measures and those with a longer payback. The research indicated that there were sufficient differences between sectors to suggest that easily defining low-cost would be a challenge. Sectors such as the food and drink manufacturing sector typically had much greater investment costs with longer pay-back periods but overall greater gains from resource efficiency measures and therefore simply defining it based on pay-back period

[67] 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

might not provide a result that businesses would recognise. Company size was also a crucial factor, smaller companies typically are required to invest much greater amounts (as percentages of their turnover) and have access to lower amounts of 'ready cash' and/or difficulty raising finance.

As opportunities needed to be quantified across a wide range of business sizes and sectors, and definition of low cost was likely to vary, the study team settled on an informed position whereby low and no-cost measures were defined as having a payback typically being shown by the research to be less than 12 months and up-front investment costs were typically less than €10,000.

6.3.5 Assessing the scope for improvement

The purpose of this task was to provide sufficient information to model the scope for business to improve from what could be defined as relatively inefficient use of resources to more efficient use. This could be, for example, through efficiency measures that decrease inputs (e.g. material inputs) whilst maintaining outputs (e.g. turnover) at a steady state (such as substitution and production optimisation) or effectiveness measures that increase output values whilst maintaining inputs at a steady state (e.g. dematerialisation, enhanced service re-design).

The task comprised two distinct elements:

1. **An assessment of the direct impacts on businesses of adopting more measures to improve their efficiency in respect of material and water consumption and generation of wastes**

This is asking what costs and benefits might a relatively inefficient business see as a result of adoption of one or more measures. As this study was only concerned with viewing costs and benefits through the lens of business, wider effects were not further quantified (albeit qualitative assessment was provided). The benefits were derived from knowledge about what material, water or waste savings could be realistically anticipated following implementation. Again wider external benefits such as increased competitiveness or enhanced market positioning were not factored in due to lack of tangible evidence upon which to base assumptions[68].

2. **An assessment of the likely level of uptake within the sector of one or more measures**

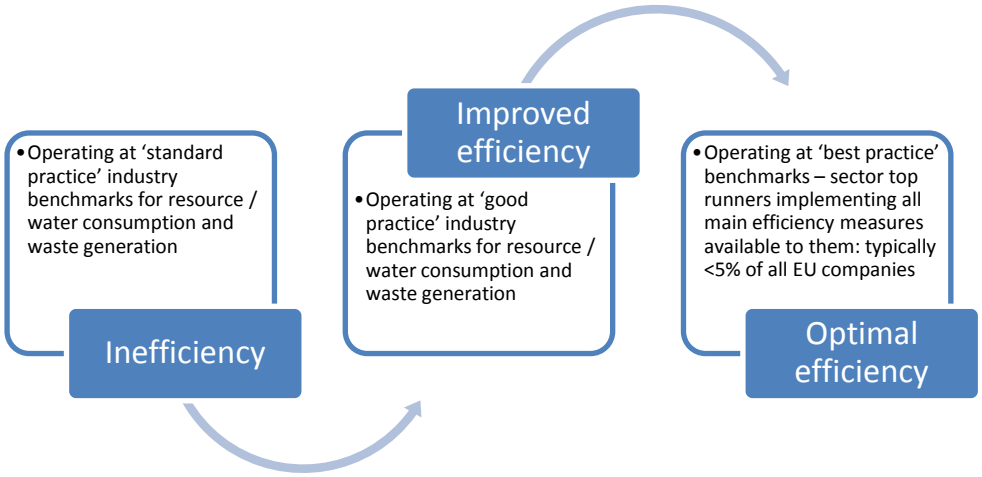
This was seeking to establish how many businesses within a sector would be likely to take up the opportunity to become more resource efficient based on the predicted benefits as well as the range of other decision-making factors. This required examination of a range of problems commonly faced by businesses operating within the sectors to be examined and analysed, in particular: market failures, barriers to uptake of more effective or efficient technologies for optimising resource productivity, barriers to system-wide waste prevention/minimisation/recovery, underinvestment and process and/or product redesign for greater efficiency over the lifecycle.

It was recognised at an early stage in the study that there were substantial theoretical and practical difficulties to arriving at a conclusion which effectively second-guessed actions that businesses might take to become more efficient in the future, particularly when the wide range of factors influencing decision making are taken into

[68] The literature review did identify several case studies where such effects were cited by businesses as being spin-offs but these were not quantified in any meaningful way.

account (see Chapter 2) and the dynamic nature of the markets within which European businesses operate. Ultimately, there simply is no reference source for likely industry uptake[69] and this is reflected in the wide ranges and high uncertainty in the final estimates. Completing this task therefore required a degree of pragmatism and objectivity. The starting point for the project team was as shown in Figure B5.

Figure B5 Classifications of inefficient and efficient businesses



The analysis conducted to inform potential scope to improve was based around a hierarchy of preferred information as follows:

- Bottom-up data on measures from specific sectors (real world examples of the costs and benefits for particular measures and information relevant to making a judgement on likely cross-transferability);
- Sharing data on measures across similar sectors (i.e. those with similar characteristics and processes); and
- Making assumptions based on wider literature and informed views (particularly those gathered through the literature reviews).

To further understand the issues faced by companies in implementing resource efficiency improvements, the study examined common drivers and barriers to increased uptake of resource efficiency measures such as:

- Drivers: cost reduction, regulatory compliance, demonstration of corporate responsibility, increased productivity, increasing cost of resources, etc.
- Barriers: access to financing, uncertain demand from the market, misalignment and lack of incentives, lack of access to knowledge, skills, technology and best practices, etc.

Presentation of the analysis along with further discussion can be found in Chapter 3.

[69] In their July 2012 Resource Efficiency Policy Paper, the UK's Environmental Industries Commission recognised that a coherent framework of indicators and benchmarks on resource efficiency for each industrial sector was yet to be developed.

6.3.6 Validation of research findings

A targeted consultation with a limited number of EU businesses and trade organisations was conducted to fill in some of the knowledge gaps remaining following the various literature reviews and to seek to verify the findings from the review work. The data gaps to fill were as follows:

- Case studies and front runners: literature review had identified some progressive companies through case studies but through consultation with industry associations, a clearer identify on the front runners and what incentives led these businesses to become top runners could be gained; to better understand the gap between inefficient and efficient as defined within the chosen sectors;
- Drivers vs. Barriers vs. Capability: drivers, barriers and capability factors and their relative significance were identified through the literature review – the validation exercise sought to verify some of the findings and the relative importance of specific factors in influencing businesses' decisions on further investment in resource efficiency;
- Measures, including:
  - The list of measures and their relevance
  - Technical ease/difficulty of implementation and why specific measures had been chosen
  - Uptake rate (particularly amongst other businesses within the sector)

The project team contacted 41 businesses over a two month period (late July - early September 2012) and received eight completed responses to a series of key questions (one fabricated metal; five food and beverages; and two hospitality). The quality of the received responses was very high however the return rate was disappointing, even given the extension of the response deadline to account for the summer holiday period across the EU in July and August.

The validation work was purposefully designed to be detailed such that it could capture new insights and views on resource efficiency from leading players within the sectors. The question set (pro-forma) and results can be found in report containing the Annexes. The analysis of the results in the context of the main findings from the study is presented in Chapter 8.3.

6.4 Main outputs

The key outputs from this study task were as follows:

- Detailed literature review providing evidence of measures used and the benefits conferred to industries – including published reports, analytical research and sector-specific case studies;
- Sector profiles for eight key sectors, three of which were later chosen for the quantification of potential savings;
- Detailed databases of measures (bottom-up analysis) together with evidence of the actual effects (costs and benefits) those measures had on businesses within the EU and globally;

- List of the measures together with estimated direct impacts (material, water and waste savings), implementation costs, cost savings, notes of additional external benefits (spin-offs);

- Examination of the causal models of businesses in respect to resource efficiency and decision-making on investment to improve – this included a detailed analysis of the drivers and barriers acting upon businesses, which are likely to influence the level or rate of uptake of further measures when set in the context of internal and external constraining factors; and

- Results of a limited survey to establish insight into business decision making behaviours, attitudes to resource efficiency and to verify some of the key findings from the literature review and published research/case studies.

7. Quantifying the opportunities to improve resource efficiency

7.1 Task overview

This section discusses the development of the quantification model and development of estimates. The objective was to estimate cost savings from resource efficiency improvement measures / interventions in a selection of sub-sectors within the manufacturing and services sectors in the European Union. This section describes the principles and procedures used in developing quantitative results.

The aim of the analysis of available data was to identify information that can contribute to the:

- **Baseline assessment:** the specification of a baseline was important for the subsequent sub-tasks; as was the understanding of the different baselines that other studies have used. For example, in this study, the baseline has recognised the need to address the degree of difference between countries at different stages of development as well as other aspects of diversity important to the selected sectors;

- **Theoretical savings assessment:** the difference between theoretical and realistic savings potential represents the net effect of a complex range of factors. The approach used a concept of 'improved practice' (where businesses are operating on optimum or near optimum based on best practice within the sector); an approach already adopted in similar studies. The review sought cost and benefit ranges from which average measure costs as well as average benefits from the ranges defined by the bottom-up research and literature reviews could be used to identify what benefits were theoretically available;

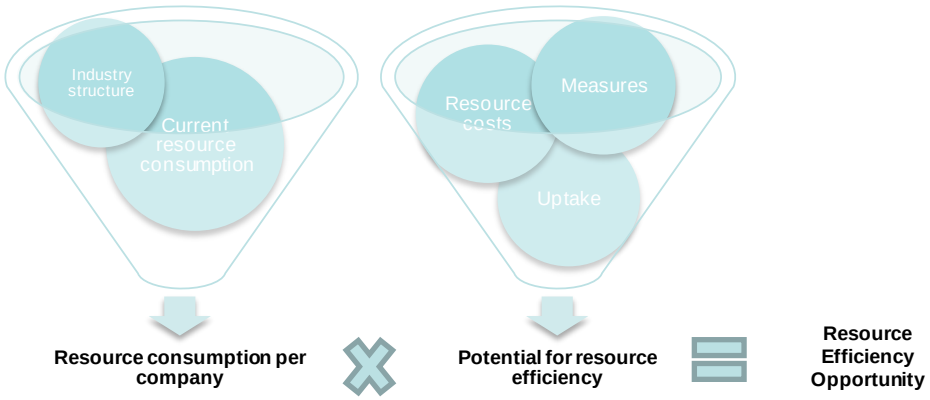
- **Realistic savings assessment:** in practice, the potential for resource savings will be increased by factors such as access to finance, the level and accessibility of information, as well as the attitudes of companies and their willingness to change. Conversely, limiting or constraining factors acting upon businesses will attenuate the potential to achieve the maximum benefits associated with optimal efficiency in any one business or sector of the economy. Through research, the aim was to gather sufficient examples and information to allow reasonable estimates of potential industry 'uptake' to be modelled as sensitivities; and

- **Aggregating methodology:** in this project we developed a methodology for combining the model of a 'typical' or average EU firm with a wider sector perspective so that possible benefits can be seen within the context of the European economy. The methodology developed for the limited number of sectors in this study was used to arrive at EU-27 costs and benefits from improving resource efficiency. The use of 'heroic assumptions' was necessary to scale the benefits, which manifest themselves as high levels of uncertainty in the aggregated results.

7.2 Analytical framework

The overall approach was based on combining a bottom-up understanding of the firm's perspectives and experiences in improving resource efficiency (based predominantly on the outputs from the scoping work detailed in Chapter 2) with a top-down representation of sectors in the European economy (based on Eurostat data). In the first instance, reflecting the focus on benefits to business in this project, improvements were valued at the private cost of savings to business rather than as a benefit to society. The monetisation of private benefits/costs used market prices where possible but also estimates based on internal measures of production depending on the sector.

Figure B6 Analytical framework for determining resource efficiency opportunity levels



This study used the data sources identified above to derive a new reference point for resource efficiency. Generally, these sources and nature of information may be EU-wide, specific to certain Member States or company-specific.

7.3 Methodology

The quantification of resource efficiency opportunities for businesses in the EU was performed by first defining an average EU company in each of the industry sectors and characterising it based on turnover, number of employees, amount of purchases, material and water consumption, and waste generation. Then benefits (e.g. material savings, reduced costs, etc.) and investment costs of the most relevant resource efficiency measures (e.g. ecodesign, waste prevention, water recovery, etc.) was estimated for each of average EU firms. Finally, to estimate the potential at the EU level, the costs and benefits of the measures were scaled up using the results of a survey on the uptake of resource efficiency in companies across the EU.

Definition of an average EU business

To estimate the potential cost savings of resource efficiency opportunities for businesses in the EU, an average EU company in each of the three sectors was defined using structural business statistics from Eurostat.

Table B5 Structural business statistics of each sector and averaged to characterise an average company (Eurostat)[70]

	Manufacture of food products and beverages	Manufacture of fabricated metal products	Hotels and restaurants
Total EU sector			
Number of companies	300,695	406,617	1,720,897
Turnover (million €)	946,522	530,904	458,552
Production value (million €)	865,402	512,232	430,420
Value added (million €)	194,417	176,602	192,816
Total purchases of goods and services (million €)	746,710	359,457	258,265
Number of persons employed	4,522,456	4,121,502	9,665,996
Average EU company			
Number of persons employed	15	10	6
Company turnover (million €)	3.15	1.31	0.27
Production value(million €)	2.88	1.26	0.25
Value added (million €)	0.65	0.43	0.11
Total purchases (million €)	2.48	0.88	0.15
- *Share of turnover* (%)	*79%*	*68%*	*42%*

These average companies are probably not very representative of the EU as many industries have a large number of people employed in large enterprises and micro-sized enterprises, but for the purposes of this study it helps illustrate the potential for resource efficiency savings. Based on this hypothetical average company, an average food and drink manufacturer in the EU has about 15 employees, €3.2 million in annual turnover, buys €2.5 million of goods and services, which are inputs to production. An average EU fabricated metal manufacturer is smaller with about 10 employees, while an average hotel or restaurant only employees 6 people. It is interesting to see the difference in production costs and value added for each industry. Hotels and restaurants create the most value compared to their purchases compared to the other industries. As expected this would indicate that manufacturing companies are more resource intensive than service businesses.

Current material consumption in each industry sector

At present, there are no comprehensive and consistent statistics tracked on the materials flows within a national economy or sector. To determine the current use of materials by companies and sectors, data was gathered from a variety of different sources to try and piece together reasonable estimates. More detailed information on this is presented in Annex B.

Eurostat's economy-wide material flow accounts (EW-MFA) track all the main material flows (e.g. biomass, minerals, metals and fossil energy carriers) in the EU economy. EW-MFA are consistent compilations of the overall material inputs from the environment into an economy (domestic extraction) and from the rest of the world

[70] Eurostat European Business Statistics [ebd_all], 2008 (or latest year available) data

(imports) as well as the material outputs from the economy to the rest of the world (exports). Although, this data set is comprehensive it does not provide detailed information about the material consumption of individual sectors or companies in the EU. The domestic extraction, domestic material input (domestic extraction plus imports) and domestic material consumption (domestic extraction plus imports minus exports) does however provide an idea of the total level of material consumption in the EU.

Eurostat's PRODCOM survey contains data on industrial production in the EU. The data contains annual production of products in amount and value. Although, the general quality of data is often questionable, this provides a good idea of the production volumes or output of enterprises. The correlation between the products produced by an enterprise and the sector in which they are registered is not always very strict, so it is not always a good representation of the actual production of a sector. The PRODCOM data does not provide data on the inputs to production, but the product categories do provide some clues on the type of resources used.

