



**PolyCE**

Post-Consumer High-tech Recycled Polymers for a Circular Economy

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## Executive Summary

The survey and interviews demonstrated that there has been a change in the perception, and awareness, of Circular Economy (CE) compared to previous initiatives. Some interviewees stated that circular economy concepts are easier to understand than climate change, for example; CE is related to more tangible concepts. The findings of the survey and interviews show that organisations are aware of the Circular Economy (CE) and Circular Economy Business Model (CEBM) concepts. There was some variance in what CE meant to them, but the overall consensus was the CE provided the business models for materials flow, and overall framework to deliver resource efficiency. Sustainability is seen as the overarching principal encompassing social, economic and environmental aspects. Resource Efficiency is seen as **the what**, CEBMs as **the how** and sustainability as **the why**.

Adoption of CEBM was applicable to whole products, components, specific materials and alternative customer relationships. In most instances responses also indicated that there were companies across different EEE industry sectors where no CEBM was adopted. Producers and designers interviewed indicate that designing with end of life in mind is becoming much more the norm, with appliances becoming more modular and component-based in some types of EEE, making products easier to dis-assemble. This development is especially true where closed loop and take back systems have more producer influence.

The interviews identified that one of the biggest barriers for adoption of CEBM's is that "businesses as usual", *i.e.* a linear model, is still economically feasible and convenient. The main external barriers to adoption of CEBM are economic and technical viability, and in the case of such as access and service models, willingness of the end user to change the way they access goods. Internal barriers can be in getting acceptance, and participation, from the different areas within the company itself.

Where CEBMs were adopted, it was primarily for consumer electronics, Information and Communications Technology (ICT), medical devices, large household appliances and lighting equipment. Costs and sustainability goals were the most significant CEBM drivers for the eight product categories (listed in the survey). By extension, it can be assumed that costs were also potentially the key overarching barrier for the uptake of CEBM. No product sector rated 'improved supplier relationship' as the most significant. There was no significant correlation between company size and the number, and type of CEBM adopted. The circular business models adopted tended to be utilised for whole products, however there are examples, from both the survey and interviews, showing that CEBMs are also applied to individual components and specific materials. Individual components were utilised as part of circular business models by small and medium sized companies or large companies (*i.e.* over 2,000 staff) especially in cooling appliances and high value ICT components. Often individual components are reused as spare parts for organisations adopting the revalue model of whole products.

Both material flows and information flow, need to be enhanced, with respondents indicating that greater understanding in supply chains is a means to develop a CE approach.

The key factors that impacted upon the use of post-consumer recycled plastics (PCR) were the size of the organisation and how the PCR plastics were bought and sold. It is assumed that **small companies lacked the resources (e.g. finance), and access (e.g. to an online**

**market platform) to** post-consumer recycled plastics. It is also possible that given their small size, that they may also simply lack the capacity to require larger quantities of post-consumer recycled plastics

One of the fundamental requirements stated by respondents, to adoption of a circular business model, is related to consistent **material availability**, with ABS, PP and HIPS being the main post-consumer recycled plastics utilised.

From the interviews and survey, it is clear that plastics availability must be analysed in parallel with the aspect of plastics **quality**. If the supply of PCR plastic is reliable in term of volume, the consistency of quality cannot be always easily ensured. The PCR plastic quality issue goes right through all the studied PCR plastic value chain. The lack of a generally accepted quality control procedures is perceived to influence all the subsequent nodes of the PCR plastic value chain and is impacting on the achievement of high rates of recycling. Moreover, it currently represents a barrier for an appropriate **valorisation** of the plastic itself.

# 1 Introduction

## 1.1 Aim and scope of the Deliverable

The overall aim of WP 1 is to determine the business environment relevant for the project, including the products and services developed with PolyCE. This deliverable starts with identifying and assessing various business models towards CE together with their impact on the value chain, with the final intention to increase circularity in the electronics sector. In the end of WP1 finding opportunities for an industrial symbiosis should be achieved.

Task 1.1 and associated deliverable D1.1 characterized the different types of circular business models that apply to the electrical and electronic equipment sector. Task 1.1 and D1.1 demonstrated an in-depth literature review analysing the range and opportunities presented by circular business models. Task 1.2 builds on Task 1.1 by further analysing the implementation of circular business models and the factors that influence their uptake and success. A stakeholder survey, together with in-depth interviews, goes beyond the theoretical implications from the literature review to gain greater detail, through direct communication with those involved. Task 1.1 developed the foundations on which the survey and interview questions were based. Two approaches were undertaken – a survey to get a bigger picture and then follow up interviews and case studies to obtain greater detail and perspectives. The results of Task 1.2 form the present deliverable D1.2 which explores the impacts, drivers and limitations of circular business models in the electronics sector. This information will then be used as input to stimulate circular business models of production in the electronics sector and consumption for high resource efficiency and help overcome the barriers and reduce risks and limitations.

## 1.2 Background

The Electrical and Electronic Engineering Industry (EEEI) is driven by constant innovation. In this highly competitive market the concept of CE represents a chance for companies to design business strategies in a more sustainable way and to gain a competitive advantage against linear business models. The shift away from a linear production model can happen in various ways and in the form of different business model types. All different business models have in common that they take a step forward towards closing the material loops. In the literature review conducted as part of D1.1 three main dematerialisation strategies were identified that constitute the concept of CE (Stahel,1994):

- Extending the service-life of goods through design for long-life use, life-long guarantees, consumer behaviour, repair, refurbishment and remanufacture
- Increasing the intensity of use of goods by offering temporary access to products (e.g. equipment leasing) or selling services rather than products (e.g. copy shop)

- Technological innovations such as LED, microchips, etc.<sup>1</sup>
- The set of choices made by a company to contribute to dematerialisation was defined as circular business model (CBM). Different types of CBMs in the electronics sector were previously identified in D1.1, together with examples of how a more circular way of business can look like for the EEEI. Even though the choices and strategies adapted by each business can differ significantly one from another, the key aspects that CBMs have in common are (See also PolyCE, D.1.1):
  - resource circularity (e.g. Mentik 2014<sup>2</sup>, Leising 2006<sup>3</sup>, Linder & Willander 2015<sup>4</sup>),
  - resource efficiency and value exploitation (e.g. Bakker, Hollander et.al 2014<sup>5</sup>; Florin, Madden et al. 2015<sup>6</sup>),
  - product design aspects (e.g. Lewandowski 2016<sup>7</sup>; Gerholdt 2015<sup>8</sup>)
  - and collaboration among stakeholders (e.g. Poutiainen 2015<sup>9</sup>, Hoffman 2017<sup>10</sup>). This deliverable will build on D.1.1, taking a closer look at the choices taken by companies which have adopted a CE approach, and evaluate what the drivers for adoption of certain dematerialization options are. The report also aims to identify barriers in changing linear production models of OEMs and to try to shed light upon what might slow down producers of electrical and electronic equipment in moving towards a CE.

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<sup>1</sup> Stahel, Walter R. (1994): The Utilization-Focused Service Economy. Resource Efficiency and Product-Life Extension. In *The Greening of Industrial Ecosystems*, pp. 178–190. Available online at <https://www.nap.edu/read/2129/chapter/17>

<sup>2</sup> B. Mentink (2014): Circular Business Model Innovation: A process framework and a tool for business model innovation in a circular economy. Master thesis. Delft University of Technology & Leiden University, Netherlands. Industrial Design Engineering. Available online at [uid:c2554c91-8aaf-4fdd-91b7-4ca08e8ea621](https://www.researchgate.net/publication/312554c91-8aaf-4fdd-91b7-4ca08e8ea621).

<sup>3</sup> Eline Leising (2006): Circular Supply Chain Collaboration in the Built Environment. A process tool to enhance Circular Supply Chain Collaboration when applying the aim of the Circular Economy in the building sector. Master thesis. Leiden University & Delft University of Technology, Leiden.

<sup>4</sup> Linder, M., Willander, M. (2015): Circular Business Model Innovation. Inherent Uncertainties. In *Business Strategy and the Environment*, pp. 1–15.

<sup>5</sup> Conny Bakker, Marcel den Hollander, Ed van Hinte, Yva Zijlstra (2014): Products that last.

<sup>6</sup> Florin N., Madden B., Sharpe S., Benn S., Agarwal R., Perey R. and Giurco D. (2015): Shifting Business Models for a Circular Economy. Metals Management for Multi-Product-Use Cycles. Edited by UTS. Sydney.

<sup>7</sup> Lewandowski, Mateusz (2016): Designing the Business Models for Circular Economy—Towards the Conceptual Framework. In *Sustainability* 8 (1). DOI: 10.3390/su8010043.

<sup>8</sup> Jennifer Gerholdt (2015): The 5 business models that put the circular economy to work. Edited by GreenBiz. Available online at <https://www.greenbiz.com/article/5-business-models-put-circular-economy-work>

<sup>9</sup> Paige Swaffer Poutiainen (2015): Designing out waste: an exploratory study of circular business models. Master thesis. Aalto University, Espoo. Department of Management Studies. Available online at <http://urn.fi/URN:NBN:fi:aalto-201609083378>.

<sup>10</sup> Florian Hofmann (2017): Wertschöpfung in Kreisläufen. Das Gestalten von nachhaltigkeitsorientierten Geschäftsmodellen im Kreislaufwirtschaftlichen Kontext. Master thesis. Leuphana Universität Lüneburg, Lüneburg

## 2 Methods

### 2.1 Stakeholder Survey

The stakeholder survey was developed using “SurveyMonkey” as it was thought that most participants would be familiar with this tool, it is easy for them to use, and results are presented in a format that supports analysis. The structure of the survey was agreed by all consortium members to ensure that the results were of maximum value to all relevant WPs and reduce the need for duplication of surveys (the same approach was adopted in the interviews).

The survey – see appendix 1 – was designed to take 10-15 minutes and to encourage participants to become members of the expert network established in WP2 and also to provide input for case studies and interviews..

The survey was split into 4 sections:

- 1) Background on organisation
- 2) Opportunities and Barriers
- 3) Circular Economy Business Models
- 4) Need for future support

Closed questions were used to make the survey quick and easy to complete, this was felt to be acceptable as more detail would be obtained in interviews.

The link to the survey was put on the website. A standard tweet was agreed by consortium members and was shared on social media. An agreed email was circulated by consortium members to contacts, including trade associations such as Plastics Europe.

Initially it was decided to limit the amount of time that the survey was available but due to the number and quality of responses received we have kept the link open and will review results periodically to ensure that the most detail is obtained.

As of the 18<sup>th</sup> April 2018, 58 responses had been received. Please note that in some cases responses do not equal 100% as respondents could indicate more than one answer

Appendix 1 – survey as presented to respondents on Survey Monkey

Appendix 2 – answers to specific questions (including those which were included for the benefit of the consortium and other WP)

### 2.2 Stakeholder Interviews

The interviews were designed to explore the key themes of the survey in more detail and to give experts and stakeholders, along the value chain, the opportunity to elaborate on the topic of CE.

Questions were agreed by a sub group of the consortium, reflecting the WPs that are undertaking surveys and interviews. This approach was agreed to ensure that each WP did not need to interview the same stakeholders.

Stakeholders were identified and contacted via email asking them if they were willing to undertake an interview, and if so a date and time were arranged. Where appropriate, Skype was used.

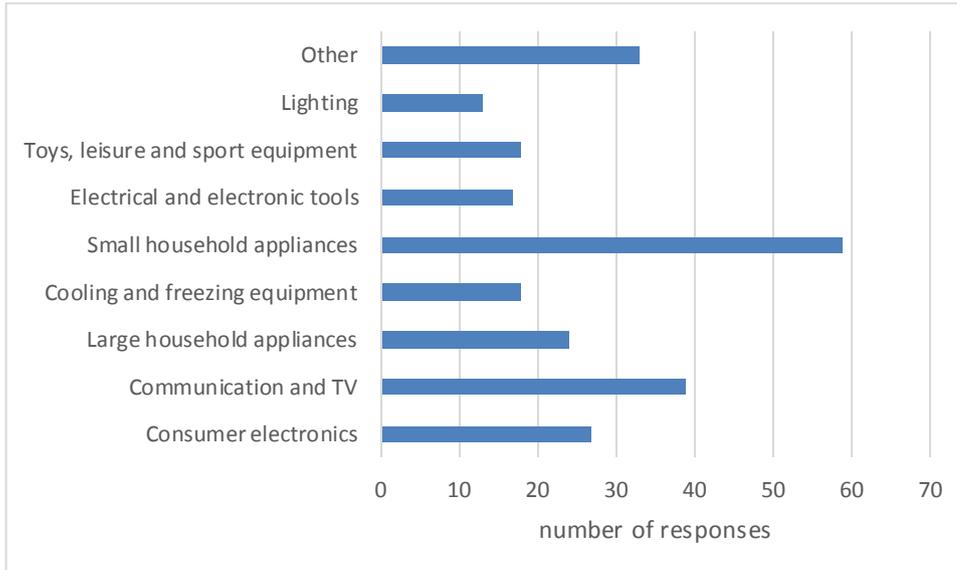
The project and the process were explained to interviewees and they were informed of their right to withdraw. Where the interviewee was willing the interview was recorded. At the end, the interview was transcribed and a copy sent to the interviewee for approval.

### 3 Survey Results

#### 3.1 Product Sectors

Figure 3.1 shows the distribution of companies and product sector. This demonstrates that the survey represents a good range of product types and is not dominated by one sector which may bias results.

**Figure 3.1** Q4: Within which sector do you operate?



Other relevant responses were Photovoltaics and all EEE.

