A report by the All-Party Parliamentary Sustainable Resource Group

All-Party Parliamentary sustainableresource Group

REMANUFACTURING

TOWARDS A RESOURCE EFFICIENT ECONOMY

Remanufacturing presents a huge financial and environmental opportunity for the UK. Estimates suggest that the value of remanufacturing in the UK is £2.4 billion[1], with the potential to increase to £5.6 billion[2] alongside the creation of thousands of skilled jobs. Further, the remanufacturing of products results in reduced greenhouse gas emissions, material use and water consumption when compared to the manufacture of new products. Remanufacturing can be considered one element of the wider 'circular economy', where products and components are designed, made and reused. However due to the opportunity that remanufacturing presents to the UK's economy it will be the sole focus of this paper.

There is no universally accepted definition of remanufacturing and there are widespread market and regulatory barriers which impede its uptake. This briefing paper identifies the opportunities and challenges relating to remanufacturing and makes recommendations to Government as to how it can overcome these.

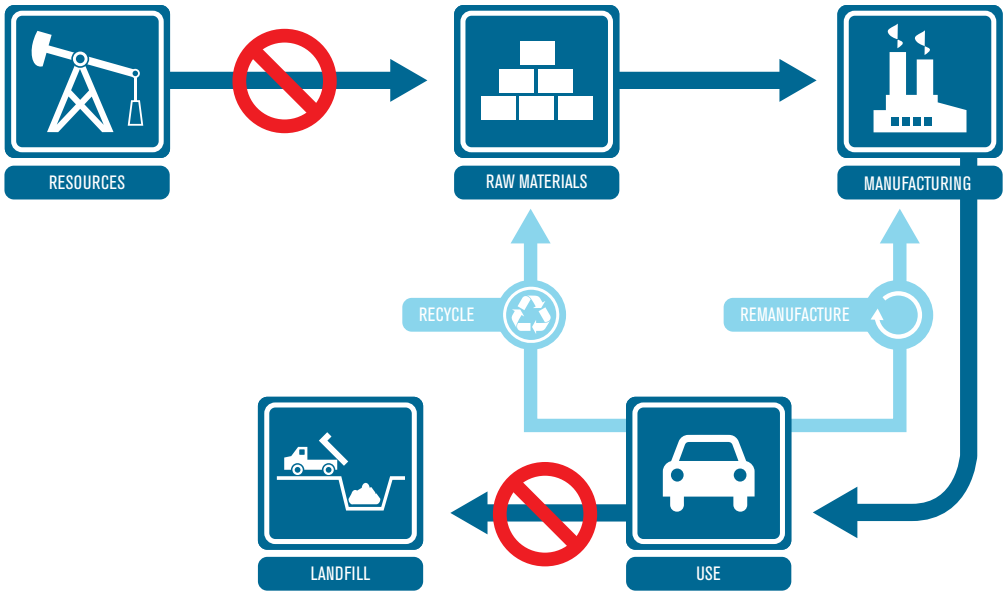
1. INTRODUCTION

a. Remanufacturing and the circular economy

Remanufacturing is often confused with other aspects of the circular economy, such as refurbishment and reuse. These processes can be distinguished from each other as follows:

Repairing	The fixing of a fault but with no guarantee on the product as a whole[3]
Reusing	The simple reuse of a product with no modifications
Refurbishing	The largely aesthetic improvement of a product which may involve making it look like new, with limited functionality improvements
Reconditioning	The potential adjustment to components bringing an item back to working order, although not necessarily to an 'as new' state
Recycling	The extraction of a product's raw materials for use in new products. This is a good option for products which are easily constructed and have minimal numbers of components
Remanufacturing	A series of manufacturing steps acting on an end-of-life part or product in order to return it to like-new or better performance, with warranty to match[4]

Figure 1: The route to a closed loop system



Source: Centre for Resource Efficient Manufacturing Systems[5]

Figure 1 demonstrates the ideal resource efficiency system, with an entirely circular economy being created through both recycling and remanufacturing, where nothing is wasted and no new resources need to be used.

Although this academic definition of remanufacturing exists, progress towards extending the uptake of remanufacture is hampered by the lack of a globally accepted legal definition. As is discussed later, this lack of definition affects the international trade of remanufactured products as they are often considered as used items. Consumer confidence in remanufactured products is also affected by this lack of definition.

Recommendation

The Government should adopt a definition of remanufacturing to provide clarity to business on what it deems as remanufacturing versus other aspects of the circular economy, such as refurbishment and reuse.

