Food and Beverage Sector Non-Labour Resource Efficiency: Unlocking Cost Savings, Jobs and Environmental Improvements

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February 2014
Next Manufacturing Revolution founding members:

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**Introduction**

This document presents the opportunities available for the UK food and beverage sector to improve its non-labour resource efficiency across four dimensions:

- Energy Efficiency
- Production Waste
- Transport Efficiency
- Packaging Optimisation

The total, combined opportunity for the food and beverage manufacturing sector is estimated to be:

- **£920M p.a.** in cost savings
- **6.6MtCO$_2$e p.a.** in greenhouse gas emission reduction

Additional benefits to the community include improved national food security, reduced need for landfills, less traffic congestion and reduced load on energy and transport infrastructure.

This paper also presents the future of resource efficiency in the food and beverage industry in the form of:

1. 2023 visions for the sector in energy, transport and waste
2. Priority barriers/enablers to be addressed to accelerate the uptake of resource efficiency
3. Diagnoses of the priority barriers/enablers towards developing solutions

Actions of key sector participants to ensure the enablers are in place to achieve the 2023 visions are presented.

This paper summarises two years of work including:

- The Next Manufacturing Revolution study and report, authored by Lavery/Pennell, the University of Cambridge’s Institute for Manufacturing and 2degrees, which drew on an extensive literature review, a survey of manufacturers and the feedback from over 40 peer reviewers. It can be accessed at [http://www.nextmanufacturingrevolution.org/nmr-report-executive-summary/](http://www.nextmanufacturingrevolution.org/nmr-report-executive-summary/). All figures in this paper that are not otherwise referenced have been taken from this work, which provides details of the original sources for data.
- An on-line discussion forum held on the 2degrees platform
- Input on barriers from leading food and beverage companies including Marks and Spencer
- A workshop on 23 January 2014 to discuss barriers and enablers bringing together leading companies, industry associations, relevant government departments and subject matter experts (attendees are listed in Appendix 1).

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1 This work is drawn from the 2013 Next Manufacturing Revolution (NMR) report, co-authored by Lavery Pennell, the University of Cambridge’s Institute for Manufacturing and 2degrees, with input from global experts, multinational corporations, an extensive literature review and a survey of manufacturers. The NMR report, which contains all of the references and calculations behind the facts and figures presented below, is available at: [http://www.nextmanufacturingrevolution.org/nmr-report-download/](http://www.nextmanufacturingrevolution.org/nmr-report-download/).
Energy Efficiency

In 2010, UK food and beverage manufacturers spent £1.26B on energy (1.4% of revenue), consuming 13.4% of the energy used by the entire UK manufacturing sector.

From 2002 to 2010, the sector’s energy use per unit of production has reduced by 2% p.a. This compares with good practice companies like Danone and Nestle who have improved at over 5% p.a., achieving a total saving of around 45% per unit of production (see Figure 1).

This difference in performance is worth £350M p.a. in reduced energy bills to UK food and beverage manufacturers – which can be achieved with an average payback period of 2.4 years. This would also reduce greenhouse gas emissions by 3.5MtCO$_2$ e p.a.

*Figure 1: Food and Beverage Companies’ Energy Intensity Improvements (i.e. per unit of production)*

Companies achieving substantial energy intensity improvements have typically addressed all of four types of energy saving opportunities, each differing in ease and investment requirement:

1. **Incremental.** These opportunities involve mostly behaviour and cultural change, such as monitoring energy usage, identifying and rectifying anomalous behaviour, addressing wasted energy and encouraging staff to reduce energy use. Incremental opportunities are often referred to as ‘quick wins’ because they can be implemented more quickly, do not involve capital expenditure and can create tangible savings. Opportunities involving behavioural change can, however, take longer to achieve.

2. **Processes and Systems.** Energy improvements that involve changes in processes fall into this category, such as establishing an energy management program/team, changing operating procedures to reduce energy use, improving maintenance regimes and setting up energy use
reporting systems. Many of these savings are inexpensive in capital terms, but can result in substantial savings.

3. **Structural Change.** Where new equipment or production process redesign is involved, this is a structural change for a company, often involving capex and usually occurring as part of scheduled maintenance or replacement. Typical areas of opportunity in the manufacturing sector include installing more efficient process equipment (e.g. pumps, motors, boilers), efficient lighting, improving HVAC in warehouses and redesigning production process to reduce energy use such as through more optimal heat cascading.

4. **Core Redesign.** Changing the fundamentals of how a business goes to market, such as redesigning products and packaging, to reduce production energy requirements.

**Production Waste**

UK food, beverage and tobacco\(^2\) manufacturers produced 7 million tonnes of production waste in 2008 – almost one third of the total waste from the whole of the UK manufacturing sector.

While food, beverage and tobacco manufacturers, on average, reduced their waste per unit of output by 2.1% p.a. from 2004 to 2008, good practice companies in food and other sectors improved at significantly faster rates, some for a decade or more (see Figure 2).

*Figure 2: Companies’ Production Waste Intensity Improvements (i.e. per unit of output)*

Note: Un-named datapoints are companies who provided data confidentially or are not named for other reasons.