A final source of data for material (and water) consumption is European System of Accounts (ESA95) supply, use and input-output tables. The tables provide detailed economic information on production activities, input and output of goods and services across all sectors of the economy including intermediate consumption. ESA95 however does not provide information on the amounts of resources used, only their monetary value.

Current waste generation in each industry sector

Eurostat provides comprehensive waste statistics by industry sector and waste stream for the years 2004, 2006 and 2008. 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 vegetable wastes, mixed ordinary wastes and mineral wastes.

Current water consumption in each industry sector

Eurostat provides some data on water consumption (e.g. gross abstraction, public water supply, self supply) and wastewater at Member State level, but the dataset has many gaps and is not updated for all Member States. There is a breakdown for 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.

Material and water consumption and waste generation in an average EU company

The material and water consumption and waste generation of an EU average company is calculated in a similar way by dividing the total EU sector figures with the number of companies within each sector.

Table B6 Material and water consumption and waste generation per year of an EU average company

	Manufacture of food products and beverages	Manufacture of fabricated metal products	Hotels and restaurants
Material consumption per year in an average EU company (in tonnes)			
Iron and steel	7.2	238.1	0.3
Aluminium	5.3	17.2	0.2
Copper	-	4.1	-
Other non-ferrous metals	-	4.2	-
Glass	59.2	-	2.6
Plastic	27.9	-	1.7
Chemicals (and other hazardous substances)	7.9	10.2	0.5
Paper and board	42.6	3.7	5.1
Wood	21.5	4.4	0.6
Food	2,371.2	-	41.5
Total materials	***2,543***	***281.9***	***52.5***
Water use per year in an average EU company (in m^3)			
Total water supply	11,598	2,807	649
Waste water	4,563	551	-
Waste generation per year in an average EU company (in tonnes)			
Iron and steel	1.6	17.5	0.1
Aluminium	0.1	1.0	0.0
Copper	-	0.5	-
Other non-ferrous metals	-	0.5	-
Glass	3.3	-	0.4
Plastic	3.3	-	0.6
Chemicals (and other hazardous substances)	6.3	8.2	0.5
Paper and board	6.7	1.2	1.9
Wood	1.5	0.7	0.3
Food	40.8	-	7.1
Other waste	-	-	0.8
Total waste	***63.7***	***29.5***	***11.7***

An average food and drink manufacturer in the EU uses over two million tonnes of agriculture and food products as inputs to their production. Significant amounts of packaging materials is also used in the form of glass, plastic, metal, wood and paper products. An average EU fabricated metal manufacturer uses about 265 tonnes of metals, ten tonnes of chemicals as inputs to production as well about eight tonnes of packaging. Most of the input to hotels and restaurants are agriculture and food products with a smaller amount of paper based products (e.g. serviettes, toilet paper, etc.).

Unsurprisingly, food and drink manufacturers have a very high consumption of water compared to the other sectors. Water is part of many beverages and large amounts are needed for cleaning, cooking and cooling food

products. Water in a fabricated metal product manufacturer is used for cleaning, surface treatment and cooling. Hotels and restaurants use water similar to domestic uses: showers, toilets, kitchen, washing of towels and bed sheets, etc.

Food and drink manufacturing creates substantial amounts of food waste. An average company in the sector generates about 40 tonnes of food waste a year. Most of this is probably inedible food waste. A food and drink manufacturer also generates a considerable amount of packaging waste. A fabricated metal manufacturer produces a lot of scrap metal (mainly iron and steel), but also significant amounts of chemical and other hazardous wastes (from surface and coating treatment). An average hotel and restaurant in the EU produces almost seven tonnes of food waste a year. A large amount of this might be edible food waste.

For some of the economic sectors, the disparity of the data sources related to material consumption and waste generation make it difficult to perform an accurate analysis. The consumption data are taken from industry associations and statistics, whereas waste statistics are provided in the Eurostat database. These different sources lead to two different accounting systems that are always consistent, due to different system boundaries, classification of waste streams, economic sectors, etc… For example, packaging waste occurs at several stages of the life cycle of products and services, and may be accounted as waste in a different economic sector than that where it was produced. These inaccuracies might be emphasised when there are multiple actors throughout the life cycle of the product or service. In this case, waste prevention strategies might affect other actors in the supply chain, such as strategies related to food waste and the size of the portions and packaging: bigger portions reduces packaging and therefore costs for producers, but its downside is that at the final consumption stage, it may increase food waste while reducing packaging waste.

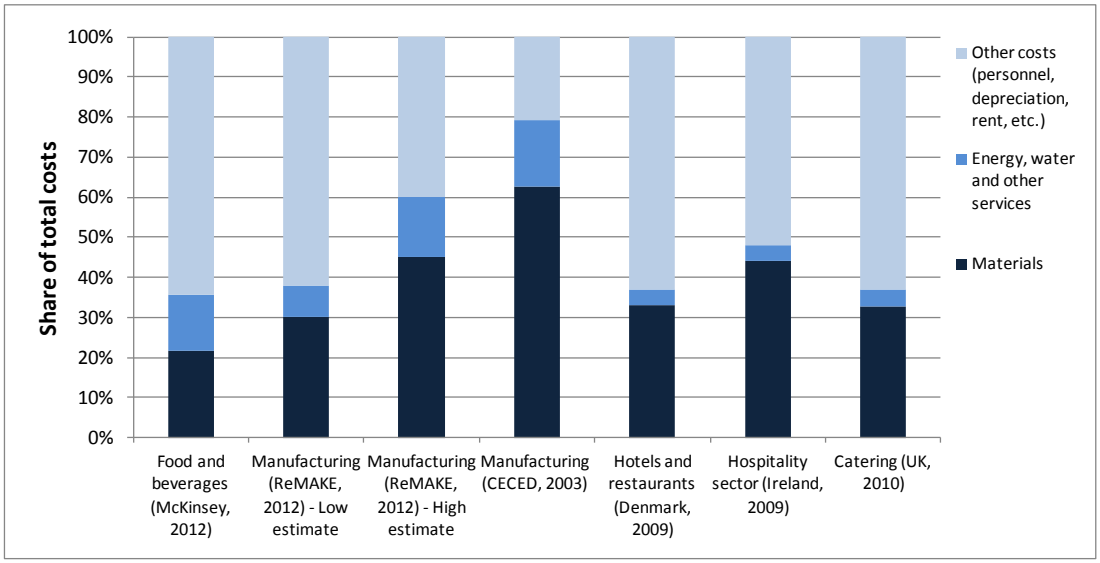
7.3.1 Quantification of costs and benefits of resource efficiency measures

A significant amount of a company's operational costs are related to the purchase of raw materials and supplies as well as utilities (e.g. energy, water) and other services (e.g. waste management). In the manufacturing sector materials and supplies are estimated to represent an average of 30 – 45% of a company's total costs[71]. Material costs may even be increasing, as 24% of EU businesses in a 2011 Eurobarometer survey claimed that material costs were more than 50% of their total costs and they expected this trend to continue[72]. Figure B7 presents different estimates of the costs of resources as a share of total costs of businesses. For all estimates material costs are a substantial part of the total costs (at least 20% and as high as 60%), often being as much as or more than the personnel costs. Energy, water and waste management costs constitute a minor share of total costs in the range of 4 – 17%. Given these ranges of cost structures, even small improvements in material efficiency could result in significant costs savings.

[71] Greenovate (REMake) (2012) Guide to resource efficiency in manufacturing.

[72] Eurobarometer (2011) Attitudes of European entrepreneurs towards eco-innovation (Flash EB Series #315) Survey conducted by The Gallup Organization, Hungary upon the request of the European Commission, DG Environment.

Figure B7 Estimates of average material and energy costs in different sectors[73]



7.3.1.1 Economic costs and benefits

The benefits of resource efficiency measures were quantified using the framework for resource efficiency measures (Figure B3), which provides estimates for the maximum potential of each measure to reduce material and water consumption, waste generation as well as other production costs. By multiplying the estimated reduction potential with the consumption and waste generation amounts determined for an average EU company, an estimate for material, water and waste savings per company was calculated. These savings were then translated into economic benefits by relating the resource savings to reduced material, water and waste management costs. This was based on cost estimates for materials, water and waste management. The investment costs of resource efficiency measures per company were already determined (see Table B4). High and low estimates for potential costs and benefits were calculated for all measures.

[73] Based on a variety of studies (estimates differ as some take taxes and margins into account):
- Greenovate (REMake) (2012) Guide to resource efficiency in manufacturing
- McKinsey Global Institute (2011) Resource Revolution: Meeting the world's energy, materials, food and water needs
- Vaeksthus Midyjylland (2012) Restaurant – start en restaurant
- Horwath Bastow Charleton (2009) Study to evaluate the cost of food preparation and service activities in the Hospitality Sector
- www.cateringmentor.co.uk

Table B7 The annual material water and waste management costs compared to the turnover for an average EU company in each of the three sectors

	Manufacture of food products and beverages		Manufacture of fabricated metal products		Hotels and restaurants	
Estimated annual costs for an average EU company	**€**	**% of turnover**	**€**	**% of turnover**	**€**	**% of turnover**
Turnover	*3,147,780 €*	*100%*	*1,305,662 €*	*100%*	*266,461 €*	*100%*
Total purchases	*2,483,280 €*	*79%*	*884,018 €*	*68%*	*112,044 €*	*42%*
Annual material costs	1,253,879 €	40%	354,105 €	27%	80,817 €	30%
Annual water costs	20,569 €	0.7%	4,979 €	0.4%	1,152 €	0.4%
Annual waste management costs	4,386 €	0.1%	2,507 €	0.2%	778 €	0.3%
Total material, water and waste management costs	**1,278,835 €**	**41%**	**361,591 €**	**28%**	**82,747 €**	**31%**

7.3.1.2 Environmental benefits

In addition to material and water savings, the greenhouse gas (GHG) emissions associated with the identified resource efficiency measures were estimated. GHG emission factors from the Environmentally Weighted Material Consumption (EMC)[74] methodology were used to calculate the reduced global warming potential of each resource efficiency measure.

The concept of EMC was developed in 2005 by van der Voet *et al.* to estimate the contribution of different materials to environmental impacts. The apparent consumption of selected base materials is combined with quantifiable impact categories by means of a multiplying (characterisation) factor which is derived by using life cycle inventory data (EMC uses Ecoinvent, 2008). In this way it provides an estimate of the environmental benefits and savings based on material flows. The potential environmental impacts of different materials are proportional to the weight or volume used. Although EMC can be used to calculate a variety of different environmental impacts, e.g. stratospheric ozone depletion, eco-toxicity, acidification, eutrophication, etc., only the impacts related to climate change were calculated as this was considered the most reliable and easiest to communicate. EMC is a simple, but relatively crude manner of calculating environmental impacts. The calculations were performed in this study to provide an indication of the associated environmental benefits, but the uncertainty associated with the methodology does not warrant including other environmental impact categories.

EMC only covers environmental pressures related to the extraction of raw materials from nature to its transformation to basic materials for further production and consumption. EMC therefore does not take into account any environmental benefits or savings from resource efficiency measures during production, transport, use or end of life, such as recycling or other ways to divert waste from landfilling. In order to quantify the potential climate change benefits of these opportunities, GHG emissions data for specific processes have been selected from

[74] van der Voet, E., van Oers, L., Moll, S., Schütz, H., Bringezu, S., de Bruyn, S., Sevenster, M., Warringa, G. (2005) Policy Review on Decoupling: Development of indicators to assess decoupling of economic development and environmental pressure in the EU-25 and AC-3 countries. Institute of Environmental Sciences (CML), Leiden University; Wuppertal Institute for Climate, Environment and Energy; CE Solutions for Environment, Economy and Technology.

the literature. These are used to estimate the associated impacts of water supply, waste and wastewater treatment, material recycling and incineration. The sources used to calculate the GHG emission savings for these measures are shown in Table B8.

Table B8: Greenhouse gas emission factors used for waste and water related measures

Resource efficiency measure	Associated GHG emissions
Water prevention[75]	0.27 kg CO_2-eq. per m^3 of clean water
Waste water treatment[75]	0.52 kg CO_2-eq. per m^3 of wastewater
GHG emissions of disposal of waste from waste collection, transport and landfilling[76]	
- Average for metal industries	7.6 kg CO_2-eq. per tonne of waste
- Average for food industries	95 kg CO_2-eq. per tonne of waste
- Average for municipal solid waste (hotels and restaurants)	95 kg CO_2-eq. per tonne of waste
Hazardous waste treatment (average)[77]	875 kg CO_2-eq. per tonne of waste
GHG savings from recycling of materials as alternative to landfilling[78]	
Incineration – organic waste	90 kg CO_2-eq. per tonne of waste
Incineration – paper and cardboard	700 kg CO_2-eq. per tonne of waste
Incineration – plastic	1290 kg CO_2-eq. per tonne of waste
Recycling – paper and cardboard	680 kg CO_2-eq. per tonne of waste
Recycling – plastic	1720 kg CO_2-eq. per tonne of waste
Recycling – glass	180 kg CO_2-eq. per tonne of waste
Recycling – metals	4110 kg CO_2-eq. per tonne of waste
Composting – organic waste	80 kg CO_2-eq. per tonne of waste
Anaerobic digestion – organic waste	180 kg CO_2-eq. per tonne of waste

Together with EMC these additional sources are used to estimate the potential reduction of greenhouse gas emissions of alternative resource efficiency strategies other than reduction of material consumption, such as waste prevention, waste recovery technologies (e.g. recycling, anaerobic digestion), water prevention and waste water recovery.

[75] Water UK. Towards-sustainability-2005-2006 (UK Water Industry Sustainability Indicators 2005/2006)

[76] ETC-SCP (2011) Projections of Municipal Waste Management and Greenhouse Gases

[77] Ecoinvent Centre (2010) Ecoinvent data v2.2, Swiss Centre for Life Cycle Inventories, Dübendorf, 2007, retrieved from: www.ecoinvent.org

[78] ETC-SCP (2011) Projections of Municipal Waste Management and Greenhouse Gases

Following the calculation methodology for resource efficiency saving potential, only the global warming impacts related to major materials were assessed (e.g. plastics, aluminium, copper, iron and steel, glass, wood, paper and board) for the three sectors (food manufacture, fabricated metals, and hotels and restaurants).

The average between the low and high estimates of material savings potential per company was scaled to the EU level by using the number of companies in the EU and the low and high uptake estimates of resource efficiency measures. This results in a range of potential material savings at EU level per economic sector. These ranges were multiplied by the characterisation factors for global warming provided by EMC and the above mentioned sources, obtaining a rough estimate of the potential reduction of climate change impacts due to the resource efficiency opportunities.

7.3.1.3 Scaling costs and benefits to EU level based on uptake of measures

The costs and benefits estimated in the previous section for an average EU company represent an average performing company that has yet to systematically implement resource efficiency measures. In this way the costs and benefits are the maximum potentials for a business. To estimate the total costs and benefits at the EU level, the results from a Eurobarometer survey on resource efficiency and green markets carried out in early 2012[79] was used. The Eurobarometer survey is fairly extensive and representative of different countries and company sizes. The Eurobarometer results were compared with findings from the literature review and the survey performed in this study.

Table B9 Q3: What actions is your company undertaking to be more resource efficient?