1 Parker, D 2010: Remanufacturing in the UK: A snapshot of the UK remanufacturing industry in 2009; Oakdene Hollins for the Centre for Remanufacturing and Reuse and the Resource Recovery Forum
2 Lavery et al 2013, The Next Manufacturing Revolution: Non-Labour Resource Productivity and its Potential for UK Remanufacturing, p 75-96
3 Ijomah, Winifred L., Childe, Steve and McMahon, Chris 2004: Remanufacturing: a key strategy for sustainable development. Proceedings of the 3rd International Conference on Design and Manufacture for Sustainable Development. Cambridge University Press. ISBN 1-86058-470-5
4 Centre for Remanufacturing and Reuse, An Introduction to Remanufacturing, 2007, p3
5 The Centre for Resource Efficient Manufacturing Systems is a collaboration between the Centre for Process Innovation, The Institute for Manufacturing Cambridge and Teesside University

b. Criteria for successful remanufacturing

Some product types lend themselves more naturally to remanufacturing, such as machinery and engines. Experience to date suggests that remanufacturing works best when certain criteria are met. These are that:

- the product has a high value
- the technology in question does not change quickly
- fashion or trends in the product do not change quickly
- the product is durable
- the product is easy to disassemble
- the product is leased or delivered as a service instead of hardware. Where this occurs there are shared motives for product durability, longevity and performance

There are many examples of areas that fit these criteria but are as yet unexplored, for example wind turbines. The UK is a world leader in offshore wind energy, with many onshore wind turbines also, and there is great potential for remanufacturing in this area.

Recommendation

The Government should use the criteria set out above to identify areas where the UK has the best potential to explore remanufacturing. The Government should then develop a fund to optimise the development of remanufacturing in these areas.

CASE STUDY: CATERPILLAR

"*As good as new, as strong as ever*"
– Caterpillar Business Model

Caterpillar design, manufacture, market and sell machinery and engines. They are the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, diesel-electric locomotives, and they also supply and remanufacture military equipment. All types of military tanks as well as Land Rover Snatch models are remanufactured by Caterpillar, which in turn boosts the military's green credentials. As can be seen from Figure 2, approximately 90% of a typical Caterpillar product is left unchanged with 10% being remanufactured.

Caterpillar's remanufacturing activity began in 1973 and has expanded exponentially. Caterpillar realised that by keeping products in-house and remanufacturing them, they would retain ownership of their products and their associated value.

Through 'Cat Reman', the company has increased profit margins whilst still producing components of the highest quality, by replacing products before they break and rebuilding them with a mixture of new and used parts, as illustrated in Figure 3.

