Improving EEE and WEEE re-use in Denmark - A roadmap

Work done for The Voluntary Agreement

January 2017
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The Danish Voluntary Agreement on WEEE is an agreement entered into in 2013 between the Minister for Environment, representatives from producers and distributors of electronic and electrical equipment (DI, FEHA and BFE) and three compliance schemes (Elretur, ERP and LWF). The agreement has run from 2014-2016. The agreement has been financed in 2014 and 2015 by Elretur, ERP and LWF and in 2016 by Elretur and LWF.

Disclaimer
The Danish Voluntary Agreement on WEEE has initiated studies conducted by external consultants financed by the Danish Voluntary Agreement on WEEE. It should be noted that such publications do not necessarily reflect the position or opinion of the Danish Voluntary Agreement on WEEE.

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List of abbreviations

EEE: Electrical and Electronic Equipment
CE Other: Headphones, adapters, portable audio, radio & hi-fi, video, speakers, cameras
DKK: Danish kroner (currency)
DPA: Dansk Producentansvar (Danish Producer Responsibility)
HER: High-End Refurbishment
IT Other: Displays, monitors, large IT, servers, routers
LHA: Large Household Appliances
MDKK: Million Danish kroner (currency)
Mn: Million
PCS: Personal Computers
POC: Proof of concept
POV: Proof of value
SHA: Small Household Appliances
TVA: The Voluntary Agreement
WEEE: Waste from Electrical and Electronic Equipment
1. Executive summary

The linear production and consumption mode – take, make, use and waste – has led to regulatory initiatives to drive improvements in the resource efficiency and the resource productivity in the electronics- and electrical equipment (EEE) industry through collection and recycling. A number of new – circular – business models have emerged as a response to on the one hand resource pressures and demand for more sustainable lifestyles and other new enabling technologies. The +9 billion DKK potential in Denmark of these new circular business models was analyzed in the report “Circular Business Models for WEEE”, and coupled with how they may achieve improved resource efficiency- and productivity outcomes.

The assessment of economic and environmental impact of the business models applied for different EEE categories showed that Recovery and Recycling, Product Life-Extension and Product-as-a-Service holds a significant +9 billion DKK economic- and 4,900 tons environmental material savings potential. The focus of this report is on Product Life-Extension (enhanced re-use of products or product components) and how to realize the economic- and environmental potential of this business model for Denmark.

To realize the re-use potential the assessment pointed to a retail drop-off model for used EEE and WEEE (hereinafter labelled WEEE). The model takes advantage of customer proximity, safe collection and the reverse logistics processes at retailers and thus enables significant efficiency gains in the take-back of WEEE. The approach establish a new value chain through three main actors: the customer, the retailer and the refurbisher/recycler each with specific roles. The customer receives an appropriate incentive to register, and drop-off the WEEE at a retailer. The incentive could be an attractive re-purchase price or a economic or in-kind reward depending on the residual value of the item. The retailer assess, receive, pay/reward the customers, store and transport items to their warehouse. The recycler or the refurbisher pick up items, processes and re-sells the items.

The retail drop-off model has a significant economic- and environmental potential. With a modicum of success the needed initial investment can be recuperated by collecting as much as 2,5 million items or ca. 40% of the available items. The items will primarily be mobile phones, pcs, tablets and other relatively valuable portable consumer electronics. Incentivizing consumers in a compelling fashion could result in the collection of as much as 4 million items annually and as high as ca. 14 million additional items due to the items stored in drawers and attics.

To implement the retail drop-off model in Denmark a three phased roadmap have been outlined - moving from experimentation, planning to roll-out and scale up. To operationalize the roadmap a coalition of willing parties – A coalition to improve the re-use of WEEE in Denmark – is envisaged. The coalition could well consist of members similar to the current membership of the ‘The Danish Voluntary agreement on WEEE’ to organize, fund and steer implementation. A charter for such a coalition have been drafted, codifying the potential parties’ commitments towards improving reuse in Denmark to collect up to 4 million items annually releasing a value add of several hundred million DKK.
2. Introduction

The linear production and consumption mode – take, make, use and waste – has led to regulatory initiatives to drive improvements in the resource efficiency and the resource productivity in the electronics- and electrical equipment industry (EEE) through collection and recycling. A number of new – circular – business models have emerged as a response to the one hand resource pressures and demand for more sustainable lifestyles and other new enabling technologies.

Policies and regulation geared towards better resource use in linear business models in some cases favor those same models and hence serve as an unnecessary hindrance to circular business models. This report describes a roadmap for improving the resource efficiency- and productivity of WEEE. This can be achieved by addressing some of the most important barriers for circular business models as identified in the report “Circular Business Models for WEEE” to create a more level playing field for WEEE.

Today, the Waste of Electrical and Electronic Equipment value chain in Denmark is facing several challenges. To reach the WEEE directive (2012/19/EU) collection target for 2019 of 65% an increase of collection by 31,000\(^1\) tons in the next three years is needed\(^2\). Trends show that increasing amounts of WEEE leave official collection channels exacerbating the challenge. Furthermore, eco-design- and circular economy directive requirements may lead to additional regulations and connected costs for producers. Further costs related to potentially increases in municipal collection fees are also looming. Our research in the report “Circular Business Models for WEEE” shows that circular economy business models, especially Products-as-a-Service and Product Life-Extension, can achieve the desired objectives without the onerous regulation. Letting the market develop more circular business models will improve the resource productivity across the value chain and help achieve WEEE directive compliance while adding value and jobs. Furthermore circular economy business models can support ecodesign, WEEE prevention, re-use and effectively compete with the unregistered WEEE collection channels.

The report is part of a series of reports on circular economy undertaken for the “The Danish Voluntary Agreement on WEEE” (hereafter called TVA), a consortium of EEE producers and the compliance schemes in charge for WEEE collection and recycling. The objective is to identify alternative ways and means of implementing the WEEE Directive (2012/19/EU) and the intentions outlined in the eco-design and circular economy directives. Specifically the series explores how circular economy business models provide a cost-effective and value adding way of reaching the intended objectives of resource- productivity and efficiency. This report presents a roadmap for promoting one of the circular business models, the re-use of WEEE in Denmark.

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\(^1\) Most figures in the report are rounded (mostly to two digits), to indicate that they are estimates. Due to rounding, some totals may not correspond with the sum of the separate figures.