Sources: Next Manufacturing Revolution Survey; Next Manufacturing Revolution literature review

\(^2\) For UK Government waste data, tobacco is grouped with food and beverage, however tobacco processing is small compared to food and beverage production.
Applying good practice improvements to all food, beverage and tobacco manufacturers in the UK has the potential to save £400M p.a. in avoided cost of wasted raw materials. This would also reduce greenhouse gas emissions by 2.3MtCO₂e through the supply chain.

Reducing waste also results in social benefits such as fewer landfill disposal sites.

Good practice companies tend to focus on two activities (which combine elements of the waste hierarchy\(^3\)) to reduce their waste and impact on the environment while improving profitability:

1. **Prevention.** First, they work to avoid process waste. To do this they typically address four types of waste saving opportunities, each differing in ease and investment requirement:

   i. **Incremental.** Such opportunities include monitoring waste, separating streams, identifying and rectifying anomalous behaviour, and educating and encouraging staff to avoid waste.

   ii. **Processes and Systems.** This includes establishing a waste management program/team, changing operating procedures to reduce waste (e.g. during line start-up/shut-down), lean production, just-in-time ordering, and setting up waste reporting systems and targets.

   iii. **Structural Change.** Typical areas of opportunity include installing more precise process equipment (e.g. heaters which can be better controlled to avoid over-cooking products; more precise cutters) and redesign of production processes to reduce waste such as moving from a manual to an automated process.

   iv. **Core Redesign.** Redesigning products to reduce waste through the supply chain.

2. **Re-use/Recycle/Recover.** Where waste is unavoidable, eliminating the cost of landfilling by finding new homes for waste streams is a second focus for good practice companies. For example, anaerobic digestion can produce natural gas for use locally or export to the grid.

### Transport Efficiency

Freight transport in the UK, worth £29.5 billion in 2011 serving all sectors of the economy, has seen no significant improvement in efficiency over the last decade. The manufacturing sector can impact a significant proportion of this transport spend through influencing suppliers’ transport choices, making decisions themselves for trans-shipping and haulage to customers and affecting downstream transportation with the weight and form of their products.

Since the 1950’s, transportation of goods has increased steadily, with a flattening in the last decade and a distinct drop corresponding with the recent financial crisis. Modal shares have remained fairly consistent through the last 40 years, although rail and water have shrunk slightly in recent years.

Foodstuffs and animal fodder accounted for 39 billion tonne-kilometres of goods transported in 2011 (17% of the nation’s total). The vast majority of this was by road.

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\(^3\) The waste hierarchy used by Defra, the Waste and Resources Action Program (WRAP) and others is: Prevention (avoid & reduce), Re-use, Recycle, Recover, Dispose.
Road transport is the most expensive surface transport mode and has been recognised to have the greatest external cost of the surface transport modes – i.e. cost to society not paid for by the user. A key externality is greenhouse gas emissions; road transport is the most emissions intensive surface transport mode, at six times higher than rail (the second most emissions-intensive).

Many blue chip companies have begun transport improvement efforts within the last five years and, based on transport greenhouse gas emissions (a proxy for transport efficiency improvement), the leaders have been achieving 5% to 10% annual improvements (see Figure 3).

Figure 3: Comparison of Company Transport Greenhouse Gas Emissions Improvements (per unit of output)

Good practice manufacturers have achieved a 36% improvement in their transport greenhouse gas emissions which, if adopted in the UK food and beverage sector, would save manufacturers £170M p.a., avoid 0.8 MtCO2e p.a. of greenhouse gas emissions, reduce NOx, SOx and particulates by 36%, and improve national productivity through reduced traffic delays.

A 36% reduction in transport emissions is considered achievable in the literature and through a detailed analysis of readily available cost-effective energy efficiency solutions, as follows.

Companies achieving substantial transport efficiency improvements have typically addressed four types of saving opportunities, each differing in ease of implementation and investment requirement. Note that savings from individual initiatives are not necessarily additive.

1. **Incremental.** The most impactful incremental transport actions have been found to be:
   a. Reducing engine idling – which can improve fuel efficiency by 5%
   b. Reducing highway speed – able to improve fuel efficiency by 5%

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2. **Processes and Systems.** Major process and system opportunities to improve transport efficiency are:

   a. Automated performance monitoring with driver feedback – enabling commercial transport fleet customers to cut their fuel costs by up to 10%
   b. Enhanced, computerised routing and scheduling, including incorporating/optimising for real time delay data – found to create fuel savings of 3%.
   c. Mode switching – considered to have a potential saving in greenhouse gas emissions for the road freight sector of 1.7% (considered a very conservative estimate).
   d. Increasing capacity utilisation – in 2007, 27.4% of goods vehicle kilometres in the UK were running empty and when carrying a load vehicles were found to be typically only 57% loaded as a percentage of maximum gross weight. As an example, avoided empty running was found to save 18% of fuel for the company Kronospan through utilising a quarter of its empty return trips.
   e. Off-peak and evening deliveries – to avoid congestion and increase vehicle utilisation.
   f. Sourcing raw materials locally, including increasing recycled content – reducing transport distances.

