

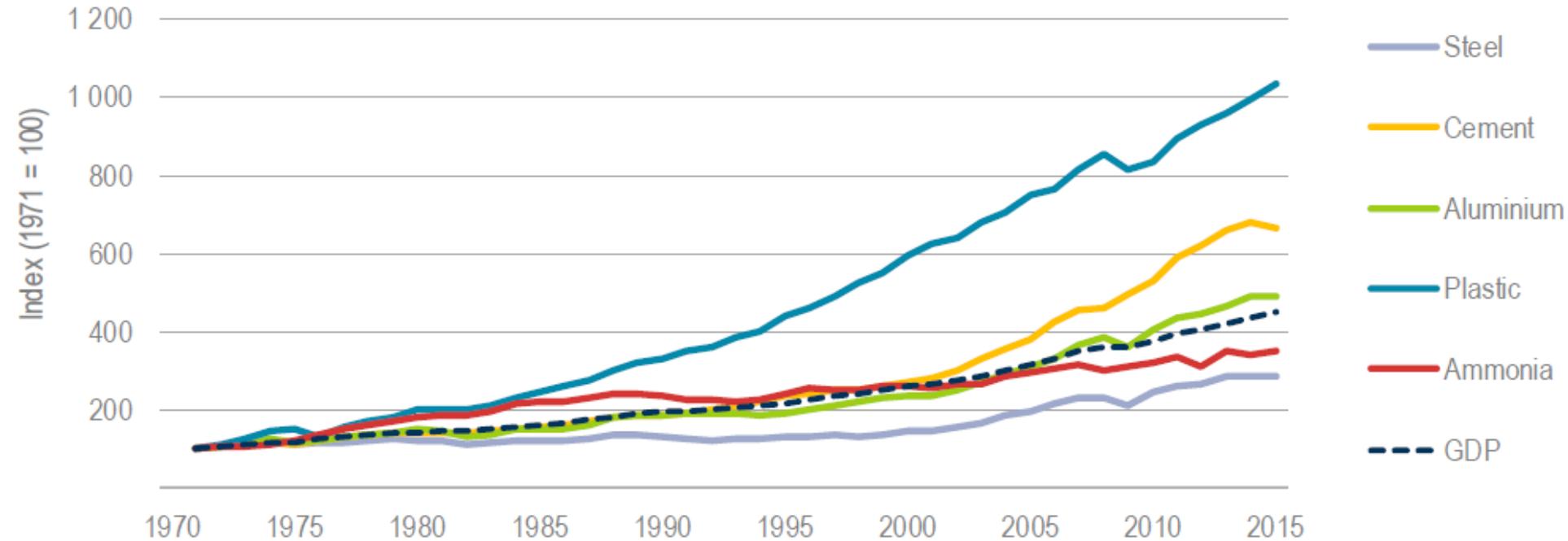


## Plastic: Too much of a good thing?

Roland Geyer, PhD, Dipl.-Phys.  
Bren School of Environmental Science and Management  
University of California, Santa Barbara  
<https://rolandgeyer.com>