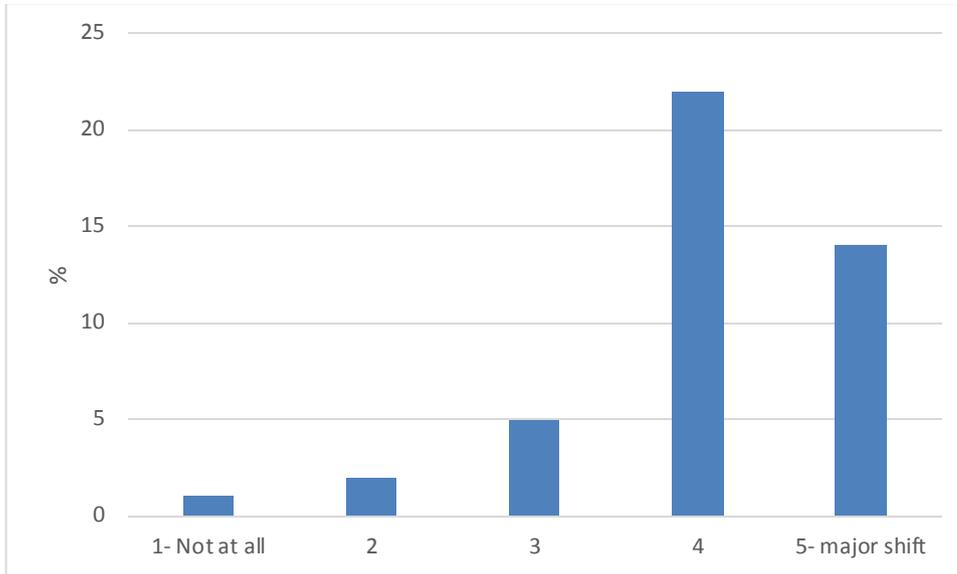
#### 3.2 Circular Economy knowledge and Interpretation (Figures in appendix)

The majority of respondents felt they have an excellent knowledge of circular economy which indicates that they are coming from an informed point of view (Figure A1).

Respondents felt that circular economy was a new way of doing business more sustainably, that circular economy gave greater ownership and control of supply chain and products, indicating greater value of materials.

### 3.3 Ease and scale of change

**Figure 3.4.** Q7: On a scale from 1 (not at all) to 5 (major shift), please rate to what extent you think the circular economy represents a major / radical shift change for YOUR business sector?

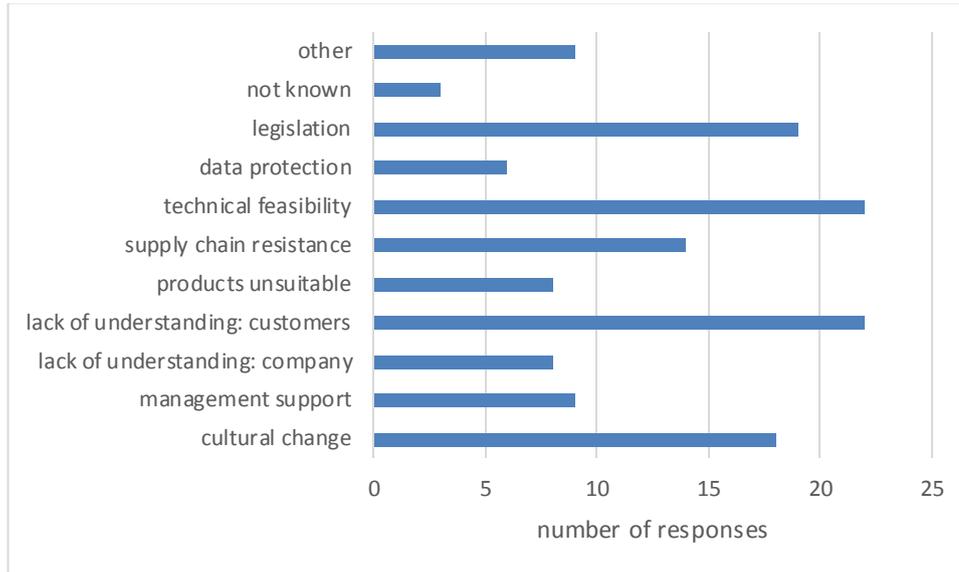


It is clear that the majority of respondents felt that the change to a circular economy presented a significant change for their business sector (figure 3.4).

Despite the fact that most people felt that the change to a circular economy was a significant shift 80% also felt it could be easily applied to their organisation (figure A3).

### 3.4 Barriers and Benefits

**Figure 3.6.** Q9 what do you think are the biggest barriers to adoption of CEBM for your organisation?

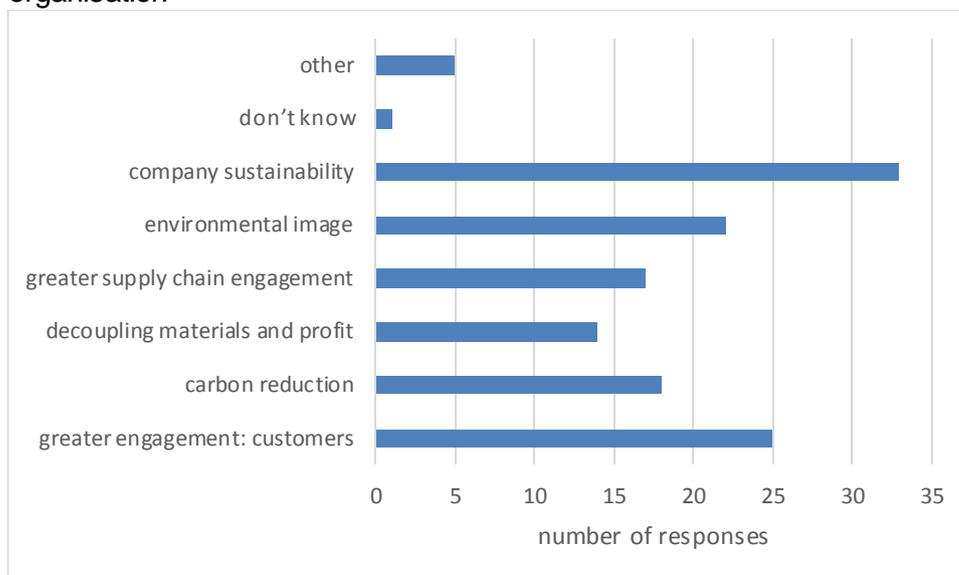


Other responses:

- Vary according to CEBM and product
- Governmental regulations that concern procurement and selection
- Products not received back in suitable state
- Cultural differences between countries in supply chain
- Economic viability

Lack of understanding by customers and technical feasibility were considered the most important barriers but legislation / regulations and cultural change were also highly ranked (figure 3.6).

**Figure 3.7.** Q10: What would be the biggest benefits to adoption of CEBMs for your organisation



Other responses:

- Acting as role model
- Risk resilience for supply chain
- Greater accessibility based on lower price point

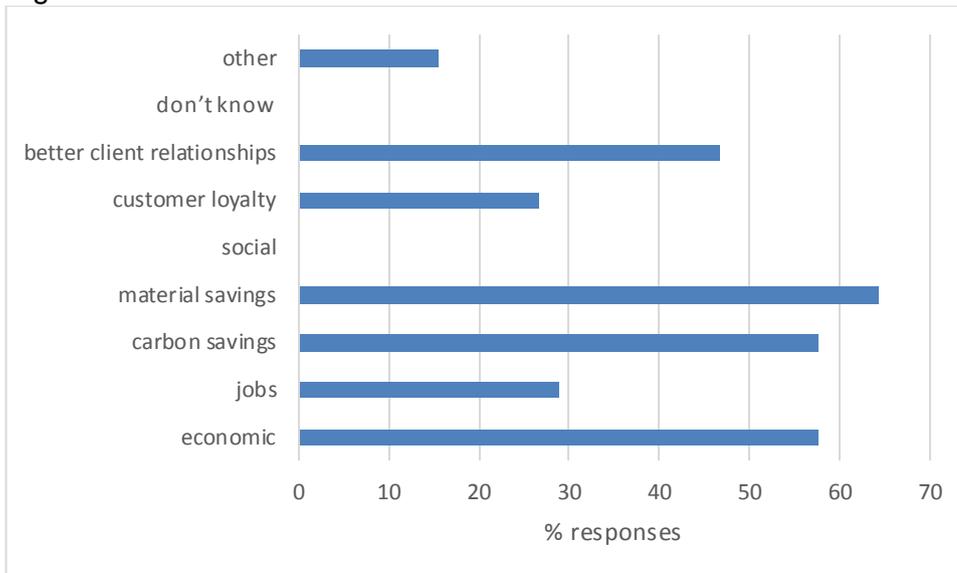
The majority of the respondents felt that company sustainability / future proofing were the key benefits. The benefits of greater engagement with customers and the environmental image of the company were also highly rated.

The measurable benefits of adopting CEBMs include savings – material, carbon and economic were considered the main measurable benefits, but many respondents also identified the greater customer loyalty as a key benefit (figure 3.8.).

Other:

- Acting as facilitator for change to relevant global issues
- Better fulfilment of the EUs REACH Regulations
- Better plastics image

**Figure 3.8.** Q11: What do you think are the measurable benefits of adopting CEBMs for your organisation?



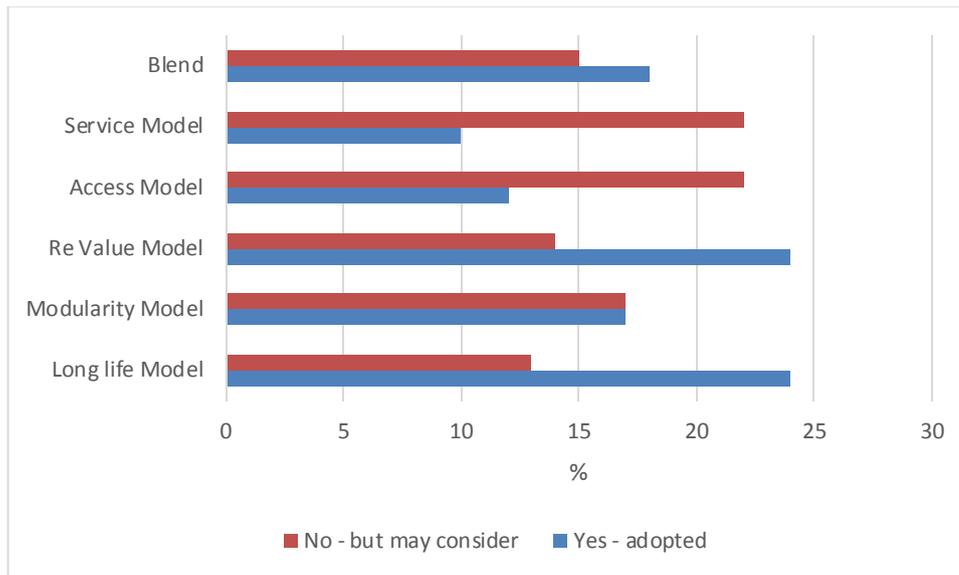
It is of note that nobody indicated social benefits as being measurable in Q11 (figure 3.8) but over half when directly prompted thought that they were relevant and measurable (figure A4).

Social benefits listed include:

- Green jobs
- Employee motivation for environmental good
- Perception of environmentally friendly for staff and customers
- Skills
- Better conflict mineral policy
- More efficient manufacturing
- Saving people money
- Reduced carbon footprint
- Reduced waste to landfill

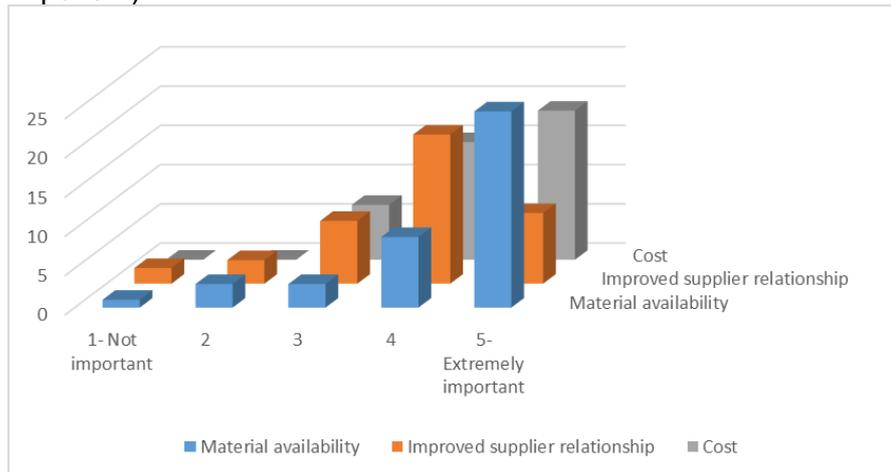
### 3.5 CEBM Adoption

**Figure 3.10.** Q13: Do you consider that you adopt circular business model?



Of those that already have a CEBM Long life and Revalue were the most popular followed by modularity. Of those that were considering a CEBM Access and Service models were equally popular, followed by modularity model.

**Figure 3.11.** Q14: When considering the adoption of CEBMs in your organisation which of the following drivers are important. Please rate on a scale of 1 (Not important) to 5 (Extremely important).



Interestingly steady guaranteed material availability was rated by most respondents as extremely important, more so than the cost of the material. Improved supplier relationship was rated as important, rather than extremely important.