Country	Saving energy	Saving materials	Waste prevention	Recycling	Saving water	Selling scrap materials
EU average	64%	57%	62%	61%	50%	24%
Micro enterprises (1-9 employees)	63%	56%	61%	61%	50%	22%
Small enterprises (10-49 employees)	67%	61%	63%	63%	51%	32%
Medium sized enterprises (50-249 employees)	72%	66%	68%	66%	52%	46%
Large companies (>250 employees)	82%	74%	72%	76%	-	44%

Energy efficiency has the greatest attention in most companies in the EU, but material efficiency in the form of saving materials, waste prevention and recycling are also common actions. The Eurobarometer survey does not specify what actions qualify for saving materials or waste prevention, but ecodesign, re-use, material flow management and process optimisation and redesign are common measures. Only half the companies are currently taking actions to save water. Less than a quarter of companies sell their scrap materials.

[79] TNS Political & Social (2012) SMEs, Resource Efficiency and Green Markets. Flash Eurobarometer 342. Conducted by at the request of Directorate-General Enterprise and Industry

When comparing the responses with the size of companies, there is a clear difference between large companies (> 250 employees) and SMEs. Almost three quarters of large companies are currently undertaking actions to save materials, prevent waste and recycle. There is less difference between micro, small and medium sized companies in relation to resource efficiency actions, but there is a general trend that the bigger the companies the more likely they are currently implementing resource efficiency measures.

It was not possible to derive from the survey findings whether the companies that have resource efficiency actions in place are achieving the full potential of the measures. Likewise, a company NOT undertaking any resource efficiency measures could be because: a) they have already achieved the full potential and see no need to continue, or b) they have not started to implement any resource efficiency measures at all. In this study we make the assumption that the companies that are NOT currently undertaking any resource efficiency measures represents the companies that have not yet implemented any measures[80] and therefore still have the full potential of resource efficiency opportunities. The findings from the survey are therefore thought to be a reasonable proxy for the maximum uptake of resource efficiency actions in the EU.

Table B10 Q4: Over the next two years, what are the additional resource efficiency actions that your company is planning to implement?

Country	Saving energy	Saving materials	Waste prevention	Recycling	Saving water	Selling scrap materials
EU average	56%	46%	53%	49%	42%	23%
Micro enterprises (1-9 employees)	56%	46%	53%	49%	42%	23%
Small enterprises (10-49 employees)	55%	45%	52%	48%	42%	21%
Medium sized enterprises (50-249 employees)	62%	51%	56%	54%	46%	29%
Large companies (>250 employees)	66%	52%	56%	51%	41%	37%

When asked what additional resource efficiency actions are planned over the next two years, not all companies currently undertaking resource efficiency measures planned to undertake additional actions. This could be understood as some of the companies do not see the need (or perceive any benefits) to implement additional actions. In this study this is interpreted as the top runners that currently have resource efficiency in place and do not plan on implementing any additional actions as they have already achieved the full potential of resource efficiency (given the current conditions). The difference between Table B9 and Table B10 is therefore the share of top runner companies that have achieved the full potential of resource efficiency.

[80] Many of the resource efficiency measures are on-going efforts which require periodic monitoring and follow-up. If a company has had good experiences with implementing resource efficiency measures they tend to integrate resource efficiency as an established part of their operations.

To provide a concrete example: *50% of all companies in the EU currently have water saving measures in place. In the next two years 42% of the companies expect to implement additional water saving measures. In this study, this is interpreted as:*

- *50% of all companies in the EU have introduced measures to reduce water consumption either as water minimisation (both through implementation of new technology or equipment, and training and monitoring) or water recycling;*
- *The other 50% of all companies in the EU have not yet tried to reduce their water consumption and have not implemented any measures yet. They have the greatest potential of benefits for water savings;*
- *42% of all companies in the EU are still in the process of achieving the full potential of water saving measures;*
- *8% (=50% - 42%) of all companies in the EU have reached their full potential of water saving measures (representing the top runners); and*
- *The low estimate of uptake of water saving measures is therefore 8% and the high estimate of uptake is 42%.*

High and low estimates for potential uptake were calculated for costs and benefits at EU level.

7.3.2 Key assumptions

The methodology to quantify the costs and benefits of resource efficiency is based on a number of assumptions. Quantification is performed by matching EU sector wide data (e.g. definition of an average EU business) with case study data on an individual company level (e.g. costs and benefits of resource efficiency measures).

The first main assumption was that it was possible to quantify an average EU company in each sector despite large variations and use this to scale up the potentials at an EU level. This was done to match the resource efficiency measures to the resource consumption and waste generation at a company level. The estimates for the current amount of resource consumption at a sector level are not very robust as they had to be derived indirectly from a combination of several sources. The current consumption and waste generation levels calculated for an average EU company in this study are in reality less than an actual average EU company that has not already implemented any resource efficiency measures. This is because the economy wide consumption and waste statistics include a mixture of companies that have already implemented resource efficiency opportunities to their full potential.

The estimates of resource efficiency potential costs and benefits are based on individual case studies, which may not represent all companies. Often only the most positive experiences of implementing resource efficiency measures are reported and this might overestimate the actual benefits. This bias was taken into consideration as the high estimates used in this study represent the average benefits reported in the case studies. The low estimates are based on the lowest level of benefits reported. The categories of resource efficiency measures were developed to be comprehensive, but without double counting any benefits or costs. As many measures are combinations of several measures often ‘hard’ and ‘soft’ type measures this is however not always possible. Care was taken to ensure that the resource savings were reasonable as the sum of the maximum of all measures is never more than the total

amount of resources used. For water use and waste generation, the maximum potential represents a situation where a company produces no wastewater and is able to prevent all waste from being sent to landfill.

The investment costs of measures are based on the study team's best estimates taking into account the available limited evidence and cross-checked with industry experts. The results are very sensitive to these estimates.

Although the large variations are taken into account by providing high and low estimates for many of the sensitive parameters, the calculation method provides a conservative estimate in that low estimates for benefits are linked to low investment costs and high estimates for benefits are linked to high investment costs. In the costs and benefits reported in the case studies, sometimes a relatively low investment cost could result in very high benefits.

The average prices for materials, water and waste management were also difficult to determine as they vary enormously across sectors and countries. These estimates drive much of the uncertainty in the calculations.

The uptake of measures is crudely determined through the use of the Eurobarometer survey. Assumptions were made to match the estimates for uptake with the measures identified in this study. Although the high and low estimates for uptake represent a wide range, the low estimate is thought to be very conservative, so the potential at the EU level is not overestimated.

Although, the data and estimates used in the calculations of resource efficiency potential are built on significant and crude assumptions, the calculation method is transparent and the values used for each of the estimates can be easily changed if better estimates become possible.

8. Study Findings

8.1 Interpretation of the findings

This section examines the results in light of the wider context of decisions being made by business on resource efficiency and examines some of the potential trends on scope to improve from adoption of specific resource efficiency measures as well as interpretation of the quantified opportunities.

8.2 Scope for businesses to become more resource efficient

It is evident from the research that certain sectors are more material, water and waste intensive than others. This study has summarily reviewed the evidence on this at a high level and focused on those sectors that were believed to represent generally good opportunities to improve across the board. This is not to say that the sectors evaluated and ultimately chosen for the detailed quantification have been standing still – far from it. The food and beverage manufacturing sector, for example, has been undertaking a wide range of measures to reduce the environmental footprint and increase the efficiency of its operations and those of its supply chain network.

Box 1	**Case Study Marks & Spencer**
In June 2012, Marks and Spencer (M&S) – a global retailer and brand with a highly complex and far-reaching supply chain network – announced the next level of its Plan A waste ambition and is set to build on its 'zero waste' achievements through targeted measures to prevent waste within its supply chain and to exploit more closed loop and eco-design measures on its product lines. Plan A has so far delivered 31% (80,000 tonnes) waste savings for M&S, which has included resource efficiency measures such as a 17% cut in transit packaging by working closely with supply chain partners on logistics and product movements, separating mixed recyclables (including discussions to source and return glass to main suppliers direct) and sending 89% of its food waste to AD for beneficial recovery. On a technology front, use of innovations in packaging to extend product shelf life, reduce portion package size and incorporate greater recycled content and widely recyclable materials have delivered greater and wider benefits. **M&S estimates that the measures taken have delivered an annual net benefit of £6.3 million (€7.9 million) in 2011-12.**	

Information portals such as FoodDrinkEurope[81], the Sustainable Agricultural Initiative Platform and Sustainable Production and Consumption Round Table are key to help shape direction and messaging on environment, sustainability and resource efficiency, whilst initiatives and agreements such as Courtauld Commitment[82] and the

[81] In particular the launch of a new mini-website for food and drink SMEs, which make up 99% of the sector's businesses (see http://www.fooddrinkeurope.eu/news/press-release/fooddrinkeurope-launches-small-and-medium-sized-enterprise-website/)

[82] The latest review of the agreement indicates an 8.8% reduction in supply chain product and packaging and an 8.2% reduction in packaging during 2011.

Food and Drink Federation's Five-Fold Ambition[83] have been vehicles to set targets on waste prevention and efficiency that have driven huge changes from within the industry itself.

One of the key challenges faced by the study team was accessing complete and comparable data sets for the sectors. Eurostat does cover material flows and waste (although less so where water flows are concerned) but in respect of crucial data on the effect of measures in any one particular sector (for example material savings from ecodesign), it becomes apparent that great reliance is placed on case studies, company-specific reports and specific sector initiatives. This is similar when seeking information on potential take-up (i.e. an estimation of how much of the industry has the potential to improve).

The conclusions of the research conducted highlighted the significance of the current gaps in knowledge and understanding around important elements when determining the scope of opportunity for improving businesses' resource efficiency. Data on the measures used by businesses was generally good for some sectors but much more fractured and unreliable in others. Some examples of where significant gaps in understanding were found included:

- How businesses are defining efficient and inefficient – some benchmarking data exists but it is limited and relatively disconnected to the resource efficiency measures targeted at reducing waste, water and material intensity metrics;
- There was little information on the costs and payback periods associated with key resource efficiency measures, typically because many of the sectoral case studies and publications of best practice choose to focus on the positive elements of the implementation within business – there was little direct data available on actual costs (both transaction and labour costs);
- Although some case studies and guidance documents provided indicative payback periods for some measures (important for establishing the low-cost/no-cost split required by the study's terms of reference), there were no sources to corroborate these judgements - typically case studies are not followed up and publications do not take account of a bedding in period where additional costs may be incurred. This verification of the payback periods highlighted in case studies and research papers actually holding true in real-world operations proved to be a source of significant uncertainty within this study and one element that has not been satisfactorily concluded; and
- There was very limited detail on the expected level of uptake (important in reaching conclusions about the extent to one can hypothesis that the potential from a measure could be realised by a cross-section of businesses in any single sector). Again, this was one aspect of the sector analysis that could not be fully concluded because whilst it can be assumed that a measure which is applicable in one business is likely to be applicable in a similar businesses, wider extrapolation without evidence is subject to significant uncertainty.

8.2.1 Measures available to businesses

The research appears to point in the direction that for sectors to improve in terms of their resource efficiency, there needs to be a catalyst for action, a strong business case and sustained momentum. Many of the quick wins are still left to be made simply because businesses exhibit the 'magpie effect', where focus falls to the 'big ticket' items

[83] The Ambition (in 2011) has cut CO2 emissions by 25%, reduced product and packaging waste in the supply chain by 6.9%, cut the carbon impact of packaging by 1.2%, reduced water use (outside of that embedded in product) by 5.3% and saved 163 million HGV road miles

such as new technology, innovation and closed-loop design, all of which require a time and financial investment that is quite often practically prohibitive in many smaller businesses. Here we see evidence that being part of an engaged supplier network can really help, not only giving smaller suppliers the confidence to invest on the back of supply contracts but also support and access to the expertise necessary to implement the measures. Whilst this study has chosen to categorise resource efficiency measures into hard and soft, it also recognises that ultimately being more efficient relies as much on the human factor as it does the design, process or technology driven factors.

The study found there to be hundreds of individual different measures available to business to improve resource efficiency, with varying degrees of subtleties depending on the application, the sector and the process. In rationalising them down to 14 broad measure descriptors, their practical application and the costs and benefits associated with this could be modelled. Measures are split into **horizontal** (those typically softer measures such as knowledge, training, housekeeping, management/ethos and employee behaviour) and **specific** (those harder measures that typically include changes to processes, procedures, new equipment, re-design supported by employee awareness and behaviour change). The evidence suggests that for businesses to realise resource efficiency savings, there needs to be combinations of measures with specific measures being supported by behavioural ones. Figure B8 outlines the 14 main measures (13 specific and one horizontal) available to businesses.

Figure B8 Main resource efficiency measures available to businesses

In scaling the effects of applying the measures, it is recognised that assumptions have been made that these measures typically apply in all businesses and in all sectors. Naturally, variation would be expected to be seen across sectors in a study encompassing a wider cross section of business sectors and yet the study concludes that broadly the measures are applicable in almost all businesses albeit some have less relevance than others.

Analysis of low-cost measures

Whilst it is noted that how businesses define low cost when viewed through an investment lens will vary radically depending on a range of internal and external factors, the study required a breakpoint such that characterisation of low cost and higher cost measures could be made in accordance with the terms of reference. The quantification of these measures is presented in Section 3.4.

In terms of what measures are available to business in the low-cost range (i.e. in the range of €0 to €10,000), the analysis indicates:

- In terms of **resource savings**, behavioural changes and simple measures such as smaller portion size, simple water prevention (reduced wastage for example whilst filling and cleaning using tap water) and waste prevention best practice (e.g. food waste, product and packaging) may deliver material savings of between 5-20%[84] and water savings of 5-50%;

- In terms of **revenue increases**, use of seasonal food (for example in hotels, cafés and restaurants) can deliver higher margins on food sales that may boost revenue by up to 10% because of the lower transport and purchase costs. Waste (resource) exchanges are also a win-win for businesses, who can receive an income (albeit a small one) from materials that would otherwise have been disposed of as waste (with a corresponding waste saving); and

- In terms of **waste savings**, many of the measures were shown to have a significant impact on reducing the costs associated with landfill and waste management. Simple segregation and recycling and food re-use/donation have been shown in businesses performing relatively inefficiently to reduce waste by up to 40% and typically by over 10%. Also of note are simple waste prevention measures delivering 5-10% savings on general wastes and 9-20% on packaging waste. The evidence shows reduction potentials for wastewater in the range of -5-50%.

Whilst these savings are theoretically possible (based on savings identified in actual industrial case studies), it is likely that the actual level of savings will vary significantly between business and sectors. Nonetheless, the evidence suggests low-cost / no-cost savings are right to be classed as the 'low-hanging fruit' simply because they can be realised at relatively small investment levels and without the need to dramatically change infrastructure and/or site services. The general evidence from the research indicates that low cost measures do yield substantial savings and whilst this study stops short of suggesting where in the range savings might be, for adoption of best practice, behaviour change and simple resource and waste prevention/recycling measures the savings are likely to be towards the higher rather than lower end of the range.