Figure 2: Components typically remanufactured in a Caterpillar machine

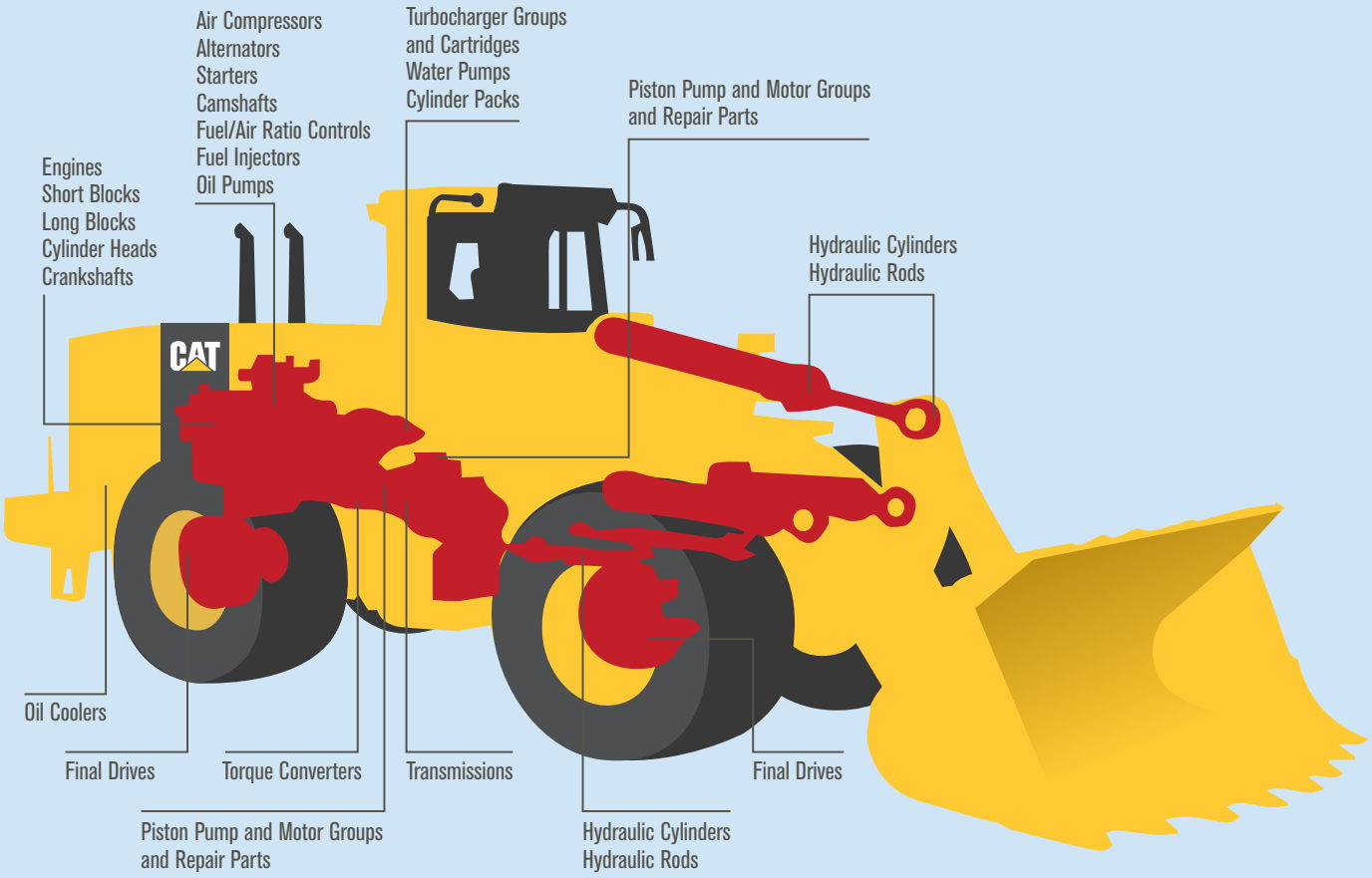
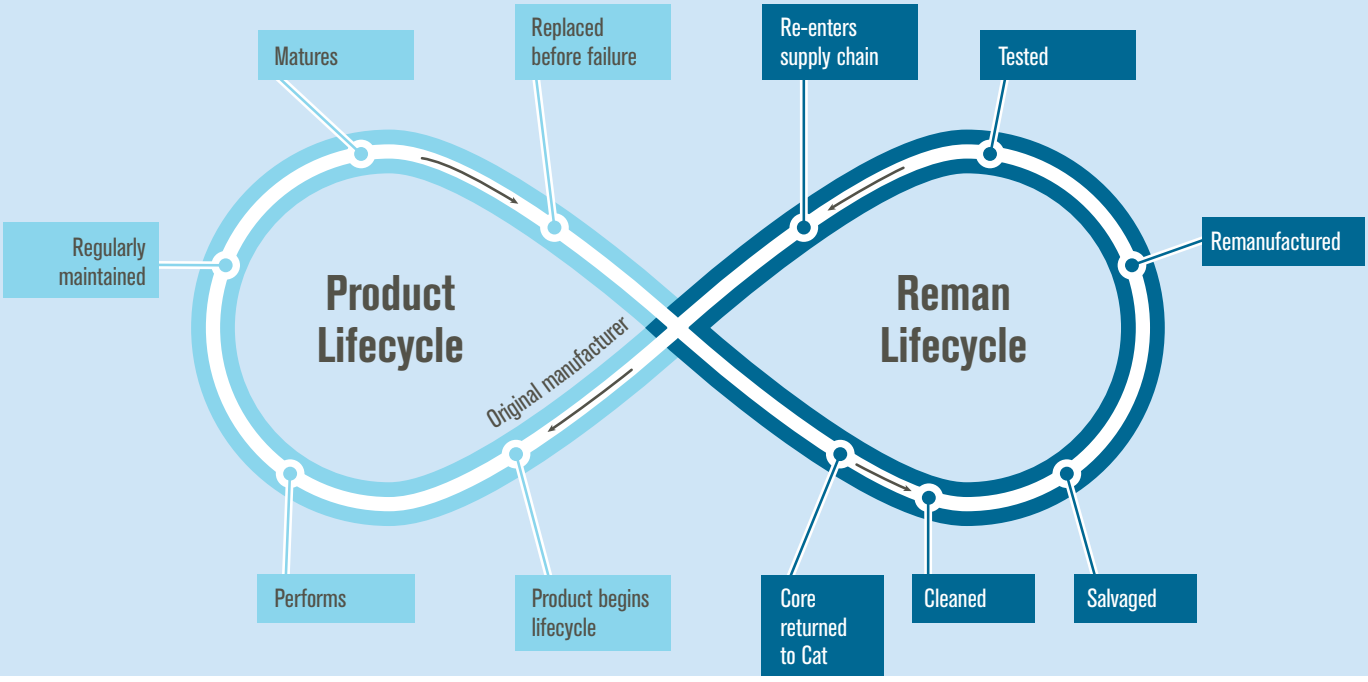


Figure 3: Product and Remanufacture Lifecycles for Caterpillar products



35% of Caterpillar's costs lie in overheads whilst 65% lie in materials costs. Salvaging materials therefore gives them a competitive advantage over companies solely focussed on driving down overheads.