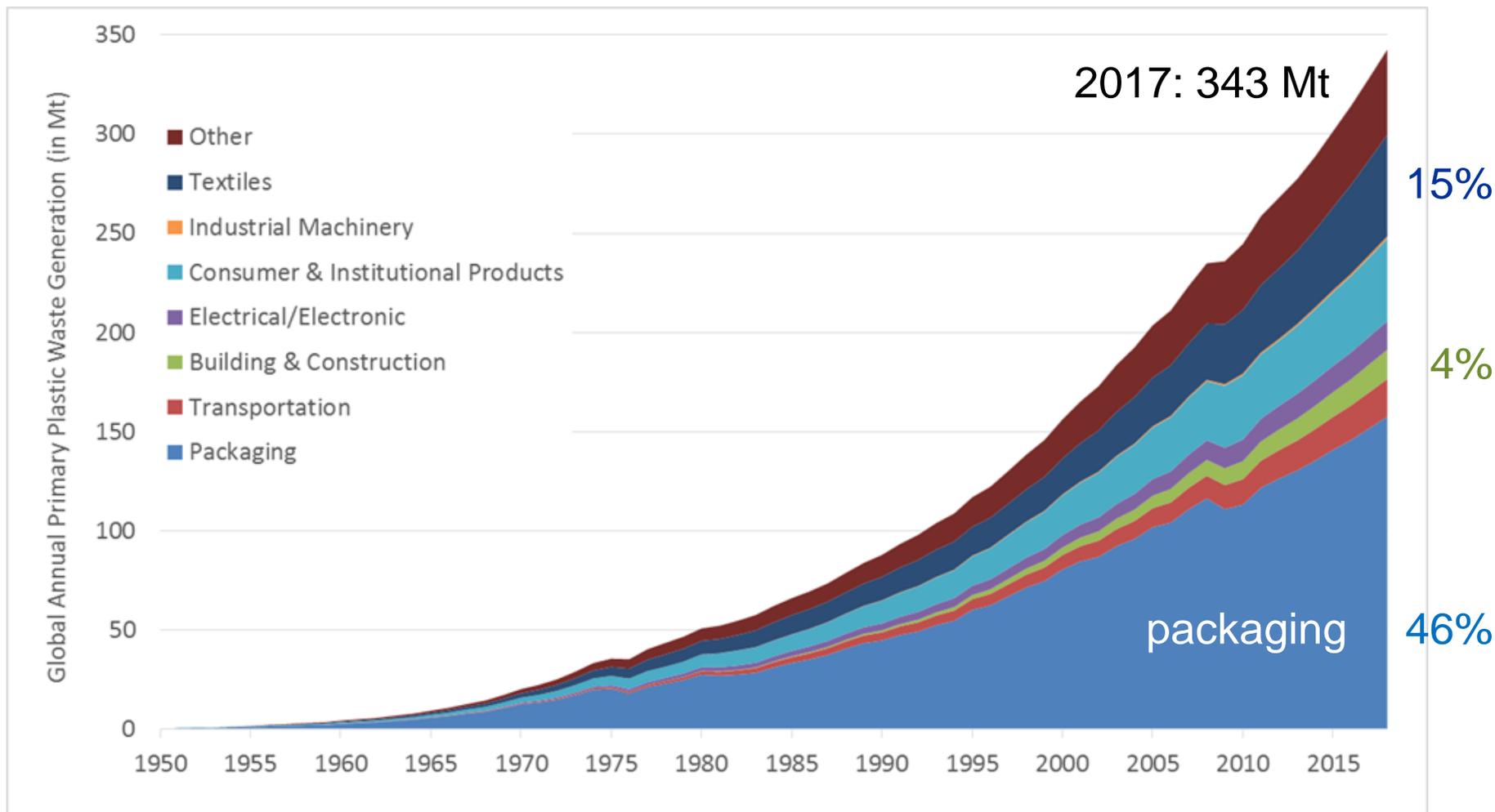
# Plastic production has grown faster than all other materials and economic output



Source: The Future of Petrochemicals, International Energy Agency, 2018



2018 global plastic waste generation was 343 million tonnes (Mt)  
 46% was packaging, 16% fiber, only 4% construction & demolition waste