3. WEEE in Denmark: Background, EU-directive and volumes

3.1. WEEE value chain in Denmark

In the report “Circular Business Models for WEEE”, conducted for “The Voluntary Agreement, we identified the WEEE value chain as a very complex network of material flows and actors in Denmark, other European countries and also countries outside of Europe. At the beginning of the value chain, there are the EEE producers and distributors that bear the producer responsibility. They register with the competent authority in the respective member state, arrange financial guarantees to meet obligations for collection and recycling, ensure data collection and WEEE collection and management. The respective Danish authority in charge is Dansk Producentansvarssystem (DPA-System). DPA-System manages the administrative tasks related to environmental legislation on producer responsibility for WEEE (and other waste streams). Instead of directly communicating with the DPA system, many producers transfer their duties under the producer responsibility to the compliance schemes.

EEE is put on the markets through various sales- and distribution channels (e.g. direct marketing or via retailers) to end-users in households or businesses. At one stage, the owner of the used EEE want to discontinue use of the equipment. The WEEE can be disposed through various channels. One channel is the compliant take-back system. The collection sites (municipal for consumers) manage the initial collection and storage. The compliance schemes organize the transport and recycling. This way, WEEE is officially registered and data is submitted to the DPA-System. The other channels for consumers often lead to a lack of registration and even approved recycling. Private consumer collection activities are not necessarily partner to the compliance schemes and thus do not report collection or assure recycling with DPA. The same holds true for fx door-to-door/street collection and WEEE recycling with scrap metal recyclers.

Some WEEE is discarded but kept in households building up a WEEE stock (e.g. old mobile phones3). WEEE also leak from the official collection- and recycling system through the general waste collection. Disposal of WEEE in mixed residual household waste accounts for 1 to 2 kg per inhabitant in the EU4. A study on Danish households revealed that the amount discarded through municipal waste is about 16% of the WEEE collected5. With a total collection of 83,000 tons in 2010, this results in 13,000 tons ending up in municipal waste each year (about 2.6 kg per inhabitant). A 2016 study confirm this finding estimating the share to be between 0,1-1% in Denmark6.

Once WEEE is returned through the appropriate take-back systems, almost all items are recycled by approved recyclers as recorded by the compliance schemes and the DPA. Depending on collection and preprocessing, the recycling rate can significantly vary (e.g. manual vs. mechanical dismantling). While preprocessing is mainly done on a regional or national scale recycling of complex materials such as printed circuit boards is done in integrated metal smelters in the global context (e.g. Belgium, Canada, Germany, Japan, Sweden)7.

Even though high volumes of WEEE are recycled there is a significant fraction of WEEE that is illegally exported. 1.3 million tons departed the EU in undocumented exports. The main purpose of the shipments is reuse and repair but an estimated 30% of the exports are waste for recycling8.

The overall performance of this value chain, is measured by the collection and recycling rate. As indicated above, only the officially registered WEEE is accounted for, leading to relatively low collection rates and thus a lower performance than actually achievable. A study on WEEE flows in the Netherlands from 2012 highlights the challenges of tracing the flows. Only 79% of WEEE as compared to the products put on market can be identified. 53% are recycled – only 28% through formal collection9. A study on the German WEEE system from 2011 found that 18% of

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1 In Germany, there are approximately 106 million unused mobile phones in households, with increasing trend. (BITKOM 2014. Erstmals mehr als 100 Millionen Alt-Handys zu Hause [in German]. Available online: https://www.bitkom.org/Presse/Presseinformation/Erstmals-mehr-als-100-Millionen-Alt-Handys-zu-Hause.html (accessed on 19 April 2014).
4 Page 55, Danish EPA project number 1848, 2016.
WEEE leak from the recycling systems and 46% is treated in a compliant way. This leaves a share of 36% to be treated in non-compliant way in Germany\textsuperscript{10}.

### 3.2. WEEE Volumes

The responsible authority for the WEEE statistics is the DPA. Nevertheless, Statistics Denmark compiles data on EEE put on market from the production, import- and export statistics. To check robustness of data we compared, the DPA-System statistics on EEE put on market with data from Statistics Denmark to analyze any discrepancy. While the distribution on individual WEEE categories varies, the overall result from the analysis done for the report “Circular Business Models for WEEE” is that the Statistics Denmark data\textsuperscript{11} reveal the total amount of EEE put on market in 2013 to be approx. 15% higher than the numbers from the DPA. DPA registered 138,000 tons of EEE put on market in 2013, whereas the total volume of produced and net imported EEE using data from statistics Denmark was 162,000 tons.

Figure 1 gives an overview on the volumes of EEE put on market in 2013 for different WEEE categories defined in the WEEE directive showing these differences. With 46%, large household appliances (LHA), such as refrigerators, freezers, dryers or washing machines) represent the biggest share of EEE (based on their high weight). The amount of EEE put on the market is relevant for calculating the collection target according to the WEEE directive and is used for the business case calculation for this report (based on the Statistics Denmark data).

While the Danish WEEE collection meets the 2016 collection target, official statistics indicate an insufficient progress on the way towards the 2019 target.\textsuperscript{12} Until 2019, Denmark has to collect 45% of the weight of the WEEE put on market (69,000 tons out of 153,000 tons in 2014\textsuperscript{13}), which was exceeded by some 2,000 tons. In 2019, the requirement rises to 65%, raising the collection requirement to 100,000 tons (assuming the same volume of EEE put on market as in 2014). That would create a sizeable shortfall in the Danish collection of WEEE of 31,000 tons (see Figure 1).

**Figure 1: Projected EEE put on market in 2013-2019, collection of WEEE in Denmark and directive requirements, tons**

![Figure 1: Projected EEE put on market in 2013-2019, collection of WEEE in Denmark and directive requirements, tons](image)

\textsuperscript{10} Okopol, WEEE Flows in Germany, December 2011

\textsuperscript{11} For Statistics Denmark, EEE put on market is calculated as \textit{Production + Imports – Exports}.

\textsuperscript{12} However, incomplete registration and documentation of collected volumes plays a role here – see e.g. the work done by COWI for DPA on this matter [http://mst.dk/media/130767/bilag-41-forprojekt-afrapportering.pdf](http://mst.dk/media/130767/bilag-41-forprojekt-afrapportering.pdf)

\textsuperscript{13} Using numbers from DPA-System ([https://www.dpa-system.dk/da/DPA](https://www.dpa-system.dk/da/DPA)) and requirements from the WEEE Directive
4. The circular business model of Product life extension

4.1. Overview of the five main circular business models

Circular business models have a great potential to contribute to the objectives of the WEEE-directive while at the same time enabling private sector value creation (please see main report “Circular Economy Business Models for WEEE” for detailed description and potential):

Accenture has identified five main circular business models:

1. **Circular Supply Chain** business models introduce fully renewable, recyclable or biodegradable materials that can be used in consecutive lifecycles.

