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Bioplastics: Industry Trends, Criteria and Opportunities

CHE Webinar
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Bioplastics: Current Context

Market share

7.5 million tonnes in 2018 of **350 million tonnes of global plastics production**

(2%)

Projected Growth: Plastics overall 3%; biopolymers 4%

Drivers and Opportunities

Global concern with **plastic pollution**; bans on single-use items, food packaging

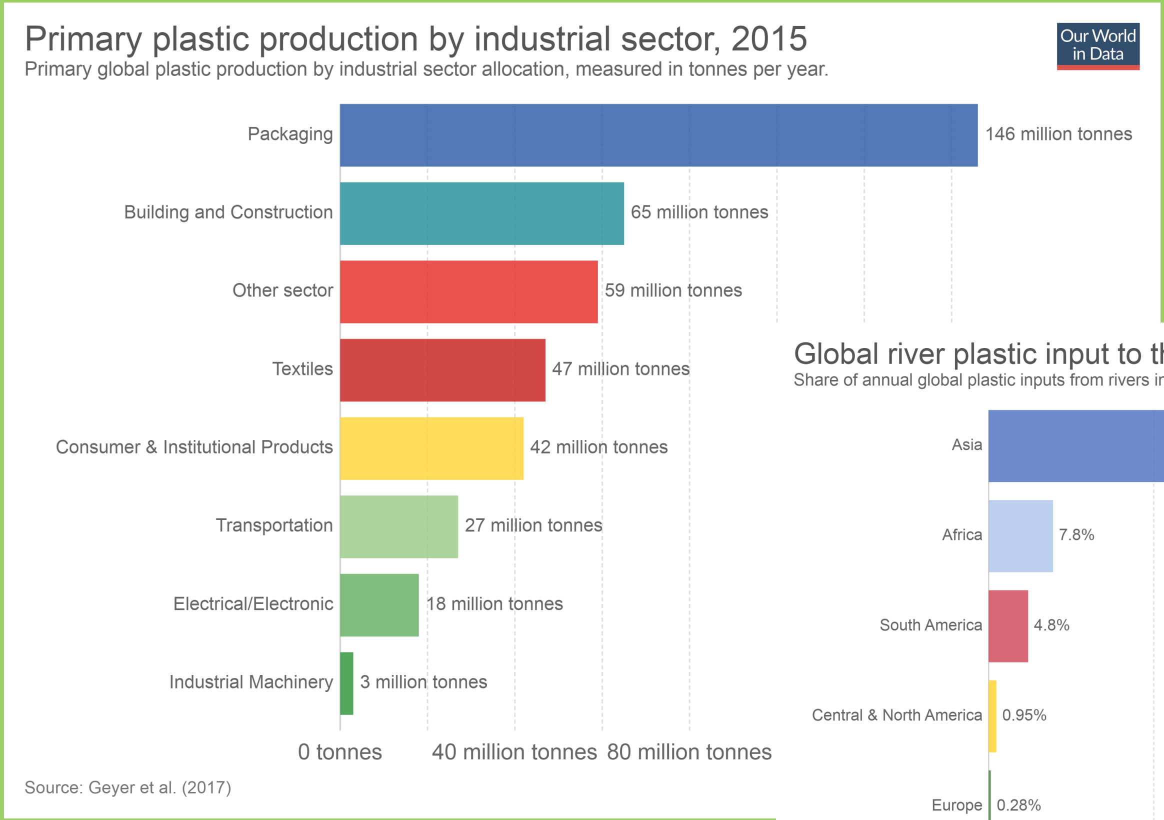
As much as **146 million tonnes (40%)**

of plastics goes to **packaging**

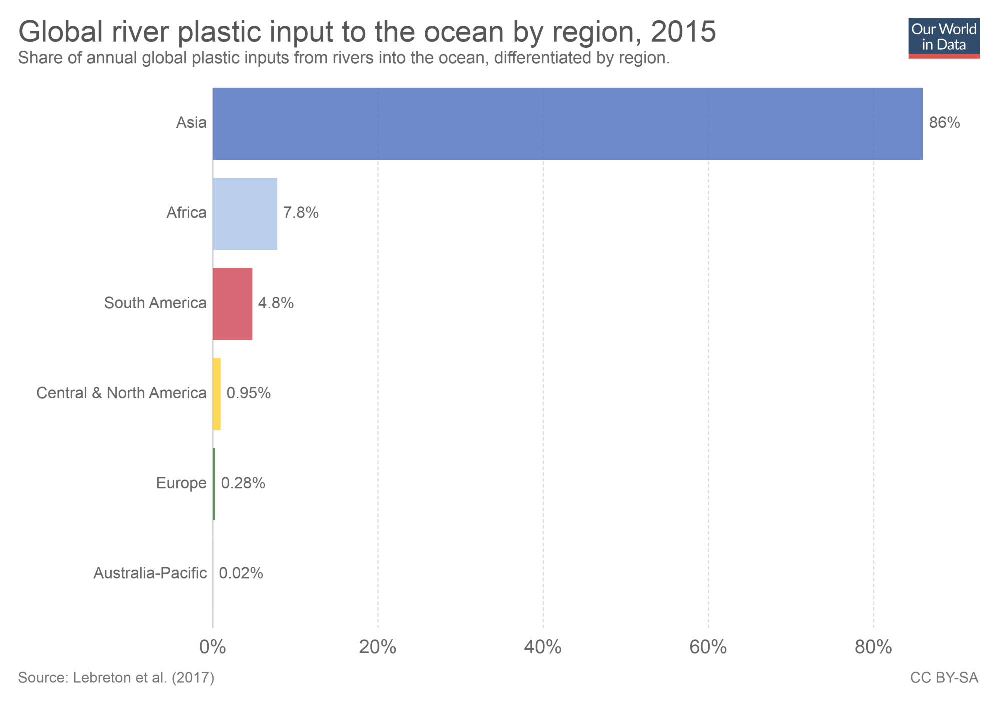
Industry Trends

Alliance to End Plastic Waste (2019)

Increase in number of companies providing bioplastic food packaging (Bioplastics News)


Primary plastic production by industrial sector, 2015
Primary global plastic production by industrial sector allocation, measured in tonnes per year.