Caterpillar also operates a returns incentive scheme. The cost of a remanufactured part, or "core", is equivalent to the cost of a new part unless an old part is returned, in which case it is cheaper. By offering this "core deposit" economic incentive to return used parts, Caterpillar ensures that it receives a high percentage of core back for remanufacture. This incentive also drives down material costs and enables Caterpillar to regain control of materials at the end of the traditional product life. The scheme also ensures fair pricing: the remanufactured price plus the core deposit equals the cost of a new product. The core deposit is then returned to the consumer upon return of the core.

The environmental benefits of Caterpillar's remanufacturing services are extensive. The company has calculated that remanufacturing a cylinder head leads to an 86% safety advantage, 61% less greenhouse gases, a 93% reduction in water use, an 86% reduction in energy used, a reduction in waste sent to landfill of 99% and a 99% reduction in material use compared to making a new product[6].

2. THE OPPORTUNITY

a. The economic opportunity and job creation

Estimates suggest that the value of remanufacturing in the UK is £2.4 billion[7], with the potential to increase to £5.6 billion[8]. The opportunity still exists for the UK to make more of its remanufacturing potential. Linked to the economic opportunity is the potential to increase skills and create jobs. For example, the United States is the largest remanufacturer in the world and between 2009 and 2011 the value of United States remanufactured production grew by 15% to at least $43 billion (£26 billion). This supported 180,000 full-time U.S. jobs in over 70,000 remanufacturing firms[9].

b. The environmental opportunity

Complementing the economic and employment opportunities is the environmental benefits related to remanufacturing. Remanufacturing typically uses 85% less energy than manufacturing[10]. Studies conducted at the Fraunhofer Institute in Stuttgart, Germany have estimated that the energy savings by remanufacturing worldwide equals the electricity generated by five nuclear power plants. This equates to 10,744,000 barrels of crude oil or a fleet of 233 oil tankers. Estimates for resource impact suggest remanufacturing also saves in excess of 800,000 tonnes of carbon dioxide emissions each year[11], roughly equivalent to 1% of emissions from cars[12]. The Fraunhofer Institute estimated that raw materials saved by remanufacturing worldwide each year could fill 155,000 railroad cars forming a train 1,100 miles long[13].

c. Competitive advantage for businesses

"*For businesses remanufacturing is about retaining both the value of products and a client base*"
– Ben Walsh, Centre for Remanufacturing and Reuse

Remanufacturing also presents a strong business opportunity and anecdotal reports have suggested it can be twice as profitable as manufacturing . It has been estimated that through remanufacturing, using either a sales-based business model with slightly reduced prices or using a leasing model (where customers effectively pay the same price as for a new product) the competitive advantage for businesses is vast. Lavery and Pennell conservatively estimate a net reduction in input costs of approximately 34%. With reduced input costs and increased labour spend there can still be up to a 50% increase in gross profit (Fig. 4).

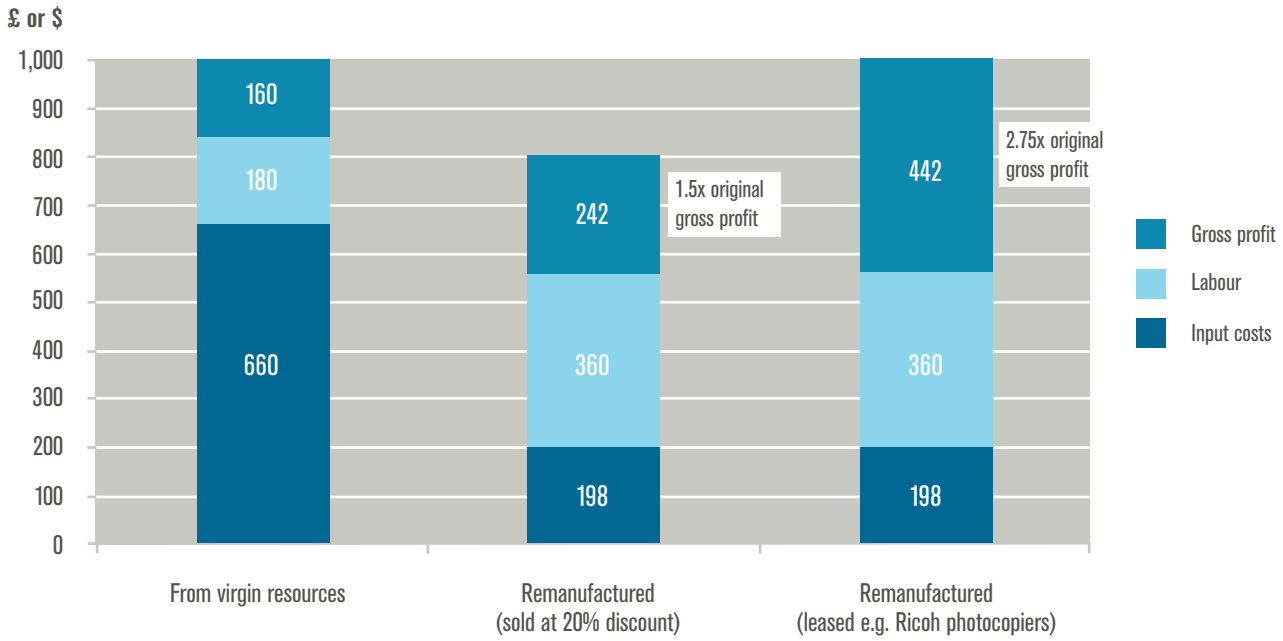
6 EEF: The Manufacturers' Organisation
7 Parker, D 2010, Remanufacturing in the UK: A snapshot of the UK remanufacturing industry in 2009; Oakdene Hollins for the Centre for Remanufacturing and Reuse and the Resource Recovery Forum, p6
8 Lavery et al 2013, The Next Manufacturing Revolution: Non-Labour Resource Productivity and its Potential for UK Remanufacturing, p 75-96
9 United States International Trade Commission Report October 2012, p21
10 Steinhilper, 2006, Remanufacturing: The Ultimate Form of Recycling, Fraunhofer IRB Verlag, p6
11 Charter, M and Gray, Remanufacturing and Product design: Designing for the 7th generation, p14
12 2012 UK Greenhouse Gas Emissions, Final Figures, Department of Energy and Climate Change
13 Steinhilper, 2006, Remanufacturing: The Ultimate Form of Recycling, Fraunhofer IRB Verlag, p6