2. Companies using **Recovery and Recycling** business models recover end-of-life products and/or by-products to recapture and reuse valuable material, energy and components.

3. The **Product Life Extension** model seeks to recapture the value in discarded products through repairs, upgrades, remanufacturing or remarketing, keeping the products economically useful for longer.

4. **Sharing platforms** create business opportunities for consumers, companies and micro-entrepreneurs who rent, share, swap or lend their idle goods, leading to higher use rates of existing products instead of purchase of additional ones.

5. Core to the model **Product as a Service** is that customers pay for a product per use, while the ownership and life cycle costs of a product stay with the producer setting incentives for resource efficiency along the complete life cycle.

The five circular business models as well as their respective impact on resource savings are summarized in Table 1.

### Table 1: Description and resource impact of the different circular business models

<table>
<thead>
<tr>
<th>Description</th>
<th>Resource Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Circular Supplies</strong></td>
<td>• Use production inputs that are made from waste or biomass instead of limited resources</td>
</tr>
<tr>
<td><strong>Recovery and Recycling</strong></td>
<td>• Recover material value of waste</td>
</tr>
<tr>
<td><strong>Product Life Extension</strong></td>
<td>• Restore product to original functionality</td>
</tr>
<tr>
<td></td>
<td>• Improve or modify original functionality</td>
</tr>
<tr>
<td></td>
<td>• Sell product to 2nd hand markets</td>
</tr>
<tr>
<td><strong>Sharing Platforms</strong></td>
<td>• Provide customers ways to collaborate on using and moving products and ownership between each other</td>
</tr>
<tr>
<td><strong>Product as a Service</strong></td>
<td>• Internalize total life cycle costs are in business model setting economic incentives for resource saving</td>
</tr>
<tr>
<td></td>
<td>• Enable customers to buy/subscribe to full solution rather than products, paying per use</td>
</tr>
</tbody>
</table>

In order to understand and devise a strategy to realize the potential of re-use in Denmark we will explore the Product life extension approach in more detail in the following sections.

4.2. **Product life extension: High-end refurbishment**

In the report ‘Circular Business Models for WEEE’ the full Danish potential for deploying product-life-extension strategies was assessed. The following sections set out to understand and devise a strategy to realize the potential.

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14 Using numbers from DPA-System (https://www.dpa-system.dk/da/DPA) and requirements from the WEEE Directive
The estimated long-term potential of refurbishing and reselling high-end used EEE with a compliant product guarantee is up to 2,000 MDKK in market size and 3,900 tons of material savings per year (about 2.4% of EEE put on market in 2013. This will reduce the expected collection and recycling shortcoming in 2019 by 13%\textsuperscript{15}).

**Business model description**

A key driver for companies investing in Product life extension through the High-End Refurbishment model is the business opportunity to refurbish used products and spare parts and then resell them to both private and corporate customer segments with a guarantee.

In the High-End Refurbishment (HER) business model, the HER company purchases high-end used EEE, refurbishes it and sells it with a warranty to customers in the local market or in markets of other developed countries. HER companies use an online channel or physical shops to sell their products with a compliant consumer product guarantee. Considering the level of costs that for many EEE are lower than for the refurbishment, this business model is applicable for large and small household appliances; consumer and IT/telecom equipment and tools.

The business model has strong value propositions for customers as it allows them to buy refurbished products at a lower price point than new products, buy discontinued product models and spare parts that are no longer widely available, and live a greener more sustainable lifestyle.

Companies in this space include Gazelle (Global: phones), Refurb.dk (Denmark: phones, laptops), Home Depot (USA: tools), EcoATM (USA: phones), L’easy (Denmark: appliances, TVs etc.), Amazon (Global: works as a platform for individual companies).

**The estimated potential**

For the main report “Circular Business Models for WEEE” we estimated that the business model of HER has a long-term resource saving potential of estimated up to 3,900 tons WEEE per year and an estimated market size of 2,000 MDKK – a part of this potential is already being addressed today, however (e.g. peer-to-peer sales of used items on online markets such as Den blå Avis and Guloggratis, local mobile phone repairs shops and laptop refurbishment). If refurbishment costs were low enough (near zero), the resource savings of HER could amount to as much as an estimated 13,900 tons per year with an increase in market size up to an estimated 3,400 MDKK.

The market potential in Denmark for HER lies primarily within mobile phones, PC & laptops and smaller valuable consumer equipment (Figure 2).

**Figure 2: Estimated HER market potential in Denmark in MDKK split across profitable refurbished EEE\textsuperscript{16}**

![Figure 2: Estimated HER market potential in Denmark in MDKK split across profitable refurbished EEE](image)

Figure 3 below provides costs examples of different refurbished EEE based on research done for the report ‘Circular Business Models for WEEE’. It shows that for vacuum cleaners and refrigerators the refurbished price is lower than the estimated costs of refurbishment, making the products unprofitable. On the other hand, the figure shows that refurbished mobile phones are expected to have an 8% margin.

\textsuperscript{15} Confer the report ‘Circular Business Models for WEEE’ pp.6-7

\textsuperscript{16} Confer the report ‘Circular Business Models for WEEE’ p. 21
Figure 3 shows that there is a positive margin (white area) for refurbishing and selling mobiles whereas the margin is negative (red boxes) for refurbishing vacuum cleaners and refrigerators. For refrigerators the logistics costs is the main cost driver making refurbishment unprofitable. For vacuum cleaners, the main challenge is that the re-sale price is too low to provide a profit margin making it unprofitable.

The main part of the resource saving potential from the High-End Refurbishment business model is through prolonging product lifetimes resulting in a lower demand for new products i.e. lower demand for natural resources. The results for different WEEE categories are presented in Table 2.

