Memorandum by Cranfield University, Centre for Resource Efficiency and Management

This response is submitted to the House of Lords Science and Technology Sub-Committee inquiry into Waste Reduction by the Centre for Resource Management and Efficiency at Cranfield University. The Centre is an applied, research-intensive unit offering postgraduate programmes in waste and resources management, innovation and design for sustainability and environmental management for business. Our published research includes studies of waste flow in regional economies, sustainable design and the impact of producer responsibility on product design. Here, we restrict our comments to the issues of waste reduction, the design mindset and materials selection.

The relationship between products, people and waste is a complex psychological one, described by social commentators since the late 1950s[1]. As we have become conditioned to seek value in ourselves as individuals and in social groups through the purchases we make[2], we can expect any attempt to reposition this relationship to be socially challenging.

Waste reduction

1. Waste reduction requires consideration of materials flow. We need to adopt a mass balance approach[3] to identify opportunities to achieve dematerialsation, i.e. to reduce materials flow per unit of economic output as well as total materials flow within an economy. A co-ordinated, twin-track approach of sustainable design and production (reduced use of materials) coupled with improved recycling and remanufacture (reduced discard of materials), represents a sound forward strategy. We are only beginning to learn how to co-ordinate these two components. However, Defra's recent repositioning of its sustainable consumption and production function alongside its waste evidence function is a valuable step forward within Government. Understanding the influences on materials selection and the design 'mindset' are also critical.

2. The price of raw materials is the main driver for waste reduction, but only where this is a significant proportion of total product cost. The barriers to waste reduction can be understood if we recognise that every product has multiple owners in its life-cycle as it progresses through the value chain, and that there is no single owner of the waste that it generates in manufacture, use and disposal. The product lifecycle requires a series of trade-offs where waste is a cost, paid at each stage. Economic trade-offs for resources vary considerably, and a product's value at any one stage of its value chain may still render high levels of waste as affordable.

   For example, the weight of automotive vehicle structures has reduced progressively year on year, yet the total weight of a vehicle has remained stable as increasing components and functions add to the payload. Thus material and fuel efficiencies may not necessarily be realised[4]. Such 'Product lightweighting'[2] is widely viewed as a better design strategy for the environment, but can itself entail the use of new materials for which there are no recycling systems.

3. The waste industry currently gains no benefits from reducing waste. The sector is driven by volume and, at present, landfill companies are capitalised by their remaining void space. Further, waste companies are disconnected from the manufacturing process. Although better design could reduce material and fuel consumption, consumers have no metric for the material and disposal costs of products and therefore cannot value any improvements in performance against these in their purchasing decisions. So, in the absence of integrated production and waste management and readily available life cycle costs, product differentiation is difficult for consumers to identify. A

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[1] Packard, V. (1960) *The Waste Makers*, Pelican books, 320pp
[2] James, O. (2007) *Affluenza*, Vermilion Publ., 400pp.
[3] Raffield, T., Herben, M., Billington, S., Longhurst, P. and Pollard, S. (2007) Coupling hidden flows and waste generation for enhanced materials flow accounting. *Comm. Waste Res. Manage.* 8 (1): 12-18 available at http://www.enviros.com/PDF/Raffield_couplinghiddenflows.pdf
[4] Oakdene Hollins & Associates and Cranfield University (2007) *Product Lightweighting*, Resource Efficiency KTN, www.resource-efficiency.org

strategy of (i) better design to encourage production of less waste at source; (ii) the efficient use of materials and (iii) influencing lifestyles to promote the value of functional products is required.

Design mindset

4. While many designers are interested in sustainable product development, there are limited opportunities for experienced designers and engineers to rethink product development processes that cross disciplinary boundaries. Designers are not equally rewarded for understanding how to create value, and protect the environment. Ecodesign is seen as contributing to product and market enhancement, rather than as an essential function. An improved understanding of life cycle thinking might support informed decision making and behaviour. Cranfield University's MSc in Innovation and Design for Sustainability, and our recent £3.8 million HEFCE funded initiative in creative design are attempts to foster interdisciplinary understanding by placing designers alongside manufacturing, materials, environmental and process specialists.

Materials selection

5. The principal factors that influence the use of materials in production processes are material availability, cost and customer demand, informalities such as habit and routine, and the design and manufacturer's knowledge of the materials they currently use. These factors are far more influential than the prospect of waste reduction. Significant investment in these features creates a reluctance to move away from established 'successful materials'.

6. High volume functional products (e.g. lighting assemblies; computers) with extended product lives are superseded when fashions change or through product innovation. Consumers in affluent nations rarely value extended life as a key product attribute. If end-of-life-costs are easily transferable to consumers without an associated reduction in demand, changes to product design are unlikely[5]. Conversely, where these costs cannot be transferred, they must be borne by the manufacturer and an environmental influence on design may be possible. This can only be influential when the true [total material] costs of raw materials are included in their price. The tracking and auditing of waste / disposal costs for specific items such as oil, tyres and aggregates can be influential in revisiting wastes as resources e.g. as now being progressed through the National Industrial Symbiosis Programme's work for specific sectors[6].

7. Today, many manufactured goods are not offered in their own right but rather as part of a package that includes service components. First, manufactured goods are provided with closely aligned services, for example, finance, insurance, maintenance warranties, repurchase clauses and service agreements. Second, manufactured goods are supplied to customers as a vehicle for accessing services. In this case, the sale of the good is not the end point of the transaction, but only the beginning of the relationship between the consumer and producer.

   Examples of these services include 'power by the hour' from Rolls Royce and document handling services from Xerox. Increasing consumption of the second category of services as substitutes for goods in 'business to business' and 'business to consumer' markets may provide opportunities to promote sustainable resource use and achieve waste prevention. Critically, within these arrangements, manufacturing firms gain incentives to produce more durable goods to support service delivery. However, not only should the design of the capital goods used to support service delivery be considered, but also the overall design of service itself so to ensure, for example, that emissions to air from the transport component of service delivery do not cancel out any improvements in resource efficiency that may be attained from this approach.

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[5] Gottberg, A., Morris, J., Pollard, S., Mark-Herbert, C. & Cook, M. (2006) Producer responsibility, waste minimisation and the WEEE Directive: Case studies in eco-design from the European lighting sector. *Sci. Tot. Environ.* 359, 38-56.
[6] http://www.nisp.org.uk/