d. Benefits to the end user

When the consumer returns a product to the remanufacturer, it enters the remanufacturing supply chain outlined in Figure 5. There will also be other products at various stages in this supply chain at the same time, with some of these at the end stage of storage. Therefore, when the customer returns a product they can receive an identical remanufactured product with no waiting time. This is of mutual benefit to the remanufacturer due to manufacturing efficiency and customer satisfaction.

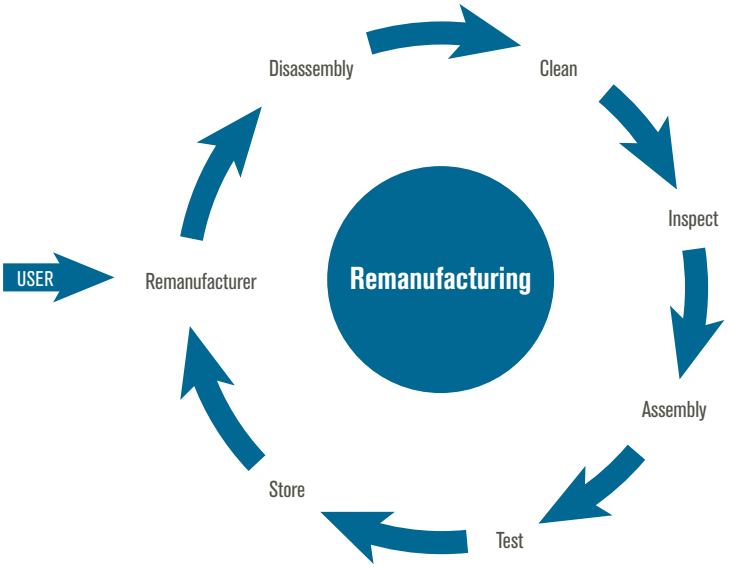
Another benefit often quoted to consumers is a cheaper product. Anecdotally however, it is felt that this can be detrimental to confidence in remanufactured products.

Figure 4: The potential for increased gross profit and employment with decreased input costs



Source: Lavery and Pennell – Next Manufacturing Revolution Report

Figure 5: The ideal business model of remanufacturing



CASE STUDY: MEDICAL DEVICES IN THE UNITED STATES

Medical devices are often very expensive and can have complex and multiple components so extending the lifetime of these devices enables a significant saving of resources. This is especially important at a time when healthcare resources are limited.

The remanufacture of Medical Imaging Devices such as X-ray equipment, CT scanners and MRI scanners occurs through both Original Equipment Manufacturers (OEMs) and third parties and has been identified as a strong market in the United States[14]. The United States is the largest remanufacturer of medical devices where the market was valued at $2.0bn (£1.2bn) and had a growth rate of 11.5% in 2010[15]. Forecasts for the market predict that it will grow by 7.57% over the period 2012-2016[16].

Key companies dominating this market in the United States are GE Healthcare, Philips Healthcare, Siemens Healthcare, and Toshiba Medical System Corporation. Purchase of remanufactured medical imaging systems is also a growing market in the US. A recent survey[17] reported that all OEM remanufacturers contacted noted increased sales due to remanufacturing. It is likely that growth in this area will continue as remanufactured imaging systems offer a good opportunity to provide extra equipment at a saving compared to new equipment, whilst maintaining standards of care to the patient and retaining equipment that still has a considerable service lifetime.