Table 2: Overview on HER status, potential with regard to EEE put on the markets and material savings

<table>
<thead>
<tr>
<th>Categories</th>
<th>HER status in the Danish market</th>
<th>HER status in other markets</th>
<th>Total # of EEE tons put on DK market annually</th>
<th>Tons applicable for HER model</th>
<th>Potential # of tons profitable in HER model</th>
<th>... of which 50% of materials are saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHA</td>
<td>No activity</td>
<td>Very limited activity</td>
<td>74,800</td>
<td>7,500</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>SHA</td>
<td>Few, very high-end products</td>
<td>Wider range of products (e.g. Overstock.com)</td>
<td>17,800</td>
<td>4,100</td>
<td>100</td>
<td>~0</td>
</tr>
<tr>
<td>IT/telecom equipment</td>
<td>Mobile phones and some IT-equipment</td>
<td>Somewhat developed market</td>
<td>22,500</td>
<td>8,700</td>
<td>4,700</td>
<td>2,400</td>
</tr>
<tr>
<td>Consumer equipment</td>
<td>Few, very high-end products</td>
<td>Wider range of products (e.g. Amazon, Sears Outlet)</td>
<td>18,800</td>
<td>6,800</td>
<td>2,600</td>
<td>1,300</td>
</tr>
<tr>
<td>Tools</td>
<td>No activity</td>
<td>A range of product (e.g. Amazon, Sears Outlet)</td>
<td>4,700</td>
<td>700</td>
<td>~0</td>
<td>~0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>162,100</strong></td>
<td><strong>27,800</strong></td>
<td><strong>7,800</strong></td>
<td><strong>3,900</strong></td>
</tr>
</tbody>
</table>

17 Confer the report "Circular Business Models for WEEE" p. 22
18 Confer the report "Circular Business Models for WEEE"
19 The WEEE that is broken beyond repair, obsolete or too cheap is not suited for high-end refurbishment. The estimate is based on what would be profitable if operating costs, repair costs and logistics costs were zero.
20 We assume that one refurbished product replaces half a new product, material-wise
21 Including all 10 WEEE subcategories
The items in scope for the retail take back model are profitable portable items. This is due to the fact that the approach relies on consumers to bring items to the retailer and for the collection to be profitable. This precludes Large household appliances and most Small household appliances. In short the take back model revolves around mobiles, laptops/pcs and tablets as well as similar other high value consumer electronics.

**Main barriers**

In the report “Circular Business Models for WEEE” the primary barriers for the High-End Refurbishment business model in Denmark, have been identified:

- A lack of homogenous input of market relevant quality in large volumes for most EEE categories: High volumes are needed in order to benefit from economies of scale in the refurbishment process. Heterogeneous products in low volumes would require higher investments that makes the business model unprofitable.

- High logistics costs: This barrier increases variable costs considerably for HER companies as compared to companies selling new products, making it difficult to maintain profitability on refurbished products sold at lower price levels than new products. This is especially the case for LHA that are relatively heavy compared to their value.

- High refurbishing costs, e.g. labor: In Denmark, labor costs are comparatively high in relation to the market price for refurbished WEEE, which makes the model unprofitable for many products. Especially for small household appliances such as hand mixers or vacuum cleaner this is a barrier.
5. Market-based solutions to promote High-end refurbishment

To address the challenges of collection, recycling and eco-design we see three complementary approaches: Regulation, enforcement and the market as outlined below in figure 4.

**Figure 4: Approaches to meet the challenges of WEEE collection, recycling and eco-design**

- **Market-based efforts to divert physical flows of WEEE into DPA-registered flows.**
  - E.g.: Take-back systems in retail centers
  - Return schemes with distributors
  - Address businesses to establish cooperations

- **Control-based efforts to divert physical flows of WEEE into DPA-registered flows.**
  - E.g.: Secured collection processes
  - Technology solutions
  - Penalties for non-compliant collection

- **Efforts to make alternative collection schemes report to the official statistics.**
  - E.g.: Strengthen registration compliance
  - Synchronize data
  - Collaboration with other actors (e.g. private collection sites)


Each of the approaches has its own merits in terms of efficacy and impacts. The mandate of this assessment is to look to market based approaches to improve collection, recycling and eco-design. In the following sections the market based approaches will be analyzed in more detail.

**5.1. Overview of solutions**

Even though our assessment of business models revealed both resource saving potential and significant economic potential, there are only few related business activities visible on the Danish market. The reason for this, is the barriers described in the previous sections. To harness the potential identified, these barriers need to be overcome e.g. through additional financial incentives for entrepreneurs or awareness raising campaigns.

To enable high-end refurbishment, we propose to reduce the main barriers identified above in section 4.2 for WEEE re-use, develop take-back channels with fx retailers for take-back and sorting. With these interventions, 39% of the economic and 36% of resource saving potential of the HER model can be harnessed, which equals about an additional ca. 800 MDKK and ca. 1,400 tons of resources saved.²²

To enable high-end refurbishment the main barriers to overcome are the lack of homogenous, large volumes for most EEE categories, high logistics costs, especially for large household appliances, and high refurbishment costs relative to the economic value of used EEE and WEEE. To find solutions to this problem, an analysis of collection and sorting initiatives was done, in order to evaluate which approaches are best suitable to solve these problems.

For high-end-refurbishment, our global scan of best practice identified three general categories for collection and sorting, with a total of seven initiatives that all have the potential to increase the volumes of somewhat homogenous flows of used EEE into refurbishment at a reasonable cost. The initiatives are not mutually exclusive and the actual mix of initiatives to pursue will depend on the agents required within the initiatives and coalitions that are formed. The initiatives are all listed in Figure 5 below.

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The identified initiatives in figure 5 are described in detail in the report ‘Circular Business Models for WEEE’, 2017. The identified solutions were all presented to the working group in a workshop. The working group decided in a consultative process to pursue the highlighted initiatives for further assessment. The choices were based on a dialogue with the industry experts of the working group based on their assessment of what could be applied and what could be effective in a Danish context.

5.2. **Down-selection approach**

From the initiatives in chapter 5.1 the voluntary agreement chose two solutions for a high-level business case assessment based on their feasibility and impact. The first choice (A.4) is to use retailers as drop-off locations for used electronics. This model introduces a new value chain to increase the re-use of electronics by incentivizing customers to drop-off their used products at retailers. The retailer’s existing logistic channels will transport the dropped-off products to the distribution centers where they can be picked up by the refurbishing entity without incurring significant additional costs. The used products are then repaired and sold as refurbished electronics. This model makes it very convenient for customers to drop-off products as the activity can be integrated into the weekly (grocery) shopping. For retailers this model can create additional customer traffic and serve as an approach to demonstrate corporate responsibility.