3. **Structural Change.** Typical areas of opportunity in the road freight sector from structural change are:

   a. Truck engine improvement – improving the efficiency of conventional engines (worth an estimated 18% saving in fuel), as well as switching to hybrid engines (worth up to 25% in fuel saving).
   b. Non-engine mechanical changes to trucks – for example transmission improvements (worth a 4% fuel saving).
   c. Truck body adjustments – these include improving aerodynamics (worth up to 14% of fuel use), longer semi-trailers (a two metre increase in length would increase payload volume by 15%), low rolling resistance tyres (saving 4% of fuel), automatic tyre inflation (worth a 1% saving in fuel) and light-weighting (considered to save 1% of fuel).
   d. Production and distribution hub number and locations (including urban consolidation centres) – enabling improved capacity utilisation and minimising distances travelled. This optimisation can be extended to incorporate the freight requirements of multiple companies (for example, supermarkets agreeing to share vehicle space when picking up from producers or when delivering to their supermarkets).

4. **Core Redesign.** Examples of core redesign opportunities to improve transport efficiency are:

   a. Concentrating product – reducing its bulk and weight. Consider the example of laundry powder and liquids which have doubled their concentration in some countries over the last decade.
   b. Better packaging design for load optimisation – increasing capacity utilisation rates, especially for awkward/delicate cargoes such as flowers.
   c. Light-weighting product – reducing the weight of products and therefore enabling greater volume to be transported for the same load weight capacity on a truck and reducing the energy required for air freight.
   d. Light-weighting and reducing packaging – this saves not only on transport from factory to customers, but also on transport of post-consumer material to disposal/recycling.
Packaging Optimisation

Packaging, including that used between sites, between companies and for customers, adds value to the manufacturing supply chain in a wide variety of ways including containing, protecting, transporting, labelling, displaying, marketing and preserving products.

In 2010, UK manufacturers spent £10.8 billion on packaging and the UK produced 10.8 million tonnes of end of life packaging. The grocery sector (food and drink and household and personal care) is estimated to account for around 60% of packaging usage.

For the grocery sector, in recent years there has been an absolute decline in the amount of packaging being used against a backdrop of increased product sales.

Grocery producers have pursued wide-ranging packaging optimisation programs including shifting to concentrates, light-weighting, removal/reduction of packaging (e.g. Coke removing cardboard under slabs of cans; direct printing to avoid extra labels), use of new materials/technologies (e.g. switching from bottles/cans to film pouches for size and weight reduction for soups and sauces; use of plastic multi-can carriers to avoid cardboard boxes) and development of re-useable packaging (e.g. collapsible reusable produce crates for taking produce from farm to retail display; re-usable transit packaging for home delivery).

Improvements by light-weighting of primary product packaging have been substantial. For example, 400g metal food cans have reduced in weight from 90g to 55g over the last 40 years, and 330ml metal drinks cans from 21g to 15g over 30 years. Figure 4 shows additional examples for PET and glass packaging - achievements of 30% weight reduction are not unusual across various types of packaging, sometimes in a very short space of time.

Figure 4: PET/Glass Packaging Light-weighting Examples


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Weight reduction has also been pursued in secondary packaging. For example, the average weight of paper used in corrugated board packaging has declined by approximately 10% over the last 10 years from 533 to 482 g/m². Design optimisation has also delivered other savings, for example through better pallet utilisation.

Historical data within WRAP’s UK Packaging Benchmark database⁶ suggests that this weight reduction is not unusual - ‘lightest in class’ items for FMCG packaging are often substantially lower in weight than ‘average in class’ packaging, across many different grocery categories (e.g. bakery, cereals, drinks). Figure 5 shows the range of differences (average vs. lowest weight) across selected categories – the range covers various individual pack types (stock keeping units) within each category.

This suggests that while some companies/product teams have worked to reduce their packaging weight, others have substantial opportunities for improvement.

Figure 5: Packaging Weight Variance Around Average (100%) for Selected UK Grocery Categories and Sub-Categories

Optimising packaging is a multi-purpose, multi-party exercise. Packaging plays a large number of vital roles, including containing, protecting, transporting, labelling, displaying, marketing, and preserving products – these functional roles need to be balanced with the benefits from any redesign. In addition, there are multiple stakeholders along the value chain who have requirements for how products should best be packaged (to achieve varying objectives) including packaging converters, manufacturers, warehouses, distributors, retailers and waste management companies.

⁶ See http://www.wrap.org.uk/content/uk-packaging-benchmark-database, a database focused on the grocery sector, providing best-practice, average and worst-practice data by grocery sector. Best-in-class weights are an approximate guide that do not take account of trade-offs between sales and transport packaging or the variety of supply chains.
Good practice companies have focussed on four types of improvement opportunities, each differing in ease of implementation and investment requirement, to optimise their packaging usage and impact on the environment, while improving profitability.

1. **Incremental.** Such opportunities include measuring packaging usage, displaying it for all staff to see and setting achievable reduction targets and KPIs. In addition, where easily substitutable materials are available at limited additional cost, but which have lower environmental impact, these have been used (e.g. using FSC-certified material; increasing recycled content).

2. **Processes and Systems.** Including establishing a packaging improvement program/team, or implementing stated policies around reducing, reusing and recycling packaging. An example is the elimination of unnecessary layers or components of packaging.

3. **Structural Change.** These opportunities typically involve working with packaging convertors (and retailers in FMCG) to redesign packaging for reduced material usage, redesign products to optimise the packaging required, or to incorporate the latest packaging materials and design techniques.