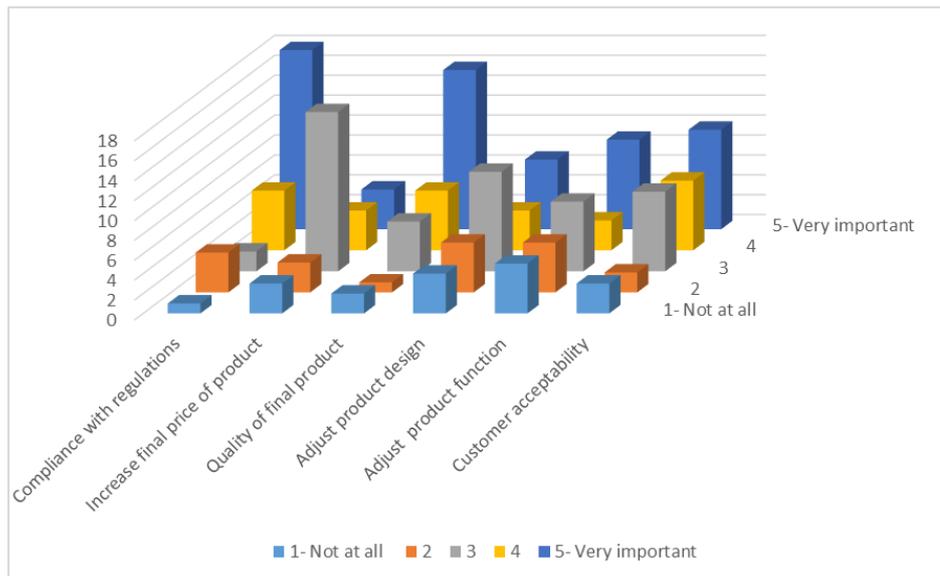
When utilising circular business models (figure A5) tended to be utilised for whole products, however CEBMs are also applied to individual components and specific materials. Individual components were utilised as part of circular business models by small and medium sized companies or large companies (i.e. over 2,000 staff) especially in cooling appliances.

### 3.6 PCR

Survey respondents indicated (figure A6) that the post-consumer materials that they used in their products were ferrous metals, non-ferrous metals (aluminium, tungsten, copper, tin, gold, tantalum, tungsten, and tungsten carbide).

PCR plastics incorporated into products were stated (figure A7) as ABS, HIPS and PP, PE, PS, PIR, cPP, PET, and PC.

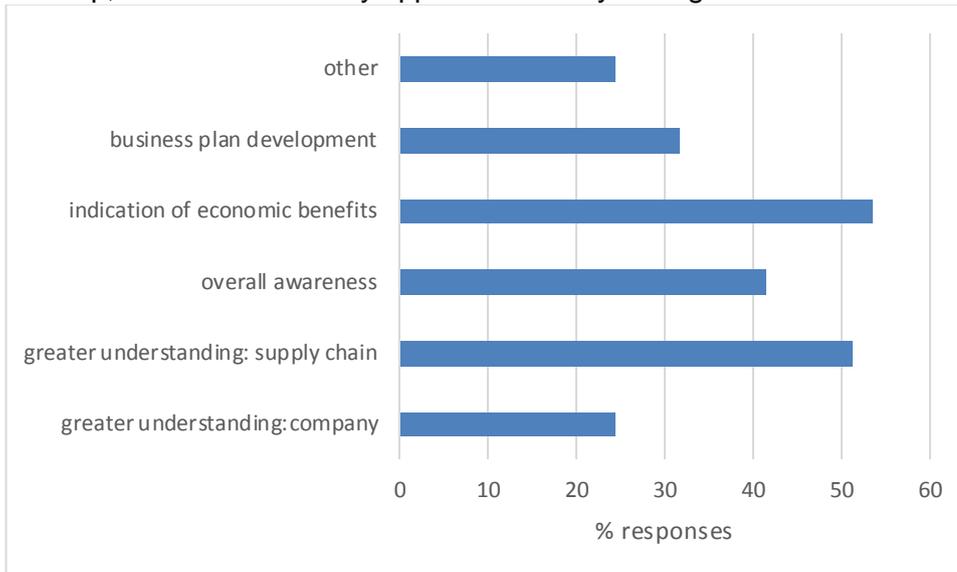
Figure 3.15. Q18: If you don't use post-consumer plastic please rate the importance of the following production issues associated with PCR use on a scale of 1 (Not important) and 5 (Very important).



The importance of production issues associated with PCR use is illustrated in figure 3.15. Compliance with regulations was considered by the majority of respondents to be very important – nobody indicated that it wasn't important. The quality of the final product was considered to be the next "very important" issue.

The majority of respondents (figure A8) did not use any recycled products in their products.

**Figure 3.19.** Q22: Which of the following would help your organisation to prepare for, or develop, a circular economy approach within your organisation?



Other responses include:

- Legislation
- Tools for identifying appropriate components for material substitution<sup>i</sup>

A greater understanding of the supply chain and a clearer indication of the economic benefits were considered to be the most important ways to prepare for or develop a circular economy approach.

## 4 Interview Results

### List of interviewees and affiliations

Company	Location	Type of Organisation
Phillips	Netherlands	OEM
Whirlpool	Italy	OEM
Imagination Factory	UK	Designer
Axion	UK	Reprocessor
WEEE Ireland	Ireland	Compliance Scheme
Plastics Europe	Germany	Trade association
Empa	Switzerland	Materials Research Laboratory
Dell	US	OEM
Envirocom	UK	Pre-processor and refurbishment
TechUK	UK	Trade Organisation
Swedish Environmental Research Institute	Sweden	Research institute
Circular Devices	Finland	Developer/Designer
Crest Cooperative	UK	Reuse Social Enterprise
Repic	UK	Compliance Scheme
British Heart Foundation	UK	WEEE Charity Retailer
Phillips Lighting	Netherlands	OEM
Wastecare	UK	Compliance, asset management and reuse organisation

## **4.1 Interview themes / responses under headings**

### **4.1.1 Geographical focus**

Interviewees included representation from Finland, France, Germany, Ireland, Italy, Netherlands, Sweden, Switzerland, UK, USA. The geographical reach of these interviewees however was Europe wide and in the case of OEMs global.

### **4.1.2 Sector**

The interviewees covered the whole supply chain from designers to re-processors.

### **4.1.3 Familiarity with CE and its relationship to resource efficiency and sustainability.**

The findings of the performed interviews (in line with the survey monkey results – Q5) show that organisations are aware of the Circular Economy (CE) and Circular Economy Business Model concepts. There was some variance in what CE meant to them, but the overall consensus was that CE provided the business with an opportunity for improved material flow and an overall framework to deliver resource efficiency. Sustainability is seen as the overarching principal, encompassing social, economic and environmental aspects. Resource Efficiency is seen as **the what**, CEBMs as **the how** and sustainability as **the why**.

Interviewees highlighted that due to EU legislation such as, the WEEE directive, and strategies such as Circular Economy Package and the Plastics Strategy, tangible changes are happening in progressing CEBMs, at a faster pace than in the past. Companies were aware of CE previously, but they were reluctant to implement the required changes. The tendency has been to wait and see what the political drivers and instruments would be to support them or to conduct further research. The exception has been the early adopters, (which include some of the interviewees).

The interviewees acknowledge that there has long been dissemination by researchers and others on resource efficiency and waste prevention and these have been adopted by varying degrees mainly due to economic and environmental considerations. CE today is more appealing, some have stated that CE concepts are easier to understand than climate change for example. CE is more tangible and as a consequence easier to potentially implement from a business perspective. The Ellen McArthur Foundation has been at the forefront of raising awareness of the benefits of circular economy and together with partners such as the McKinsey Global Institute has communicated this effectively to a global audience.

### **4.1.4 Understanding of Circular Economy Business Models**

Many of the organisations have a long history of embedded sustainability and resource efficiency goals. Increasingly though, organisations are seeing added value in developing closed loop systems and other CEBMs both from an economic and environmental perspective. Interviewees are looking to;

- expand their current CEBMs on a geographical scale
- work with end users to produce a greater quality and quantity of useable raw materials
- increasing products containing recycled content
- increasing the amount of recycled content within those products currently already using recycled content.

#### **4.1.5 CE a radical shift?**

There is no doubt that CE represents a radical shift in our society; both in consumption patterns and how business is conducted. It is seen as an important shift, views on how this shift will be monitored and the pace that it can happen vary, but it is generally agreed that the pace will be determined by both the legislative framework and the commercial attitude to change. It's simpler currently for business to be conducted in a linear way, and the adoption of CEBMs will need to run in parallel with linear business practice before a paradigm shift is achieved.

There are varying views about goods that have a quick and high turnover for example mobile phones, with some interviewees stating that more needs to be done, whilst others highlighting that this is an area where we are already seeing a radical shift to longer use of these products through a growing reuse market. Design of products and development of alternative business models are also seen as a major factor in how these types of products will be consumed in the future. This design will look more at the potential lifetime of the product and would vary depending on whether it was designed for recyclability, reduced material uses or refurbishment. Different electrical and electronic products will vary depending on their projected lifetime, and some OEMs are researching which types of business model are the most fitting/ suitable for their products in the long run. ICT mobility products are moving towards the thinner and lighter design resulting in less material being required to manufacture.

#### **4.1.6 Ease of application of CEBM**

The economic feasibility, in addition to positive environmental impacts, need to be understood in order to adopt a CEBM. CEBMs have been often instigated by the sustainability sections of organisations, but only when they are recognised by the whole organisation as economically feasible, are they adopted, implemented and become viable.

The application of CEBM will only be facilitated by the adoption of a collaborative approach along the value chain. Each part of the value chain is inevitably interrelated and a relationship of trust needs to be established in all directions. Both material flows and information flow, need to be enhanced (as confirmed by more than 68% of survey monkey answers that consider improve supply relationship an important/extremely important driver for the adoption of CEBM in their organization – Q14-; by 31% of respondents that consider the supply chain resistance one of the biggest barriers to adoption of CEBMs – Q9; and by 51.22% of respondents that indicates a greater understanding in supply chain as a mean to develop a CE approach).

Producers and designers interviewed indicate that designing with end of life in mind is becoming much more the norm with ICT and small household appliances becoming more modular and component based, making products easier to dis-assemble.

#### **4.1.7 Challenges and Barriers to Adoption of CEBMs**

The main external barrier to adoption is the perceived viability of CEBMs and the willingness of the end user to change the way they access goods, particularly for the Access and Service

models, but also for the Revalue model. Internal barriers can be in getting acceptance and participation from the different areas within the company itself.

Often B2B CEBMs such as service models are easier to implement and sell as a concept, as the relationship between producer and customer is more direct and can therefore be tailored to meet their needs. The interviews show as one of the biggest barrier for the CEBM adoption consists of the fact that the businesses as usual *i.e.* linear models, are still economic feasible and perceived as more convenient.

Where recycled content is used, on average this constitutes around 35%. Any material developed needs to perform and be cost-effective. Current barriers to increasing recycled content are around aesthetics such as colour and visible imperfections. Other barriers include the end use and achieving the quality appropriate for skin contact, or food grade applications. There are a number of important technical barriers that need to be overcome, examples cited included brittleness due to the recycled plastic having been exposed to heat previously, and the risk of presence of potential hazardous substances such as brominated fire retardants.

Legislation around transferring of materials, according to interviewees, is not necessarily a barrier. The cost of transportation; connecting potential recyclers with partners can be challenging and complex, and can act as an economic barrier. In order for increased stability in developing better quality recycle, one of the suggestions was the regulation of quality of export plastics by EU countries. It was considered that if the plastics previously going to Chinese markets are simply diverted to Thailand, Vietnam, Taiwan and Malaysia this will stop investment by processors in Europe.

#### **4.1.8 Drivers for adoption of CEBM**

The main drivers for adoption have been the parallel benefits of increased resource efficiency and economic drivers. In addition, legislation from the EU such as the WEEE directive has assisted in pushing this forward. Futureproofing security of supply of materials is seen as an important driver going forward by many of the interviewees.

Consumptions patterns and an increasing demand by consumers for more sustainable goods and services are also seen as a key driver.

#### **4.1.9 Measurable benefits**

Many of the interviewees had their own metrics for measuring circularity or resource efficiency rather than using generic measures. As different organisations use different metrics this must be borne in mind when comparing different organisations and products

#### **4.1.10 Social benefits**

The social benefits of the potential for reuse were highlighted during interviews, with a number of interviewees participating directly or via partners. Many interviewees recognised the social benefits in providing good quality affordable second life appliances, and the valuable skills and employability benefits provided for those working in the reuse sector.

Measurement of the social benefits that can be obtained through the adoption of CEBM from the respondents of the survey monkey results is seen as difficult to quantify (43% of answers states that there are not measurable social benefits of adopting CEBM – Q12-). Interestingly however interviewees have seen uplift, in the past few years, in interest in reused products, not just as source of affordable products, but in increasing the life span of products. Many of the interviewees, whilst they were aware of reuse happening, had lower knowledge of the amount it was happening, as it is complex to track reuse of products especially in the B2C world. For those interviewees involved in delivering revalue models, whilst difficult to measure, it is seen as a key factor

Concerns were raised by some interviewees regarding the variability in methodology and internal standards within Europe in preparing for reuse. Specifically, this included the liability of producers for reused appliances that may not reach quality standards and may pose a hazard to second life users. The solution was felt to be the development of a high-quality standard for methodology in preparing for reuse or the use of established trustworthy partners.

#### **4.1.11 CEBM applies to components etc**

There is an increasing reuse of harvested components in some sectors. In the B2B world this is mainly happening in the ICT sector with valuable components being refurbished and reused on an increasing scale. There were also examples given where components with a shorter lifetime than the whole product were refurbished to match the lifetime of the whole product. In the B2C world this is also mirrored with items such as television boxes and Wi-Fi hubs, which are part of a service offer, being designed with future component reuse in mind, these are harvested via takeback schemes by the service providers. Interviewees from the reuse organisations will strip down non-working appliances to harvest spare parts, and there is a growing interest in supplying these spare parts via platforms such as E-bay.

