Samsung Galaxy Note 7: The Cost for the Planet

The resource impact of dumping of 4.3 million phones

Date OCT 31ST 2016

Following the global recall of the Samsung Galaxy Note 7 Greenpeace, alongside the Oeko-Institut, a research and consultancy institution based in Germany, has calculated the potential resource implications of dumping or destroying 4.3 million smartphones. If Samsung can do it right, this global recall will be a unique opportunity to develop a well-designed recycling system.

Basic Timeline[1]

Aug. 19th	*Launch of the Note 7*
Aug. 24th	*First reported explosion (Aug 25th~30th series of explosions)*
Sept. 2nd	*1st global recall & replacement*
Oct. 11st	*All production & sales are stopped (Model 'discontinued')*
Oct. 13th	*Expanded global recall to replacement phones*

Samsung has produced 4.3 million Galaxy Note 7 phones. From the launch on August 19 until the first global recall on September 2nd 2.5 million Note 7 phones were produced (1.5 million were sold). After the first recall, 1.5 million further replacement products were produced. Samsung sold a further 0.2 million devices in China after the first global recall (the country was not included in the recall as the batteries were sourced elsewhere). The company also sold a further 0.1 million more in Korea from October 1 after resuming sales.[2]

A. The Problem

Samsung has not officially announced any concrete analysis on the causes of the default seen in the Note 7. Most speculation has pointed to the battery as being the main cause. Samsung has also yet to detail how it will deal with these phones once it has collected them but did announce it will dispose of all the Note 7 produced. This means that the majority of the components which are brand new and might be still working fine could be destroyed, leading to the tremendous waste of the materials, energy and labour that went into making these devices.

1. Production: from resource extraction to manufacturing and assembly

4.3 million Galaxy Note 7 estimated to contain[3]:

- **Cobalt**: more than 20 metric tonnes. To produce that amount of cobalt, more than 1,000 tonnes of rock, ore and fossil energy had to be excavated for which artisanal miners in the DR Congo would have to work for about 20 years
- **Tungsten**: more than one tonne
- **Tantalum**: several kilos[4]
- **Palladium**: approximately 20 to 60 kilograms. To produce that amount between 700 and 2,200 tonnes of rock, ore and fossil energy had to be excavated.
- **Gold**: more than 100 kilograms. To produce that amount of gold, almost 100,000 tonnes of rock, ore, and fossil energy had to be excavated.
- **Silver**: more than 1,000 kilograms of silver. To produce that amount of silver, almost 9,000 tonnes of rock, ore, and fossil energy had to be excavated.

[1] http://www.newsis.com/ar_detail/view.html?ar_id=NISX20161011_0014441331&cID=10401&pID=10400
[2] http://www.hankyung.com/news/app/newsview.php?aid=2016101161201
[3] Source: data calculated by the Oeko-Institut.
[4] This is an estimation as Tantalum content can vary from model to model

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According to UNEP (2013)[5], aluminium, silver, gold and rare earth metals "pose concerns primarily related to the processes used to extract them, as opposed to inherent toxicity of the metals themselves." In particular, mercury and cyanide are used for gold mining.

Table 1: Selection of precious minerals per Note 7[6]

All calculations are based on Note 7 Specs: 169g[7], battery 46g[8], 153.5 x 73.9 x 7.9 mm (0.1535 x 0.0739 x 0.0079 m)

	per device [g]	for 4.3M devices [t]	Cumulative Energy Demand(CED) [MJ]	Cumulative Raw-material Demand(CRD) [t]
Cobalt(Co)-content	6.348	27.3	2,811,775	1,553
Tungsten(W)-content	0.44	1.892	99,164	650
Tantalum(Ta)-content	0.02	0.086	288,601	789
Tantalum(Ta)-content (conservative)	0.002	0.009	28,860	79
Palladium (Pd)-content	0.01	0.043	6,727,625	1,588
Gold(Au)-content	0.03	0.129	33,696,116	95,501
Silver(Ag)-content	0.31	1.333	2,223,827	9,111

Table 2: GHG emission in production[9]

Samsung has not disclosed the amount of energy used to produce the Note 7 or any other Galaxy series phone. The closest estimation of what emissions might have been used to produce the Note 7 can be estimated by comparing with the iPhone6 Plus or iPhone7 Plus, as all models use aluminium casing and have a similarity in the size of LCD screens which share the most GHG emission among all components.