In terms of the **costs of these measures**, there remains some substantial uncertainty regarding how much it might cost a company to fully implement measures to yield the projected benefit from being more resource efficient. The published evidence here is particularly weak and studies have shown, for example, the sharing of information and best practice (including the realistic challenges and costs of implementing measures) in industrial clubs and fora to be particularly helpful, especially for smaller companies in the SME bracket. Anecdotal evidence gathered over many years of resource efficiency support would suggest that direct contact with like-for-like businesses and

[84] Estimates made by demea (German Materials Efficiency Agency) from over 600 SME manufacturing companies show indicative material resource savings of 5-10% through measures with a <1 year payback.

commercial enterprises is a more effective knowledge transfer mechanism than information hosted on remote websites, even where these receive positive publicity amongst the business community.

The simplest measures (donation, smaller portions, and behaviour changes) are likely to cost very small sums in investment terms, with the majority of the cost made up of time investment to implement the measures and train staff. Procurement (e.g. renegotiating contracts), waste prevention and waste exchange are likely to be more costly, especially in larger businesses, where effort will be required to understand the changes necessary and implement them. The estimates put the range of cost between €1,000 and €10,000, which was felt to be a ceiling in respect of how businesses (particularly smaller ones) are likely to view the size of the investment required.

Analysis of higher cost measures

On paper, the gains (benefits) to be made by businesses as a result of making investment in higher cost measures do not appear to be significantly greater than those for low cost. This is a key finding of the report and something the evidence does support – simple measures lead to substantial savings. That said, measures such as ecodesign, and material re-use can save companies between 6% and 20% in raw materials and lead to dramatic reductions in waste, potentially as high as 30%. Higher cost measures require businesses to take not only a strategic view on becoming resource efficient (the payback periods for the highest cost measures are substantially longer – five to seven years is typical for a water recovery/treatment/re-use system) but also use a tactical approach to 'cherry pick' those measures that are the most cost effective to implement – it is highly unlikely that businesses would invest in a wide range of high-cost measures in any single investment cycle; typically businesses are more likely to spread the investment costs over several cycles, preferring to work progressively towards greater efficiency.

In terms of the measures available to business in the higher-cost range (i.e. €10,000 to €3,000,000) the analysis indicates:

- In terms of **resource savings**, technological measures on water and waste prevention have the greatest returns (in the range 15-50% for water savings and 10-20% for waste) but also carry the highest costs with investments of several tens of thousands of Euros up to hundreds or even millions for large and complex sites. Material re-use is a key measure in the mid-cost range - investments in the region of €5,000 to €1,000,000 are likely due to research and development, product quality testing and potential re-tooling – delivering between 10 and 30% material savings in many cases. Ecodesign (e.g. of key product packaging lines) is being widely used as a primary measure to reduce packaging waste within Europe's food and grocery supply chains and retail stores. This study estimates that between 5% and 20% of material could be saved[85]; and

- In terms of **revenue increases**, ecodesign may bring marginal benefits however these vary in scale depending on the sector and are therefore highly sensitive to specific applications. Waste recovery of food waste in a manufacturing facility through the use of on-site anaerobic digestion has significant savings potential and even possibly increase revenue (from heat recovery and sale of electricity[86]) and between 10-40% reductions in waste sent to landfill. This measure does however require very high investment costs, often several million Euros on larger sites and on-going operational costs throughout

[85] Considerable variation in both savings and costs can be expected from eco-design measures due to the wide range of influencing factors.

[86] In plants where combined heat and power is used in combination with anaerobic digestion

its service life. Staples Vegetables in the UK projects a financial saving from on-site anaerobic digestion of around €750,000 per annum with investment costs of around €8.1 million[87].

Water recovery is the other significant measure with savings of 10% to 50% (or more) to be expected from investment in water recovery, cleaning and re-use technologies. Such measures will not suit the scale of many businesses and often very high investment and paybacks (5 years or more) create challenges for strong business cases; often businesses that are keen to be more efficient look to lower cost measures first. A main driver for the reduction of waste and wastewater is the cost of waste management and water treatment. In countries where legislation has high landfill charges and strict water discharge standards, the savings potential is greater. Waste (resource) exchanges are also a win-win for businesses, that can receive an income (albeit a small one) from materials that would otherwise have been disposed of as waste (with a corresponding waste saving). In terms of **waste savings**, the evidence suggest most technological measures offer a substantial waste saving (solid waste or wastewater) in the range 10-30%.

Box 2 Case Study Heinz – Ecodesign (lightweighting)

Packaging is a significant cost to the food manufacturing industry but also a cornerstone of their product offering – increasingly sophisticated packaging designs are being developed to keep products fresher for longer with less material and incorporating higher recycled content. Heinz is a good example of relatively simple re-design.

Heinz worked with its can end supplier Impress and steel supplier Corus to reduce the amount of material used in its cans. New can ends were trialled at Heinz's Kitt Green factory in Lancashire. This is Europe's largest food processing site, with an output of more than one billion cans per year. At just 0.18mm thick, the new end is 10% thinner than Heinz's previous ends, which were already the thinnest available. There were a number of challenges for the new end to overcome including:

- Opening characteristics of the can end remained unchanged, e.g. ring pulls did not twist
- Look and feel of the can was not altered
- Can performance during filling, processing and packaging remained unchanged

Heinz **saved £404,000** and **1,400 tonnes of steel** every year by lightweighting and 18% more cans can be carried per pallet, which means greater distribution savings, lower vehicle weight and better fuel efficiency.

Work is progressing on the next phase to reduce the weight of the can body.

In terms of the **costs of these measures**, some are significant and would require large investments of both finance and time. There is evidence to suggest that hard measures and more technology-based ones can be favoured by businesses because they are simply more tangible – or at least the benefits of implementing them are in principle. Whilst there is a lot of anecdotal evidence in reports and case studies to suggest that simple waste and water prevention measures coupled with a sustainable ethos and leadership can drive efficiency from within a business, there are equally as many anecdotes about businesses selecting harder measures due to the visibility of the savings.

This study concludes that benefits can be delivered by different measures and those benefits (as well as costs) are likely to vary dramatically between individual businesses, even within the same sector and location. Many factors influence the baseline efficiency of a business and what might be a highly successful measure in one business is not guaranteed to be in another. Many businesses lack the internal knowledge and support to fully characterise the

[87] http://www.wrap.org.uk/content/etf-project-staples-vegetables

problem and analyse the opportunity provided by certain measures and this is where case studies, promotion and publication of measures and benefits (particularly through close industrial networks) can act as a genuine catalyst to pique interest in greater investment to raise efficiency from within.

Although this study has sought to put some numbers around the possible savings to be made by businesses implementing measures, there are wide and quite often deep gaps in the data that mean broad assumptions have been required. Whilst businesses must evaluate measures on a case-by-case basis taking account of constraints as well as drivers, the review of measures concluded that there are a number of data gaps that could be filled to increase the accuracy of the estimates provided in the later sections of this report; the common ones include:

- Limited information on the baseline (i.e. where companies are actually starting from – typically set out by collection and publications of complete and robust benchmarking data for key resource efficiency indicators);
- Limited data (at either a business or a sector level) from which to project the possible level of uptake of the measures;
- Limited cost data (specifically how much CAPEX (Capital and Operating Expenditure) was required and what the payback period was); and
- Very limited information on the barriers to implementing a measure and how these were overcome.

8.2.2 Challenges faced by business in becoming more resource efficient

In its 2012 report[88], the World Economic Forum highlighted a series of key value drivers for business to become more resource efficient, described in four categories: cost avoidance, cost reduction, revenue growth and revenue protection. Using these terms to describe the business thinks in respect of decisions made on investment and efficiency firmly centres the debate on the economics. In the current economic climate, businesses are finding themselves increasingly under pressure to cut costs whilst simultaneously boosting revenue in a competitive market with shrinking consumer demand in key sectors. The findings of the analysis on measures tell us that by adopting resource efficiency measures (particularly where there is careful consideration of the costs, benefits and practical application) businesses are likely to receive direct benefits in three key areas: resource savings (cost avoidance), additional revenues (revenue growth) and reductions in waste (cost reductions).

The challenges to becoming more resource efficient also vary between companies and sectors. Whilst the type of company is important in determining which measures apply, the size (physical and financial), geographic location and ethos are powerful factors. Research by the demea illustrated that for the manufacturing sector, the larger the company, the higher the annual benefits from efficiency but also the higher absolute investment costs (although as a percentage of turnover these are typically much lower). When analysed as material inputs against savings, smaller companies do significantly better from resource efficiency – material savings of 8.6% can be expected in smaller organisations whereas only 4.2% can be expected in the largest[89]. Investment and finance are therefore a highly

[88] WEF (2012) More with Less: Scaling Sustainable Consumption and Resource Efficiency

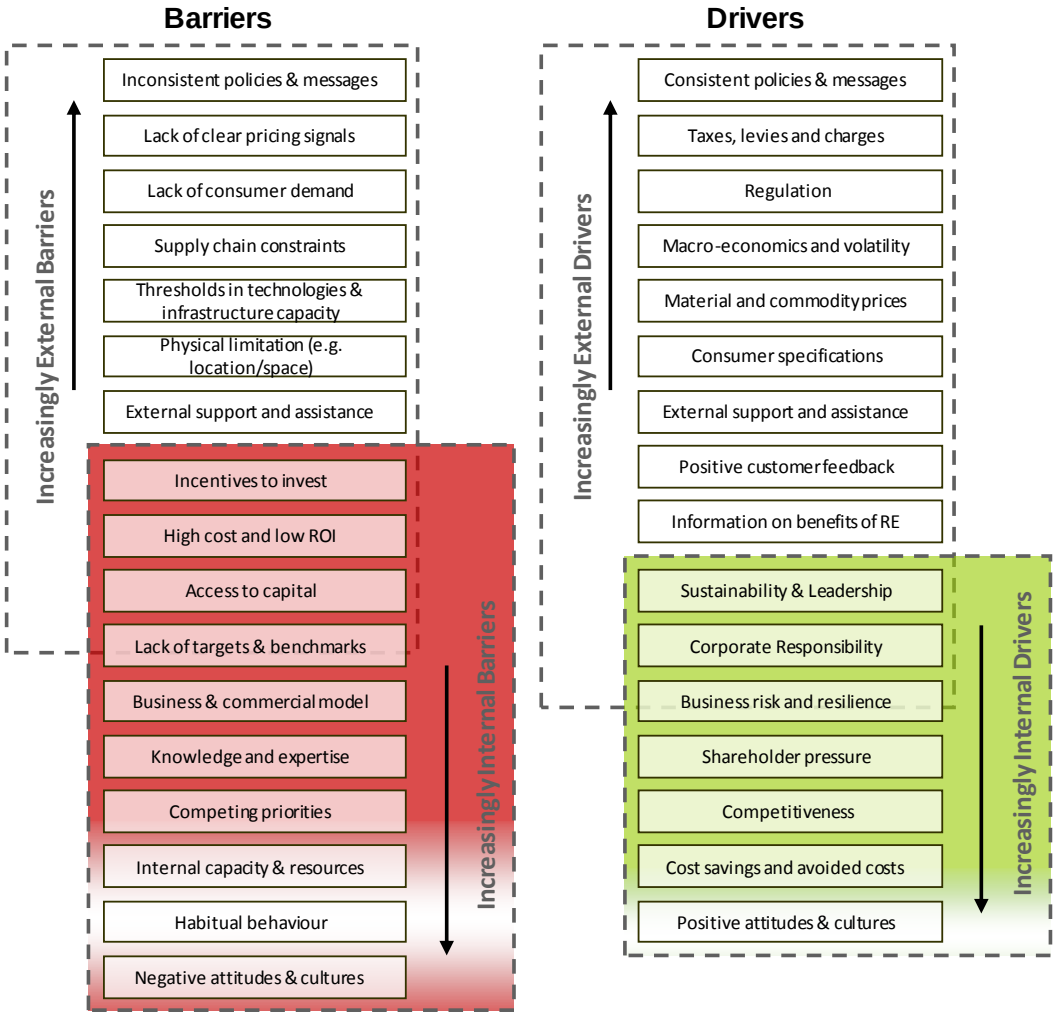
[89] Greenovate (REMake) (2012) Guide to resource efficiency in manufacturing

significant influencing factor on a business's ability to improve efficiency and indeed in company polls, factors with the financial theme such as funding, grants, loans, investment capital and cash are almost always featured in the top three most critical things to consider. Furthermore, rising raw material prices, increased volatility and the increasing internalisation of external costs in the supply of key resources, cost increases which are unlikely to be fully recoverable from consumers in many cases, are likely to place further economic challenges on businesses.

These, as well as many others, are strong signals for businesses to act to drive efficiencies through their organisations and yet resource efficiency remains an area competing for attention and investment, not least because of the cascade of constraints and limitations facing businesses[90]. Whilst this study stops short of taking a highly sophisticated level of analysis around the likely 'ability' of businesses to realise the potential benefits from resource (due to the inherent challenges in quantifying and scaling this with any precision), it has identified from the extensive literature reviews and case study analysis, key drivers and barriers that businesses report as being of critical importance in influencing how and indeed whether or not they choose to uptake measures to become more efficient in using resources. These factors are graphically outlined in the diagram in Figure B9.

[90] In a recent survey of around 400 businesses commissioned by edie, Temple Group and Sustainable Business showed the five competing priorities for business (in order of importance) to be: turnover, energy, waste, carbon and water.

Figure B9 Drivers and Barriers facing business when seeking to become more resource efficient



Quantifying the influence each driver or barrier has in business decision-making is an imponderably complex task and one far beyond the boundary of this study. If the barriers were to be conceptualised as push and drivers as pull factors, what can be discerned from examining the diagram is that there are a number of instances where both a push and pull force is being exerted on business – examples include pricing signals, policies/messages and support and assistance. Where opposing forces are visible, these could present intervention 'pressure points', where intervention to relieve the pressure could help businesses to move forward in terms of resource efficiency. Further and more complete examinations of the drivers and barriers, as well as interventions that could act to reduce barriers whilst promoting drivers, could be an area of research for the policy maker aiming to understand whether and where to invest resource at the most cost effective point.

8.3 Verification and validation of findings

The completion of a limited business consultation was intended to provide additional information and data on some of the most pressing knowledge gaps highlighted by the literature and case study reviews. The results were disappointing; of the 41 companies directly approached and engaged only eight completed questionnaires.

However, the results received, whilst obviously not statistically significant, were of good quality. Moreover, the messages they passed are in line with previous, larger consultations and so do seem to provide additional confidence in the results.

The consultation and questionnaire was split into two different parts intended to elicit responses that reflect the overall attitudes to resource efficiency as well as the actions being taken by organisations to become more resource efficient. The businesses responding were large multi-nationals with global sales and brand image. The results are therefore atypical of the relevant sector as a whole but typical of companies who have examined and addressed resource efficiency as part of their corporate or core strategies and analysed the costs and benefits. A summary of the highlights from analysis of the responses is presented below in bullet format:

Understanding and prioritising resource efficiency

- The businesses who responded perceived resource efficiency to be a medium / long term investment – this could be due in part to the size of businesses (generally global brands and multi-nationals);
- On a scale of one (not important) to five (very important), resource efficiency was perceived to be important (four) or very important (five) to business – this is reflected in a recent survey of business[91] that showed 43% of businesses consider resource efficiency to be a top-three priority and 85% consider it will be a higher priority in two years time;
- The majority of businesses responding had set internal resource efficiency targets / goals on water, waste and materials – this is concurrent with the size and nature of the companies responding. For the businesses with publicly stated resource efficiency goals, reputation and achieving the goals is also important;
- All businesses recorded resource efficiency performance in material terms; about one half records in financial terms too;
- Resource efficiency planning often applies uniformly in different geographic areas of operation – this is a key finding here which suggests many companies do take a process-driven approach to improving efficiency and may discount the effect of geography and markets. If all companies were to take such an approach, it may be less likely that in scaling results across Member States we would see visible trends in potential amongst different Member States, a finding not aligned with those responding to the Eurobarometer survey in 2012[92];
- Most businesses have taken five or more resource efficiency actions in the last year – this is to be expected given the size of the companies and fits generally with the trends seen in Eurobarometer;
- Financial costs/benefits are the most significant factor in resource efficiency decision making, followed by resource savings. Regulatory requirement is less significant compared to other factors; and
- The businesses responding reported that providers of resource efficiency measures/technology and other businesses in the network implementing measures were the most significant sources of resource

[91] edie, Temple Group and Sustainable Business – 400 commercial businesses, 2012.

