ELLEN MACARTHUR FOUNDATION
Rethink the future

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TOWARDS THE CIRCULAR ECONOMY

Economic and business rationale for an accelerated transition

Founding Partners of the Ellen MacArthur Foundation

Mobile phones—Extracting lasting value out of fashionable items

With 1.6 billion mobile phones produced in 2010, more phones are entering the market than there are consumers.[54] As a result, in mature markets (Western Europe, North America, Japan) consumers own 1.1 mobile phones and average usage time is down to less than 2.5 years.[55] In emerging markets, the sector is nevertheless still poised for growth.

In 2010, Waste Electrical and Electronic Equipment (WEEE) volumes in the EU-27 for IT and telecommunications equipment were estimated at 750 thousand tonnes. Over the next four years, total WEEE volumes in the EU-27 are expected to grow cumulatively by more than 10%.[56] Yet looking at volumes of waste generated does not reveal the true value embedded in consumer electronics waste. While not being particularly significant in terms of weight, mobile phone waste has considerable value embedded in its materials and components. Typically weighing less than 150 grams, a mobile phone is packed with valuable materials such as gold, silver, and rare earth metals. Given today's low collection and recycling rates, nearly all of this material is lost. In Europe alone, for example, 160 million discarded but uncollected devices represent a material loss of up to USD 500 million annually. With collection rates in Europe hovering around 15% and mobile phone designs becoming increasingly integrated, there is hardly any component reuse or remanufacturing, and the secondary mobile phone market (while fast growing) is almost negligible at around 6% of the primary market.[57]

In order to understand the economic implications of circular activities in the mobile phone market, we applied our circularity calculator to a standard low-cost mobile phone valued at USD 36.[58] We first assessed the economics of different circular options for mobile phones and subsequently considered associated environmental benefits (with a focus on carbon emission savings).

In today's world with low collection rates, partially attributable to contract schemes that, in the majority of cases, do not require customers to trade in old devices after the typical 24-month period, we did not identify a lot of economic potential except for the obvious phone resale. Yet this circular option also suffers under today's limited return incentives and inadequate reverse logistics, in that many collected devices are in poor condition both functionally and in terms of appearance. Further, demand for used devices strongly varies between handset make and model.

With the advent of shortages of some rare earth[59] and precious metals, the recycling of mobile phones has gained momentum over the past year. Now, the share of phones being channelled to recycling has risen to 9%, but only a small fraction of the more than 20 different materials they contain is ultimately recuperated.[60]

To maximise the economic benefit of keeping mobile phones or at least certain components in a tighter circle at a profit for the manufacturer, only a few things would need to change in the short term (Figures 11A, 11B):

Improving overall collection from 15% to 50% (close to the proposed WEEE regulation target of 65% by 2016).[61] A better collection system would allow manufacturers, remanufacturers, and vendors to gain scale, which would justify investments in larger, more streamlined facilities and hence further improve the attractiveness of these circles by increasing their efficiency. Collection can be encouraged with lease/buy-back models, an improved customer dialogue, and, under certain circumstances, with deposit system, and will need to be complemented with more semi-automated treatment and extraction systems or better pre-sorting before shredding (to catch reusable phones and materials). For greater efficiency when moving into the 'advanced' circularity stage, the phone industry would need to form joint collection systems (e.g., with original equipment manufacturers (OEMs), operators, retailers, manufacturers, reverse logistics companies). Such concerted efforts are essential to fully overcome interrelated quality leakage points along all reverse value chain steps.

54 Gartner statistics on mobile device sales, February 2011

55 CIA World Economic Factbook, 2011

56 Jaco Huisman et al., 2008 Review of Directive 2002/96 on Waste Electrical and Electronic Equipment - Final Report, United Nations University working paper, August 2007; Jaco Huisman, WEEE recast: from 4kg to 65%: the compliance consequences, United Nations University working paper, March 2010

57 U.S. Environmental Protection Agency (EPA), Electronics Waste Management in the United States Through 2009, EPA working paper, May 2011; Eurostat, WEEE key statistics and data, 2011

58 'Basic mobile phones' include low-cost phones and basic communication devices as defined by Gartner and excludes smartphones. For our calculations, we considered a sample of four mobile phones selling at prices between USD 30 and 60 before VAT

59 Rare earth elements contained in mobile devices include Neodymium, Terbium, and Erbium—Marc Humphries, Rare Earth Elements: The Global Supply Chain, Congressional Research Service Report, September 2010

60 Roland Geyer and Vered Doctori Blass, 'The economics of cell phone reuse and recycling', International Journal of Advanced Manufacturing Technology, 2010, Volume 47, pp. 515-525