4. **Core Redesign.** The above opportunities can be extended by working together with suppliers and customers to fundamentally redesign/optimise the packaging flow along the value chain between factories/warehouses and commercial/retail or to eliminate packaging altogether (or reduce by a substantial amount). For example, various core redesign opportunities for packaging have been adopted by pioneering manufacturers:
   - Reusing packaging at intermediate steps of the value chain, for example agricultural producers utilising re-usable crates for fruit and vegetables which are then sent back to the supplier to use again; this is not done for most other grocery categories.
   - Reusing packaging at the end-of-life stage of the value chain: soft drinks companies often have reusable glass bottles for on-trade channel (e.g. bars, restaurants). On-trade beer barrels are re-used many times (and are high value, so are tracked carefully).
   - Concentrating product. For example, Tesco has won an award for its home brand concentrated lemon squash product.

This report has not included a headline estimate of potential savings from B2C packaging optimisation because while light-weighting may result in transport and environmental savings, the lighter packaging may cost the same as before, especially if additional functions such as improving produce longevity, are included.

However, we note that the latest Courtauld 3 Commitment includes a target for 2015 of a 3% reduction in B2C packaging waste, worth £150mln at values indicated in the recent announcement. This is equivalent to a 1.5% p.a. packaging intensity reduction; 0.6% ahead of the historical improvement rate in UK packaging intensity of 0.9% p.a. (and hence worth £30mln p.a. over and above historical improvement rates).
Recent Resource Efficiency Developments in Food and Beverage Sector

From June 2013 to the writing of this document (February 2014), there have been a number of developments in resource efficiency in the food and beverage sector:

- July 2013 saw the publication of the Next Manufacturing Revolution report covering all UK manufacturing sectors, including food and beverage. The report is available at: http://www.nextmanufacturingrevolution.org/nmr-report-executive-summary/
- Publication of the results of Courtauld Commitment Phase 2 in November 2013, showing falls in both packaging and supply chain waste. The report is available at: http://www.wrap.org.uk/content/courtauld-commitment-2-1
- Publication of research on the amount of food waste in the home which showed consumers had reduced avoidable food waste by 21% since 2007. The reports are available at: http://www.wrap.org.uk/content/household-food-and-drink-waste-uk-2012
- Publication by the Product Research Forum of data on the environmental impact of grocery products showing where in the lifecycle the biggest impact are located and what can be done about them. Also the launch of “pathfinder” projects looking at ways to minimise the impact. The reports are available at: http://www.wrap.org.uk/content/product-sustainability-forum-psf
- Publication of progress on FDF’s five-fold environmental ambition. The details can be found at https://www.fdf.org.uk/environment_progress_report.aspx
- Publication of the British Retail Consortium’s “Better Retailing Climate” setting out how the industry plans to improve its environmental impact further. The report can be found at http://www.brc.org.uk/brc_policy_content.asp?iCat=43&iSubCat=673&spolicy=Environment&sSubPolicy=A+Better+Retailing+Climate
- Launch of the Soft Drinks industry road map to reduce the impact of this Sector. The report can be found at http://www.britishsoftdrinks.com/default.aspx?page=1062.
- Publication of research on the arsing of waste in the hospitality sector and how it might be mitigated. For the reports see: http://www.wrap.org.uk/content/overview-waste-hospitality-and-food-service-sector.
- Publication of data on the growth in Anaerobic Digestion and composting capacity to recycle waste from the food and drink sector. For the report see http://www.wrap.org.uk/content/organics-recycling-survey-2012
- The All-Party Parliamentary Sustainable Resource Group (APSRG) is now conducting, with Policy Connect, a study into remanufacturing, chaired by Caroline Spelman MP. This may include various aspects of the food and beverage sector, such as secondary packaging.
2023 Vision\textsuperscript{7} for Waste, Energy and Transport Efficiency

The industry expert working group which met on 23 January 2014 developed visions for the food and beverage sector for 2023 in Waste, Energy and Transport Efficiency.

The working group’s vision for energy and transport efficiency in the food and beverage sector in 2023 is: a substantial reduction in greenhouse gas emissions, energy use and the use of fossil fuels and involves substantial local electricity generation (e.g. through biomass, anaerobic digestion, wind and solar) and gas production (specifically biogas).

Waste is an important topic because it is not just about cost, but also about food scarcity and creating a resilient and sustainable food sector. Waste extends beyond just the production plant to farms, transport, distribution, retailing, food service and consumer refuse. It should be considered as a resource for which value should be maximised so that it is avoided where possible and husbanded into its highest value purposes where it cannot be avoided.

By 2023, a number of quantitative waste targets should be achieved:

- Zero waste to landfill for all manufacturing facilities by 2016
- 45% of avoidable household food waste eliminated (towards a 50% reduction by 2025)

How these waste, energy and transport aims will be achieved, along with further efficiency improvements in the food and beverage supply chain, is suggested in Figure 6.

\textsuperscript{7} 2023 was the date chosen for the vision so as to include only technology that is commercially available now and cost-effective today or will become cost-competitive by then.
Figures 6: 2023 Vision for Waste, Energy and Transport Efficiency in the Food and Beverage Sector

ABSugar provided examples of initiatives in a number of the topics in Figure 6. These are described in ABFoods’ 2013 Corporate Responsibility report on page 30. See http://www.abf.co.uk/responsibility/cr-downloads

Transport efficiency by 2023 will be significantly improved through the widespread uptake of existing solutions as listed in the Transport Efficiency section above.