[92] Flash Eurobarometer 342, March 2012 SMEs, resource efficiency and green markets (TNS Political & Social)

efficiency information. This finding also supports some of the anecdotal evidence suggesting that point of delivery advice and network information services may be more effective communication tool on resource efficiency than open publicly-funded websites. General literature and government campaign/programmes were reported are the least significant sources.

Taking action on resource efficiency

- Generally, respondents preferred to answer about knowledge / action level and some declined to provide views on the industry;
- Knowledge & action:
  - Businesses know a lot about the resource efficiency measures applicable in their sector and to their operations and have already taken actions on a number of measures – symptomatic of the firms and staff responded (informed survey group).
  - Most businesses know a lot about and have taken actions on resource efficiency actions under the 'the simple things' category, especially measuring consumption & analysing business operations.
  - Business knows about and has taken actions on resource efficiency actions under the "doing more things with less" and "process and technological solutions" categories.
  - Under 'doing more things with less' category, simple waste minimisation, improved material handling and storage, external recycling/re-use of by-products are most widely known and implemented.
  - Under 'process and technology solutions' category, knowledge and action levels are similar across the resource efficiency measures.
  - In comparison, the knowledge and action levels are less for resource efficient actions under the 'new business model' category.
- Payback: about two thirds of the measures already taken had a payback period of more than one year (the remainder are less than one year).
- Industry-wide uptake:
  - Businesses perceive that about a half of the businesses within their industry have taken action on resource efficiency measures (assuming that 'most' is 75% and 'some' is 40%).
  - Businesses perceive that more actions under 'process and technological solutions' have been taken compared to 'doing more with less' in the industry.
  - Businesses suggested that the industry-wide uptake level of closed-loop service model, product redesign and increasing awareness are likely to increase in the next 12 months.
  - Businesses expected the industry-wide uptake level for most resource efficiency measures would increase slightly or would stay constant at the current level during the next 12 months.

8.4 Quantifying the opportunities for business from resource efficiency

This study identifies considerable opportunities for businesses in the example sectors to gain from implementing resource efficiency measures (see Table B11). These results were then used as the basis for estimating results at EU level.

Table B11 The annual material water and waste management costs compared to the estimated annual (gross) benefit for an average EU company in each of the three sectors

	Manufacture of food products and beverages		Manufacture of fabricated metal products		Hotels and restaurants	
Estimated annual costs for an average EU company	**€**	**% of turnover**	**€**	**% of turnover**	**€**	**% of turnover**
Annual material costs	1,253,879 €	40%	354,105 €	27%	80,817 €	30%
Annual water costs	20,569 €	0.7%	4,979 €	0.4%	1,152 €	0.4%
Annual waste management costs	4,386 €	0.1%	2,507 €	0.2%	778 €	0.3%
Total material, water and waste management costs	**1,278,835 €**	**41%**	**361,591 €**	**28%**	**82,747 €**	**31%**
Estimated annual benefits of resource efficiency measures for an average EU company	**€**	**% of turnover**	**€**	**% of turnover**	**€**	**% of turnover**
Total annual benefits with payback less than a year	227,476 €	7.2%	110,634 €	8.5%	15,773 €	5.9%
Total annual benefits with payback between 1 and 2 years	- €	-	21,880 €	1.7%	3,116 €	1.2%
Total annual benefits with payback between 2 and 3 years	522 €	0.0%	8,862 €	0.7%	- €	-
Total annual benefits with payback more than 3 years	196,274 €	6.2%	80,042 €	6.1%	8,624 €	3.2%
Total annual benefits (regardless of payback time)	**424,272 €**	**13.4%**	**221,419 €**	**17.0%**	**27,514 €**	**10.3%**

In terms of the financial impacts for companies in the three sectors, the annual benefits for the food and drink manufacturing sector at the EU level are in the range of €110-227 billion. For the fabricated metal industry the estimate is between €44-83 billion and in the hospitality sector (hotels and restaurants) is €18-43 billion.

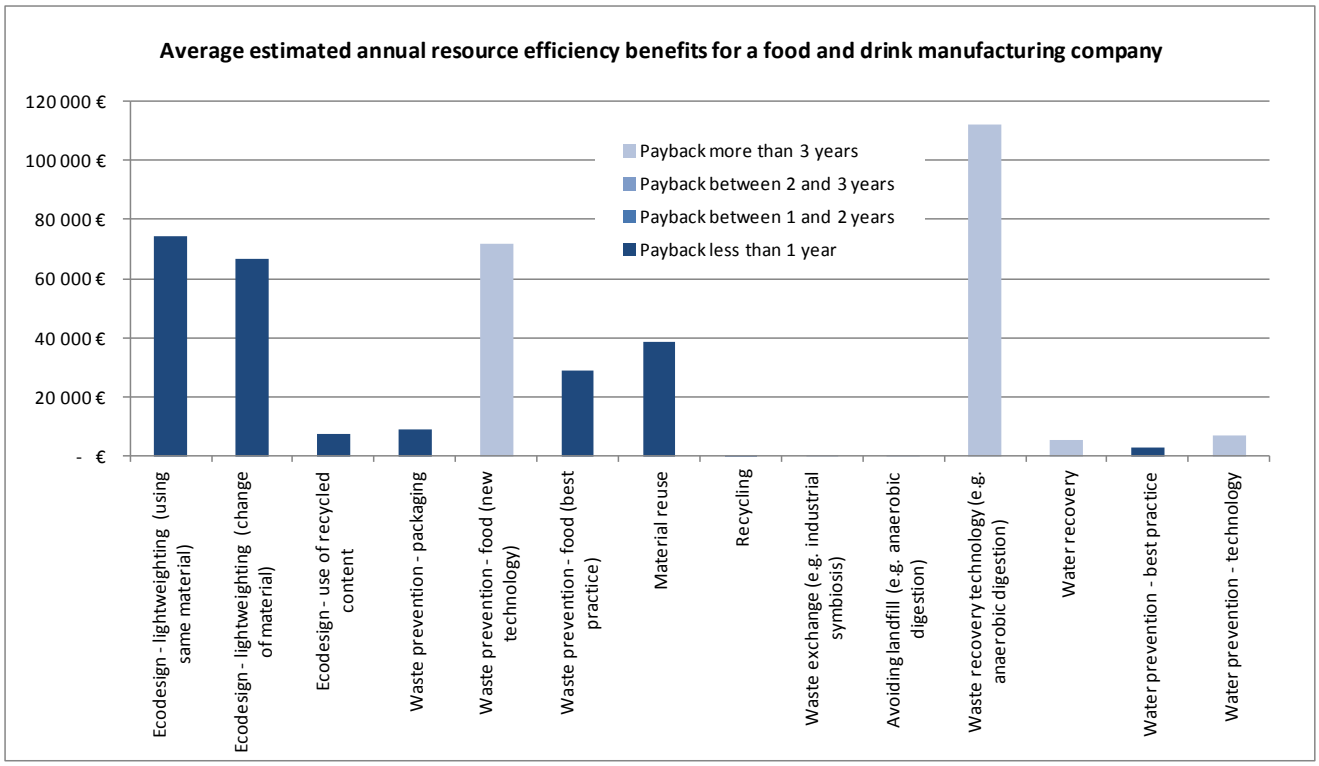
The estimates for resource efficiency potential are based on a range of assumptions that due to lack of comprehensive data, have much uncertainty attached to them. That said, the calculations and estimates provided are thought to be conservative estimates and have received secondary validation by cross-checking with literature sources and other comparable estimates. The methodology for calculating the potential costs and benefits is however transparent and further estimates can be easily calculated, if more reliable data becomes available.

8.5 Results from the three example sectors

8.5.1 Food and drink manufacture

The total annual gross benefits for an average food and drink manufacturing company, if it implemented all the possible resource efficiency measures (regardless of investment costs), is estimated to be about €424,000. This represents 13% of the company turnover. Figure B10 shows the spread of individual measures together with benefits and payback periods for the key measures available within the food and drink manufacturing sector based on a review of the available evidence.

Figure B10 The average annual benefits of resource efficiency measures for a food and drink manufacturer in the EU



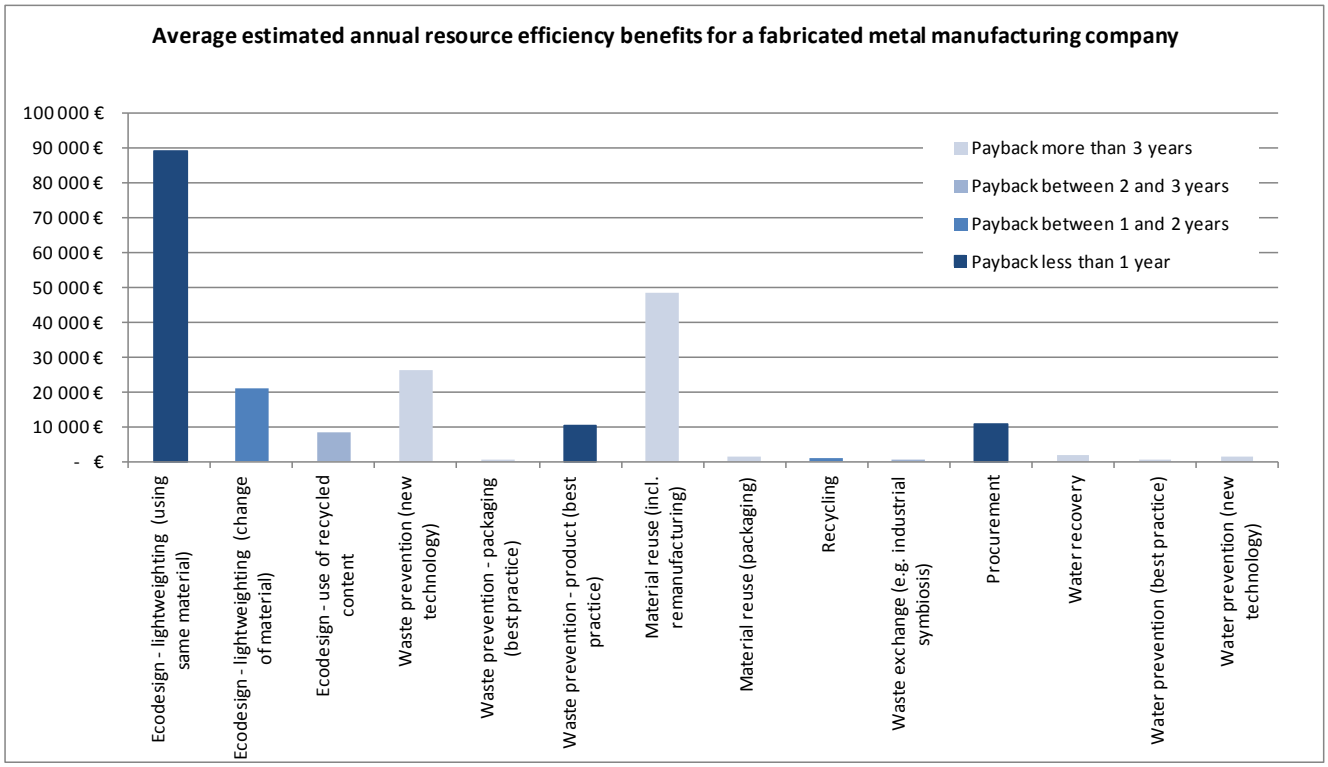
The resource efficiency opportunities most appropriate in this sector are the redesign of packaging (lightweighting and choosing more resource efficient materials and designs), waste prevention of food (both installing new resource efficient technology and implementing 'soft' best practice), reuse of packaging and internal waste recovery and reuse. The packaging related measures are relatively simple and often have a payback that is less than a year. In some cases, the hygiene or security requirements of packaging directly in contact with food might prevent the reuse of packaging materials.

The measures that involve investment in new technology for food processing and waste treatment have payback times of two or more years. Due to the low price of water and waste water treatment, the water measures provide the least annual benefits.

8.5.2 Manufacture of fabricated metals

Figure B11 shows the spread of individual measures together with benefits and payback periods for the key measures available within the fabricated metal products sector based on a review of the available evidence.

Figure B11 The average annual benefits of resource efficiency measures for a fabricated metal product manufacturer in the EU

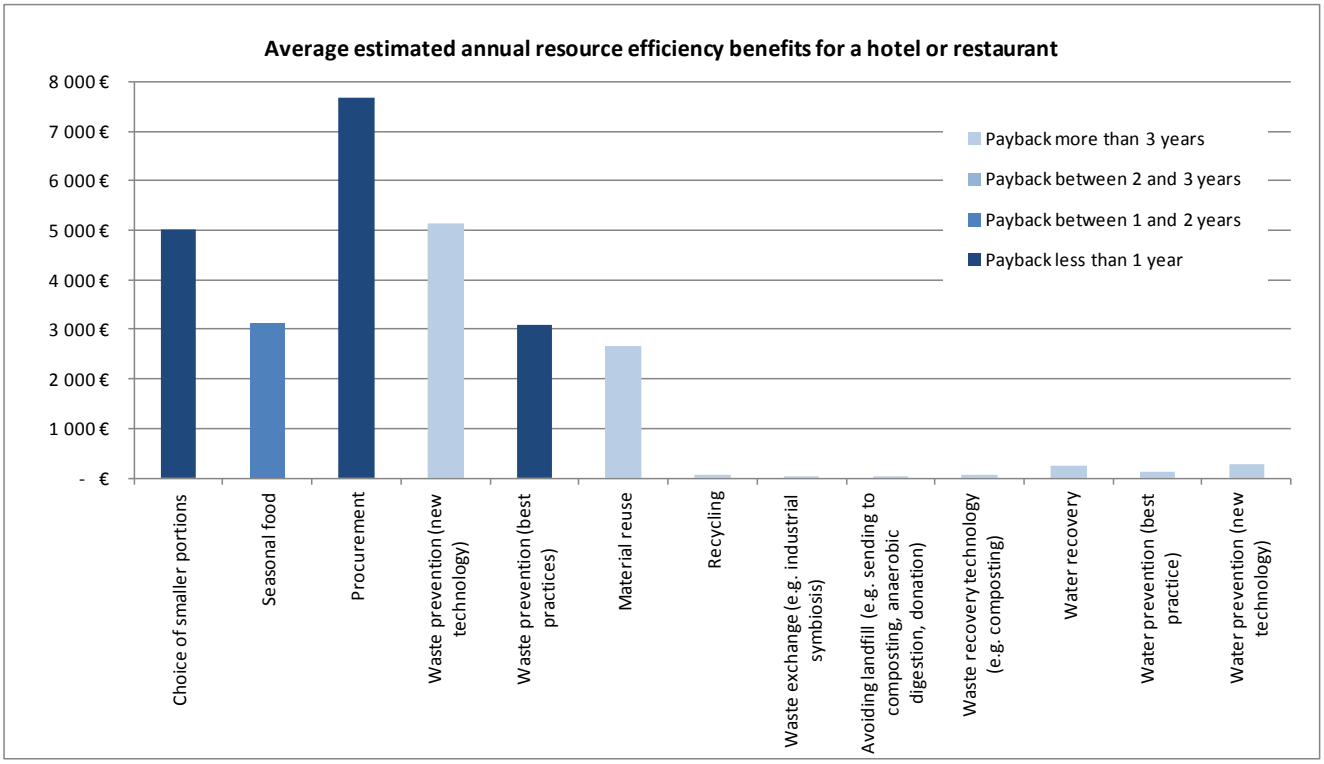


The most relevant resource efficiency measures for a company manufacturing fabricated metal products are ecodesign (lightweighting), waste prevention (using production processes that do not create waste) and reusing materials in a closed loop system such as remanufacturing. These three measures could bring in over €160,000 annually in cost savings or 13% of an average company's turnover. Lightweighting, procurement and best practices in product waste prevention have payback periods of less than a year. Purchasing new production equipment and establishing a take-back or remanufacturing system require high investments that would have a longer payback. Recycling and selling by-products do not provide any significant additional benefits as the sector already recycles their materials quite efficiently. More detailed information on the definition of sectors, materials and statistics consulted is provided in Annex B.