The remanufacturing of medical equipment is also making significant improvements to the environment. Many vendors market their remanufactured devices as eco-friendly as well as economical. For example Siemens Healthcare has an eco-line portfolio which includes a wide range of remanufactured medical systems.

Given the success of remanufacturing in this sector in the United States, there is potential for the UK to further explore the significant resource savings that remanufacturing could make in this sector both in terms of revenue and material streams.

3. THE CHALLENGES

a. Barriers to uptake

Design

Design directly impacts on the ability of a company to monitor, disassemble, inspect and reassemble products and is often quoted as the most important factor for enabling remanufacturing . Products need to be designed with the circular economy in mind. Prescriptive design briefs provided by senior management do not always allow for innovative design for remanufacture and greater collaboration is needed between those who issue the design brief and the designers themselves.

OEMs manufacture their own products or components in-house and then sell them to a Value-Added Reseller (VAR). OEMs such as car manufacturers control the design process and as such there is an opportunity for them to control the remanufacturing process. Third party companies are recognising the opportunities that remanufacturing presents and, as identified in the Caterpillar case study, OEMs should capture the opportunity to bring this process in-house to further incentivise design for remanufacture.

Some manufacturers, such as Rolls Royce, have recognised that through leasing business models, the selling of a service can incentivise better design. In 1962, Rolls Royce developed a “Power by the Hour” approach to selling products, whereby a complete replacement service is offered on a per hour basis of use. Mutual benefits are received, where customers are guaranteed a fixed engine maintenance cost over an extended period of time and Rolls Royce keep the design and associated benefits of remanufacture in-house.

14 Remanufacturing of Medical Imaging Devices, Centre for Remanufacturing and Reuse http://www.remanufacturing.org.uk/pdf/story/1p89.pdf?-session=RemanSession
15 The Market Outlook for Refurbished Medical Devices to 2016, Regulatory environment, opportunities, and market forecast, SCRIP Insights
16 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249744/bis-13-1182-draft-statutory-instrument-waste-electrical-and-electronic-equipment-regulations-2013.pdf
17 Gray and Charter, Remanufacturing and Product Design – Designing for the 7th Generation. Centre for Sustainable Design

Design for remanufacture is not a 'one size fits all' approach and in some cases will not be the best option, either economically or environmentally. For example, for fast-moving consumer goods where fashion is highly relevant and technology moves quickly, it may be better to encourage other strategies such as recycling or reuse. There are also regulatory opportunities where design could be more formally exploited, including the Freedom of Information Act (explored in the regulatory framework section of this briefing). The United States has been particularly proactive in this area and has amended legislation to enable remanufacturing through having a transparent design process.

Supply chain communication

To enable the UK to make the most from remanufacturing, better communication is needed between different supply chain companies. Information sharing in product supply chains must exist not only for product design, but for disassembly, quality checking, sub-component sourcing, reassembly and testing. Only through such an integrated approach can the remanufacturing of component parts or products occur.

The sustainable resource industry and regulatory framework

Regulation on sustainable resource management, energy using products and chemical use can be both an enabler and inhibitor to remanufacturing.

The Waste Electrical and Electronic Equipment (WEEE) Directive requires EU member states to ensure that producers do not prevent WEEE from being reused "unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements[18]". Therefore, WEEE should not prevent OEMs from remanufacturing. However, in practice this is sometimes the case as there is no clarification as to whether a product at the end of its life but before it is remanufactured is classified as 'waste'.

The definition of waste has been in use in its current wording for over three decades and is now embedded in the 2008 Waste Framework Directive[19] as:

"*...any substance or object which the holder discards or intends or is required to discard...*"

The current 'Guidance on the Legal Definition of Waste' and its application also adopts this definition but does not mention remanufactured products.

Recommendation

The Government should amend its Guidance on the Legal Definition of Waste to distinguish a product that is due to be remanufactured as being exempt from those products considered as waste. This will ensure that they do not fall within the remit of waste regulations.

The effect of the End of Life Vehicles (ELV) Directive on remanufacturing is also unclear. It should encourage remanufacture due to the requirement that vehicle manufacturers should take responsibility for vehicles. However, no credit is offered for remanufacture, making other options such as recycling more attractive to some manufacturers.

The Freedom of Information Act seeks to give individuals the right to access information held by governments and corporate bodies. However, as seen in the design section of this brief, a key opportunity is being missed as there is currently no scope for remanufacturers to access design specifications. The remanufacturer must reverse engineer all products before any remanufacture process can begin, adding to time and investment costs of remanufacturing.

18 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249744/bis-13-1182-draft-statutory-instrument-waste-electrical-and-electronic-equipment-regulations-2013.pdf
19 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69590/pb13813-waste-legal-def-guide.pdf

Recommendation

The Government should amend the Freedom of Information Act to include the requirement that a designer is compelled to state, upon request from a manufacturer or remanufacturer, the components of a product to enable easier remanufacturing.