There are a number of tools and technologies to substantially reduce waste in food and beverage which will need to be implemented widely and in some cases more substantially developed in order to have a major impact by 2023, including:

- Predictive modelling to drive strategies using concepts such as Just In Time delivery and storing surplus
- Flexibility in technology allowing near-real-time option selection
- Improved procurement which takes into account waste reduction
- Precision agriculture
- Intelligent packaging which can extend use-by and best before dates
- Education
- Behaviour change
Many resource efficiency improvements will require a system-wide approach to bring together the multiple stakeholders to collaboratively develop solutions. This will require “convening” instruments such as WRAP’s Product Sustainability Forum.

**Key Enablers to Improving Resource Efficiency**

The top 6 enablers to improving resource efficiency in the food and beverage sector were prioritised in the 23 January 2014 workshop from the agreed long list of barriers (which is presented in Appendix 2):

1. **Collaborating along the supply chain** to reduce resource use by looking for system solutions, creating lower impact products which better meet customer needs (including servicing), and driving scale. This includes optimising across the farm and manufacturing system.
2. Robust and comprehensive **business cases** to attract funding, expressed in the language of finance.
3. Including resource efficiency in **design** processes including for new production processes, products, packaging and distribution systems. This includes design for reuse, remanufacture, recycling, and inclusion of bio-based and recycled materials in products and packaging.
4. **CEO leadership** and genuine commitment to resource efficiency
5. Understanding the **production system** – knowing where it is best to act on a meta level and how single organisations can act within the system to support progress
6. **Staff taking responsibility** for both disseminating and looking for good practice between sites/divisions

**Enabling the Enablers and Overcoming Barriers**

At the workshop on 23 January 2014, these priority enablers were discussed and recommendations made on how they are being and can be further enhanced:

**Collaborating along the supply chain AND Understanding the production system (enablers 1 and 5 combined)**

Collaboration along the supply chain brings a range of advantages including:

- More optimal solutions for all parties, because optimising across multiple systems is always more efficient overall than optimising sub-systems
- **Scale**
- Resource efficiency through better understanding of others’ needs, resource constraints and usage patterns

However, collaboration is difficult when there are many participants in a supply chain, each with their specific characteristics and differences. Ideally this is best approached by mapping/modelling all participants as a dynamic system. This can be done, but it was noted that this is not a trivial exercise when done properly and would require funding.

Such a systems map would have to include the consumption phase to be accurate and useful, and would inevitably hold a global scope, even if the intention is to use the map to find interventions that work at a national level. Such a systems map can be used to explore the transition itself, including asking questions about the circular economy and how to get there – for example, is it
better to reduce the quantity of resources going into the system and then work to close the loop, or to allow larger volumes to enter the system but concentrate efforts on retaining those materials? Key challenges in any system map would include deciding the best boundary to use, identifying the key places to intervene, recognising when assumptions are being made and whether they are useful or even harmful, and being able to test for unintended consequences of any system change. Techniques do exist for these but are in their infancy in practice and need to be handled with care. It was felt that systems maps are currently reliant on political will – to bring actors together and even to fund the effort – and this is not a good plan for the sector, which could organise its own efforts.

Currently, WRAP’s Courtauld Commitment Phase 3 is focusing on promoting collaboration to reduce waste in the supply chain, optimise packaging and help consumers reduce waste in the home. This aims to deliver a further 1.1 Mt of waste prevention by the end of 2015. For more information see http://www.wrap.org.uk/content/what-is-courtauld. This builds on the estimated 2.9 Mt of waste that was reduced by the previous 2 agreements.

The Hospitality and Food Service Agreement is also helping this sector reduce waste and recycle more see http://www.wrap.org.uk/content/hospitality-and-food-service-agreement-3 for more information.

The Product Sustainability Forum is thinking about using a systems approach to drive change through its “pathfinder” programme; see http://www.wrap.org.uk/node/16190 for more details.

2degrees is also assisting Tesco and other retailers to work together with their suppliers on resource efficiency to benefit all parties.

The IfM and Centre for Industrial Sustainability are involved in a range of research projects in the area of supply chain collaboration including system mapping to identify the relationships between various actors within a system and the dynamics of effective collaboration. (More information is available at www.industrialsustainability.org or at dcm32@cam.ac.uk).

The logical owners to drive supply chain collaboration are trusted neutral parties who can bring participants together. This trust and neutrality is recognised as vital to overcome traditionally adversarial relationships which have focussed heavily on cost per unit to the exclusion of other cost-saving collaboration and system optimisation opportunities.

Recommended facilitators of this issue to drive action are:

- 2degrees Enterprise Solutions, continuing to assist companies to connect with their suppliers and to publish case studies on the projects including benefits achieved
- WRAP through, for example, its voluntary agreements with the sector, its consumer campaigns such as Love Food Hate Waste and collaborative fora such as the Product Sustainability Forum
- The Institute for Manufacturing to model and help optimise complex systems – as well as continue its research into supply chain collaboration.