8.5.3 Hotels and restaurants

It was estimated that an average hotel or restaurant in the EU could save just under €30,000 annually if they adopted all the resource efficient measures available. This represents about 10% of a typical business' annual turnover. Most of the measures with the greatest benefits are no cost/low cost measures that could be paid back in less than a year, e.g. serving variable sized portions, changing procurement practices and implementing best practices for cleaning and cooking. Limiting the menu to local seasonal food could also result in cost savings. Investing in technologies to reduce waste (e.g. refillable and or bulk containers/dispensers) and durable supplies (instead of disposable napkins, cutlery, etc.) also leads to cost savings, but with longer payback times.

Figure B12 The average annual benefits of resource efficiency measures for a hotel or restaurant in the EU



8.5.4 Basis for use of results for estimates in other sectors

The analysis of resource efficiency for the three sectors taken together provides a range of possible actions and outcomes that reflect the circumstances that are likely to occur in many firms. This is the basis for the use of the results to make estimates for other sectors and is described in following sections. All estimates depend on the impact, cost, and uptake of individual measures and it is these micro-impacts that represent the resource efficiency potential for these sectors.

Here the impacts from the typical firms in the three example sectors are used as a proxy for results at EU level. Understanding the impact of the measures in each sector is the basis of the corresponding understanding of potential impacts at EU level. Furthermore, the contrasts between the results from the three example sectors

provides an understanding of the potential variation in the impacts of measures in different EU sectors and, in addition, highlights many of the implications for businesses in applying resource efficiency measures.

The table below shows the potential benefit broken down by measure and is a collation of the information presented in the graphs. The **values in the table are percentages of annual turnover of an average firm in each of the sectors**. The three left hand columns show the gross benefits and the columns to the right show the benefits net of costs. In some cases the percentages are negative which implies that the discounted costs are greater than the annual benefits. In practice, companies would not take up these benefits. The sum of the benefit is shown at the bottom of each column. For the right hand columns the sum is also shown excluding the measures with negative benefits.

Figure B13 RE savings potential expressed as % of turnover of a typical European firm in the three example sectors (average measure benefits, average measure costs), assuming 100% uptake

	annual benefit only			annual benefit including annualised costs		
	FBM	FMP	HaFS	FBM	FMP	HaFS
Ecodesign - lightweighting (using same material)	2.4	6.9		2.2	6.5	
Ecodesign - lightweighting (change of material)	2.1	1.6		2.0	1.3	
Ecodesign - use of recycled content	0.2	0.6		0.2	0.3	
Waste prevention - packaging	0.3			0.3		
Smaller portions			1.9			1.9
Seasonal food			1.2			0.9
Waste prevention (new technology)	2.3	2.0	1.9	0.9	0.9	0.3
Waste prevention - packaging (best practice)		0.0	1.2		0.0	1.0
Waste prevention - product (best practice)	0.9	0.8		0.9	0.7	
Material reuse (incl. remanufacturing)	1.2	3.7	1.0	1.1	-2.6	0.1
Material reuse (packaging)		0.1			-0.1	
Recycling	0.0	0.1	0.0	0.0	0.0	-0.1
Waste exchange (e.g. industrial symbiosis)	0.0	0.0	0.0	0.0	0.0	-0.1
Avoiding landfill (e.g. sending to composting, anaerobic digestion)	0.0		0.0	0.0		-0.1
Waste recovery technology (e.g. biogas, composting)	3.6		0.0	-5.5		-0.9
Procurement		0.8	2.9		0.8	2.5
Water recovery	0.2	0.1	0.1	-1.1	-3.0	-1.5
Water prevention (best practice)	0.1	0.0	0.0	0.1	0.0	-0.1
Water prevention (new technology)	0.2	0.1	0.1	-1.2	-6.4	-1.6
total	**13.5**	**17.0**	**10.3**	**-0.2**	**-1.6**	**2.3**
preferred measures (total)				**7.6**	**10.5**	**6.6**

Note: Preferred measures are only those identified as having a positive cost/benefit return, which takes account of the fact companies are less likely to implement measures with net costs.

Estimates taking account of the level of uptake are shown in Figure B16. These figures are adjusted to reflect the low and high estimates of potential uptake, which itself is a measure of how well optimised businesses are in

resource efficiency terms (low uptake meaning higher numbers of business are already taking action and to whom some measures will not apply.

Figure B14 RE savings potential expressed as % of turnover of a typical European firm in the three example sectors, if scaled by a high level of uptake (91%) and low level of uptake (45%) (average measure benefits, average measure costs)

	High uptake scenario (91%)						Low uptake scenario (45%)					
	annual benefit only			annual benefit including annualised costs			annual benefit only			annual benefit including annualised costs		
	FBM	FMP	HaFS	FBM	FMP	HaFS	FBM	FMP	HaFS	FBM	FMP	HaFS
Ecodesign - lightweighting (using same material)	2.1	6.1		2.0	5.8		1.0	2.9		1.0	2.8	
Ecodesign - lightweighting (change of material)	1.9	1.4		1.8	1.1		0.9	0.7		0.8	0.5	
Ecodesign - use of recycled content	0.2	0.6		0.2	0.3		0.1	0.3		0.1	0.1	
Waste prevention - packaging	0.3			0.2			0.1			0.1		
Smaller portions			1.7			1.7			0.7			0.7
Seasonal food			1.1			0.8			0.4			0.3
Waste prevention (new technology)	2.1	1.8	1.8	0.8	0.8	0.2	0.9	0.8	0.7	0.3	0.3	0.1
Waste prevention - packaging (best practice)		0.0	1.1		0.0	0.9		0.0	0.4		0.0	0.4
Waste prevention - product (best practice)	0.8	0.7		0.8	0.7		0.3	0.3		0.3	0.3	
Material reuse (incl. remanufacturing)	1.1	3.7	0.9	1.0	-2.6	0.1	0.5	2.8	0.4	0.4	-2.0	0.0
Material reuse (packaging)		0.1			-0.1			0.1			0.0	
Recycling	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste exchange (e.g. industrial symbiosis)	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1
Avoiding landfill (e.g. sending to composting, anaerobic digestion)	0.0		0.0	0.0		-0.1	0.0		0.0	0.0		0.0
Waste recovery technology (e.g. biogas, composting)	3.5		0.0	-5.4		-0.9	2.7		0.0	-4.2		-0.7
Procurement		0.7	2.6		0.7	2.3		0.3	1.1		0.3	1.0
Water recovery	0.2	0.1	0.1	-1.1	-2.8	-1.4	0.1	0.1	0.0	-0.6	-1.5	-0.7
Water prevention (best practice)	0.1	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1
Water prevention (new technology)	0.2	0.1	0.1	-1.1	-5.9	-1.4	0.1	0.1	0.1	-0.6	-3.2	-0.8
total	**12.5**	**15.6**	**9.4**	**-0.8**	**-2.0**	**2.0**	**6.8**	**8.4**	**4.0**	**-2.2**	**-2.3**	**0.1**
preferred measures (total)				**6.9**	**9.4**	**6.0**				**3.1**	**4.4**	**2.5**

Note: Preferred measures are only those identified as having a positive cost/benefit return, which takes account of the fact companies are less likely to implement measures with net costs.

Analysis of results for use of measures in other sectors

Ecodesign without a change in materials provides the greatest single potential benefit of all measures. The benefit of ecodesign is most seen where materials are expensive (e.g. in FMP – 6.9% of turnover) and also where they are used in high volumes (FBM – 2.4% of turnover). This benefit can be obtained at low to medium cost. Even in sectors where ecodesign in relation to *products* is not directly applicable (e.g. HaFS), measures exist based on an approach using a similar perspective on *other aspects of the business* (in this case smaller portions and seasonal food) and give improvements of a similar scale (1.9% and 1.2%). These benefits are similarly at low cost.

Providing slightly less benefit than ecodesign, waste prevention using new technology also has a similarity in impact across the three sectors (between 1.9 to 2.3%). In contrast to measures with similarity in impacts, material reuse and procurement show some of the greatest differences between sectors (from 1.0% to 3.7% and 0.8% to 2.9%) and for some sectors these measures may not apply. These are also low cost measures.

It is clear that low cost measures include both those with wide applicability across sectors and those with high specificity to sectors. Even though low cost, these are not necessarily easily applied or simple in concept.

At a more detailed level, ecodesign with a change in materials is less effective (for both FBM and FMP) than ecodesign using the same materials. To some extent this demonstrates that materials are already well chosen (or that substitutes are priced to match them). There is also greater variability between sectors in the application of ecodesign with changed materials reflecting the difficulty for some sectors to change materials.

Some of the more well-known measures do not show high performance. These include recycling, use of waste exchanges and avoiding landfill through participation in composting and anaerobic digestion schemes. An important reason is that the material streams involved have relatively low prices. Companies will see a greater financial benefit when they focus on the higher value-added materials and products under their control, which means businesses must understand all elements of their value chains before selecting those resource efficiency measures with the highest economic benefit overall.

Water recovery and use prevention are also of low value due to the relatively low prices for water. All water measures are in fact seen to have a negative benefit. Changing the discount rate will improve their effectiveness for companies but not substantially.

Differences and similarities between example sectors

All sectors show variance between which measures deliver the greatest benefit (potential) and in each case the sector obtains the majority of its benefit from just a few key measures, albeit these vary by sector as would be expected from sectors with different material use profiles and activities.

Figure B15 Relative savings (%) from measures in the three example sectors

	annual benefit		
	FBM	FMP	HaFS
Ecodesign - lightweighting (using same material)	17.5	40.4	
Ecodesign - lightweighting (change of material)	15.7	9.5	
Ecodesign - use of recycled content	1.8	3.8	
Waste prevention - packaging	2.2		
Smaller portions			18.3
Seasonal food			11.3
Waste prevention (new technology)	16.9	11.8	18.7
Waste prevention - packaging (best practice)		0.1	11.2
Waste prevention - product (best practice)	6.8	4.7	
Material reuse (incl. remanufacturing)	9.1	21.9	9.7
Material reuse (packaging)		0.7	
Recycling	0.1	0.4	0.2
Waste exchange (e.g. industrial symbiosis)	0.0	0.2	0.1
Avoiding landfill (e.g. sending to composting,	0.0		0.1
Waste recovery technology (e.g. biogas,	26.4		0.2
Procurement		4.9	27.9
Water recovery	1.3	0.8	0.8
Water prevention (best practice)	0.6	0.3	0.4
Water prevention (new technology)	1.6	0.7	1.0
total	**100.0**	**100.0**	**100.0**

The analysis of the measures applicable to the FBM sector shows three main measures deliver over 75% of the available benefit, which are ecodesign, waste prevention technologies (more efficient equipment and processes) and waste recovery technologies (e.g. on-site anaerobic digestion or composting of food waste).

In the FMP sector, the majority of the benefits (over 60%) are concentrated on just two measures: ecodesign and material reuse. The figures reflect these sectors' main activities and use of materials.

In the HaFS sector, efficient procurement (avoiding wastage) is the key measure (27% of the total benefit) with four other measures focused on reducing portion and packaging sizes to avoid waste along with seasonal food and waste prevention using new technologies (efficient machines and processes).

Allocation of costs and benefits in time

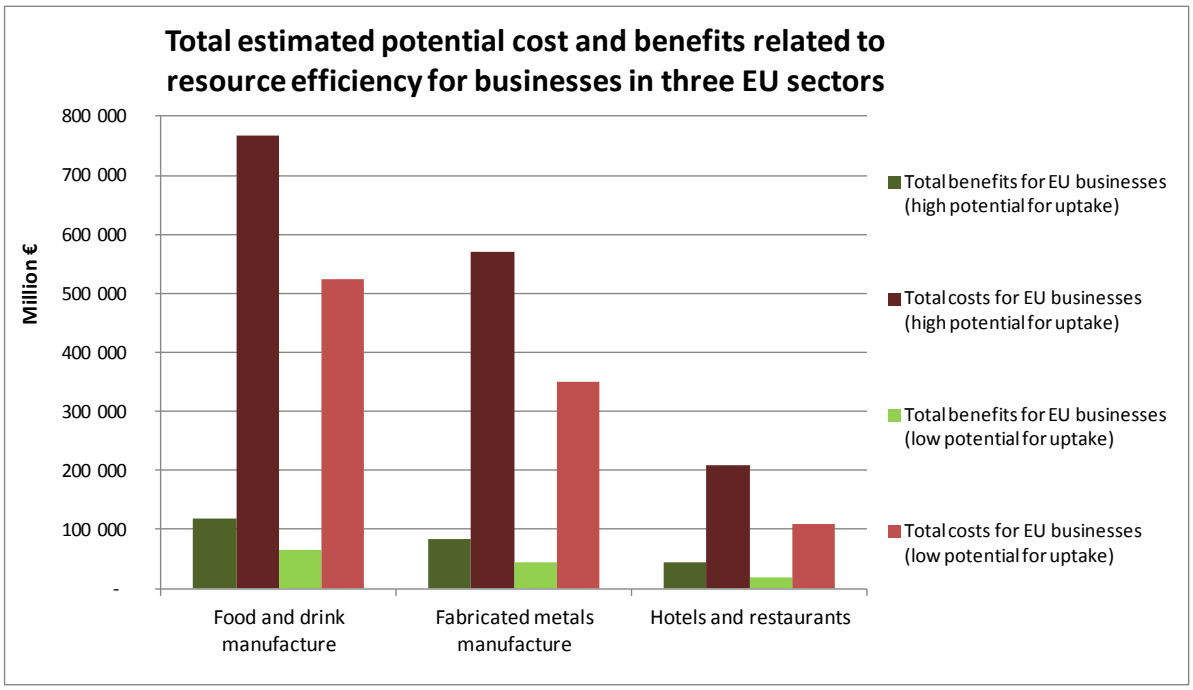
The left hand columns in Figure B15-16 (gross benefits) are shown without including an estimate of the cost of implementing a measure. Some measures are no cost/low cost measures a payback time of less than a year and, for these, the gross benefits are very similar to net benefits, especially as, after the first year, there are no additional costs. Measures which require investment have net benefits which are lower than gross benefits which are shown in the right hand columns of Figure B15-16.