	Amount of GHG emission in production of 4.3M phones	**Equivalent GHG emissions**	**Equivalent co2 emissions needed**
iPhone 6sPlus[10]	402,050 metric tonnes co2e	85,000 vehicles driven for a year[11]	102 wind turbines installed[12] 429,025,584 pounds of coal burned[13]
iPhone 7Plus[14]	224,718 metric tonnes co2e	50,000 vehicles driven for a year[15]	56.8 wind turbines installed[16] 239,795,476 pounds of coal burned[17]

[5] UNEP (2013) Global Chemicals Outlook, Towards Sound Management of Chemicals, ISBN: 978-92-807-3320-4 Job Number: DTI/1639/GE Copyright c United Nations Environment Programme, 2013. page 26

[6] Source: data calculated by the Oeko-Institut.

[7] http://www.gsmarena.com/samsung_galaxy_note7-8082.php

[8] http://electroiq.com/chipworks_real_chips_blog/2016/09/15/samsungs-galaxy-note-7-is-more-than-the-batteries/

[9] Source: data calculated by the Oeko-Institut.

[10] http://images.apple.com/environment/pdf/products/iphone/iPhone6sPlus_PER_sept2016.pdf

[11] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[12] Ibid

[13] Ibid

[14] http://images.apple.com/environment/pdf/products/iphone/iPhone_7_Plus_PER_sept2016.pdf

[15] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[16] Ibid

[17] Ibid

2) Disposal: pollution and scale of damage

Samsung produced 4.3 million Galaxy Note 7, which has the equivalent weight of 726.7 tonnes (not including chargers). If not separated and reused this could lead to the creation of e-waste equivalent to:

- Approximately 28 of 40-feet shipping containers (max load of 40-feet containers are 26.2 tonnes)
- Approximately 122 African elephants (average weight 6 tonnes)
- Approximately 512 SM6 vehicle by Renault Samsung

If laid out, the 4.3 million Galaxy Note 7 would reach 660.5 kilometres. This would be equivalent to:

- More than the distance between Seoul and Busan, twice

Hazardous chemicals

Samsung claims that all parts of its smartphone are free of TBBP-A, BFRs, PVC, Phthalate, Beryllium, Chlorinated Flame Retardants, and Antimony, but the charger, the power cord, the adapter, the cable and other accessories associated with the smartphone may not yet be free of hazardous chemicals. Samsung did also not announce if the accessories associated with the phone would be smelted or recycled.

As Samsung does not disclose whether hazardous chemicals such as brominated flame-retardants or chlorinated materials such as PVC have been eliminated from the whole supply chain, it is not possible to predict the exact amount of hazardous chemicals that could be released into the environment following inappropriate disposal or incineration. If PVC or BFR or heavy metals have been used, significant releases of hazardous chemicals cannot be excluded.

B. The Solution

There are two ways in which the environmental and health impact of the smartphone sector can be reduced:

1. Extending product lifespan to reduce resource consumption. This can be done by product re-design to enable repair, refurbishment, component reuse, and material recycling;
2. Closing the loop/ switching to a circular production model by ensuring discarded products can be collected and recycled into clean secondary materials

Product design as a game changer:

Designing for durability, and recycling to extend product lifespan not only enables the materials to be reused, but can also generate a revenue stream, being crucial for economic viability.

- The increasing complexity of product design can make the recycling and recovering of precious metals more difficult.
- A good product design should take into consideration reusing the components and recycling the resources since the beginning, and include using recycled materials for production instead of virgin materials, and make the phones easy to be dismantled after being discarded, so that working components can be reused.

The August 2015 winning paper[18] of the "Atlas: Research for a better world" award[19] indicates that smartphones are ranked as the most promising ICT product to generate revenue through recycling because they contain precious metals, like gold, copper, silver, platinum, and rare earths related to an estimation of WEEE generated volumes in 2020.[20]