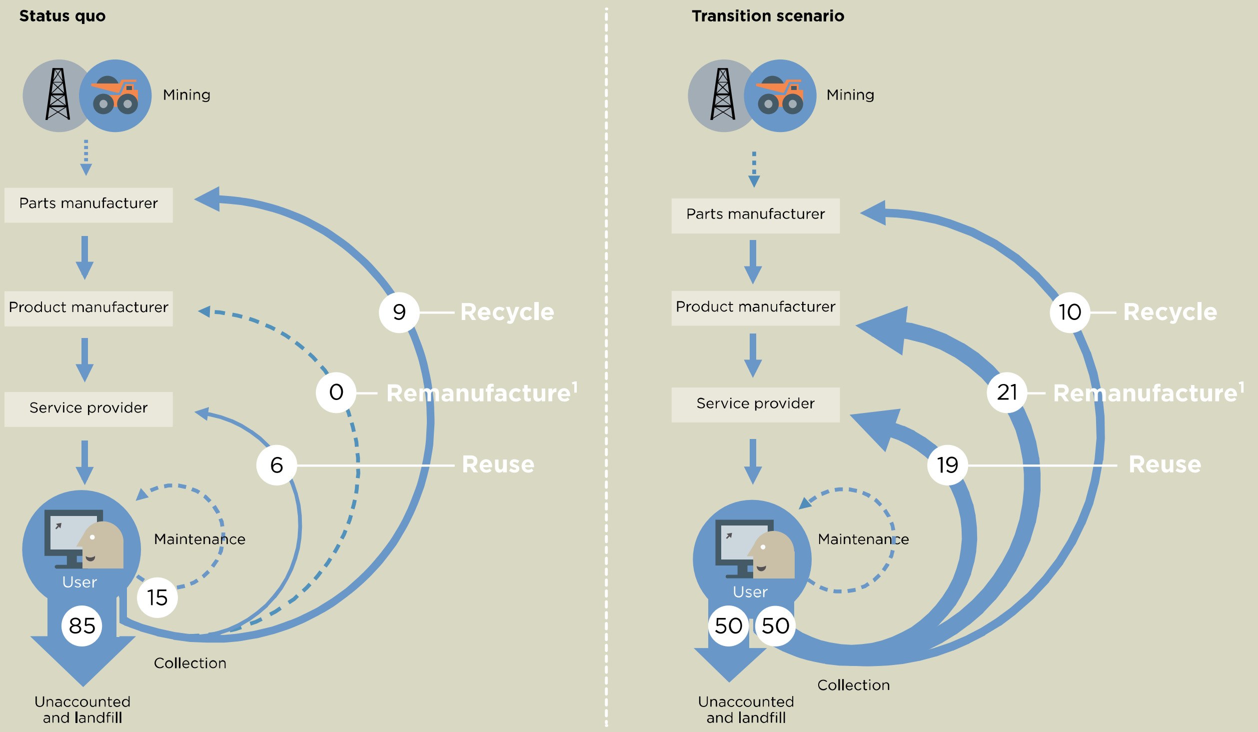
61 European Commission, 'Proposal for a Directive of the European Parliament and of the Council on Waste Electrical and Electronic Equipment (WEEE)', Proposal for a directive, COD 2008/0241, December 2008

3. How it works up close
Continued

FIGURE 11A
Mobile phones: Reuse and remanufacturing as a viable alternative to recycling

ESTIMATES

End-of-life product flows based on 2010 EU figures
Percentage of total end-of-life devices



1 Remanufacturing, here refers to the reuse of certain components and the recycling of residual materials
SOURCE: Gartner; EPA; Eurostat; UNEP; Ellen MacArthur Foundation circular economy team

Selling the entire phone 'as is' after minimal cleaning and repackaging. Our analysis shows that a second-hand vendor can realise a profit of USD 6 (30% margin) per device, even if placing the product on the market with a 40% discount and spending USD 17 on return collection (including buy-back incentive), remarketing, and processing. A used-phone market would benefit from guarantees to customers that manufacturers have software to completely erase a customer's personal data after use, as well as from material choices that extend the life of the product 'core'.

Stripping out reusable components and implementing required design changes to do this more easily. Of the 10 to 12 major components of a standard mobile phone, the top candidates for remanufacturing are the camera, display, and potentially the battery and charger. They are among the most valuable parts within a phone, are comparatively easy to disassemble, and could be used in the production of new devices or in aftermarkets. Key factors for making such a circular treatment economically and technically feasible are standardising components such as displays, cameras, and materials across models and potentially brands through agreement on industry standards; moving to disassembly-friendly product designs (e.g., easy-access, clip-hold assembly instead of adhesives) to enhance the ratio between the value of the material and components reclaimed and the labour needed to extract it; and making reverse supply-chain processes more automated.

As shown in Figure 11B, we estimate that the costs of remanufacturing low-cost mobile phones could be cut by around 50%[62] per device from their current level (e.g., USD 1.0 for collection and transport, USD 3.5 for disassembly, and USD 1.9 for initial screening) when proposed changes of the transition scenario can be realised. In addition, costs occurring in the reuse and recycling process could be reduced by USD 0.7, through more efficient transport and initial screening. In such a scenario, remanufacturing would yield material input cost savings of almost 50% in the final phone production process. Functional recycling could save up to 20% of material input costs and reusing the entire phone does not require any direct material input.