#### **4.1.12 Post-consumer recyclates**

The complexity of WEEE was seen as a major challenge when segregating materials out. Extraction of metals is seen as commonplace and steel was cited as having 37% recycled content already. In general, there is a willingness to incorporate more post-consumer recyclates but, as mentioned previously, the main criteria is performance quality, and health and safety requirements. Large investments have been made by re-processors into shredding machines which means that this will continue to be a key process in reprocessing plastics from WEEE. A number of interviewees cited that there needs to be a continuation in research and technology to ensure improvements in chemical, and mechanical processes, downstream of the shredding process. This will be key in the future in ensuring both quality and quantity of materials. The other key element is in pre-sorting prior to shredding, this is seen as increasingly important with economic investment taking place to remove contaminants such as wood and appliances known to contain hazardous materials.

Other comments included reducing the complexity of the types of plastics being used. The light weighting and slim lining of mobile products was seen as potentially challenging from a PCR standpoint. Other product types such as vacuum cleaners, fridges and ICT equipment such as monitors and all-in-ones were seen as remaining a good source of PCR plastics, as they have larger plastic housings and their design is unlikely to change as rapidly. The Chinese ban on importing of plastics was seen as an important driver in stimulating the market to invest in new technologies to be able to access higher value markets. Unfortunately, in the short-term the Chinese ban has resulted in the markets for lower grade plastics from WEEE reducing, and lower market values for the higher grades such as HIPs from fridges (up to 50% less).

#### **4.1.13 PCR plastics**

Incorporation of either a higher percentage of PCR into products, or incorporation of PCR into new products, was seen as being easier in products with a higher overall plastic percentage composition. Examples cited included stationary products like a monitors or desktop computers, due to them having lower requirements around things like drop testing, which requires a higher performing resin. However, through close partnerships with suppliers it was felt PCR solutions for other ICT products were possible. Sources of food grade plastics from items such as refrigerators were seen as having great potential as they are already segregated out.

There was a general opinion that the use of PCRs, both currently and in future, would be determined by OEMs, as the OEMs set the material requirements, whether it is primary or secondary material, for their products and product parts.

According to the respondents, in order to operationalize CEBM and to tackle the plastic problem, two strategies should be synergistically applied: prolong the lifespan of the product and use plastic only where it is strictly necessary and no other material options are available. It is evident that looking at the plastic issue from this perspective, the role played by OEMs is extremely relevant.

#### **4.1.14 PCR production issues**

The main issues were about presence of hazardous substances and the changing nature of what is a hazardous substance. There is perception of huge variance in supply of different types of PCR depending on investments made by the re-processors. To achieve a higher quality of plastics from WEEE large investments need to be made in density separation lines electrostatic and sensor -based separation equipment.

#### **4.1.15 PCR plastic procurement**

Plastic procurement was seen as complex, from an OEM perspective the supply chain providing both quality and quantity of different types of plastics was key factor? For re-processors accessing supply chains was a lengthy process.

#### **4.1.16 PCR platform preferences**

Interviewees were ambivalent about the use of a platform. For OEMs they tend to have a trusted supplier list which is carefully vetted and ensures long term consistent supply. For re-processors there is an interest, however they highlight that being procured is a long process.

#### **4.1.17 Support**

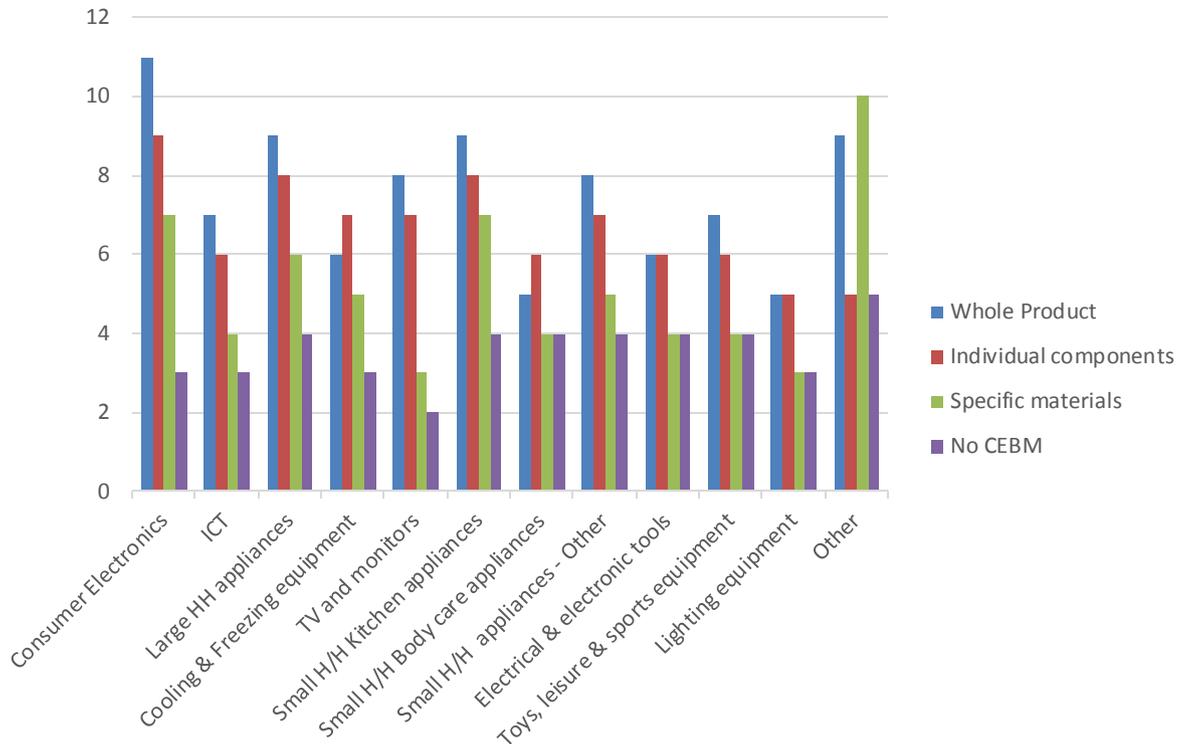
For those interviewees who expressed an interest in support, access to online sources of support were seen as preferable, however the longer viability of a platform was questioned, who would maintain update etc. It was mentioned that there are a number of platforms already available and that any platform should support, or encompass, existing ones to be viable.

## 5 Preliminary Survey Results Analysis.

### 5.1 Uptake of CEBM

Figure 5.1. shows that application of CEBMs is highest in general for whole products of the different categories of EEE, but also, they are being applied to individual components and specific materials. This extent of this varies across the different appliance categories, notably in cooling and freezing appliances CEBMs are more likely to be applied to components rather than whole products. In most instances responses also indicated that there were companies across each product sector where no CEBM was adopted.

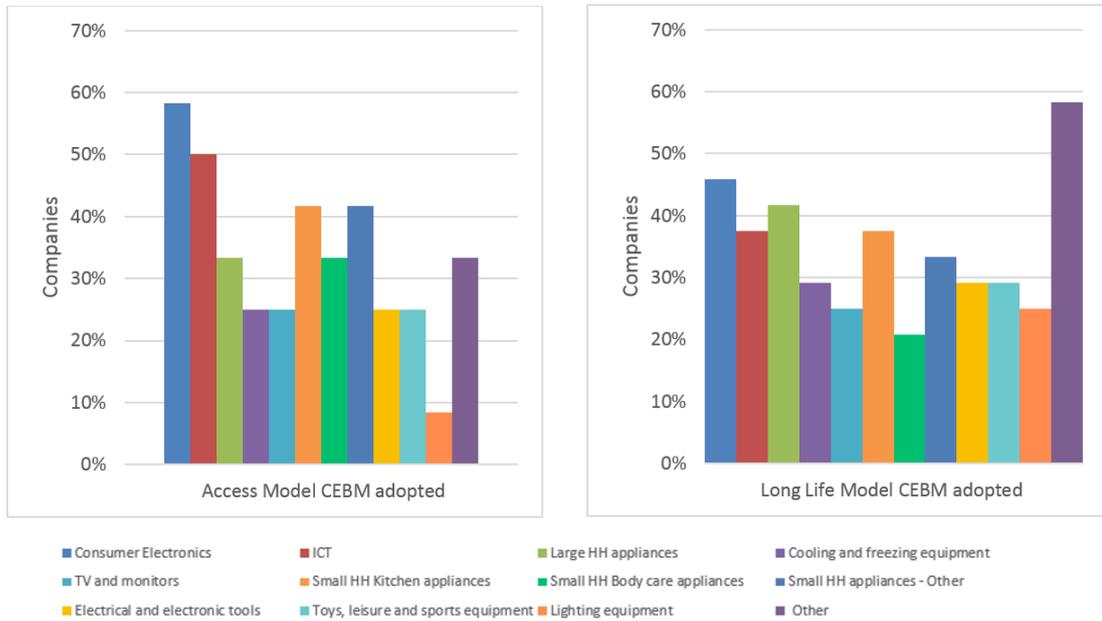
Figure 5.1 Q15 What does your CEBM involve?



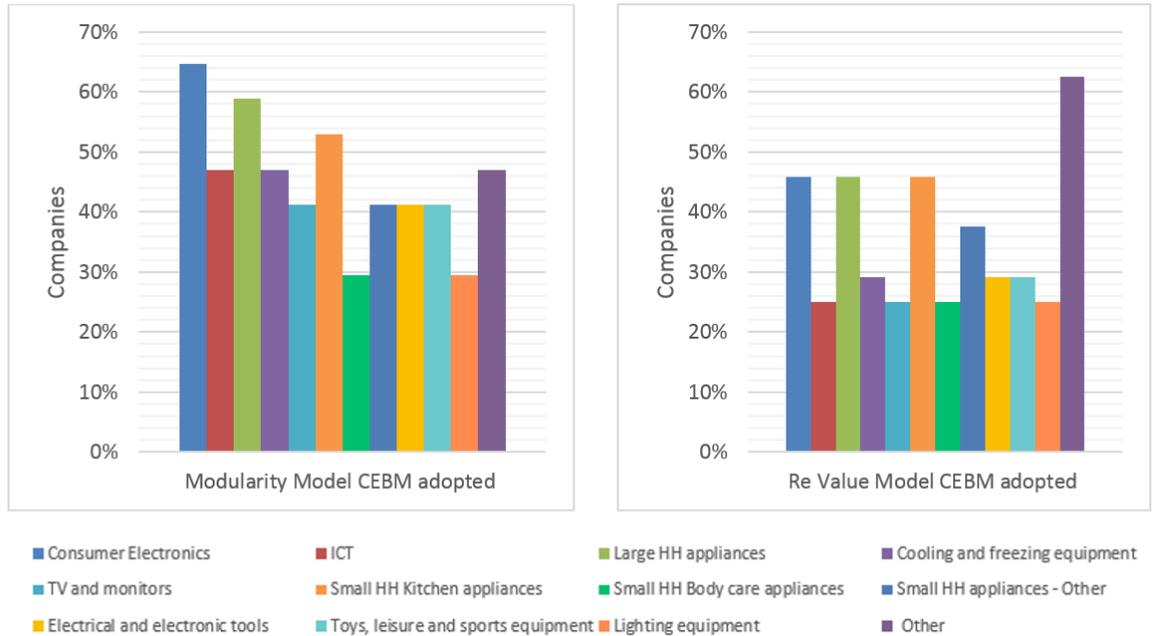
#### 5.1.1 CEBM adopted and product type

Where CEBM were adopted, it was primarily for consumer electronics, ICT, large HH appliances and lighting equipment (figures 5.2 - 5.4).

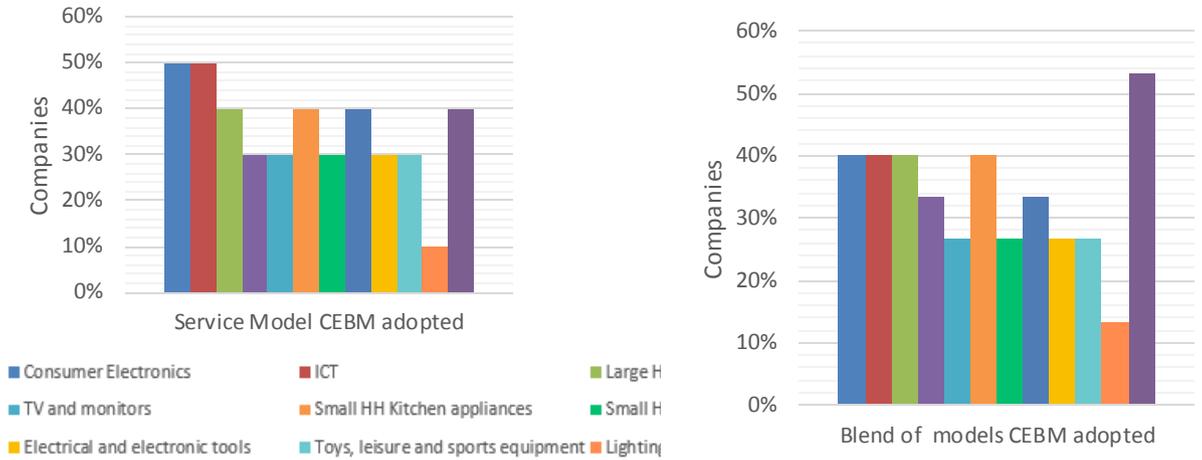
**Figure 5.2. Access Model and Long-Life Model**



**Figure 5.3 Modularity Model and Re Value Model**



**Figures 5.4. Service Model and Blended Models.**

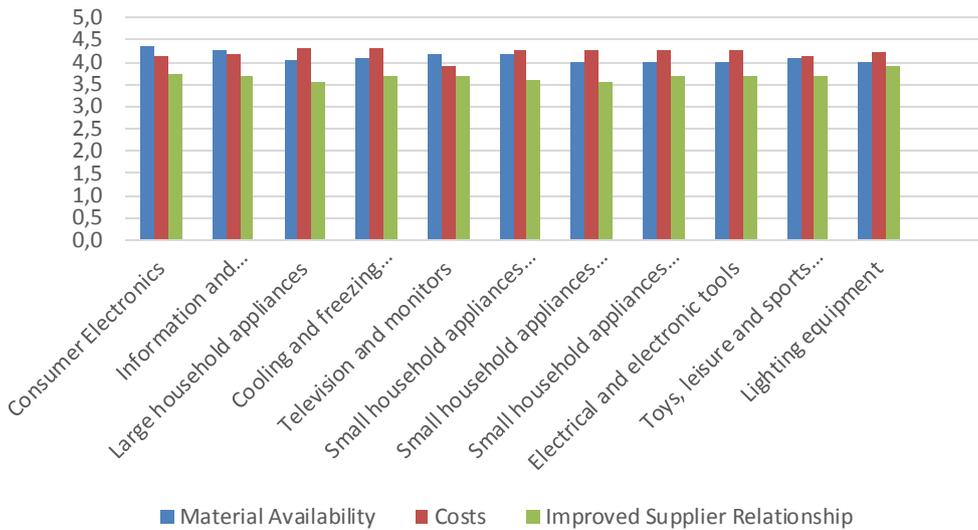


## 5.2 Key factors influencing the uptake of CEBM

### 5.1.2 Costs

Figure 5.5 illustrates that economic costs were the most significant CEBM driver for the eight product categories. By extension, it can be assumed that costs were also potentially the key overarching barrier for the uptake of CEBM. No product sector rated 'improved supplier relationship' as the most significant.

