The New Plastics Economy: Rethinking the future of plastics

Background to key statistics from the report (February 2016)

Plastics have become the iconic workhorse materials of the modern economy, going from niche to ubiquitous in just half a century. With a production that is expected to double over the next 20 years, the opportunity to design a system that captures this material's benefits whilst reducing its negative externalities beckons: using the plastics innovation engine to move the industry into a positive spiral of value capture, stronger economics and better environmental outcomes.

The report *The New Plastics Economy: Rethinking the future of plastics* has drawn on the expertise and contributions of a group of 40+ participant companies and cities along the global plastics value chain, as well as extensive consultation with academics, experts and NGOs. In total, more than 180 experts and over 200 publications were consulted during the report development.

Among the multiple symptoms revealing the current system's drawbacks, two are arguably amongst the most striking: our analysis indicates (i) that 95% of the value of plastic packaging material, worth $80-120 billion annually, is lost to the economy, and (ii) that, on the current track, there could be more plastics than fish in the ocean (by weight) by 2050. Background on the derivation of these insights can be found below.

Plastic packaging material value loss explained

Our analysis indicates that 95% of the value of plastic packaging material, worth $80-120 billion annually, is lost to the economy. This analysis builds on the first-ever assessment of global plastic packaging collected-for-recycling rates, an assessment of average value losses during after-use sorting and reprocessing, and an assessment of average material value prices.

Analysis and synthesis from across many dispersed data sources has indicated a 14% global collected-for-recycling rate for plastic packaging. This is based on detailed industry data from Plastics Europe and EPRO for the EU27+2, detailed data from the US EPA for the United States, and World Bank data for the rest of the world.[1] While the 14% estimate is based on the best available data, the *New Plastics Economy* report explicitly acknowledges that *"The analysis not only reveals a significant opportunity to increase circularity and capture material value, but also highlights the need for better alignment of reporting standards and consolidation on a global level. Specific efforts could be dedicated to improving the data from developing markets with informal waste sectors."*

Due to value (volume and price) losses during sorting and reprocessing, this 14% collected-for-recycling rate translates into a material value retention rate of just 5% - meaning 95% of plastic packaging material value is lost each year. An average recycling volume yield of 72%[2] means that the *volume* output of plastic packaging recycling processes is 14%*72%=10% of total plastic packaging volumes put on the market annually. With an average *price* discount of 50% of recycled

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1 See Appendix A of the *New Plastics Economy* report for details

2 Deloitte, *Increased EU Plastics Recycling Targets: Environmental, Economic and Social Impact Assessment – Final Report* (2015)

plastics versus 'virgin' (new) plastics (based on our analysis comparing prices for virgin and recycled plastics (2015 sample averaged over six resin types, Plastic News) and expert interviews), this means the total material value retained for a next cycle is just 10%x50%=5% of the material value put on the market each year.

This 95% plastic packaging material value loss translates into an annual value loss of $80-120 billion. The total material value put on the market each year is $86-125 billion, based on 78 million tonnes of plastic packaging put on the market each year (from Transparency Market Research[3]) and an average plastic packaging material value per produced tonne of 1,100 – 1,600 $/tonne (from Plastic News, The Plastics Exchange, Plasticker, EUWID, Expert interviews). Hence, the total material value loss each year is 95%*($86-125 billion) = $80-120 billion.

Plastics vs fish in the ocean explained

Our analysis indicates that, on the current track, there could be more plastics than fish in the ocean (by weight) by 2050. This analysis builds on research on plastics stocks and flows into the ocean by Jambeck et al. published in Science magazine in 2015,[4] a 2008 assessment of global fish stocks by Jennings et al.,[5] a 2015 assessment of plastics stocks and flows into the ocean as well as fish stocks in the ocean in the report *Stemming the Tide* by Ocean Conservancy and the McKinsey Center for Business and Environment,[6] and future global GDP growth rates by the International Energy Agency.[7]

Using these inputs, our analysis reveals that there could be – in a business-as-usual scenario – plastics stocks in the ocean of about 850-950 million tonnes by 2050, versus fish stocks of 812-899 million tonnes. In the *New Plastics Economy* report, for reasons explained below, the lower end of both these ranges has been used, i.e. 850 million tonnes of plastics and 812 million tonnes of fish, so more plastics than fish (by weight) by 2050. The 2050 forecast of "more plastics than fish (by weight)" would hold equally if the high end of the ranges had been used.

While – by their very nature – there are uncertainties around such estimates, we are confident that this 2050 forecast relies on overall conservative assumptions, as elaborated below. Future research would be welcome to refine the estimates of plastics stocks and flows in the ocean as well as these of total fish biomass in the ocean, yet the order of magnitude of the ocean plastics issue that can be derived from existing academic work, together with other economic and externalities arguments as laid out in the *New Plastics Economy* report, undoubtedly provide a strong case for upstream action.