The second choice (B.5), is to improve collection at municipalities, increases the amount of re-usable products at the municipality by improving the sorting and storage of discarded products. This increases the quality of products that are still re-usable at the moment of the drop-off at the municipality by sorting them right at the beginning and providing a safe storage, preventing theft and weather damage. The refurbishing entity can then pick up the products right at the municipality.

We quantified a high-level business case for both choices. It was decided to drop solution (B.5) since the assessment showed that it was not economically significantly inferior to solution A.4. The two main drivers were the limited amounts of relevant re-useable units currently at the municipality waste sites combined with the significantly higher costs associated with the municipal solution.

The Parajuly et al has analyzed the composition of a municipality collection cage, assessing the number of products that were still in working condition or feasible to refurbish. Mapping this against the product categories that we have identified as economically feasible to refurbish showed a low degree of overlap. This led to the conclusion that

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the untapped value pool of products that could be re-used ending up at municipalities is not significant and insufficient in off-setting the relatively high costs of collecting the items at all the 395 municipal collection sites country-wide. 

Lastly, a comparison with model (A.4) (see Figure 6), proved model (A.4) to be superior on most dimensions. Consequently solution (A.4) was chosen as the proposed business model solution. This solution will be presented in detail in the roadmap on the following pages.

Figure 6: Comparison retail collection with municipal model
6. Re-use scenarios

To set out a roadmap for enhanced reuse of WEEE in Denmark based on retail take back we undertook a number of interviews with retailers and refurbishers in Denmark\textsuperscript{24}. This bottom-up approach supplemented the model for reuse developed in the by specifying all process steps and costing each for a specific value retail value chain. The process led to a number of revisions of the specification of the original model. Overall the costs of collection and sorting as come significantly down enabling more categories of WEEE becoming profitable to refurbish and reuse.

6.1. Description of business model and process

There are different factors influencing the decision of customers of what to do with their used electronics. Mostly it is a combination of convenience and assumed value. Larger items are inconvenient to transport but also inconvenient to keep at home when space is limited. Hence for larger items many customers prefer a (fee-based) pick-up at home or to sell the item. For smaller items the inconvenience of simply stockpiling is limited, the transaction costs of selling or disposing items, when value and data-protection is unclear is rather high. In totality consumers choose to store many items in the attic, offload items in the grey market or support a significant online peer-to-peer market trade, which all leave items unregistered and thus un-accounted for with respect to the Dansk Producentansvar.

Understanding the potential for improving re-use comes with one main caveat. The indicated potentials is made with considerable uncertainty as the willingness of consumers to deliver their EEE/WEEE is not fully understood. Based on interviews with retailers and refurbishers, literature review\textsuperscript{25} and Accenture’s own analysis and reuse model we have reason to believe that with an appropriate incentive structure and certainty as regards quality of service consumers will be adequately motivated. Incentives could include data protection guarantees backed by brand names, monetary and non-monetary incentives such as lotteries and outright competitive purchases of items such as Samsung and Apple mobiles.

Figure 7: Overview of business model

The partners and activities are purposefully described on a generic level that cover all necessary and sufficient undertakings for orchestrating a retail based take back, refurbishment and re-sale. It matters less whom will undertake the individual roles. The best organization is best found through a market based solution.

\textsuperscript{24} The interviewees included Refurb.dk, Norsk Ombruk, Danish Supermarket Group, Coop as well as industry experts in the working group and selected municipalities.

\textsuperscript{25} Danish EPA report number 1848, 2016
To tap into this value pool we propose implementing a retailer drop-off model as described in brief. In this model the customer is incentivized to drop-off the used WEEE due to convenience and/or a monetary reward. We have foreseen three different scenarios, depending on the value of the items in scope (see Figure 8).

**Figure 8: Overview of retail take back scenarios in Denmark**

### Scenario 1: Take-back of high-end products
- Retailers take-back only products commercially attractive for refurbishment and re-sale
- Software and skilled employees are needed to evaluate the products at the stores
- The retailer manages evaluation, payment, logistics

*Positive business case for 224 MDKK p.a.*

*0.5 mn items p.a.*

### Scenario 2: Take-back of recyclable products*
- Retailers take-back products not suitable for re-sale in the (Danish) market
- Customers are incentivized by a lottery (or any reward)
- Take-back is completely automated/self-serviced
- Investment in vending machines and software to enable a seamless automated flow of products
- Products are sold to a recycler

*Positive business case for 4 MDKK p.a.*

*1.5 mn items p.a.*

### Scenario 3: Take-back of all items*
- Retailers take-back all items independent of their age and residual value
- Take-back is depending on value (thus either take-back 1 or 2)
- Items sold to refurbisher and recycler
- Investment needed as in scenario 1 and 2
- Economies of scale and scope (e.g. marketing costs) can be leveraged

*Positive business case for 228 MDKK p.a.*

*2 mn items p.a.*

*Recurring. Attic effect year 1-2: +20 MDKK and +9 mn items* 

**approx. profit**

**approx. # of items**

---

Scenario 1 concerns items that are profitable to refurbish/resell whereas scenario 2 concerns items that are not profitable to refurbish/resell and hence are sold to recyclers to retrieve material value primarily gold. Scenario 3 is the case where both types of WEEE are collected either for refurbishment/resell or for recycling.

Scenario 3 is envisaged for two reasons. If a retailer decides to take back WEEE it may not be feasible for practical reasons to only take back WEEE that is profitable to refurbish/resell. The consumers may well bring fx mobiles that are too old/too low value. To proposition a simple and convenient solution to consumers we looked at a scenario where evaluated the feasibility of taking back all small consumer electronics eg. all mobiles, laptops/pcs and tablets. The second reason is that scenario 3 provides some economies of scale in terms of fixed investment and marketing costs making it the most profitable model overall.

In all scenarios, the upfront investment is limited to from ca. 2MDKK up to 5MDKK with significant opportunity to recuperate investments by collecting between 1.700 items of high end items respectively 1 million scrap items. The business case is convincing with limited risks in terms of investment at stake. Regardless of scenario the business case is positive. The attic effect will impact collection of scrap items with up to 9 million items short term. The profits related to the attic effect is expected to amount to approximately 20 MDKK.

**Scenario 1:**

In scenario 1 the retailer only takes back high-end items with a significant value, that are profitable to be refurbished and resold. This allows for an in-person handling at the store but also requires a more careful handling and storing of the items.