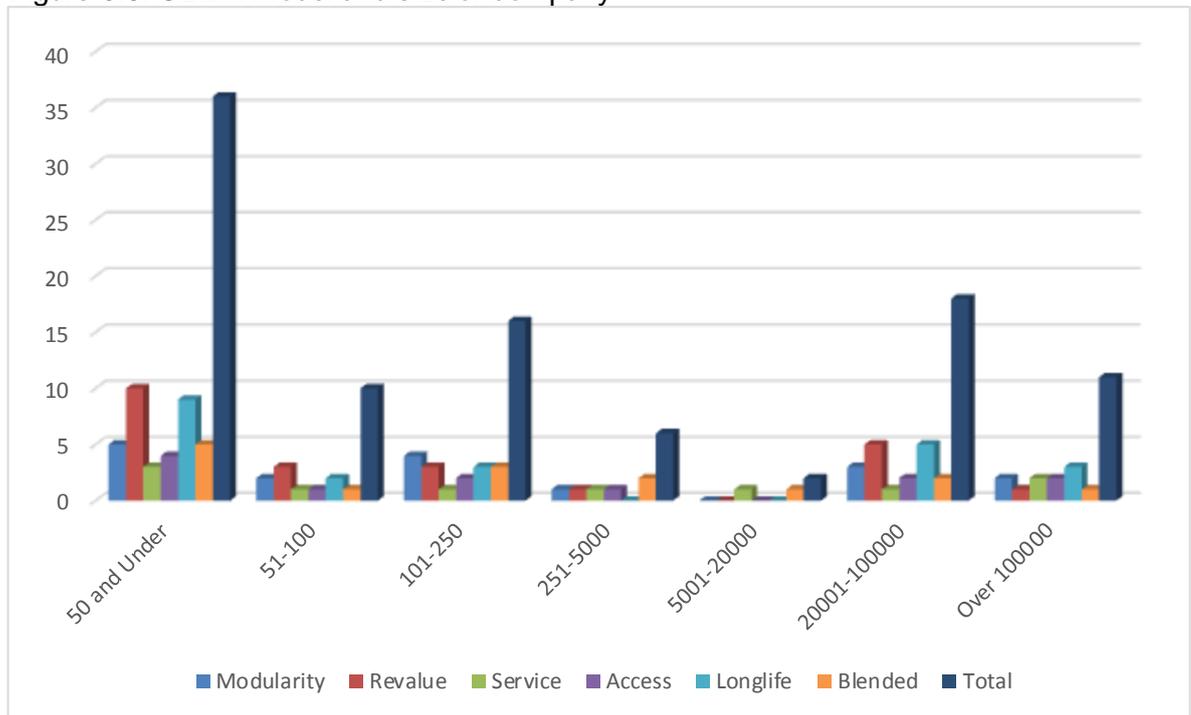
**Figure 5.5 Product type and drivers - weighted average**



### 5.1.3 Company size

Generally when using a highly categorised breakdown it was found that the smaller companies had the greatest adoption of CEBM. However when categorised into small (less than 50), medium (50-250) and large (over 250) the larger companies had the greater adoption, followed by small and then medium. This analysis indicates that initially there is no significant correlation between company size and adoption of CEBM in the EEE Sector. Overall the Revalue and Long life models were the most popular. In small companies, with 50 or less employees the Revalue and Long life models were the most popular CEBM. For companies with 50 – 250 employees the Modularity and Revalue models were equally popular followed by Longlife CEBM. For above 250 employees the Longlife and Revalue models were the most popular.

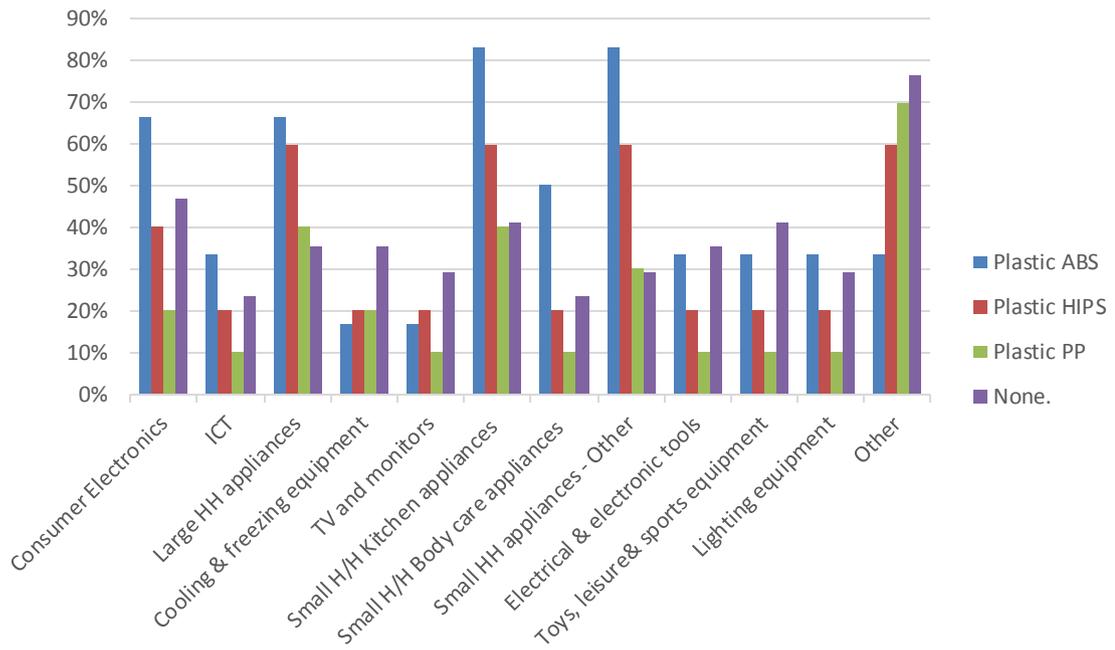
Figure 5.6. CEBM model and size of company



### 5.3 Product type and the use of PCR

Figure 5.7 shows that plastic ABS and HIPS were the main PCR employed by the respondents.

Figure 5.7. PCR and Product type



#### 5.1.4 Resources, access and capacity

Figure 5.8 Lack of PCR use/plastics and size

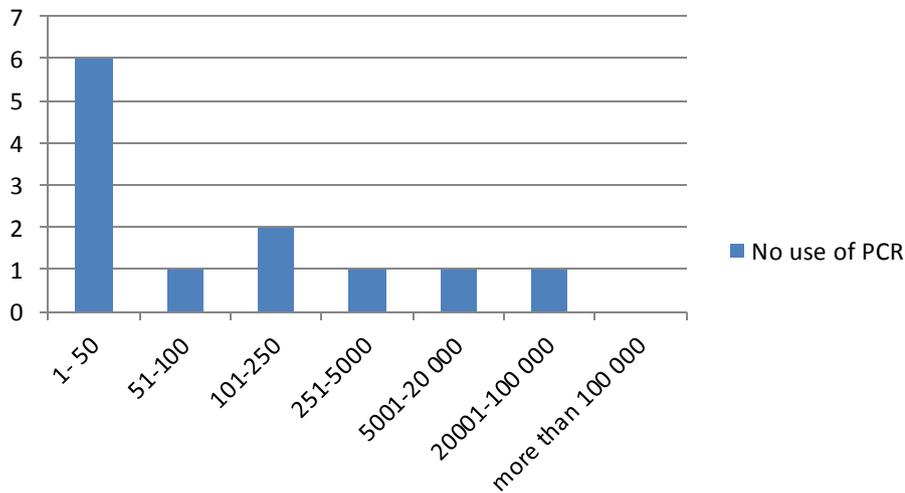
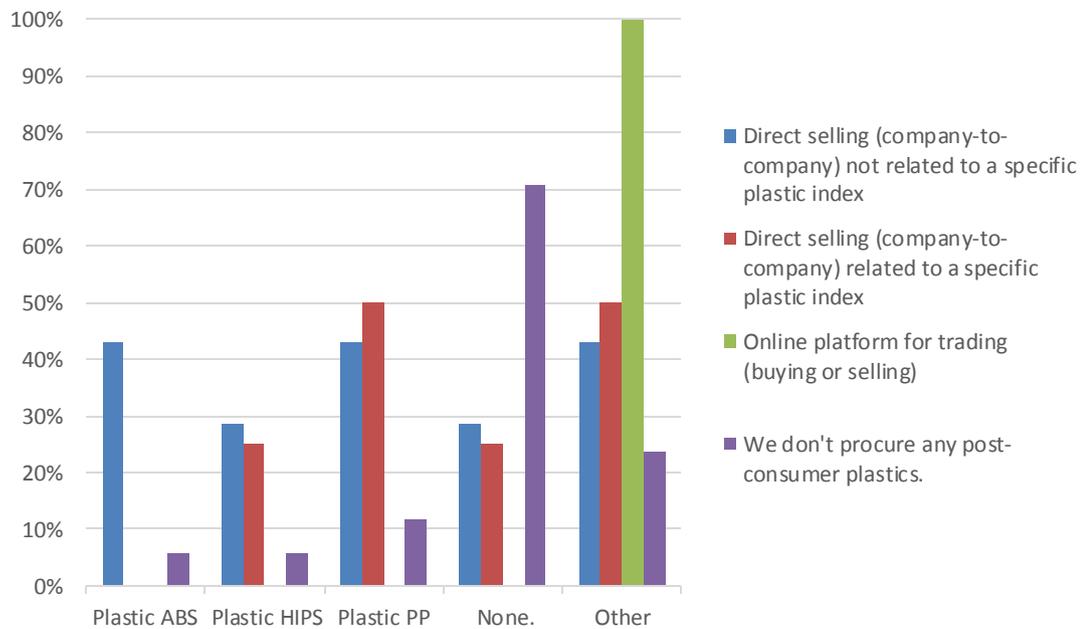


Figure 5.9. Procurement and PCR type



Figures 5.8 and 5.9 suggest that the key factors that impacted upon the use of PCR were the size of the organisation and how the PCR was bought and sold. Presumably, small companies lacked the resources (e.g. finance), and access (e.g. to an online platform) to PCR. It is also possible that given their small size, that they may also simply lack the capacity to require larger quantities of PCR.

One of the main concern of the respondents, most of them operating within the EEE/WEEE sector, is related to the **material availability**, that is seen as an fundamental requirement for the adoption of circular business model (more than 82% of survey monkey respondents indicates material availability and cost important/extremely important drivers for the adoption of CEBM – Q14). However when considering the stakeholders inputs and comments from PolyCE partners along the EEE/WEEE value chain, it is clear that the availability issue must be analysed in parallel with the **quality** one. If the supply of PCR plastic is reliable in term of volume, the stability of quality cannot be always easily ensured. In accordance with this statement, the survey monkey results show that 73% of the respondents that do not use PCR plastics in their products (45% of the total), consider the quality of the final product as important/extremely important.

When asked why PCR plastics are not included into their production line, a concerns regarding the quality of the final product was rated as very important by 60% of the respondents. The concern on quality aspects, as the main barrier to a company adopting a long-life model, seems consistent since durable products make up the centrepiece of their business strategy and this can only be achieved through high quality material properties. Compromises in material properties would impose a high risk on the company's good reputation for future sales. Lack of customer acceptance is also rated highly when considering barriers to integration of more PCR plastics into products. Therefore, ensuring high-quality PCR through testing and standardized material properties is regarded, by many, as the main driver for adopting more PCR plastics into their products (73%). It would provide a company that has adopted a long-life model with a quality guarantee that could then be better communicated to its customers in order to gain their confidence in higher recycled content. Another possibility for the company, once the material quality is ensured, would be to not actively inform customers of the incorporation of PCR plastics into their product, as many remain sceptical, and keep the information only on the "minimum required" level.