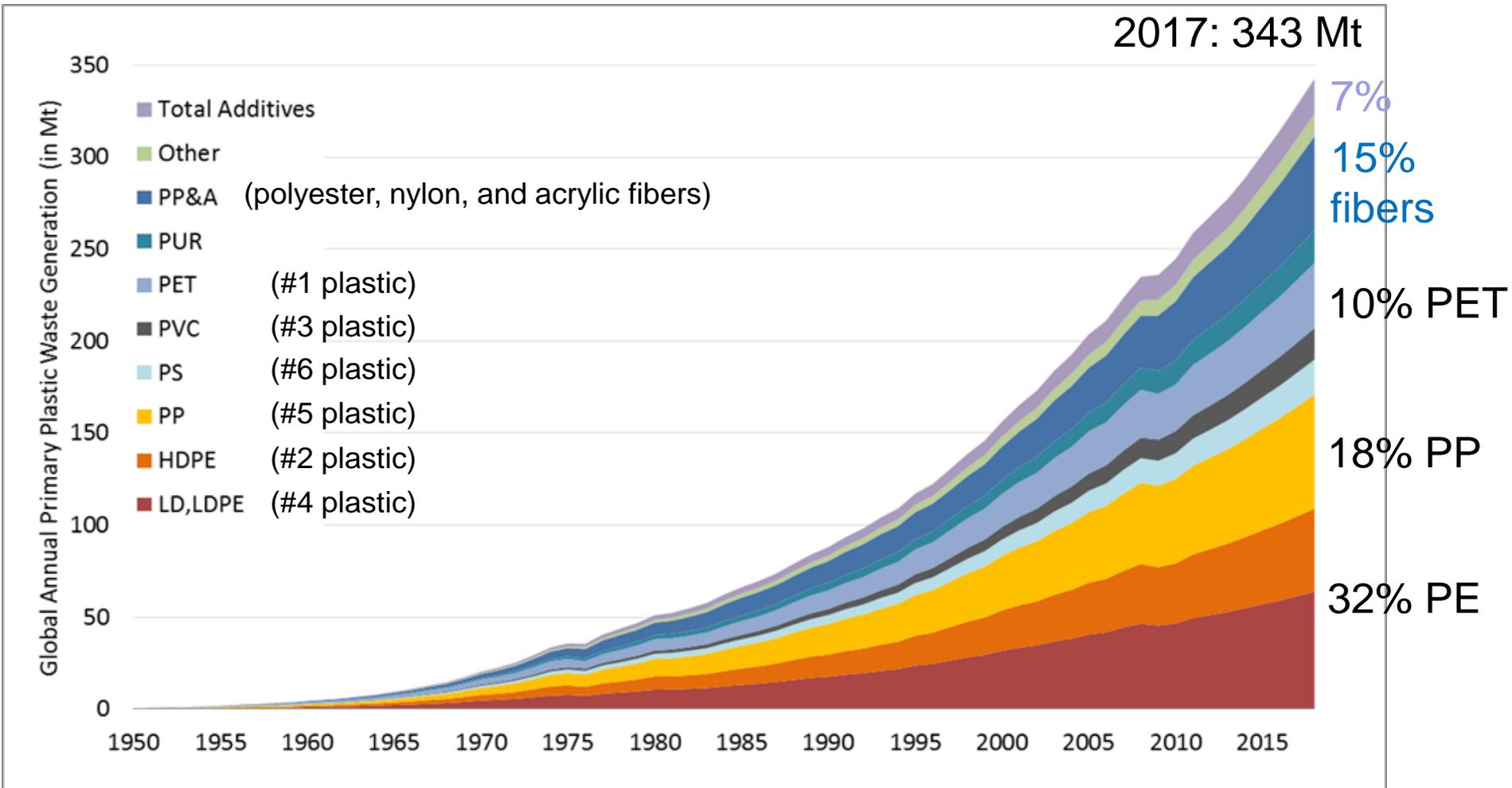


Source: R Geyer, 2020



# 9 thermo-polymers make up over 95% of total plastic waste

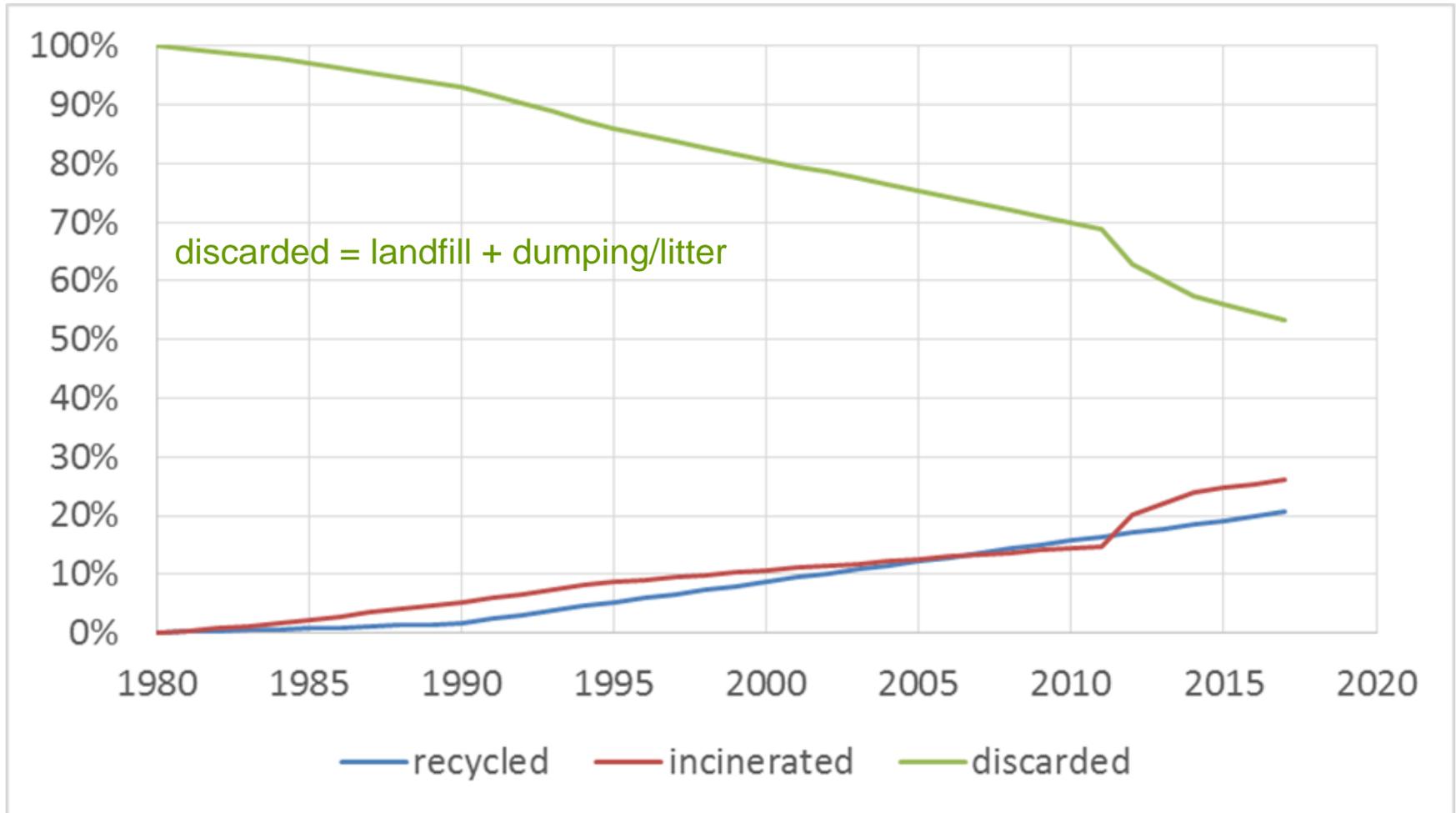
Plastics also contain complex chemicals as additives, 7% on average



Source: R Geyer, 2020



Since 1980 we increased the rate at which we recycle and incinerate out plastic waste, albeit slowly



Source: R Geyer, 2020



# Different countries manage their plastic waste very differently

| <b>Country</b> | <b>Recycling</b> | <b>Incineration</b> | <b>Landfill/Dumps</b> |
|----------------|------------------|---------------------|-----------------------|
| Canada         | 9%               | 4%                  | 86%                   |
| USA            | 9%               | 16%                 | 75%                   |
| China          | 25%              | 30%                 | 45%                   |
| EU 30          | 31%              | 42%                 | 27%                   |
| Indonesia      | 7% *)            | 0%                  | 93%                   |
| Uganda         | 6% *)            | 0%                  | 94%                   |

\*) no specific to plastic

- 50-60% of European and North American plastic waste collected for recycling used to go to China.
- In 2017 China announced its National Sword program, which banned import of recyclables unless minimally contaminated.