The consumer is incentivized to return their electronics by a combination of doing good by returning items safely, feeling safe by having the data protected, and getting rewarded by receiving a money/voucher for the item. The retailer is incentivized by increased footfall and potential sales, better reputation and by adding a new revenue stream. The refurbisher is incentivized by getting access to a large homogenous volume of items at competitive prices, which improves their business model and a potential off-taker for the items to be resold.
Figure 9: Scenario 1 – Refurbishable/resell able items

<table>
<thead>
<tr>
<th>Customer</th>
<th>Retailer</th>
<th>Refurbisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Customer enters basic data of the item into website</td>
<td>✓ Retailer grades, package and stores items</td>
<td>✓ Refurbisher picks-up items from the warehouse and transports items to company site</td>
</tr>
<tr>
<td>✓ Website evaluates and assess the value of the item and generates a barcode</td>
<td>✓ Retailer manages packing list, packaging and communication with logistics company</td>
<td>✓ Refurbisher sorts, tests, deletes and cleans items</td>
</tr>
<tr>
<td>✓ Customer prints barcode at shop</td>
<td>✓ Retailer ensures registration and chain of custody</td>
<td>✓ Refurbisher repairs items as needed</td>
</tr>
<tr>
<td>✓ Customer brings item and barcode to retail agent</td>
<td>✓ Transport operator delivers to retailer warehouse</td>
<td>✓ Refurbisher manages re-sale of the items</td>
</tr>
<tr>
<td>✓ Customer receives voucher/payment for the item</td>
<td>✓ Retailer stores items at the warehouse</td>
<td></td>
</tr>
</tbody>
</table>

Our analysis of what products may be profitable to take back and resell shows that this scenario could enable to attract approx. 0.5mn high-end items (over all profitable product categories as indicated in Table 3.) annually. The investment is estimated at around 0.7 mDKK for website, software, training and storage. Based on the costing and pricing information from the interviewed retailers and refurbishers and the Accenture reuse model this volume of items is estimated to result in more than +224 MDKK in profits annually. A more detailed account of the reuse model for high-end refurbishment can be found in the report „Circular Economy Business Models for WEEE“, Accenture Strategy 2017.

Scenario 2:

In scenario 2 the retailer takes back items that consumers consider to be scrap and/or not profitable for refurbishment/resale. These items still have a residual value through recycling and recovery of valuable materials (such as gold). As this value is by nature significantly lower compared to scenario 1, an automated system for the physical take back, is required to reduce the handling time spent per item and thus the associated labor costs.

The consumer is incentivized to return their electronics by a combination of doing good by returning items safely and getting rewarded by receiving a lottery ticket for the item. The retailer is incentivized by increased footfall and potential sales, better reputation and by adding a new revenue stream. The recycler is incentivized by getting access to a large volume of items containing precious metals at competitive prices, which improves their business model.

Figure 10: Scenario 2 – Items for precious metal recycling

<table>
<thead>
<tr>
<th>Customer</th>
<th>Retailer</th>
<th>Recycler</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Customer enters website to register item(s) and enter lottery</td>
<td>✓ Retailer stores the items in the store</td>
<td>✓ Recycler picks-up items for recycling</td>
</tr>
<tr>
<td>✓ Customer prints barcode at retailer</td>
<td>✓ Retailer manages packing list, packaging, and communication with logistics operator</td>
<td>✓ Payment for items</td>
</tr>
<tr>
<td>✓ Customer drops-off phone to be eligible for a lottery ticket</td>
<td>✓ Retailer ensures registration and chain of custody</td>
<td>✓ Recycler recycles items</td>
</tr>
<tr>
<td>✓ Customer receives lottery ticket online</td>
<td>✓ Logistics operator manages delivery to warehouse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Retailer stores items at the warehouse</td>
<td></td>
</tr>
</tbody>
</table>

For the first year, we estimate a potential collection a significantly higher number of items due to the “attic effect” (all the items that are lying around in drawers, cupboards or attics). When factoring in the attic (please see Table 4

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26 Information on acquisition prices, refurbishment handling and costs, outbound logistics and 2nd sales can be found in the report Circular Business Models for WEEE, 2017. Inbound handling and logistics costs, storage, website, software and training investments have been identified through interviews with retailers, refurbishers and developers.
below), the collection could add up to approx. 9 mn additional items over the first couple of years. The investment is estimated at 3,5 mDKK for automated deposit, website, evaluation software and training. Medium- to long term we estimate a collection of up to 1,5 mn items annually. This will result in a positive business case with profits of +4 MDKK/year\textsuperscript{27}. The profits could be boosted by up to 20 MDKK in the first couple of years due to the attic effect. A more detailed account of the precious metal recycling model can be found in the report „WEEE recycling in Denmark”, Accenture Strategy 2017.

**Scenario 3:**

In scenario 3 the retailer takes back both WEEE categories the both the high-end items for refurbishment/resale and the scrap for precious metal recycling. Taking back all smaller consumer electronics in scope enables economies of scale due to cost sharing (e.g. it and marketing), which improves the business case.

Scenario 3 could result in up to +228 MDKK in profits annually by collecting approx. 2 mn items/year. As was the case in scenario 2 an additional collection of up to 9 mn items and 20 MDKK in profits due to the attic effect is expected in the first couple of years.

**Assumptions for the retail take back business case**

The business case is based on a number of assumptions (see Figure 11, for list). The estimated collection rates and profits are based on the listed set-up. If a selected retailer has less coverage of the Danish population and/or more distribution centers the collection rates and profitability will be reduced due to less items collection and more costs added.

**Figure 11: Overview of reuse retail take-back business case assumptions**

<table>
<thead>
<tr>
<th>Basic retail take back assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 20 retail stores that take-back electronics covering most all Danish households</td>
</tr>
<tr>
<td>• One central distribution center for collection and storage</td>
</tr>
<tr>
<td>• Reverse logistics from the stores to the warehouse at marginal costs</td>
</tr>
<tr>
<td>• Single center pick up for refurbisher/recycler to pick-up items at warehouse</td>
</tr>
<tr>
<td>• Storage at the warehouse at marginal costs</td>
</tr>
<tr>
<td>• Storage at the stores at marginal costs</td>
</tr>
<tr>
<td>• Physical capacity to store items in the stores</td>
</tr>
</tbody>
</table>

If the selected retailer needs to establish a physical infrastructure due to insufficient storage space this will increase the required upfront investment, negatively impact the business case and increase the investment at risk.