The PCR plastic quality issue goes right through all the studied PCR plastic value chains. Even at the very beginning of the chain (WEEE pre-processors) the quality of the mixed plastic fractions (the output stream of the WEEE pre-treatment process) is determined by the absence of contaminants. The contamination of other materials, as metals, wood, glass, should be avoided as much as possible. However, neither quality standards nor standardized analysis are applied at this stage of the chain. The lack of, generally accepted, quality control procedures is influencing all the subsequent nodes of the PCR plastic value chain and is impacting on the possibility to reach high rates of recycling. Moreover the lack of standards is seen as a barrier for an appropriate **valorization** of the plastic itself.

Today, mixed plastics fractions **price** is established after a bargaining process and it is strongly influenced by market situation (demand). Unfortunately, the demand is influenced by several factors including a global dynamic. The China bans on plastic waste imports gives a concrete example of a sudden and unforeseen market shrinking: the closure of a relevant market channel and the related problems of price reduction and stock material management caused a severe price reduction. This price impact increased the need to build infrastructure to recycle large volumes of WEEE plastics to keep competitive and to stabilize the costs of WEEE treatment.

From the interviews it was clear that pre-processors rarely measure the quality of the mixed plastics outputs, due to lack of standards. This is a barrier to widen the use of PCR plastics in

new products because it exposes the EEE producer to a market that is not stable, and it was suggested that a system to differentiate between different mixed plastic outputs would be beneficial. Potentially, recycled plastic should take advantage of a more stable market scenario taking into account its independence from the oil price evolution (in contrast to the virgin plastics). However actual picture of PCR plastic materials procurement approach is completely different as confirmed by the survey monkey answers. Within the interviewees who use PCR plastic, the majority stated that they proceed with direct selling (company-to-company) not related to a specific plastic index (Q20). However, a “quality indicator” (to classify every bale of PCR material offered on the marketplace, the origin of the waste stream, the processes performed on the materials) is strongly advised (by 45% of the respondents – Q21) to stabilize the market environment. Overall, stability of volumes and quality would support visibility and long-term contracts condition incrementing the willingness to invest in the sector.

Additionally, compliance with regulations is rated important (89% of survey monkey respondents) by those that don't use PCR plastic when considering the relevance of production issues associated with PCR use (Q18). It was felt that the PCR plastic market would be strengthened by the definition of a common and harmonized set of rules (legislation and its enforcement, including monitoring/control of recyclers; requirements on sorting of brominated/POP/hazardous plastics; standardization and certification of recycled plastics from WEEE not available so far - "end-of-waste" clear regulation for WEEE plastics).

## **6 Summary of Results (interviews and surveys) / Key Findings for each business model**

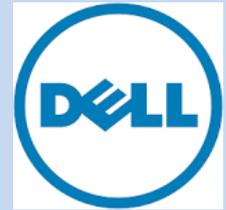
In Deliverable 1.1 different business models were identified, and are outlined below. The organisations interviewed however, were found to be adopting a number of different business models rather than one fixed model, as they believed they needed to offer a variety of value propositions to the customers within existing manufacturing, retail and marketing systems. This variety results in a fluid business model which incorporates elements of the different business models depending on its fit with the organisations implementing them as CEBMs require the development and establishment of a relationship with the customer, which requires significant input and effort.

### **6.1 Long-life Model**

The Long- life Model describes the production and sales of high-quality long-lasting products, which retain extensive value after use by the consumer so that reuse or refurbishment is likely. It is the CEBM that is based on traditional linear ownership models, where manufacturers design and produce a product line and the consumer gains possession by purchasing the product. It is included as CEBM because the product is considered a quality functional product and has been designed to be recycled, repaired or refurbished. From the interviews a number of companies adopt the long- life model, reducing the frequency of replacement of a product through extending its lifetime by making the product more durable and making maximum use of the resources within the product. These products are often more expensive in the short term, but more cost effective in the long-term. The environmental impact of the product over its lifetime is reduced significantly.

The survey reveals that adopters of a long-life model see the economic benefits of their business model (75%) through material savings. Another benefit ranked highly, and supported by the interviews is the better client relationship (63%) as customers are likely to be satisfied for a product that remains functional for longer. These results are in line with the theoretical implications identified in D1.1, where the motivation of establishing a high value and long life brand is stable customer relations and encouraging brand loyalty.

## Case Study – Closed Loop Model



### Dell – Closed Loop Model

In the USA, Dell works in partnership with Goodwill to provide a consumer takeback programme. The system allows people to donate any brand of electronics. Goodwill then distributes the item to any of their stores if useable, or if not, they'll will arrange for it to be recycled.

If not usable items are shipped to a recycling hub in Texas, just north of Dallas. There the products are manually disassembled. Plastics are separated, baled and shipped to Malaysia and Taiwan for pre-processing and further purifying into pellets. The pellets are subsequently shipped to China to be used as raw materials in manufacturing Dell products such as desktops, all-in-one computers and displays.

#### Drivers for adoption of a closed loop model

- Added environmental benefits of using a closed loop source rather than just a recycled source
- Natural Capital value
- The ability to leverage an existing supply chain partner

#### Barriers for adoption of the closed loop model

- Setting up the core group the supply chain required, and getting buy in and active participation from a lot of different areas within Dell
- Having to ship waste electronics back over to China – using reverse logistics
- Extending the programme beyond the US.

#### Results

- Design of products that are easy to dis-assemble
- Over 30% closed loop recycled content in desktops, all-in-ones and displays
- Over 50 million lbs of sustainable materials in recycled content plastics and other sustainable materials

***Stephanie Schafer - Regulatory Senior Engineer, Environmental Affairs, Dell.***

***" Dell has been using recycled content since 2008 but we really saw an added value in developing a closed loop supply chain, in order to, not only, reuse material that is EoL, but to use our own material and material from our industry."***

## 6.2 Modularity Model

Adopters of a modularity model contribute to the CE concept by prolonging the lifetime of a product through a more modular design. By easily replacing, or repairing, parts, or enabling a product upgrade, costumers are motivated to keep using products for longer. The need, or desire, for early purchase of a new, replacement, device before the product has reached its ultimate end-of-life is thereby reduced. Replacing only certain parts of an electronic device is a step towards balancing out the relatively large environmental footprint of the manufacturing process of electronic goods (Nissen 2017).

For businesses which are transforming into a modularity model, the greatest benefit is perceived as the future proofing of the company (91%), as well as material savings (82%). Since the electronic sector is in need of a steady supply of (critical) raw materials, the motivation for going more circular and thereby gaining more control over the material flows is consistent. Technical feasibility is still perceived as one of the biggest barriers (64%), since material properties in developing a modular design are an important factor and not easily compromised. A quality indicator which could classify each PCR batch offered on the market, together with an indication of the origin of waste streams and the applied processes would help improve the uptake of PCR plastics in their modular business model (90%).

From the interviews the modularity model was seen as an important model for the future, especial in the ICT and mobile devices sector. It is seen as a way to make products such as short lifetime appliances more circular. In the ICT sector it will allow devices to be upgraded easily rather than replaced reducing the amount of materials used. It was seen as less important for large HH appliances as the elements that can be modular are limited.

## 6.3 ReValue Model

The ReValue model represents any business model which reuses either whole products, component parts or materials. The ReValue models therefore encompass a large variety of possible business models, including re-use, refurbishment, repair and recycling. Material flows are treated as raw materials into new production circles by giving them a new value.

The reuse sector emerged as an important sector during the interviews, of all the CEBMs adopted this was the one that was most popular, retaining maximum value of materials in products for as long as possible. This model is adopted by large organisations, refurbishing and reusing over 1000 appliances a week and smaller organisations where the number of appliances is in the 10s. In addition to the material benefits, this type of model also has an important social impact with skills development being important, generating apprentices and helping people gain valuable new practical skills in repair and refurbishment.

An important factor in maximising the reuse of appliances is the collection infrastructure of takeback systems. Where appliances are collected directly from household the % chance of reuse can be as high as 90%, which reduces to 10% for appliance collected at retail outlets and 1% from local recycling centres. This is often due to handling, when an appliance is collected from a home then it travels with new appliances and is handled with care.

Introducing recycled plastics into the production of new consumer electronics is gaining importance in the plastic intensive electronic sector. From the survey the lack in understanding of consumers of electronic products still seems to be the persistent barrier for companies for

including PCR plastics (80%). Manufacturers of appliances with food contact or skin contact face extremely strict regulations on the necessary standards and certificates of the materials in use. Currently there is no WEEE PCR material commercially applied with a quality standard high enough to meet the strict regulations on food and skin contact.

In a re-value model, pre-processors and recyclers are important actors in the value chain to increase the level of PCR plastics into electronic devices. However, many of the stakeholders working in the sector interviewed highlight that there is not enough quality product in sufficient quantities, OEMs that are using high volumes of PCR plastics tend to have a trusted relationship with their suppliers, but sometimes this is seen as a barrier for new reproducers in accessing these markets. Often this barrier to buyers can reduce the likelihood of being able to justify the financial investment needed to guarantee a quality standard.

Technical feasibility is also ranked as an important barrier by the participants of the survey (60%), especially quality aspects as colour and smell. Hence, a useful tool for increasing PCR uptake by adopters of a re-value model is some kind of quality indicator (73%) that could for instance ensure a steady supply of a certain colour needed for new applications. Colour and smell seems to be one important aesthetic hurdle currently hindering the integration of more PCR plastics into electronic applications.

## Case Study – Revalue Model



### WasteCare

Wastecare are a waste management companies that aim to fully embrace the circular economy. They return over £5 million a year to clients for materials recovered from waste and were the first, in the UK, to set up a dedicated Reuse facility for retailer take-back. Around 10% of all takeback appliances collected are refurbished for reuse. These include fridges, freezers, washing machines, clothes dryers, TV's, monitors, laptops, desk tops and some mobile devices.

The electrical recycling follows a comprehensive step by step process from collection to reuse and is fully asset tracked for total security. On arrival at WasteCare's facility items earmarked for reuse, or data bearing, are barcoded, this code contains all the details about collection depot, driver, date and customer. As the appliance goes through the testing and refurbishment system the details associated with the barcode are updated. Data bearing appliances are wiped using Blancco, a certified data erasure tool. Appliances are then tested for functionality and then, if suitable, refurbished and, if needed, rebranded. When the whole product can't be reused, component parts, where possible, are harvested to be used for refurbishment of other appliances. For every three appliances deemed potentially suitable for reuse two are reused, approximately.

#### Drivers for adoption of revalue model

- Many asset management clients preferred option- reuse and refurbishment is positively encouraged
- Maximising recoverable value
- Market demand for refurbished products

#### Barriers for adoption of revalue Model

- Brands and retailers have PR concerns around exportation
- Some brands prefer to have their products rebranded so as not to weaken the brand
- Concerns around data on appliances such as Smart TVs where data wiping systems are not established

#### Results

- Over 1000 white goods appliances refurbished for reuse per week
- Over 450 Desktop PCs & TVs refurbished for reuse every week
- Customers get a rebate on any value achieved, which is worth over £5million/year.

#### Graeme Parkin, Chief Operating Officer...

***"We are committed to maximising recoverable value whilst achieving sustainable and environmentally sound solutions for over 1000 different waste streams"***

## 6.4 Adopters of Access Model

In an Access model, the ownership of a consumer good remains in hands of a company offering the product as a rental service and the consumer returns the product after its paid use (see also D1.1.) This alternative consumption model is the gateway to a sharing economy, where product use is more important than gaining possession rights over a product. Thereby the utilization factor of a product is maximized, as the resources inherent in an electronic product are being used more efficiently. Furthermore, maintenance remains in the company's hands, who will ensure that their products will remain in good shape can thus be accessed for a long period of time and prolonging an end of life. 90% of the respondents that stated to be adopters of the access model also claim that they have adopted a long- life model, where the value of a product is retained after use that reuse and refurbishment is likely. There seems to be a correlation between high quality, long lasting products and the offering of an access service, where products suitable for leasing also fulfil the criteria of the before mentioned long life model. Respondents rated the biggest benefits of adopting an access model in future company sustainability (83%) and a greater engagement with customers (75%). A unique attribute of the access model over other circular business model types lies in the very close relationship between the product / service provider and the consumer. Adopters of an access Model are in close contact with the consumer throughout the entire use phase of the product and can even gain accurate knowledge on consumption patterns and preferences. The case study from D1.1 demonstrated that in some cases the close customer relationship might even enable product providers to stimulate its clients towards more sustainable consumption behaviour (by e.g. educational campaign on eco-friendly washing).

A major barrier is perceived to be the cultural change in customers (50%). For many products the conventional concept of buying a product might still prevail, hindering the change to alternative circular consumption models. Interestingly some of the interviewees had examples of where the customers preferred leasing instead of buying as they like the service element of the CEBM. This CEBM is being adopted for an increasing variety of products such as TV set top boxes, wireless hubs, beauty products and coffee machines.

The majority of the respondents which have adopted an access model were producers of small household appliances as well as consumer electronics. According to the online survey, 95% of adopters of the Access model also considered adopting a Service model which implies a similar shift in perception where the consumer is more interested in the service that the product provides rather than the direct ownership of the product (Stahel, 1994<sup>11</sup>). This could illustrate a cultural shift in consumer behaviour towards a sharing economy in the E-sector and that this shift could be a strong driver for adopting circular business models, away from product, ownership in the future.

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<sup>11</sup> Stahel, Walter R. (1994): The Utilization-Focused Service Economy. Resource Efficiency and Product-Life Extension. In *The Greening of Industrial Ecosystems*, pp. 178–190. Available online at <https://www.nap.edu/read/2129/chapter/17>

### 6.5 Adopters of Service Model:

In a Service model, the focus lies on the benefits of an electrical good rather than to the material attribute of the product. The service which is provided by an electronic good is fully delegated to a company who is providing a desired performance (Bakker et al.2014). The consumer is decoupled from the actual product and is only interested in the service that is obtained from the product. From a material point of view, the electronic good remains in the hands of “professionals” who have access to maintaining and servicing the machines/devices. The service provider is also in full control of the material flows and the product status. This type of business model is likely to favour energy efficient devices as well as long lasting high-quality devices.