Sources: Sci. Adv. 3, e1700782 (2017), Environment and Climate Change Canada, U.S. EPA, Plastics Europe, World Bank



## Summary of environmental issues

| Environmental issue  | Significance                                  |
|--|---|
| Fossil fuel use  | Not significant<br>(6% of oil, 4% of gas)     |
| Production emissions:<br>Climate change, acidification, smog<br>(all driven by fossil fuel combustion) | Somewhat significant<br>(4-6% of fossil GHGs) |
| Production emissions:<br>Human and eco-toxicity  | Fairly significant                            |
| Plastic as environmental pollutant   | Significant                                   |

Source: This is a summary of my personal assessment



# What can be done about plastic pollution?

## Remediation

- Beach cleanups
- The Ocean Cleanup (“great Pacific garbage patch”)

## Pollution Control

- Landfill
- Incineration with energy recovery, pyrolysis

## Pollution Prevention

- Source reduction (use less)
- Reuse & recycling (use again)
- Material substitution (use something else)

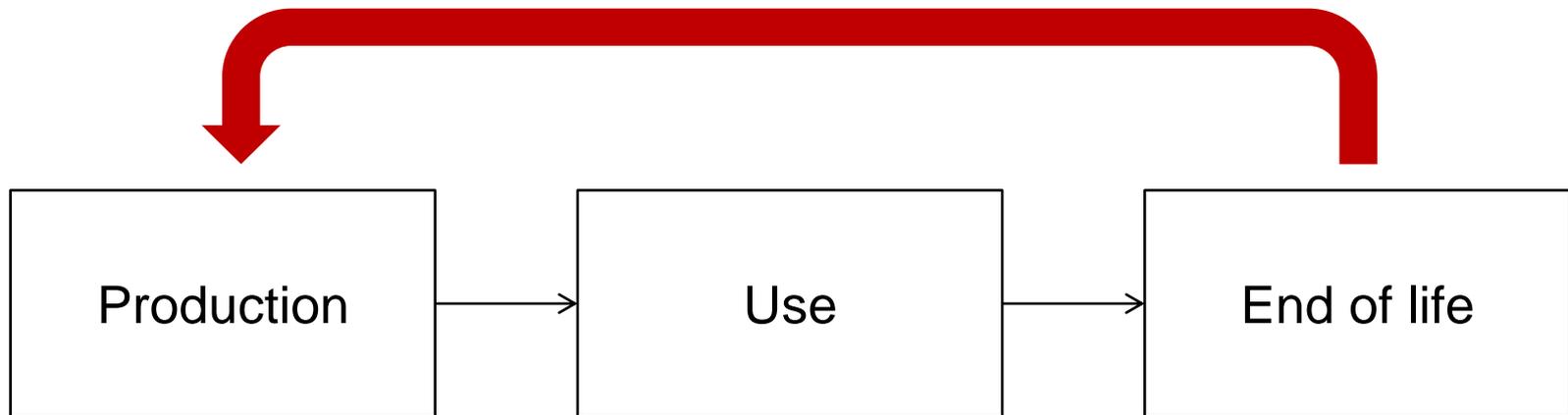


# Material substitution can shift environmental burdens

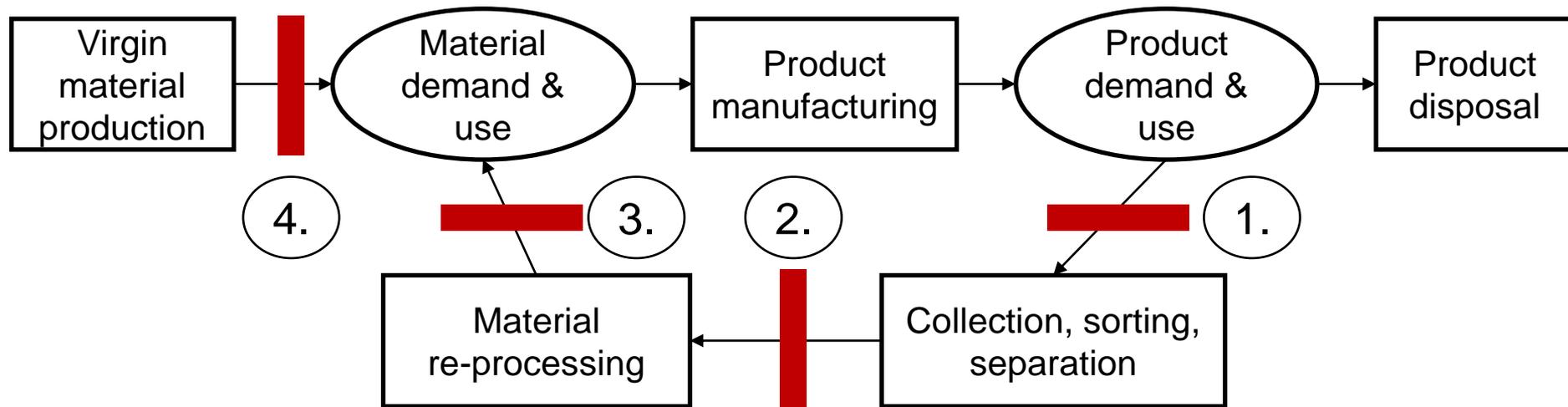
**Risk 1:** Shift environmental burden from one concern to another



**Risk 2:** Shift environmental burden from one life cycle stage to another



# Successful recycling needs to overcome 4 obstacles



## Economic success:

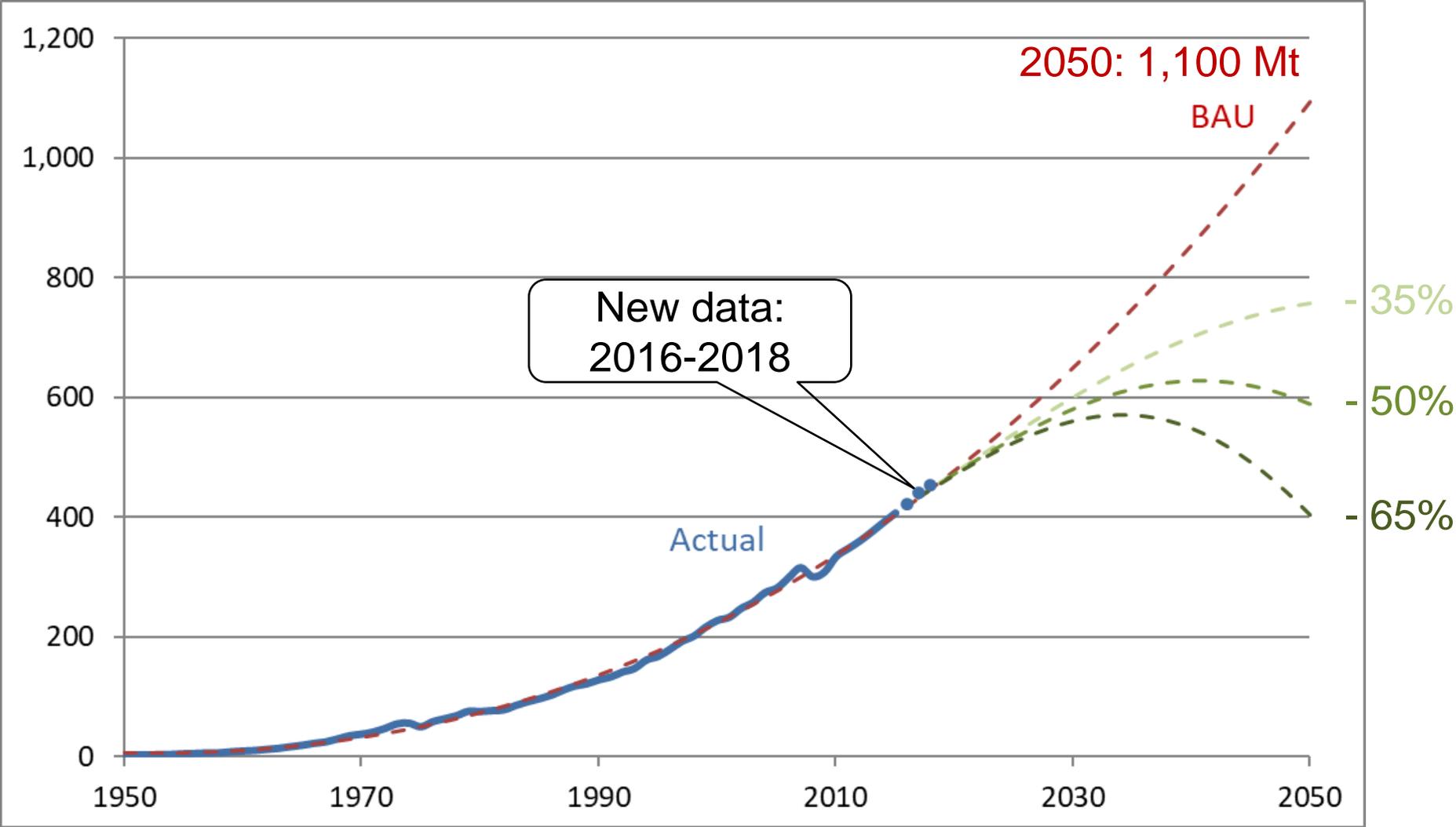
1. Recyclables need to be collected and pre-processed
2. Collected recyclables need to be reprocessed into secondary materials
3. The secondary materials need to have market demand