All benefits will reoccur annually, giving rise to a long term stream of benefits. Investment costs may be incurred less often, sometimes only once, at the beginning of the periods. Cases requiring investment raise the issue of cost allocation over time. **In calculating net benefits in the Figures B15-16, the costs have been allocated over a 10 year period and are discounted with a 10% discount rate.** This allows an amortised annual cost to be subtracted from the annual benefit to calculate a net annual benefit.

Businesses need to understand the level of investment relevant to resource efficiency measures and how to finance it, as they may need to borrow to make such investments. Figure B18 shows the total investment required to achieve all the benefits in the table above and compares these with the level of annual benefits. It shows that a significant amount of resource efficiency opportunities require large capital investments. The left most bar in each group shows the total annual reoccurring benefit and the next bar to the right shows the total costs to achieve this annual level of benefit. Very approximately, the relative size of the two bars indicates the number of years required to pay off the investment (cases for high and low uptake potential are shown in each group).

This graph is a total for all measures which sums measures with and without capital investment requirements. A smaller level of benefit could be obtained with a much lower capital investment by, for example using only no/low cost measures.

Figure B16 Comparison of annual benefits with total costs for all measures in each of the three example sectors (EU totals)



8.5.5 Estimates of benefits at European level using scaling of the example sectors

The aim of this section is to use the results from the three example sectors to obtain an estimate for other sectors in Europe.

Scaling methodology

Strategies for the use of these results require the consideration of the following main factors:

- Selection of a mix of the example sectors that best comprises a composite that can be used to represent other sectors;
- The choice of scaling parameter (for example turnover, number of companies or employees); and
- The applicability of the example sectors to other sectors.

The method used here for scaling is based on turnover. The reason is that the main resource efficiency benefits arise where activities in the company are using higher value material streams. For example measures will be applied first to more expensive and more highly used materials. Companies are naturally concerned to manage such streams efficiently. In broad terms, resource efficiency measures will be taken up in the order they affect profits.

The measures which are most effective across the three sectors are ecodesign (using the same materials) and waste prevention. These measures are applicable in most industrial sectors and suggest that, for these measures, the results for the three example sectors can be used to represent a wider set of sectors. Their preponderance in the

breakdown of impacts by measure (see Figures B15-17) also suggests that the wider residual variation in other measures (for example use of water prevention) will have a commensurately small effect and is not a reason not to use a simple scaling.

Despite these broad themes relevant to application of the example results to other sectors, the selection of a composite sector that can be used as a source of a 'typical set' of measures requires a technical choice on how a mix of these three sectors is constructed. The simplest is to take one example sector as representative of all other sectors (implicitly using a 100%, 0%, 0% split across the three examples). Almost as simple but more representative methodology would use a simple average with a 33%, 33%, 33% split across the three.

At a more detailed level the three example 'source' sectors could be matched with 'target' sectors based on their specific characteristics. This would imply use of a customised split for each target sector. Additional evidence for matching source and target sectors is not available, and would also require a structured approach. For the generation of high level results which are aggregated across sectors, it is not necessarily the case that such an approach would be more accurate.

Target sectors

The example sectors differ in their characteristics in respect of the range of processes, company organisation, size and value of input materials; however they are all industrial activities which involve the transformation or trade of materials. All three are sectors where financial interests and resource flows are closely related.

Target sectors will be better represented by example sectors where they share the same basic characteristics. For this reason, the scaling has been applied to sectors identified in Eurostat as mainly industrial sectors with some commercial (as HaFS is not an 'industrial' sector)[93].

These sectors collectively have a turnover of ~€7 trillion which can be seen in the context of an EU total GDP of €11 trillion Euros.

The principal sectors excluded on this basis are agriculture, forestry and fishing; retailing; distribution and all financial services sectors. All of these are special cases for resource use and can be seen not to be logically represented by the example sectors.

European estimates

The resource savings estimates for Europe (assuming 100% uptake) are shown in Table B12. Savings are based on a composite firm represented by the savings in the three example sectors in the ratio of 33%, 33%, 33%. The top line of the table shows annual benefits, the second line shows annual benefits minus the costs of the measures (amortised over 10 years at a 10% discount rate).

[93] NACE codes: B05,B07,B08,B09,C10,C11,C110,C12,C13,C14,C15,C16,C17,C18,C19,C20,C21,C23,C24,C25, C26,C27,C28,C29,C30,C31,C32,C33,D35,E36,E37,E38,E39

Table B12 RE savings potential for European firms in industrial sectors, assuming 100% uptake (average measure effects, average measure costs)

	Annual Value[1] (millions EUR)	As % of turnover		
		Average	Minimum[2]	Maximum[2]
Benefits	€ 995,826	14%	10%	17%
Benefits net of costs of measures	€ 604,290	8%	7%	11%

Notes
(1) EU turnover € 7,329,008 (million)
(2) Minimum and maximum reflect differences between sectoral estimates which include earlier averaging

Estimates taking account of the level of uptake are shown in the following two tables below, the first showing estimates with a high potential level of uptake (i.e. businesses have typically done less on RE leaving more room for opportunity with figures calculated on 11% of the sectors being 'optimised' in RE terms), and the second with a low level (i.e. a higher proportion of businesses are optimised for RE – in this case 55%, leaving 45% to improve their resource efficiency and realise the potential).

Table B13 RE savings potential for European firms in industrial sectors, if scaled by a high level of uptake (91%) (average measure effects, average measure costs)

	Annual Value[1] (millions EUR)	As % of turnover		
		Average	Minimum[2]	Maximum[2]
Benefits	€ 914,023	12%	9%	16%
Benefits net of costs of measures	€ 543,819	7%	6%	9%

Notes
(1) EU turnover € 7,329,008 (million)
(2) Minimum and maximum reflect differences between sectoral estimates which include earlier averaging

Table B14 RE savings potential for European firms in industrial sectors, if scaled by a low level of uptake (45%) (average measure effects, average measure costs)

	Annual Value[1] (millions EUR)	As % of turnover		
		Average	Minimum[2]	Maximum[2]
Benefits	€ 466,852	6%	4%	8%
Benefits net of costs of measures	€ 245,257	3%	2%	4%

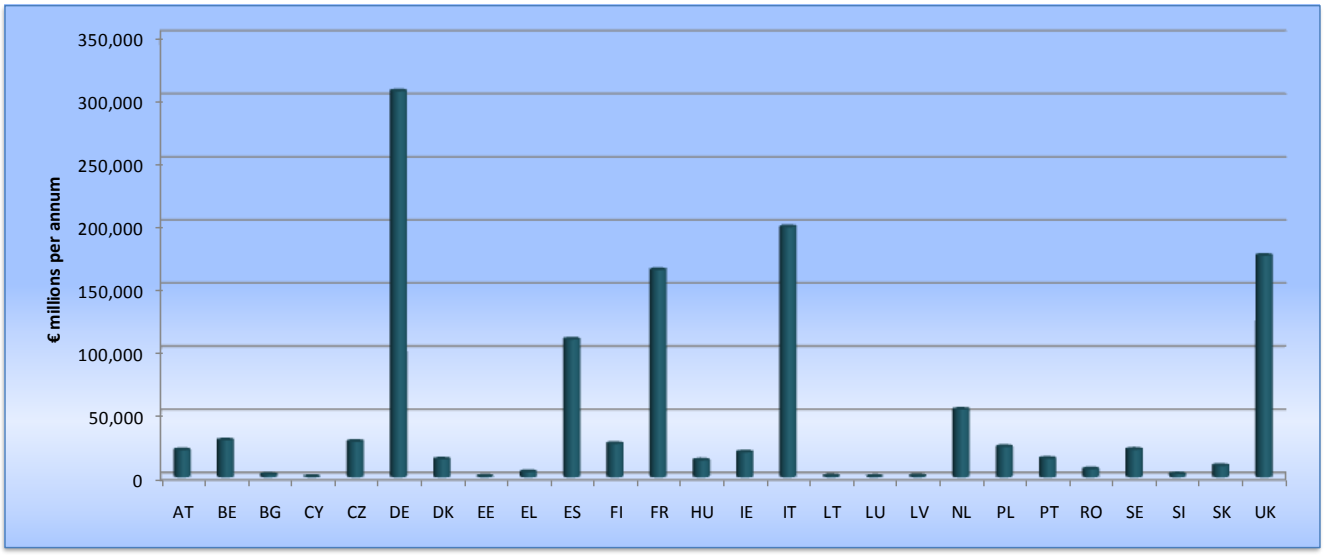
Notes
(1) EU turnover € 7,329,008 (million)
(2) Minimum and maximum reflect differences between sectoral estimates which include earlier averaging

Breakdown by Member State

The analysis here is conducted in terms of a European average firm as a composite for representing a typical European firm in other sectors. It is recognised that sectors are of different sizes both absolutely and relative to the size of the national economy within each Member State and resource efficiency savings will correspondingly differ in relative and absolute terms even when using the average firm as a basis.

When a composite firm is used, it represents a firm in any sector and so differences in sectoral composition of Member States, which is available from Eurostat, is not a factor that can be accounted for when making resource efficiency estimates at Member State level. Differences between Member States arise firstly from different scale of economic activity in each of them. The other information that can be used is evidence from the TNS Eurobarometer which provides survey statistics on potential take up of measures in different Member States. The resulting variation in resource efficiency potential by Member State is shown in Figure B17.

Figure B17 RE savings potential scaled for all European firms in industrial sectors, by Member State and at a 100% uptake (average measure effects, average measure costs)



Potential refinement to scaling methodology

According to the Eurobarometer survey there is a large difference in the types of measures that companies implement as well as great variation between Member States. There are fewer differences in uptake of resource efficiency measures across industry sectors, although each sector has its specific measures that are most appropriate. As expected, large enterprises are most advanced regarding the implementation of resource efficiency measures. Medium-sized and small enterprises (between 10 and 250 employees) are currently implementing many measures, but still have a large potential to do more. Micro-enterprises (fewer than 10 employees) have the least uptake of resource efficiency measures.

8.5.6 Environmental impacts of resource efficiency measures

This section assesses the environmental impacts of using fewer materials and less water as well as reducing waste and avoiding landfilling. The avoided impact potentials are only shown for the material streams and sectors studied in detail, and for the environmental impact 'climate change' in Figure B17, Figure B18 and Figure B19. These environmental impact savings are mainly societal benefits as they do not accrue directly to the companies and may not have a financial value to them. Nevertheless, companies may consider that actions they take that contribute to such environmental benefits provide a corresponding benefit to the company in terms of its reputation and so include an imputed benefit when deciding on particular measures.

The environmental benefits of the material savings were calculated using Environmentally-weighted Material Consumption, which uses Life Cycle Inventory data to estimate the potential environmental impacts of different material flows. This crude calculation method provides only an indication of the potential environmental benefits which will depend on the specific measures. In terms of greenhouse gas (GHG) emissions, the resource efficiency opportunities for the three example sectors represent between 2-4% of the total annual GHG emissions in the EU. This takes into account the avoided GHG emissions of the production of materials (particularly food), which includes extraction and agriculture. This estimate is in the same order of magnitude as the estimate provided by Oakdene Hollins[94] for non-energy related resource efficiency savings for businesses in the UK in 2009. Here the potential GHG emission savings for waste and water related resource efficiency measures were estimated to be around 7% of total UK GHG emissions[95].

The main observations in respect of the three example sectors are:

- Reducing the amount of food purchased provide the highest environmental impact savings potential in the sectors food manufacturing and hospitality. The potential of measures addressing the use of paper and board and plastic is also important in food manufacturing;
- The fabricated metals sector can have the highest environmental impact savings potential through measures which address use of iron and steel, glass, aluminium and plastics. The sector's use of wood and paper and board has significant impacts and savings in the 'land use' category of environmental impacts.

[94] Oakdene Hollins (2011) The Further Benefits of Business Resource Efficiency. A research report completed for the Department for the Environment, Food and Rural Affairs, UK.

[95] Non-energy related resource efficiency opportunities (regardless of payback time) was estimated at 47 Mt CO_2-eq. annually, compared with the total annual GHG emission of the UK in 2009: 700 Mt of CO_2-eq.

Figure B18 Annual avoided GHG emission saving potential per average company in each of the three sectors taking into account all resource efficiency measures (regardless of payback time)