The online survey revealed, that all of the participants which stated to adopt a service model are either already adopting a re-value model (67%) or are considering of integrating a re-value model in the near future (33%).

Extending the lifespan of products through refurbishment and repair seems to constitute a core part of the service business model. This seems consistent since a service provider has a strong interest in keeping the product in use for as long as possible and avoid EoL. The online survey also revealed that one of the biggest barriers of adopting a service model is the lack of understanding of customers (50%) as well as legal issues (47%). This may also be an indication that consumers might simply not be aware of service providers or that they do not trust the service model yet. However, a cultural shift in consumer behaviour could encourage the uptake of more service model types in the near future.



## Philips Lighting (now Signify) – Managed Services

Philips Lighting delivers a turnkey approach to lighting. Their managed services include everything from design and build, to operation and maintenance of lighting systems. Customers choose to simply buy the light they use, instead of owning the equipment. Typically, a new lighting system has an average lifetime of 10 years, then for either technical, or economic, reasons users often change it. A product service combination, which is very agile, can postpone this to 20 years basically maintaining the value of the system. This model doesn't so much focus on an input model where economic value is brought into the economy, it's much more about how much economic value is maintained in the economy.

Initially starting as pilot projects the lighting managed services model is gaining widespread acceptance with applications including lighting for car parks, airports, offices and power plants.

### Drivers for adoption of a service model

- Long term savings, no requirement to buy or dispose of lighting
- Design of End to end solutions
- Prolonged lifecycle of lighting products, extends both the technical and economic lifetime
- Collaborative approach

### Barriers for adoption of service model

- Different way of accessing lighting
- Change in employee behaviour
- One supplier

### Results

- Pay only for the light used rather than purchasing lighting equipment
- Optimization of return on investment due to no requirement for capital expenditures or maintenance and replacement costs
- Access to the latest and future technology updates

### Anton Brummelhuis, Senior Director of Sustainability...

*“The adoption of full service models requires a paradigm shift for both Phillips Lighting and the customer and whilst it is difficult for all parties, they are convinced this is the future”*



	<b>EEE products most suitable</b>	<b>Benefits of the adoption of the CBM</b>	<b>Barriers of implementation of the CBM</b>	<b>Drivers for adopting more PCR plastics in future</b>	<b>Main changes in the EOL management</b>
<b>Long life Model</b>	Mature product; medium-high price; Frequent use	Company sustainability /future proofing; greater engagement with customers	Quality of final product	Reference standards to ensure quality of final product	
<b>Modularity Model</b>	Medium-high price; Quickly-outdated devices (IT)	Company sustainability / Future proofing, greater engagement with customers	Technical feasibility	Quality indicator to ensure compliance with regulation	
<b>Re-Value</b>	Mature products, medium-high price,	Material savings, Company sustainability / future proofing	Lack of understanding of customers	Quality indicator to ensure Compliance with regulation	
<b>Access Model</b>	High-priced products	Material savings, company sustainability /future proofing	Lack of understanding of customers	Reference standards to test PCR to ensure Compliance with regulation	
<b>Service Model</b>	Devices needed for daily life	Company sustainability /future proofing, material savings	Lack of understanding by customers	Reference standards to test PCR to ensure Compliance with regulation	

## 7 Next Steps

Although it was initially planned that the survey would be closed it has been determined that this will be kept open for a number of reasons:

- To ensure that as many opinions are gathered
- To recruit for the expert panel
- To identify case studies
- To determine if behaviours and opinions vary over the duration of the project

The survey will be regularly checked and results updated, where appropriate.

Interviews will be ongoing for several months. This is for the reasons listed above. Initial interviews focussed on organisations that are aware of circular economy, this is for a number of reasons: they are proud of their sustainability credentials, it is easier to identify new initiatives, PolyCE partners and stakeholders tend to have contacts in these areas. In the future more surveys will be undertaken that include, where possible, those businesses that have not adopted circular business models. In addition there have been some delays due to coordination of surveys and timing of interviews so we will continue to get good value chain representation.

### 7.1 Contribution to other WP

WP1 – this deliverable will inform other WP1 tasks by enabling the circular business plans to be analysed and strengths and limitations identified based on already identified factors.

WP 2 – provided key input from stakeholders to the survey and the interviews. The survey and the interviews were also used to provide recruits for the expert network. The survey also raised the profile of the project via existing networks (such as Plastics Europe) and stakeholders.

WP3 – the deliverable provides supporting information on technical, social, environmental and economic barriers and drivers for CEBM and incorporation of PCR.

WP4 - the deliverable provides supporting information on technical, social, environmental and economic barriers and drivers for CEBM and incorporation of PCR.

WP6 - the deliverable provides initial support for the on line platform and gives outline ideas for content.

WP7 - the deliverable provides supporting information on technical, social, environmental and economic barriers and drivers for CEBM and incorporation of PCR that can then be directly addressed in the demonstrators to encourage greater uptake.

WP8 – the results of the project have been presented as a keynote address “From Waste to Resources - Driving the Circular Economy” at Eurasia 2018- Waste Management Symposium, 2-4 May 2018, Istanbul, Turkey.

# Appendix 1 – blank survey

## PolyCE circular business survey

This survey should take no longer than 15 minutes to complete. All responses are confidential and any personal data will remain anonymous.

The questionnaire is split into four sections:

Your Organisation  
Opportunities and Barriers

Circular Economy Business Models  
Support

At the end of the survey you have the opportunity to join PolyCE's expert network panel.

## Your Organisation

1. Please state the name of your Company/Organisation.

2. Please state the geographical focus of your business activities.

3. Approximately how many employees work at your organisation?

4. Within which sector do you operate? Tick all that apply:

a. Consumer Electronics

b. Information and Communication Technologies (ICT)

c. Large household appliances

d. Cooling and freezing equipment

e. Television and monitors

f. Small household appliances - Kitchen appliances

g. Small household appliances - Body care appliances

h. Small household appliances - Other

i. Electrical and electronic tools

j. Toys, leisure and sports equipment

k. Lighting equipment

l. Other (please specify)

5. How familiar do you feel with the term circular economy?

- a. Excellent knowledge
- b. Understanding of the principles
- c. Vague understanding of concept
- d. Heard of it but don't know what it means
- e. Never heard of it
- f. Other (please specify)



9. What do you think are the biggest barriers to a adoption of CEBMs for your organisation.

- |  |   |
|--|---|
| <input type="checkbox"/> a. Cultural change                      | <input type="checkbox"/> f. Supply chain resistance |
| <input type="checkbox"/> b. Management support                   | <input type="checkbox"/> g. Technical feasibility   |
| <input type="checkbox"/> c. Lack of understanding within company | <input type="checkbox"/> h. Data protection         |
| <input type="checkbox"/> d. Lack of understanding by customers   | <input type="checkbox"/> i. Legislation             |
| <input type="checkbox"/> e. Product range unsuitable             | <input type="checkbox"/> j. I don't know            |
| <input type="checkbox"/> k. Other (please specify)               | <input type="checkbox"/>                            |
| <input type="checkbox"/>   |   |

10. What would be the biggest benefits to adoption of CEBMs for your organisation

- a. Greater engagement with customers
- b. Carbon reduction
- c. Decoupling of materials from profit
- d. Greater supply chain engagement
- e. Environmental image / marketing
- f. Company sustainability / future proofing
- g. I don't know
- h. Other (please specify)
- 

11. What do you think are the measurable benefits of a dopting CEBMs for your organisation?

- a. Economic
- b. Jobs
- c. Carbon savings
- d. Material savings
- Customer loyalty
- f. Better client relationships
- h. I don't know
- i. Other (please specify)
-

12. Do you think there are measurable 'social benefits' of a adopting CEBMs for your organisation?

No

Yes. Please specify

13. Do you consider that you adopt circular business model?

No - but future CEBM plans may consider the following model/s

Yes - we have adopted a CEBM in the following model/s

a. Long Life Model  
(retains the value of a product after use, so that reuse, or refurbishment, is likely).



b. Modularity Model  
(increase in product lifetime by encouraging repair through replacement of faulty components).



c. Re Value Model  
(extends the lifespan of products, or materials, by giving them new value as the same, or an alternative, product after the first phase, via redistribution, refurbishment or recycling).



d. Access Model  
(describes businesses which, instead of selling a product, offer a rental or a leasing service).



e. Service Model  
(describes businesses which provide a service rather than sell a product).



f. Blend of the above models



g. Other (please specify)

14. When considering the adoption of CEBMs in your organisation which of the following drivers are important. Please rate on a scale of 1 (Not important) to 5 (Extremely important).

	1. Not important	2.	3.	4.	5. Extremely important
a. Material availability	<input type="radio"/>				
b. Improved supplier relationship	<input type="radio"/>				
c. Cost	<input type="radio"/>				
d. Other (please specify)	<input type="radio"/>				

15. If you have adopted a CEBM which of the following does your current CEBM involve:

- a. Whole products
- b. Individual components
- c. Specific materials
- d. No CEBM adopted
- d. Other (please specify)
- 

16. Do you incorporate any of the following post-consumer metal recyclates into your products?

- a. No
- b. Ferrous
- c. Non ferrous please specify
- 

17. Do you incorporate any of the following post-consumer plastics recyclate into your products?

- a. Plastic ABS
- b. Plastic HIPS
- c. Plastic PP
- d. None.
- e. Other (please specify)
-

18. If you don't use post-consumer plastic please rate the importance of the following production issues

as associated with PCR use on a scale of 1 (Not important) and 5 (Very important).

	1. Not at all	2.	3.	4.	5. Very important
a. compliance with regulations	<input type="radio"/>				
b. increase the final price of the product	<input type="radio"/>				
c. quality of the final product	<input type="radio"/>				
d. adjust the product design	<input type="radio"/>				
e. adjust the product function	<input type="radio"/>				
f. customers' acceptability	<input type="radio"/>				
g. Other (please specify)	<input type="radio"/>				

19. Please specify the content (in percentage) of post-consumer plastic in your products.

<input type="checkbox"/> a. We use plastic but only from virgin supply	<input type="checkbox"/> d. More than 30% but less than 50%
<input type="checkbox"/> b. Less than 10%	<input type="checkbox"/> e. Between 50% and 100%
<input type="checkbox"/> c. Between 10% and 30%	<input type="checkbox"/> f. None
<input type="checkbox"/> g. Other (please specify)	<input type="checkbox"/>
<input type="checkbox"/>	

20. Which of the following describes your approach for procuring post-consumer plastic materials?

a. Direct selling (company-to-company) not related to a specific plastic index

b. Direct selling (company-to-company) related to a specific plastic index

c. Online platform for trading (buying or selling)

d. We don't procure any post-consumer plastics.

Other (please specify)

## Support

21. If your organisation had access to an online platform or website for PCR which of the following tools/functionality would be useful:

a. A European wide marketplace for buyers and sellers of virgin and recycled plastics material

b. A "quality indicator" that classifies every bale of PCR material offered on the marketplace, the origin of the waste stream, the processes performed on the materials

c. Reference standards (methodologies) to test PCR material properties

d. Market reports

f. Other (please specify)

22. Which of the following would help your organisation to prepare for, or develop, a circular economy approach within your organisation?

a. Greater understanding in company

b. Greater understanding in supply chain

c. Overall awareness

d. Clearer indication of economic benefits

e. Business plan development

f. Other (please specify)

23. If you are interested in further support/help please tell us which methods you would prefer.

a. Seminars

b. Webinars

c. Telephone support

d. Case studies

e. One to one support

24. If you are willing to be used as a case study please provide details below.

Name

Company

Address

Address 2

City/Town

State/Province

ZIP/Postal Code

Country

Email Address

Phone Number

## Join PolyCE'S panel of experts

You are kindly invited to join PolyCE's expert network bringing together key stakeholders from the material, additive, electronics, plastics compounding, reprocessing, and recycling industries.

Please join the network by filling the following form which can be accessed here: [Join PolyCE's panel of experts](#)

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# Appendix 2 – Additional Survey Figures

Figure A1. Q5 How familiar do you feel with the term circular economy?