While a value of USD 6 to 7 per phone sounds negligible and is typically lower than the average profit margin on a new standard low-cost phone (up to 25% of the selling price), capturing a significant fraction of the value in the 190 million collected and uncollected end-of-life mobile phones in Europe, many of which could produce value like that shown in our case study, can be economically attractive for third parties as well as manufacturers. From the OEM perspective, the resale market is to a certain extent a threat to sales of new products. In contrast remanufacturing activities on a component level reduce material costs by incremental manufactured components and will not pose a threat to sales of new products as long as the latter are offered as 'new' and without a discount. Such circular business practices also offer a solution to the widespread problem of exporting consumer electronic waste and improper end-of-life treatment in developing countries. By increasing their circular activities, manufacturers could thus also benefit from a more positive public perception.

From a macroeconomic perspective, the transition to a circular economy has major implications for material and energy consumption as well as for the balance of trade in the European mobile phone market. In a transition scenario in which 50% of devices are collected (of those, 38% are reused, 41% are remanufactured, and 21% are recycled), market-wide savings on manufacturing material costs could add up to USD 1 billion (~30% of total industry material input costs), and manufacturing energy costs savings to USD 60 million (~16% of total industry energy input costs) a year. These savings refer to costs incurred in the phone production process; further savings occur in upstream value chain steps.[63] In an advanced scenario with 95% collection and an equal split between reuse and remanufacturing, material and energy savings are estimated to be more than USD 2 billion on material and USD 160 million on energy annually, both net of material and energy used in the reverse-

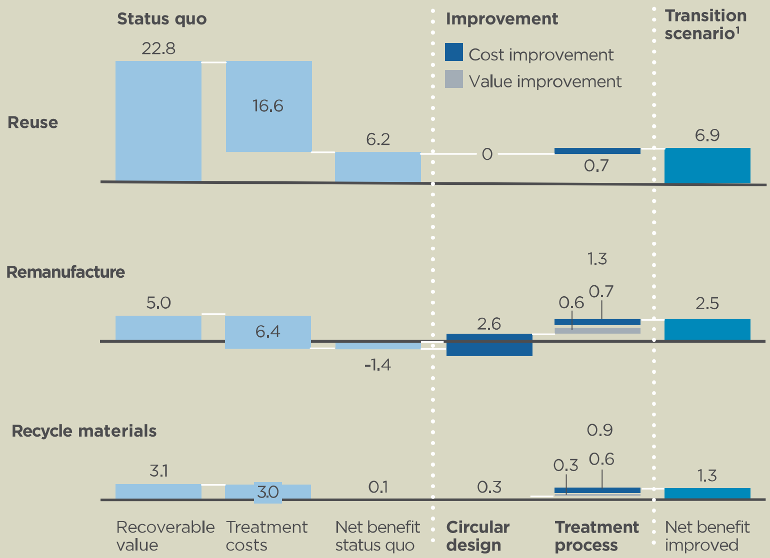
62 Costs for the entire disassembly process could be reduced by ~USD 2.5 per phone; an additional USD 0.8 per phone could be saved in collection and transport, as well as in the initial screening process

63 Metal recycling leads to reduced energy consumption in the extraction phase. but is implicitly considered in the material value of recycled metals, not in energy cost savings

3. How it works up close
Continued

FIGURE 11B
Mobile phones: Design changes and investments in reverse infrastructure could greatly improve the circular business case

USD per device ESTIMATES



1 Transition scenario: Conservative assumptions on improvements in circular design and the reverse cycle, within today's technical boundaries

SOURCE: Geyer & Doctori Blass (2008); Neto & Bloemhof-Ruwaard (2009); Neira et al. (2006); EPA; Umicore; LME; Metal Bulletin; recellular.com; amazon.com; recyclemobilephones.co.uk; Ellen MacArthur Foundation circular economy team

cycle process. Taking into consideration the material extraction and whole manufacturing process of parts and product, greenhouse gas emission savings from circular activities could amount to 1.3 million tonnes of CO_2e in a transition state and around 3 million tonnes (or 65% of primary production emissions) in the case of 95% collection.

While primary mobile phone production is largely located outside Europe, resellers and recycling firms are typically geographically close to the market. As remanufacturing activities also include the recycling of residual material, the process is assumed to take place within Europe (also in order not to confront the topic of illegal e-waste export—though a case could also be made for re-export markets, given labour cost differentials). As a result, circular business practices would have a positive USD 1 to 2 billion effect on Europe's trade balance surplus due to overall reduced imports of new phones and component and material inputs.

Pushing the concept further by improving designs to bring more components into the remanufacturing loop, enabling mobile phones to cycle not only once but potentially multiple times through a product life cycle could even lead to further optimisation potential and further decrease material and energy input costs in the market.