## Environmental success:

4. The secondary materials need to reduce virgin material production



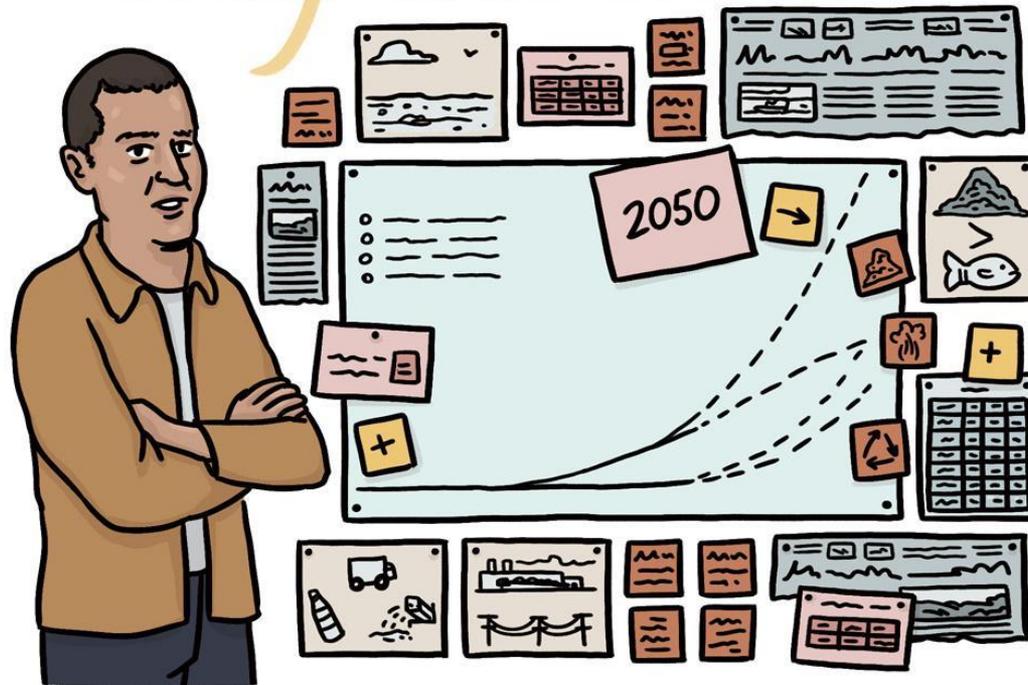
# Bending the curve of global virgin plastic production



Source: R Geyer, 2020



Thank you for your kind attention!



Artwork by  
Susie Cagle

To see the whole comic go to:

<https://www.theguardian.com/us-news/2019/jun/23/all-the-plastic-ever-made-study-comic>



World Bank Group – October 21, 2020