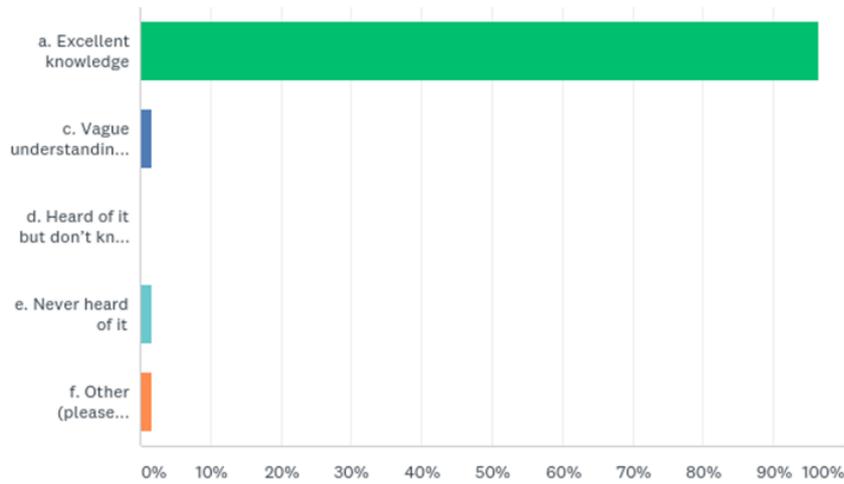
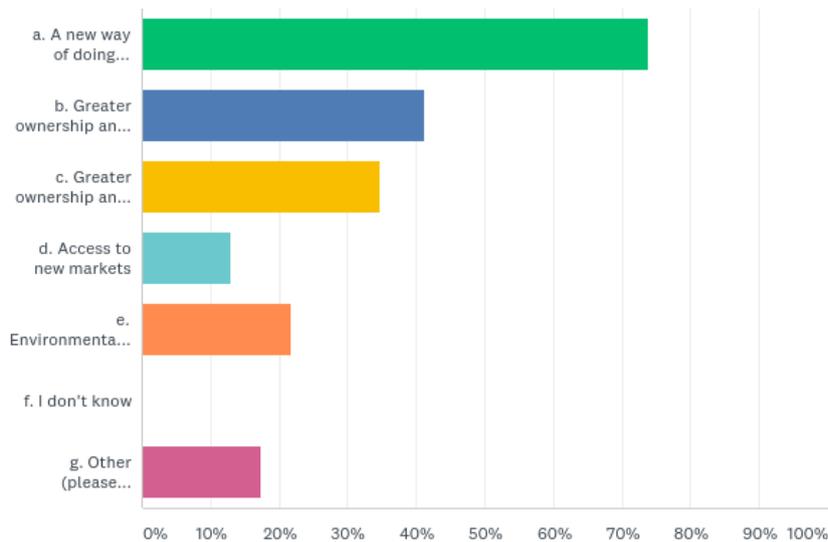


Figure A2. Q6: What does circular economy mean to you?



Other Responses:

- A new mind-set requiring new approaches to conventional business models.
- Greater ownership and control of materials
- Circulating materials
- Research into new applications of co products
- Greater awareness of critical raw materials
- waste is feedstock and, services and products are designed accordingly
- Waste into resource

Figure A3. Q8: Do you think that the concept of circular economy can be easily applied to your organisation through a circular economy business model (CEBM)?

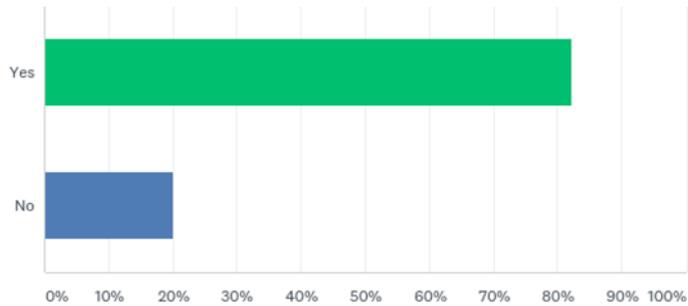


Figure A4. Q12: Do you think there are measurable 'social benefits' of adopting CEBMs for your organisation?

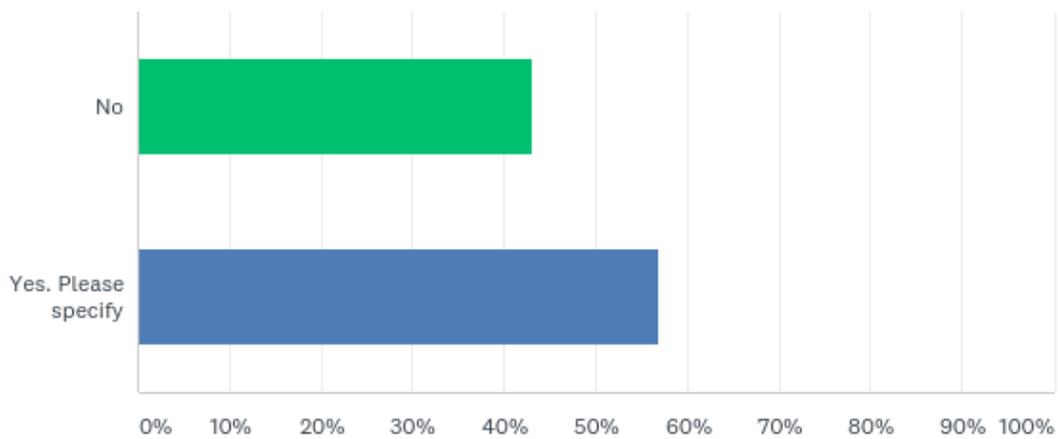


Figure A5. Q15: If you have adopted a CEBM which of the following does your current CEBM involve:

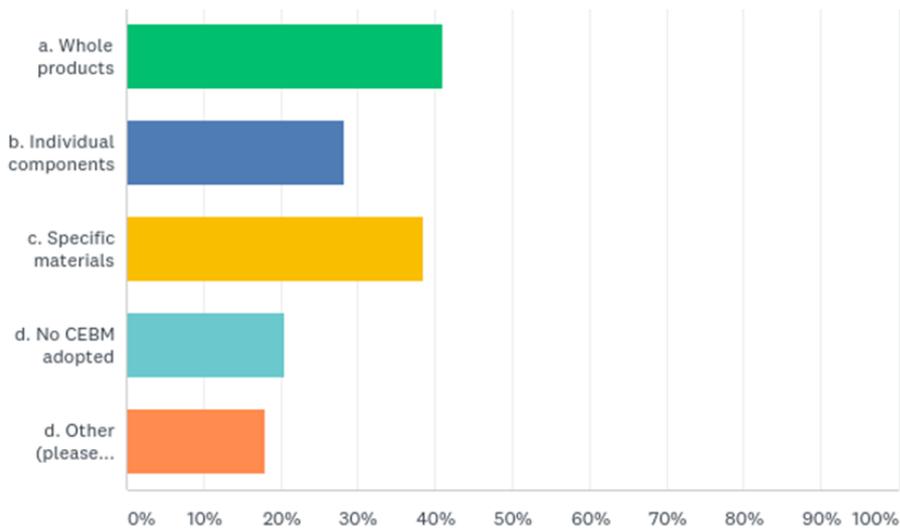


Figure A6. Q16: Do you incorporate any of the following post-consumer metal recyclates into your products?

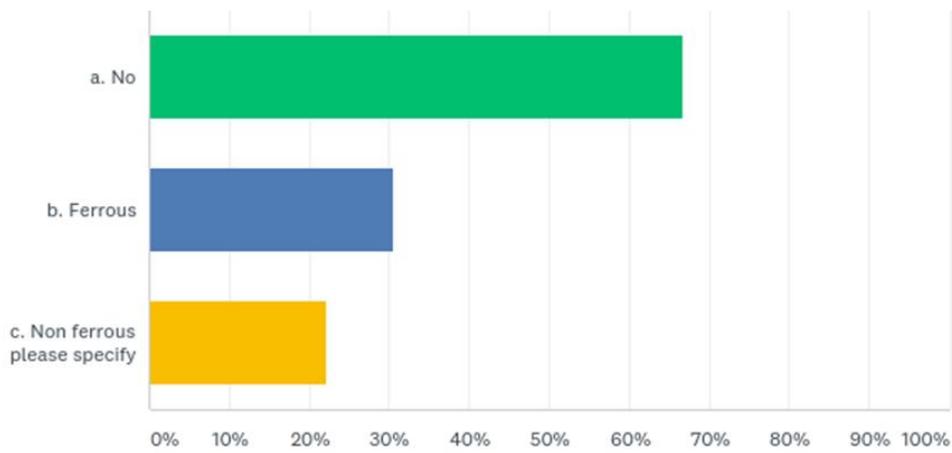


Figure A7. Q17: Do you incorporate any of the following post-consumer plastics recyclates into your products?

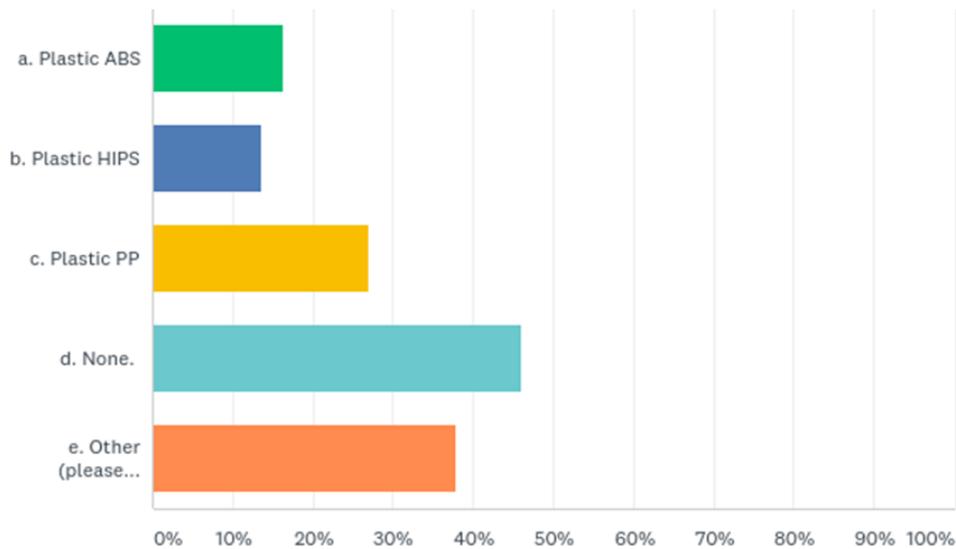


Figure A8. Q19: Please specify the content (in percentage) of post-consumer plastic in your products

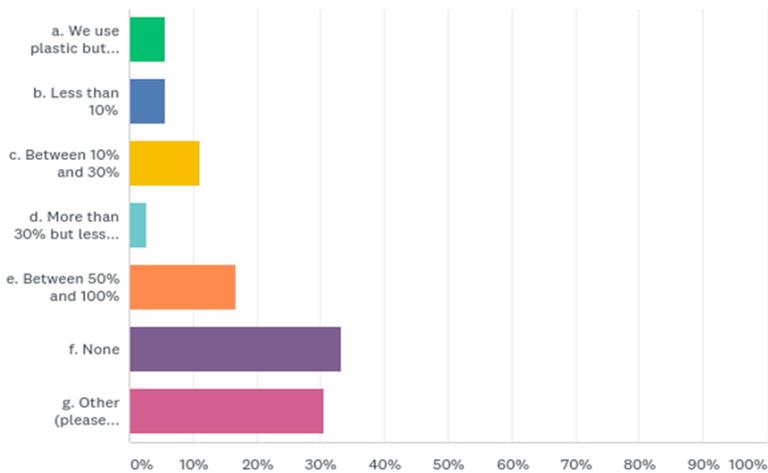


Figure 3.17 shows the different approaches to procuring plastics. The most used approach is direct selling not related to a plastic index..

Figure A9. Q20: Which of the following describes your approach for procuring post-consumer plastic materials?

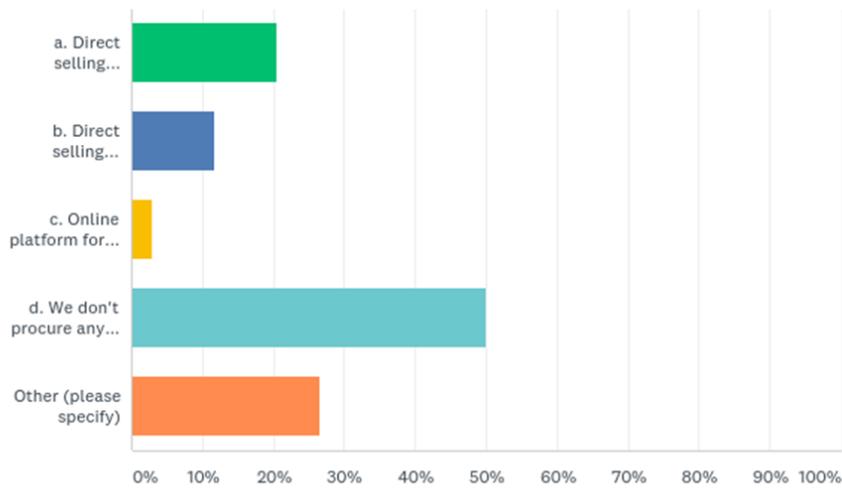


Figure A10. Q21: If your organisation had access to an online platform or website for PCR which of the following tools/functionality would be useful

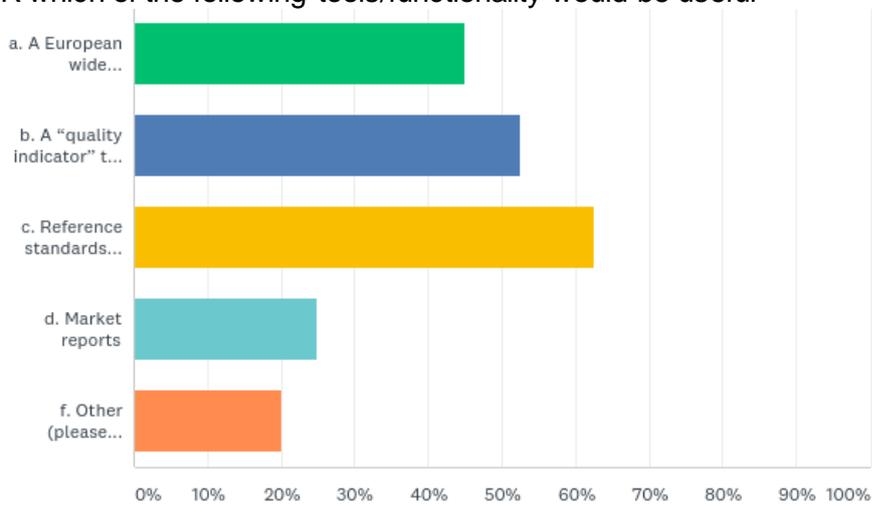


Figure A11. Q23: If you are interested in further support/help please tell us which methods you would prefer