**6.2. Overview of products**

There are certain product categories in line for this business model, depending on their actual availability, residual value, age, refurbishment costs and trade price. Generally products that are older than 8 years are not commercially viable for refurbishment or resale, most interesting are products in the age range of 0-4 years. Our analysis shows that the four product categories with significant profit potential are PCs and Laptops, Mobile phones, IT items such as displays, monitors, routers and larger IT items, as well as Consumer Equipment, such as headphones, adapters, portable audio, speakers, cameras etc. The revenue potential for mobile phones is by far the largest due to their low weight and high trade price, especially for newer items. The value and convenience makes them exceedingly attractive for this business model.

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\textsuperscript{27} Information on acquisition prices, refurbishment handling and costs, outbound logistics and 2nd sales can be found in the report „Circular Business Models for WEEE“, 2017 respectively the report „WEEE recycling in Denmark“, 2017. Inbound handling and logistics costs, equipment, website, software and training investments have been identified through interviews with retailers, refurbishers and developers.
Table 3 shows the annually available number of units per product category that are either profitable to be repaired or recycled as well as the resource saving potential. Underlying the resource saving potential is the assumption that for every item re-used, half an item is saved and thus the respective resources for this item. For the production of each item a certain energy effort is needed, which it thus also saved.

<table>
<thead>
<tr>
<th>Category</th>
<th>Volumes</th>
<th>Weight</th>
<th>Total # of items</th>
<th># repairable items</th>
<th># items in working condition</th>
<th>total (kilo)</th>
<th>material saving (kilo)</th>
<th>MJ savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling</td>
<td>7.335</td>
<td>4.236</td>
<td>3.099</td>
<td>520.739</td>
<td></td>
<td>260.369</td>
<td>341.277</td>
<td></td>
</tr>
<tr>
<td>Washing machines</td>
<td>1.304</td>
<td>1.304</td>
<td>0</td>
<td>60.150</td>
<td></td>
<td>30.075</td>
<td>39.421</td>
<td></td>
</tr>
<tr>
<td>LHA other</td>
<td>2.494</td>
<td>1.028</td>
<td>1.466</td>
<td>86.742</td>
<td></td>
<td>43.371</td>
<td>56.849</td>
<td></td>
</tr>
<tr>
<td>SHA other</td>
<td>11.075</td>
<td>8.677</td>
<td>2.399</td>
<td>57.038</td>
<td></td>
<td>28.519</td>
<td>37.381</td>
<td></td>
</tr>
<tr>
<td>PCs &amp; laptops</td>
<td>274.802</td>
<td>49.617</td>
<td>225.185</td>
<td>74.524</td>
<td></td>
<td>37.262</td>
<td>130.648</td>
<td></td>
</tr>
<tr>
<td>Printers &amp; scanners</td>
<td>15.080</td>
<td>12.876</td>
<td>2.204</td>
<td>229.477</td>
<td></td>
<td>114.738</td>
<td>402.295</td>
<td></td>
</tr>
<tr>
<td>Mobile phones</td>
<td>776.828</td>
<td>304.187</td>
<td>472.641</td>
<td>193.636</td>
<td></td>
<td>96.818</td>
<td>376.938</td>
<td></td>
</tr>
<tr>
<td>It other</td>
<td>103.555</td>
<td>44.088</td>
<td>59.467</td>
<td>745.084</td>
<td></td>
<td>372.542</td>
<td>1.306.203</td>
<td></td>
</tr>
<tr>
<td>Screens</td>
<td>26.907</td>
<td>11.517</td>
<td>15.390</td>
<td>330.013</td>
<td></td>
<td>165.007</td>
<td>642.413</td>
<td></td>
</tr>
<tr>
<td>CE Other</td>
<td>82.133</td>
<td>42.726</td>
<td>39.407</td>
<td>797.394</td>
<td></td>
<td>398.697</td>
<td>1.552.230</td>
<td></td>
</tr>
<tr>
<td>Household tools</td>
<td>2.777</td>
<td>2.516</td>
<td>261</td>
<td>13.816</td>
<td></td>
<td>6.908</td>
<td>9.054</td>
<td></td>
</tr>
<tr>
<td>Professional tools</td>
<td>499</td>
<td>499</td>
<td>0</td>
<td>7.921</td>
<td></td>
<td>3.960</td>
<td>5.191</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.304.789</td>
<td>483.270</td>
<td>821.518</td>
<td>3.116.534</td>
<td></td>
<td>1.558.267</td>
<td>4.899.900</td>
<td></td>
</tr>
</tbody>
</table>

*From the report Circular business models for WEEE, 2017 1 IT Other: Displays, monitors, large IT, servers, routers. 2 CE Other: Headphones, adapters, portable audio, radio & hi-fi, video, speakers cameras.

The items in scope are limited to items that consumers may transport easily ie carry and that retailers may store fairly easily as well. In addition the items need to have significant resale value and/or significant precious material content ie a printed circuit board with significant gold content. In figure 12 below a list such products is displayed.

Figure 12: Overview of profitable product categories in scope

![Figure 12: Overview of profitable product categories in scope](image)

The four product types mentioned in figure 12 are the products in scope for the re-designed reuse take back business model. Additional product categories or high-end brands in other categories could possibly also become profitable to re-use once the infrastructure for collecting items at scale is in place.

6.3. The attic effect

When calculating the annual volumes of recyclable products, we factored in an “attic effect”. This means we are assuming that in the first year of the roll-out we will receive a significant number of products that were lying around households for quite a while and are now, due to the high convenience, being dropped off very quickly.
To estimate this effect, we used the annual number of products on the market and their average life span. Assuming a normal distribution, with a mean of distribution depending on the type of products, we calculated an age distribution that was then simulated over 8 years. This leads to roughly 8mn mobile phones and 8.6 mn PCs and laptops making up the attic effect (see Table 4).