The Sale of Goods Act (SoGA) also presents a barrier to remanufacturing as the burden is placed on the retailer instead of the manufacturer if a product is faulty. This does not incentivise an OEM to make long-lasting products that are easily remanufactured.

The Trade Descriptions Act (TDA) prevents manufacturers, service industry providers or retailers from misleading consumers as to what they are purchasing. Remanufactured products are often considered by consumers as being less reliable than new products. Following the recommendations surrounding a legal definition of remanufacturing and certified mark for remanufactured products could increase consumer acceptance.

The REACH (Registration, Evaluation, Authorisation and restriction of CHemicals) Regulation requires manufacturers of products which contain more than 0.1% weight of any Candidate List Substance of Very High Concern (SVHC) to provide customers with sufficient information to allow safe use of the product. The use of chemicals must therefore be managed through the supply chain and this can be a large financial burden to remanufacturing.

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive can also be a barrier to remanufacturing. It has recently been added to the Conformité Européenne (CE) Directive and means that if part of a product is replaced, the whole product will have to be reassessed in order to be awarded the CE mark. In this respect, the RoHS represents a legal black hole when looked through the prism of reuse and remanufacture.

Remanufactured components may not be as energy efficient as new components of more recent design. The Energy using Products (EuP) Directive is continually revised to reduce standby and in-use energy consumptions and there is potential for it to become impossible to sell remanufactured products if they use more energy than new, low-energy models. Although lowering stand-by and in-use energy consumption is beneficial in isolation, it may not be the best measure to drive holistic improvement. A more holistic approach focusing on the entire supply chain of products should be used to assess energy-saving potential.

Recommendation

The Government should review the regulatory barriers to remanufacturing outlined above and address the legal black holes identified.

Buying Standards

Related to regulatory impediments are buying standards. Their role could have a big impact on the way remanufactured products are perceived and accepted in the UK.

Buying standards have already been proven to work in many areas. The Forest Stewardship Council (FSC)[20] was founded in 1993 and is an organisation dedicated to promoting the responsible management of the world's forests. It runs a global forest certification system with two key components: forest management and Chain of Custody certification. The "tick tree" logo is well recognised and allows consumers to identify, purchase and use timber and forest products from well-managed forests. The adoption of a similar tick mark for remanufactured products could greatly strengthen consumer confidence in their reliability.

20 http://www.fsc-uk.org/

Recommendation

The Government should consider the potential of a certified mark for remanufacturing to demonstrate that products have been tested and fully comply with those standards of a new product. The Government should also adopt whole life costing which would incentivise the purchase of remanufactured goods.

Market dynamics and consumer concepts

A key barrier to the uptake of successful remanufacturing is the return of end-of-life products (or 'core') from the consumer back to the remanufacturer. A number of small remanufacturing firms in the United States operate a market-driven product acquisition management approach, whereby incentives are given to the customer to return end-of-life products. By controlling the quality of acquired products that serve as input to the remanufacturing process, overall profitability of a remanufacturing system can be optimised.

Market demand may also vary depending on the product type or market being considered. The price of remanufactured products should therefore be carefully considered by businesses. As in other industries, the more established the market, the higher the price for remanufactured products. Although remanufactured products are sometimes sold at 30-70% of the cost of new products, the industry is thought to perform best in markets where there is no or little discount for remanufactured products compared to new (see Caterpillar case study). In these cases the market has accepted that remanufactured products are as good as new[21]. Customer confidence in remanufactured products can also be established in this way.

International trade

International trade conditions are a key barrier to encouraging the remanufacture of products. Many countries such as Brazil, China and Russia do not have a set of standards that distinguish remanufactured products from used products so remanufactured products cannot be imported. Remanufacturers may have to develop a remanufacturing plant in a particular country in order to sell the remanufactured products in that country. A commonly accepted global definition of remanufacturing would help overcome these trade barriers.

Skillset

Although the remanufacturing sector has the potential for huge job creation, these jobs are skilled and the associated costs of training a new or existing workforce are high.

A Centre of Excellence for Remanufacturing could reduce the impact that these costs can have on businesses. For example, in 2008, VSE Corporation launched a state of the art military equipment refurbishment centre in Virginia, USA. This Centre of Excellence facility provides complete lifecycle engineering, logistics, maintenance and remanufacturing services to extend and enhance the life of existing military equipment. It provides a useful best-practice example of the full remanufacturing process, from full service washing and sand blasting to painting the finished product. In the UK, leading manufacturers of vacuum equipment BOC Edwards now operate a pump remanufacturing facility in Crawley, which is a Centre for Excellence for all semiconductor and specific pumps[22]. A Centre for Excellence can also contribute to innovation in remanufacturing through the advertisement of successful design for remanufacture approaches.