Robust and comprehensive business cases

The lack of robust business cases was identified as a barrier to further uptake of resource efficiency within companies. The lack of robustness can take several forms, including:

- A lack of definition of the problem being solved – is the problem well-articulated?
- A lack of visibility of the problem within the organisation – is the problem widely recognised?
• A lack of data as part of the business case, particularly with regard to financial information
• Limited understanding of internal processes, particularly stage-gate processes to get sign-off of business improvement opportunities
• A lack of skills with respect to preparation of business cases, including the areas described above

Several potential solutions were articulated including development of validated business cases for different solutions/technology types. One area that was identified as particularly promising was the development of standardised processes and templates for business case development; these might be supported and/or disseminated through the various trade/professional/governmental bodies active in this space, for example:

• Energy Institute, Energy Managers Association, ESTA, IEMA would benefit from establishing a common framework for business case development and training members in its use (including with Continuing Professional Development credits)
• Such a business case would be even more powerful if it could be used as the de-facto standard for complying with Government mandates (e.g. CRC, ESOS) and accessing Government funding (e.g. Green Investment Bank, EEDO, TSB, DEFRA)
• Other relevant bodies could also be involved to ensure the robustness of the standard, e.g. IPMVP, accounting organisations
• Logical organisations for disseminating a standard business case template are industry associations (e.g. EEF, FDF) and government departments (e.g. DECC/EEDO, DEFRA, BIS)

A robust business case should include:
• Strategic fit of the opportunity
• Body of evidence for value being claimed (e.g. validated case studies)
• Value claimed, including:
  o Tangible value from energy reduction
  o Other tangible value (e.g. maintenance cost reduction)
  o Intangible benefits
• Cost of implementation, including opex and capex with relevant tax advantages included (such as Enhanced Capital Allowances)
• Risk analysis, e.g. technology, production risks
• Sensitivity analysis
• Financial case (including NPV, IRR, cash flow profile, simple payback period)

It was felt that the logical distributors of such a business case template would either be one (or more) of the energy relevant professional bodies (e.g. IEMA, Energy Institute) or alternatively one of the accounting professional bodies (e.g. CIMA) and eligible for Continuing Professional Development credits.

Specific actions for this enabler are:
• Next Manufacturing Revolution to discuss creation of template with the above-mentioned institutions
• EEF to consider implementing

In addition, the IfM and Centre for Industrial Sustainability will examine the opportunities to work with IEMA, WRAP and other bodies to initiate some research into what works most effectively in preparing business cases with a sustainability driver at their core. Key contact: Ian Bamford (ian@industrialsustainability.org)
Case studies of what has already worked are useful in developing a business case and WRAP’s website has assembled a range of these. See [http://www.wrap.org.uk/content/courtauld-commitment-2-signatory-case-studies](http://www.wrap.org.uk/content/courtauld-commitment-2-signatory-case-studies) and [http://www.wrap.org.uk/content/business-resource-efficiency-hub](http://www.wrap.org.uk/content/business-resource-efficiency-hub). Key contact: Roger Papworth (roger.papworth@wrap.org.uk).

**Including resource efficiency in design processes**

The overall issue related to design identified at the workshop was that design for resource efficiency is not currently embedded within design processes. Beyond this, an issue of problem definition was identified, namely:

- Whether this was a fundamental knowledge issue (i.e. more research required), or one of roll-out of existing information and knowledge
- The contrast was most evident in current student teaching which was felt to include discussions on sustainability, whereas industry experienced people may not have been trained in sustainability

Until this fundamental question is better understood, it is difficult to progress the discussion. However, several approaches that should be included were identified, including:

- Whole life costing and impact approaches for equipment, process design and product design
- KPIs for designers linked to resource efficiency
- Introduction of service-based business models and how these can influence design and value captured by a company

It was recognised that design solutions can cause early adopters to have a first mover disadvantage – for example a slimmer container can reduce shelf real estate, causing reduced product visibility and lower sales volumes.

As the topic is so broad, the group did not reach any decision on who was the logical owner of such an approach. The immediate next step was therefore to convene a group under the guidance of IfM to better define the problem.

It was recognised that the RSA is now thinking about designing for a circular economy – which is one sub-set of resource efficiency. In addition, WRAP now has a design project running with a retailer on sustainable design.

**CEO leadership and genuine commitment**

It was recognised in the workshop that for CEOs, issues that heavily impact profits are likely to be prioritised. This means that resource efficiency should be messaged in relation to the biggest profit drivers and not couched only in sustainability or environmental terms. For example:

- For branded products, reputation and image are important drivers of profitability so resource efficiency should be discussed in terms of how it adds brand equity
- For commodity companies (i.e. where commodity costs are a substantial proportion of costs), resource efficiency should be discussed regarding how it reduces commodity costs, reduces commodity price volatility and mitigates against future commodity cost increases

To encourage CEO leadership, the working group discussed basic emotional motivators of people, which include respect, fear and jealousy. Role models and the actions of peers were therefore identified as additional levers for encouraging CEO support of resource efficiency. The benchmarks
in this report and the full Next Manufacturing Revolution report are useful in drawing comparisons of improvement rates in resource efficiency with peers, competitors and respected companies.

For CEOs, it was also recognised that communications need to be concise, with key messages able to be expressed in 10 seconds. Further information is best delivered as a one-to-one discussion of how other companies have achieved their results – enabling the CEO to test ideas and ask specific questions - rather than written case studies.

Therefore, enabling CEO leadership was seen to be related to communications, although it was recognised that CEOs are well protected and therefore communications need to occur in fora where CEOs are in attendance or by credible individuals with access to one or a number of CEOs.