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[3] Transparency Market Research, *Plastic Packaging Market — Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2014–2020* (2015)

[4] J. R. Jambeck et al., *Plastic waste inputs from land into the ocean* (Science, 13 February 2015).

[5] S. Jennings, et al. *Global-scale predictions of community and ecosystem properties from simple ecological theory*. (Proc. R. Soc. London Ser. B, 275: 1375-1383, 2008)

[6] Ocean Conservancy and McKinsey Center for Business and Environment, *Stemming the Tide: Land-based strategies for a plastic-free ocean* (2015)

[7] International Energy Agency, *World Energy Outlook 2015* (2015)

Specifically, our analysis of the "plastics vs fish in the ocean" statistic is based on:

- Total plastics stocks in the ocean of about 850-950 million tonnes by 2050, in turn based on:
    - Total plastics stocks in the ocean today: 150 million tonnes, from the above mentioned report *Stemming the Tide.*
    - Annual plastic flows: the above mentioned research by Jambeck et al. estimates (in its middle scenario) annual plastic flows in the ocean of 8 million tonnes in 2010 and 9.1 million tonnes in 2015.[8]
    - The same research by Jambeck et al. estimates (again in the middle scenario) the annual growth rate of plastics leakage into the ocean to be 5.4% between 2010-2025, with a slower growth rate between 2010-2015 and an accelerated rate of 6.8% p.a. between 2015-2025. We conservatively rounded down these expected growth rates to 5.0% until 2025. This is higher than the average annual growth rate of global plastics production over the same period (3.8%), as most growth in plastics consumption occurs in high-leakage regions.
    - Between 2025 and 2050, we applied the expected global GDP growth rate of 3.5% p.a.[9] to the flow of plastics in the ocean. Growth of plastics flows into the ocean could be even higher since (i) global plastics consumption has historically grown faster than GDP and (ii) most of the growth in plastics consumption is expected to occur in high-leakage countries (which are typically also high-growth, e.g. South-East Asia). As such the estimate of 3.5% p.a. is considered conservative and takes into account incremental improvements in waste management in high-leakage countries but no drastic, concerted action to stop the flow of plastics into the ocean – i.e. a business-as-usual scenario.
    - Applying these figures leads to a range of about 850-950 million tonnes of plastics by 2050, depending on whether the initial 5.0% growth rate of plastics flows into the ocean is applied for the period 2015-2025 only (starting at the above mentioned 9.1 million tonnes annual flow in 2015) or for the full period 2010-2025 (starting at the above mentioned 8.0 million tonnes in 2010). Even the higher end of this range leads to lower plastics flows by 2025 than that assumed in Jambeck's middle scenario. Yet, we have conservatively used the lower end of the range in the report, leading to about 850 million tonnes by 2050.
- Total marine fish stocks of 812-899 million tonnes, in turn based on above-mentioned research by Ocean Conservancy and Jennings et al.
    - The 812 million tonnes was considered the best estimate for global fish biomass by the Ocean Conservancy for use in its 2015 report *Stemming the Tide*. The number corresponds to the estimate of total teleost biomass. Teleosts "include virtually all the world's important sport and commercial fishes, as well as a much larger number of lesser-known species".[10] This group is used for headline figures in the *New Plastics Economy* report, as it is what most people would consider as "fish". Its definition excludes non-fish marine animals such as marine mammals (e.g. whales, dolphins) and shellfish. It also excludes sharks and rays. While sharks are considered "fish" by some due to their external form, they differ from them so

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[8] http://science.sciencemag.org/content/sci/suppl/2015/02/11/347.6223.768.DC1/Jambeck.SM.pdf, Table S1

[9] International Energy Agency, *World Energy Outlook 2015* (2015)

[10] Encyclopædia Britannica, *Teleost* (Encyclopædia Britannica Online, 2016, http://www.britannica.com/animal/teleost).

widely in structure that they are often placed in a class by themselves (Jordan, "Guide to the Study of Fishes, Vol. I. pp506-511).
  - The 899 million tonnes corresponds to the 812 million tonnes mentioned above, plus the biomass of sharks and rays.
  - The 812-899 million tonnes are an assessment of fish stocks *today*. No adjustments were made to arrive at the 2050 number – meaning that potential effects of overfishing are not taken into account.
  - The assessment of total global fish biomass is inherently uncertain. Other estimates exist, and there is scope for refinement in future research.
- For the reasons explained above, in the *New Plastics Economy* report, the lower end of both these ranges has been used (i.e. 850 million tonnes of plastics and 812 million tonnes of fish biomass by 2050) for headline figures – but the 2050 forecast would hold equally if the high end of the ranges had been used.

Highlighting this undeniable system flaw combines with the economic arguments laid out above and in the *New Plastics Economy* report to create a compelling case for an overall redesign of the plastics value chain. The *New Plastics Economy* report provides a blueprint for such a redesign, and offers pathways towards a circular future for plastics.

Download the full report and infographics from
http://www.ellenmacarthurfoundation.org/publications/the-new-plastics-economy-rethinking-the-future-of-plastics