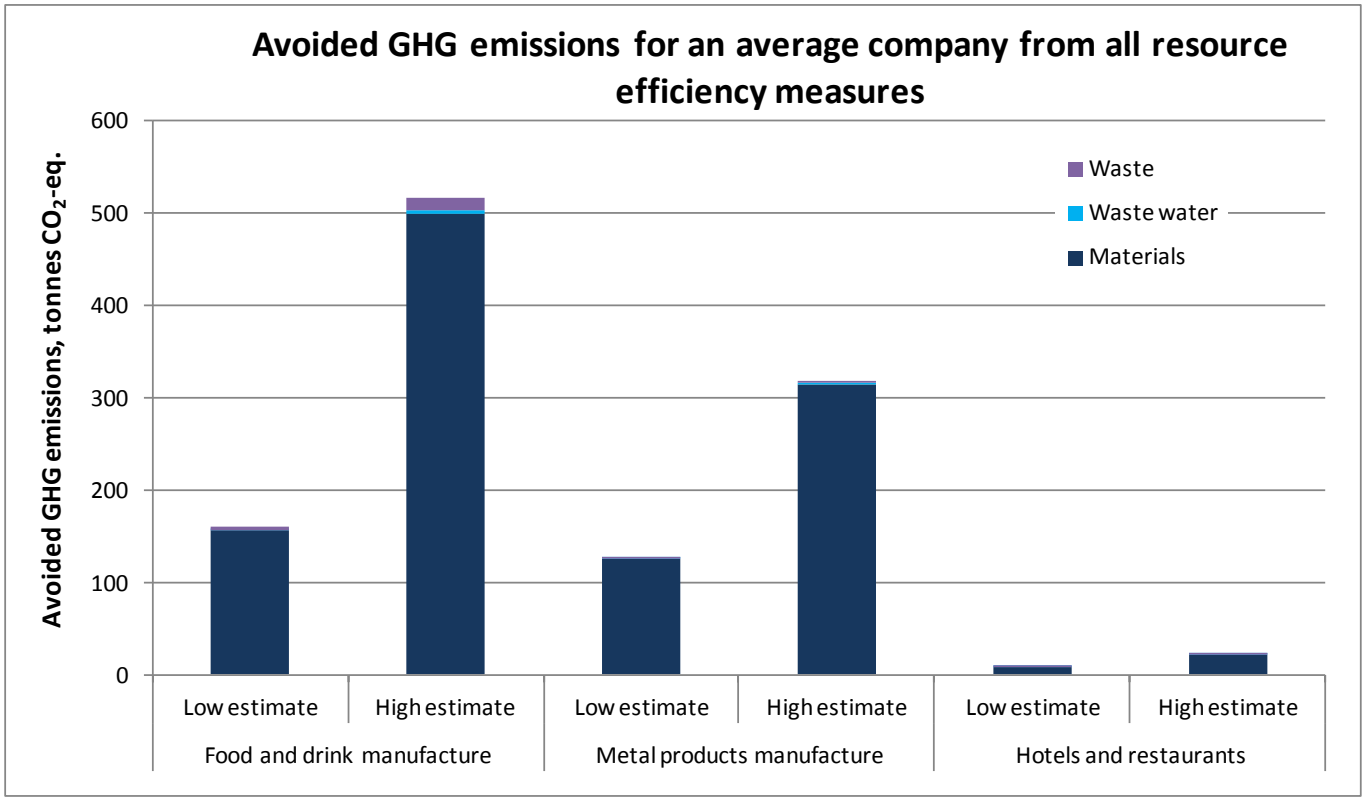
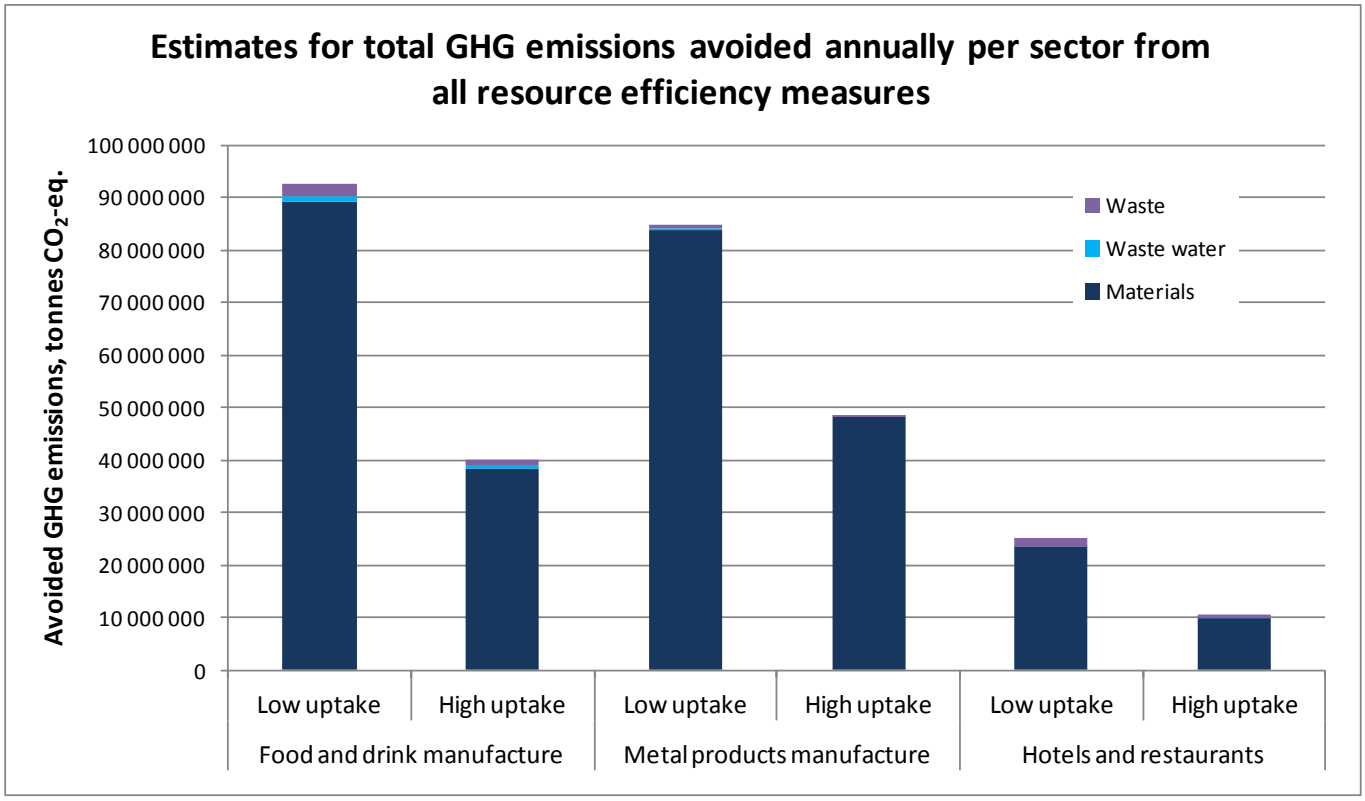


Figure B19 Total annual avoided GHG emission saving potential in the EU-27 per sector for all resource efficiency measures (regardless of payback time)



8.5.7 Other impacts of resource efficiency measures

As well as the financial and environmental benefits for companies, there is a range of other impacts from resource efficiency measures that may affect their operation. These include:

- Impacts on other companies upstream and downstream in the supply chain, most of which will result in overall material reductions[96];
- Rebalancing of the supply chain. One example is take-back schemes, which illustrate a form of vertical integration. Companies may also sell off or outsource certain activities allowing further efficiencies by, for example, permitting growth of a new company specialising in that activity;
- Substitution of materials by labour. Ecodesign is such an example where time spent designing is compensated by material savings. Companies may be able to purchase ecodesign services rather than materials;
- Attitudinal changes as promotion and adoption of resource efficiency measures at work leads consumers to change their behaviour at home, potentially affecting markets for the companies' products; and

[96] There may be local increases where additional investment is required.

- Development of common practice in which there is further improvement in the application of resource efficiency measures with society becoming 'more efficient in applying resource efficiency'.

8.6 Sensitivity analysis

A simple sensitivity analysis was carried out by changing the values of the key parameters and comparing the results with the best estimates. **The parameters that influence the overall results of the potential annual benefits most are the material consumption of the sector and the price/costs of materials**. Interestingly, the overall pattern of which resource efficiency measures have the greatest benefits (and often) shortest payback does not change much when the key parameters are changed. In general, the resource efficiency measures that reduce the amount of materials needed are typically the ones with the greatest potential. This is because even a small reduction in material consumption will result in significant cost savings due to the material costs (particularly in material intensive sectors) being such a large share of the total costs of doing business.

Resource efficiency measures that only focus on water savings and waste management options do not represent large cost savings in comparison to material reduction measures. This is due to the relatively lower unit costs of water and waste management in relation to the overall operating costs of a business. Even with significant cost increases to water and waste management, this does not change the overall potential annual benefits that much. Similarly, changes in the amount of waste that is not sent to landfill (e.g. recycling, waste exchange, anaerobic digestion, etc.) do not represent the greatest cost saving potential although no account has been taken of possible future rises in waste taxes.

Lowering the estimates of investment costs of each measure does not change the annual benefits, but it does shorten the estimated payback time. As most of the measures have either payback periods of less than a year or more than three years (only a handful are in the mid-range of 2-3 years), lowering the estimates of investment costs does not change this distribution of the payback period of measures.

Based on the sensitivity analysis performed we find that the general pattern for which resource efficiency measures have the greatest cost saving potentials does not change when the key parameters are altered. What does change is the overall maximum potential for resource efficiency (cost) savings. As the results in this study are provided with a fairly large range due to the uncertainty in the present uptake of resource efficiency measures, this 'hides' many of the other uncertainties in the calculations.

9. Interpretation of the findings

9.1 What the findings mean for business

Despite clear benefits, many European companies have failed to fully implement the changes needed to become more resource efficient. In general, business may be unaware of the potential, have other priorities or the financial incentive is not great enough. The analysis in this study includes a literature review of measures applied in the example sectors and highlights barriers and complexities in the factors a business must consider in selecting actions to achieve more efficient behaviour.

Although market conditions are currently challenging, this study shows that businesses seeking savings through adoption of resource efficient measures can benefit most by recognising the following key themes:

- Sectors have intrinsic characteristics. Some sectors have potential concentrated in only few areas, others need to focus on a wider mix.
- Measures need to be carefully chosen to realise financial benefits. The selection is more important than the level of investment and poorly chosen measures can have less of a positive benefit.
- The types of measures fall into two broad groups, those with a payback of a year or less, and those with a longer payback (greater than 3-5 years). There are fewer measures with an intermediate payback period.
- For business managers, attention should focus on time windows which are in the short and the longer term compared to the more typical medium term focus for decision making. For the shorter term the focus should be on embedding resource efficiency within daily and monthly management reviews. In the longer term, companies should prioritise resource efficiency considerations within their investment planning and strategy for company management.
- Many low-cost/no-cost measures provide substantial benefits and are relatively simple to implement.
- Financial benefits may be related to government policies. For example landfill taxes increase the benefits available from waste prevention at the company. Remaining informed of the policy agenda allows such savings to be prefigured and built into business plans.
- Waste within the supply chain is a particular challenge because preventing it can require investment and for businesses to introduce new processes – this means that many of the best resource efficiency opportunities cannot be realised in the low-cost/no-cost category and require a longer-term vision as well as a commitment to invest to achieve savings.
- Engaging the supply chain as partners to meet waste prevention and resource efficiency targets (e.g. by setting targets and agreements on key resource and waste metrics), can be a catalyst for innovation throughout the supply chain.

More specifically, the measures identified which most benefit business are ecodesign, waste prevention, procurement and material reuse. Waste prevention using new technology generates gross benefits of between 2 -

3.4% of turnover in the three example sectors. The other measures provided higher benefits of 4-6% but only in specific sectors.

As an illustration of practical impacts, the baker Warburtons, is working to reduce food waste among consumers by taking initiatives such as creating new 'waste less' products as well as promoting 600g mid-sized loaves 'designed actively to promote waste reduction'. This can be seen as an ecodesign measure with a range of associated impacts. It reduces waste, which is a headline message attractive to consumers, but also allows the same number of loaves to be stored in a smaller space. This means the retailer can supply the same number of customers while at the same time encouraging resales and releasing storage space for additional products and overall offering greater choice and fresher products.

Despite the obvious advances made by many businesses it is clear more needs to be done. The following quote from a recent review of the UK's Courtauld II agreement (which has delivered 8.8% reduction in packaging waste from the food manufacture and retail supply chain) illustrates this point.

"*But while the cost and efficiency benefits of tackling waste prevention at retail and manufacturing sites across the supply chain are being realised, work is still needed to embed good practices so that businesses can profit more effectively*[97]".

In the current economic climate, businesses are finding themselves increasingly under pressure to cut costs whilst simultaneously boosting revenue in a competitive market with shrinking consumer demand in key sectors. The findings of the analysis on measures tell us that by adopting resource efficiency measures (particularly where there is careful consideration of the costs, benefits and practical application) businesses are likely to receive direct benefits in three key areas: resource savings (cost avoidance), additional revenues (revenue growth) and reductions in waste (cost reductions).

The forth business cornerstone, revenue protection, has not been quantified because there is insufficient tangible evidence to determine the extent to which being a more resource efficient company protects revenue; however, there is powerful suggestive evidence that leaner companies, who think and manage their resources more efficiently, are likely to be more competitive, innovate and be open to new ideas/concepts and engage consumers whose preferences (notably also in the emerging new consumer markets) are prioritising lower lifecycle impacts, more sustainable companies and greener products.

9.2 What the findings mean for policy makers

If markets operated in a perfect world there would be no need for policy makers to intervene – there simply would be no market failures to redress; resource efficiency would be achieved automatically. The existing environment for business includes incentives for resource efficiency, such as increasing commodity prices, to which companies already respond without the need for intervention. The question is how should policy makers such as the European Commission intervene, where is intervention most appropriate and which interventions are the most cost-effective?

[97] Source edie newsroom, October 2012 (http://www.edie.net/news/news_story.asp?id=23355&title=Courtauld+signals+more+work+needed+on+waste+prevention+)

This study illustrates the following focus of public policy for resource efficiency in a business context:

- Policies which work within the existing structure of industrial organisation and rely primarily on the response of companies to well-understood types of signals such as prices; and
- Policies which address areas which are important to business but, while important for society, cannot rely on a response from companies as signals cannot be easily created.

Landfill taxes are an example of a signal which builds on existing structures (charges for waste disposal) to encourage waste prevention. Encouraging water saving would however require such large increases in the price signal that they would be difficult to implement. The potential impacts of this kind of fiscal instruments based on taxes should be carefully assessed, as they may have unexpected downsides on other aspects such as competitiveness and productivity.

This study addressed potential behaviour change by existing companies within a pre-existing structure defined by their current operating context. The primary concern is that financial and resource efficiency measures are treated as investments. This characterisation reflects the most myopic and limited conception of business behaviour with implementation of all measures reflecting self-interest at the company level and taken by the company independent of other parties. All measures are assumed to be currently available and implementation of measures does not affect sales volumes or prices of final products.

Some of the principal factors which are not included are reform of industrial organisation more widely (such as sector wide measures), the impact of ongoing improvements such as technology enhancements (other than eco-design undertaken by the company itself), and possible price impacts (such as energy and carbon) flowing through into commodity prices.

For this narrow context, the estimates in the study of potential benefits in the order of 14% of turnover may seem high. While the potential exists, estimates are affected by potential uptake with net benefits for the example sectors estimated as between 2% and 9% in practice. A sector implementing these measures would see some increased profits, redeployment of capacity or staff in sectors supplying saved materials (e.g. to serve new export markets) and, depending on competition, some pass through of savings to customers.

Waste prevention features highly in the list of measures from the example sectors being accountable for between 11% and 18% of the potential total benefit. Other measures which are important to individual sectors, each responsible for 20% or more of the potential in across the sectors examined, are ecodesign, material reuse, waste recovery technologies and procurement practices.

In promoting these measures, policies can draw on the following points:

- Ecodesign results in a substitution of labour for materials and so is naturally aligned with a transition to a decoupled economy as well as with attitudinal changes; In fact, ecodesign applied to products within a company may complement policies where ecodesign is applied (e.g. by policy makers) to organisations, tariffs and markets;
- At the company level, ecodesign requires specific knowledge and experience of practices in the sector. The suggested policy priority is to build on existing systems of provision of expertise such as industry/university links and to focus on working with existing experts. New intellectual property is a

possible benefit with companies increasing their licensing of technology (both as buyer and seller) and reducing their material consumption so benefitting decoupling;

- Waste prevention by companies is driven by taxation policy which is an effective mechanism in waste reduction but is only part of the overall impact. Higher levels of landfill tax can lead to increased evasion and social costs from illegal dumping which in turn requires a stronger enforcement capability. A reduction in materials is associated with an increase in labour (enforcement officers) which is again in line with moves towards a decoupled economy. Strong use of landfill taxes is planned under European Commission programs; this study shows its relevance and importance as part of a more general model;

- Reuse of material at the micro-level is conceptually equivalent to moving to a circular economy. Reuse is already part of normal manufacturing practices with a 'circle' within the company. Other 'circles' may require consideration of local factors and new coordination between companies and public institutions with a need to overcome potential competition concerns.; and

- The need for good procurement practices reflects the Commission's Green Procurement agenda with well-researched potential policies such as visible standards and labelling policies. The establishment of indicators as well as reporting standards is part of developing better procurement practices.

More generally, policy makers may recognise that:

- Of the three resources of focus in the study, materials and waste are responsive to price signals, but water is relatively cheap in comparison and requires other policies for a change in company behaviour;

- The focus on measures with paybacks of less than a year is very relevant to a business with taxable profits, as they provide a way of investing in the business, avoiding tax (on the re-invested profits) while maintaining the same level of annual turnover; and

- Tax strategies as well as other policies may be better known to advisers than to the company itself. Information programs for advisers in contact with more than one company may benefit overall company uptake.

Overall, the study confirms the potential for resource efficiency to deliver economic benefits at the company level and environmental/social benefits for the wider community with a key overarching theme regarding the achievement of the potential being the diversity of contexts and applications.