Logical parties for encouraging CEO leadership were therefore considered to be:

- Government Ministers: Resource efficiency should be a subject raised in Ministerial discussions with CEOs
- The University of Cambridge’s Institute for Manufacturing – which has access to a range of CEOs and has an excellent reputation
- Industry associations (e.g. EEF, FDF): resource efficiency should be raised as a topic for inclusion in annual industry association conferences which attract CEOs to hear about the latest developments in manufacturing
- Other organisations engaging with CEOs on the topic of resource efficiency and sustainability

The group agreed that representatives from these bodies would pursue opportunities to include resource efficiency into events involving CEOs.

**Staff taking responsibility for disseminating and looking for good practice**

It was recognised that the key to good practice dissemination of improvement ideas is to have staff asking their peers for help; a closed “not invented here” culture where external ideas are not considered is a barrier to spreading good practice.

A receptive attitude comes from staff valuing the interactions with their peers and the sense of community that results. No financial rewards should be needed to perpetuate this culture – although recognition through peer respect and senior executive acknowledgement builds a sharing culture, as seen in Toyota (see link to video below).

Key things to be avoided when developing a sharing culture include:

- Aggressive competition between peers or sites, which results in good ideas being protected for competitive advantage which is sub-optimal for the whole company
- Managers who discourage sharing of ideas or interactions looking for new ideas. This can occur, for example, if managers instruct staff not to “waste time talking with other plants and just get on with the tasks at hand”.
- Manager visibility of peer networking communications – which discourages staff for asking for help for fear of exposing a gap in their skills or knowledge
- Forced sharing through KPIs requiring a number of case studies to be written each year – this demotivates staff (through creating paperwork) and encourages poor quality material which accumulates into a body of information that is not used or valued
- Peer discussion groups that are too broad, resulting in specific requests being lost in the morass of information and lack of interest by participants because the bulk of the discussion is outside of their interests/expertise
Involvement of suppliers in discussion groups brings new perspectives and should be encouraged.

A good practice example of a culture that shares improvement ideas and actively seeks good practices of others is Toyota. Their practices are revealed in the following video: http://www.nextmanufacturingrevolution.org/video-how-toyota-drives-non-labour-resource-efficiency/

The IfM and Centre for Industrial Sustainability has a range of research in areas associated with these barriers. One research stream is focused on the reasons why similar factories have significantly different levels of environmental performance. The evidence suggests that effective information sharing is important, as is the effort to build a library of good practice together with guidance on how to identify the most appropriate concepts and potential to focus upon. Information on these projects can be found at www.industrialsustainability.org or from Ian Bamford at ian@industrialsustainability.org

The logical owners to improve sharing of ideas are:

- Companies themselves, potentially assisted by best practice guides and case studies
- The Institute for Manufacturing through their research work looking at how to better encourage idea sharing

Existing networks for idea sharing related to resource efficiency in the food and beverage sector are:

- The Product Sustainability Forum has an idea sharing forum and case studies. This is free to join. See http://www.wrap.org.uk/content/courtauld-commitment-2-signatory-case-studies and http://www.wrap.org.uk/content/business-resource-efficiency-hub.
- The Courtauld Commitment provides free access to its idea sharing site, although users must commit to improvement targets. See http://www.wrap.org.uk/category/initiatives/courtauld-commitment
- The Food and Drink Federation has a sharing group for its members (membership required)

Duplication of these networks would be counter-productive and hence there is a need to publicise their existence for use by as many practitioners as possible. This will be done through this report and other communication channels.

**Actions and Next Steps**

**WRAP:**

- Continue to drive collaboration across the food and beverage supply chain regarding resource efficiency through the Courtauld Commitment, the Hospitality and Food Service Agreement and the Product Sustainability Forum.
- Continue to build and drive resource efficiency idea sharing through the Product Sustainability Forum and the publication of case studies
- Encourage the expansion of the AD and composting sector to encourage more recycling of food waste and renewable energy generation.
- Disseminate findings (including through the Next Manufacturing Revolution community and via EEF and FDF) from the current project examining sustainable design in the food and beverage sector.
Government:

- Include resource efficiency in its discussions with CEOs to encourage leadership and commitment
- Continue to monitor the development of resource efficiency and address policy and regulatory barriers to resource efficiency which may become important as the above-listed priority enablers are addressed.

EEF and FDF:

- Include resource efficiency in their events attended by CEOs to encourage and inspire leadership and commitment
- Contribute to the development and dissemination of initiatives led by other parties to address the priority enablers
- FDF to continue to facilitate resource efficiency idea sharing amongst members through its dedicated group

IfM:

- The Institute for Manufacturing has included some of the outcomes of this work by adjusting its research programme.
- Further effort, should funding be identified, could be applied to map the complex food and beverage supply chain towards optimising resource use across the entire system. Such a mapping effort would need to be broadly inclusive and recognise that the sector is not homogenous. Existing fora would need to be involved. Such a system map would help to identify the best places to intervene in the system – where the smallest effort generates the greatest return. These are often collaborative efforts and the act of jointly developing a system map goes some way to building relationships that can work together on solutions.
- The IfM will also continue to communicate the opportunities within resource efficiency in its discussions with and events including CEOs to encourage leadership and commitment

Lavery Pennell on behalf of the Next Manufacturing Revolution:

- Work with EI, IEMA, EEDO, WRAP and other resource-related and accounting bodies to create and disseminate a business case template for resource efficiency projects that meets the requirements of all organisations and improves the quality of business cases. This would ideally conform with the application/reporting requirements of organisations including GIB and ESOS. The EEF and FDF could also assist in disseminating this template for the benefit of their members. Participants would be required to contribute funding for the development of this important tool.
- With the financial support of relevant organisations, develop an easy-to-use best practice guide for companies to assist them to improve resource efficiency idea searching and sharing by staff.
- Assist to organise a manufacturing sector resource efficiency event for CEOs and senior executives on 10 March.