### Table 4: Estimation of the attic effect in Denmark

<table>
<thead>
<tr>
<th>Category</th>
<th>Volumes</th>
<th>0-2 years</th>
<th>2-4 years</th>
<th>4-8 years</th>
<th>&gt; 8 years</th>
<th>Attic volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCs &amp; laptops</td>
<td>1,5 mn annually</td>
<td>25,2%</td>
<td>49,5%</td>
<td>25,2%</td>
<td>0,0%</td>
<td>8,1 mn</td>
</tr>
<tr>
<td>Mobile phones</td>
<td>2,6 mn annually</td>
<td>31,2%</td>
<td>53,4%</td>
<td>15,45</td>
<td>0,0%</td>
<td>8,6 mn</td>
</tr>
</tbody>
</table>

To estimate this effect, we used the annual number of products on the market and their average life span. Assuming a normal distribution, with a mean of distribution depending on the type of products, we calculated an age distribution that was then simulated over 8 years. This leads to roughly 8mn mobile phones and 8.6 mn PCs and laptops making up the attic effect (see Table 4).
7. Implementation phases & governance

7.1. Implementation

Our assessment suggest that there is a strong business case for re-organizing a WEEE value chain through retail take back. We have however also identified a number of uncertainties that may impact the business case and require re-design of the re-use take back. We would therefore propose to implement a re-use model in phases. To cover all aspects we have chosen scenario 3 as the case in the following. Scenarios 1 and 2 is hence a subset of the below proposed plan. We propose to implement the re-use business model in three phases (see figure 13).

Figure 13: Proposed re-use implementation phases

Phase 1:
Phase 1 is set to experiment with, test the re-use concept, and validate commercial feasibility and potential. In the 6 months the technical prototyping of the scanners for the recyclable items as well as the testing of the overall equipment incl. scanners and the evaluation software and website integration should be conducted. This is also the time to experiment with the incentives and test to which incentive customers respond to. This could for example be done by running one-off campaigns with a selected retailer offering a certain incentive in a specified geography for a specific product category. It could for example also involve building and testing the IT and equipment needed.

The first 6 months are dedicated to reducing to an acceptable level the most important uncertainties (see Figure 14 below) that were identified during the interviews with the involved retailers/refurbishers. The major uncertainties are: Efficacy of the equipment; Effective incentives; Expected volumes; and, ability to grade items. This phase will thus also provide proof of concept concerning the equipment and it, the expected volumes, the incentives, the correct grading of the items and the resulting commercial feasibility (proof of value).

The phase should also be used to identify and test potential partners for the implementation phase. We propose to conduct a process to select appropriate vendors discussing the most important levers to build a solid foundation e.g. the expected volumes, the roles and responsibilities of each partner and for each step of the value chain as well as the actual roll-out and communication. This process is probably iterative and will be re-evaluated along the implementation phases, but a thorough assessment and selection should have been conducted before phase 2.
The phase is concluded by a completed test plan in addition to a proof of concept and proof of value as regards the selected re-use model and WEEE categories.

**Phase 2:**

In phase 2 the insights generated from the testing in phase 1 will be used to undertake the planning for the roll-out and scale up of the selected re-use model in phase 3. This includes the decision on selected product categories, sequencing, incentive structures, grading mechanisms, desired partners and the corresponding investment need and financing. Moreover the roles and responsibilities of the involved stakeholders along the value chain will be defined. The design of the institutional set up and the governance structure to guide the role out will be designed and set. Phase 2 is concluded by finalization of an implementation plan, the agreement of the institutional set up and governance structure and successful funding of the required investments.

**Phase 3:**

Phase 3 is the roll-out and scale up, which includes the establishment of institutions as needed including the establishment of a governance system. In this phase the selection/sourcing of partners and contracting will be undertaken as needed. The institutional set-up will monitor progress against the planned milestones as regards WEEE categories and target collection and recycling rates including the monitoring and evaluation of results. Ongoing alignment with the involved partners and stakeholders will be undertaken throughout this phase. Communication of results in terms of collection and recycling including reporting to Dansk Producentansvar will be managed by the institutional set-up.
8. Recommendations

In order to move from concept to action we propose to build a coalition of willing parties – A Voluntary Agreement on improving re-use of WEEE in Denmark. To do this we propose a process to commit the willing parties to actual targets but also to provide funding to operationalize the model. The parties could be one or more of the compliance schemes, the producers of EEE, retailers and refurbishers.

The objective is to codify the parties’ commitment on scope, results, timing and funding. We have proposed that includes these elements in a charter (see figure 15 below for a proposal) build on the proposed roadmap. The charter is specific to ensure the implementation of the concept but leaves room for refining and tailoring an approach depending on the nature and ambitions of the committed parties. The charter will enable measurement of progress and success of the coalition by stating realistic and measurable targets that are bound to a certain time horizon.

Figure 15: Example of a charter

<table>
<thead>
<tr>
<th>A. General Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>This charter stipulates the intention to increase the re-use and recycling of electronic products in Denmark by 2020 by xx% compared to the current y%. This will be achieved by introducing a new value chain to collect used and recyclable electronics through drop-off points at retailer stores. The project will be implemented in three phases, starting in 2017.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>The objectives of this project are to have the ambition of:</td>
</tr>
<tr>
<td>o Increasing the re-use of electronic products by xx tons by 2020</td>
</tr>
<tr>
<td>o Increasing the recycling of electronic products by xx tons by 2020</td>
</tr>
<tr>
<td>o Reducing the amount of new products put on market by xx tons by 2020</td>
</tr>
<tr>
<td>o Implementing a new value chain to enable customers to drop-off used electronics by 2018</td>
</tr>
<tr>
<td>o Establishing a well-functioning governance with clear roles and responsibilities of this value chain by 2018</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Timeline &amp; Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>The implementation will be conducted in three phases:</td>
</tr>
<tr>
<td>1) Experimentation: The first phase will be used to test the concept incl. a technical prototyping and testing of the scanners and software used to evaluate the products, a testing of the effectiveness of the chosen incentives, a testing of the volumes that are dropped-off and a testing of the grading mechanism of the products’ value.</td>
</tr>
<tr>
<td>→ The first phase will be implemented by the end of 2017 and lead to a test plan and proof of concept as well as proof of value</td>
</tr>
<tr>
<td>2) Planning: In the second phase the gathered insights from phase 1 will be used to plan the actual roll-out of the concept at scale. In this phase a selection of the product (categories), incentives and grading mechanism will be conducted as well as an adjustment and fine-tuning of the process flow. The parties will agree on the roles and responsibilities of all involved stakeholders along the value chain as well as on the desired target rates.</td>
</tr>
<tr>
<td>→ The second phase will be finished by the end of Q1 2018 and lead to a plan for executing the final roll-out</td>
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<tr>
<td>3) Roll-out: In the third phase the actual roll-out of the concept will be conducted.</td>
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<tr>
<td>→ The roll-out will start in Q2 2018 and will include a regular evaluation of results and the status towards the defined target rates.</td>
</tr>
</tbody>
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