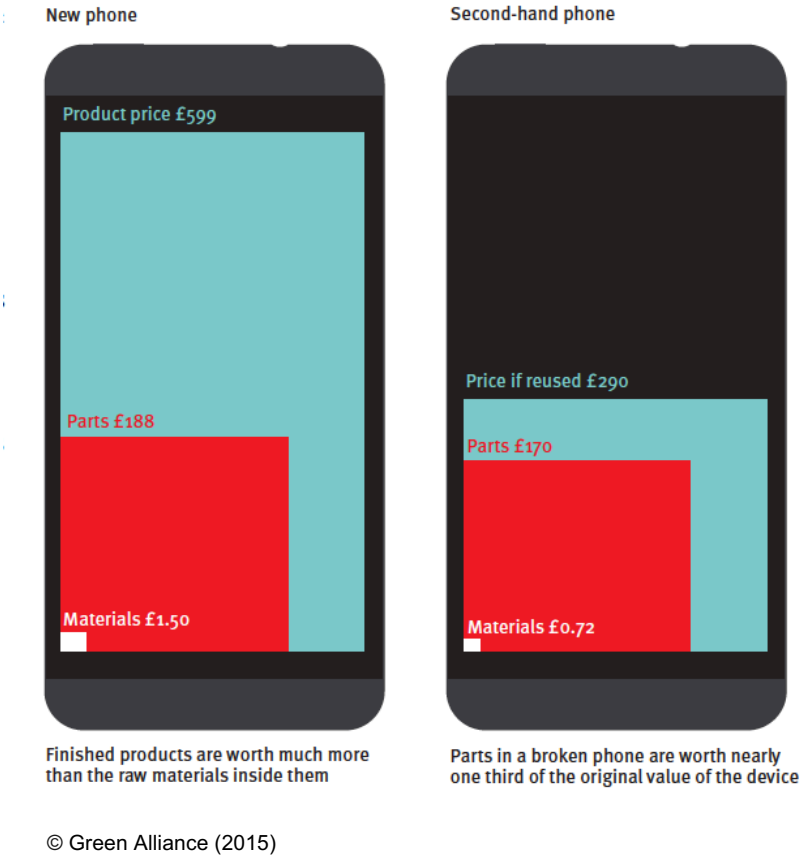
[18] Renewable and Sustainable Energy Reviews Vol. 51, 2015: Recycling of WEEEs: An economic assessment of present and future e-waste streams
[19] https://www.elsevier.com/atlas/about
[20] https://www.elsevier.com/atlas/story/planet/is-there-a-future-for-e-waste-recycling-yes,-and-its-worth-billion

Table 3: Overall potential revenues – base scenario

Products	Ranking	Potential revenues* ($ million Euro)
Smartphone	1	746
LED Monitor	2	546
LED TV	3	519
LCD Monitor	4	435
LCD TV	5	413

**Related to estimated WEEEs generated volumes in 2020*

Furthermore, according to Green Alliance (2015)[21], reuse and parts harvesting are much more valuable than recycling. The report claims that parts in a broken phone are worth nearly 30% of the original phone value. If Samsung reuses components and recycles resources, the company will not only minimize the environmental impact of disposal, but also create an opportunity to regain revenue from already made components.



Closing the product cycle can benefit both the economy and the environment

Smartphone manufacturers have to move towards closing and slowing the product loop in order to save resources, avoid inefficient waste management and create business opportunities. This would include:

1. Better product design to make products more durable while also considering the level of ease to repair, reuse, dismantle, and recycle to reduce resource consumption.

[21] **Green Alliance (2015), A circular economy for smart devices - opportunities in the US, UK, and India, pg 17** http://www.green-alliance.org.uk/resources/A%20circular%20economy%20for%20smart%20devices.pdf (p17)

2. Cleaner production process to eliminate using and discharging hazardous materials, to benefit the health of workers, local communities and the environment, to enable clean recycling (without contaminated materials), and to manage waste (including mining waste).
3. Transparency in manufacturing: identifying the hazardous chemicals used and released from the factory and disclose such information to workers and the public.
4. Producer responsibility of the gadget manufacturers should be fulfilled by taking actions like product take-back programs and financing the cost of recycling. Governments can adopt policies - such as subsidiaries or tax incentives - to further motivate companies.

Circular Economy: a great opportunity, yet challenging for smartphone companies

A circular economy, according to the European Commission, is a system in which the value of products and materials is maintained for as long as possible, waste and resource use are minimized, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value.[22]

The European Commission also estimates that circular economy can benefit the mobile phone industry by more than EUR 1 billion from the savings on manufacturing material costs, if 95% of mobile phones were recycled efficiently.[23] This requires a systematic approach combining knowledge and skills of multiple disciplines across science, technology, engineering, designing, and advertising. It is indeed disruptive innovation which can transform the smartphone market, the ICT industry, and eventually lead the world to a brighter future.

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[22] http://europa.eu/rapid/press-release_MEMO-15-6204_en.htm
[23] European Commission, Op Cit. page 4