Three further resource efficiency workshops are planned for the sectors, to be coordinated by the Institute for Manufacturing and the Next Manufacturing Revolution:

- Automotive
- Textiles and apparel
- General manufacturing (encompassing all sectors not previously covered)

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8 Roger Papworth is the key contact at roger.papworth@wrap.org.uk
Further Reading

For further details, including deeper discussions, additional data and the references and calculations behind the facts and figures presented above, see the Next Manufacturing Revolution report, available at: http://www.nextmanufacturingrevolution.org/nmr-report-download/.
### Appendix 1: Workshop Attendees

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Attendee</th>
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<tbody>
<tr>
<td>AB Sugar</td>
<td>Gary Punter</td>
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<td>AB Sugar</td>
<td>Stefan Gartner</td>
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<tr>
<td>Jackson Foods</td>
<td>Gavin Milligan</td>
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<td>Crown Cork</td>
<td>Cormac Neeson</td>
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<td>Frank Roberts and Sons</td>
<td>Simon Roberts</td>
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<tr>
<td>Engineering Employers Federation EEF</td>
<td>Susanne Baker</td>
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<tr>
<td>Food &amp; Drink Federation</td>
<td>Andrew Kuyk</td>
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<tr>
<td>Department of Business Innovation and Skills</td>
<td>Jonathan Yewdall</td>
</tr>
<tr>
<td>Waste and Resources Action Program</td>
<td>Richard Swannell</td>
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<tr>
<td>Department of Environment, Food and Rural Affairs</td>
<td>Simon Cox</td>
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<td>Technology Strategy Board</td>
<td>John Whittall</td>
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<td>Green Investment Bank</td>
<td>Malcolm Ball</td>
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<td>Urban Mines/ Policy Connect</td>
<td>Lynva Russell</td>
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<tr>
<td>University of Cambridge Institute for Manufacturing</td>
<td>Steve Evans</td>
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<tr>
<td>University of Cambridge Institute for Manufacturing</td>
<td>Ian Bamford</td>
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<td>Lavery Pennell</td>
<td>Greg Lavery</td>
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<td>Lavery Pennell</td>
<td>Nick Pennell</td>
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Appendix 2: Agreed Barriers to Resource Efficiency in UK Food and Beverage Manufacturing

The following short list was derived from:

- An extensive literature review
- Peer review by over 40 subject matter experts
- 2degrees webinar (14 January)
- 2degrees online discussion forum
- Responses from attendees (including M&S and Mars who sent their apologies)
- EEF members survey in 2012
- Discussion in the workshop of barriers

Short-listed barriers to be overcome to increase resource efficiency were:

1. CEO leadership and genuine commitment, supported by the Board, especially the Board Chairperson
2. Management execution of resource efficiency assisted by KPIs, company values/norms, and expert knowledge (e.g. provided by Head of Sustainability)
3. Understanding of the system – know where to act on meta level and how can act within the system as a company
4. Information/data on own, suppliers’ and customers’ energy, waste, and transport (useful information, knowledge and how to act)
5. Information on solutions available (including 4 types of improvement)
6. Knowledge of the size of the opportunity/case studies with costs, benefits & risks of the solutions
7. Staff taking responsibility for disseminating and looking for good practice between sites/divisions
8. Availability of internal funding for projects
9. Access to external funding for projects
10. Robust and comprehensive business cases to attract funding, expressed in the language of finance
11. Skills – there is a shortage of engineers and it is difficult for SMEs to access specialist skills
12. Availability of human resources execution capability
13. Holistic design thinking
14. Resource efficiency is not included in design processes including for production processes, products, packaging and distribution systems. Includes design for reuse, remanufacture, recycling, inclusion of bio-based and recycled materials in products and packaging
15. A standard language/lexicon of resource efficient design
16. Feedback mechanism into design which returns learnings from a product’s life to designers
17. Including resource efficiency when setting product specifications
18. Private standards preventing resource efficiency
19. Companies saving energy unable to capture the full value (e.g. avoided network upgrading; avoided investment in new power stations)
20. Regulations & standards making re-use impractical or undesirable, including substituting recycled material may need to comply with the safety assessment programmes of importing countries, such as China and Korea; REACH disclosure obligations require companies to notify customers of the presence of substances of very high concern (SVHC) – difficult for recycled materials e.g. packaging
21. Better interaction needed with regulators to improve resource efficiency
22. Perception that competition law preventing collaboration with peers (noting that this is not seen as a real barrier – it is the perception that this is an issue)
23. Continuity of infrastructure provision into the future including waste collection, waste separation, transport
24. Poor waste data – not building infrastructure where needed
25. Internal disciplines working together on resource efficiency (e.g. marketing and packaging designers)
26. Collaborating along the supply chain to reduce your and their resource use by looking for system solutions, creating lower impact products which better meet customer needs (incl. servicising), and create scale
27. Optimising across farm and manufacturing systems