Recommendation

The Government should set up a Centre of Excellence for those products that have the most potential for remanufacturing in the UK, for example engines. Centre of Excellences need to be linked with a leading UK University to enable key players to collaborate on a hub-and-spoke basis. This will encourage and stimulate greater knowledge transfer and understanding about the practical application and potential of remanufacturing in the UK.

21 Charter, M and Gray, C Remanufacturing and Product design: Designing for the 7th generation, p48
22 Bic Edwards Invests in Remanufacture, Pump Industry Analyst, 2004, Issue 10, p13

Incentivising remanufacturing

A lot of remanufacturers are independent companies operating with fewer than five employees[23]. Extra incentives may be needed for these companies to incorporate remanufacturing into their business plan.

Recommendation

The Government should consider implementing a tax break for remanufacturers in order to encourage the uptake of remanufacturing in the UK.

CASE STUDY: ORANGEBOX

Orangebox, based in South Wales, is an SME that designs and manufactures furniture using a Cradle to Cradle (C2C) Design approach which it believes has the potential to become the worldwide standard for intelligent manufacturing. Though a small business, it creates products that have a big impact and it has recognised many of the barriers to remanufacturing outlined above and has adjusted its business model accordingly.

Design is key to the Orangebox brand and using a C2C approach makes Orangebox environmentally effective by developing products for closed loop systems in which all the materials are either naturally biodegradable or can be fully recycled into high quality materials or remanufactured. Orangebox was the first European Union manufacturer to design and develop a C2C accredited office chair and its ultimate aim is to eliminate the concept of waste, through better consideration of what is used in its products and how materials can be recovered.

Orangebox recognises that the largest percentage of its environmental impact is determined by the materials it uses in its products and how those materials are put together. Typically, a new Orangebox office chair includes around 98% recyclable content. Communication is also key to Orangebox's success and both design and remanufacture are done in-house. Its products are light and easy to disassemble at the end of their life and it acts together with its suppliers to achieve its aim of truly smart manufacturing.

One of the biggest challenges that Orangebox faces as an SME in the remanufacturing sector is getting products back from consumers at the end of their lives in order for them to be remanufactured. Larger corporations such as Xerox also identified this as a problem and now operate a system for the acquisition of end-of-life products. Apart from those in excellent condition, Xerox operate a reverse-logistics process to take all end of first life (end-of-life) products to be remanufactured. In order to incentivise this process, it 'buys back' each product at a given rate, dependent on demand. The product is then disassembled and reassembled (remanufactured).

In addition, Orangebox is aware that big corporate companies are sceptical about remanufactured products. Due to remanufactured parts or products often being wrongly classified as 'waste' large organisations are nervous about their health and safety implications. Although Orangebox products comply with UK, EU and US standards of new products, it believes a certified mark would help as organisations respond to accreditations when they are well known. Orangebox also believes that the UK could take the lead in remanufacturing but that there should be a tax incentive for SMEs to enter the industry, as at present only few are willing to take the initial leap of faith needed to change their business models.

When these barriers are overcome, Orangebox proves that market share can grow and a better product can be developed through remanufacturing.

23 Charter, M and Gray, C Remanufacturing and Product design: Designing for the 7th generation, p2

b. Overcoming the barriers

Overcoming the barriers to remanufacturing outlined above must be complemented by a cross-departmental approach to remanufacturing.

Recommendation

The Government should recognise remanufacturing as a cross-departmental challenge. It should establish a cross-departmental committee, led by BIS and suppported by Defra, to ensure there is a cross-departmental collaboration when considering those policy areas where remanufacturing plays a key role.

CONCLUSION

There is little doubt that there is huge potential for remanufacturing in the UK. Its uptake can contribute greatly to the UK economy and enhance skilled job creation, as well as forming a key part of the move towards a truly 'circular economy'. Energy use can be reduced with associated reductions in greenhouse gas emissions, alongside reductions in the consumption of water and materials, reducing in turn upstream environmental impacts. Waste production is also thereby reduced.

Businesses can benefit from enhanced margins while consumers can benefit from products with enhanced lifespans. However, barriers need to be overcome if remanufacturing is to become a more dominant part of UK manufacturing. Leadership is vital to achieve this. A number of regulatory impediments must be addressed on a cross-departmental basis, whilst improving consumer confidence.

Finally, incentives are needed to encourage those smaller businesses that cannot rely initially on a 'leap of faith' approach and better education is needed through the creation of a new Centre of Excellence for UK Remanufacturing.

Considered and tackled together, the issues outlined in this paper could provide the UK with the opportunity to make the most out of its remanufacturing potential and become a world leader in this field.

'Remanufacturing: Towards a Resource Efficient Economy'
The All-Party Parliamentary Sustainable Resource Group, March 2014

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