Our World in Data
Packaging
146 million tonnes
Building and Construction
65 million tonnes
Other sector
59 million tonnes
Textiles
47 million tonnes
Consumer & Institutional Products
42 million tonnes
Transportation
27 million tonnes
Electrical/Electronic
18 million tonnes
Industrial Machinery
3 million tonnes
0 tonnes
40 million tonnes
80 million tonnes
Source: Geyer et al. (2017)


Drink O-Pop
Maggi
PHAROLIT
NESCAFE
Masako
Super 89
Donat Special


Global river plastic input to the ocean by region, 2015
Share of annual global plastic inputs from rivers into the ocean, differentiated by region.
Our World in Data
Asia
86%
Africa
7.8%
South America
4.8%
Central & North America
0.95%
Europe
0.28%
Australia-Pacific
0.02%
0%
20%
40%
60%
80%
Source: Lebreton et al. (2017)
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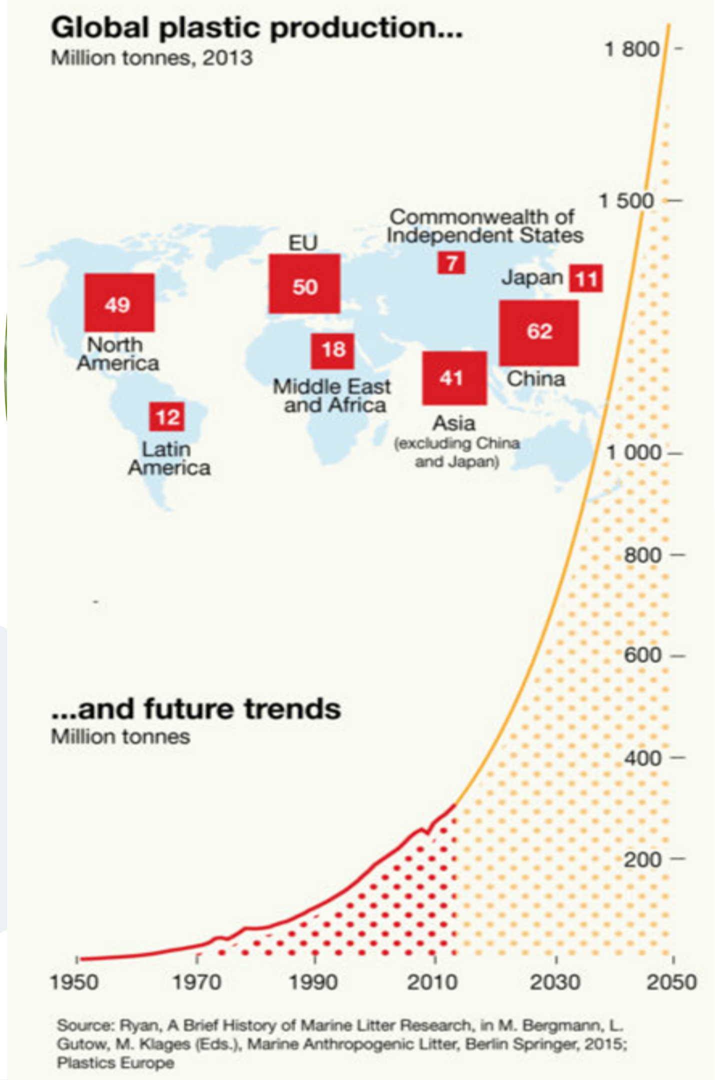
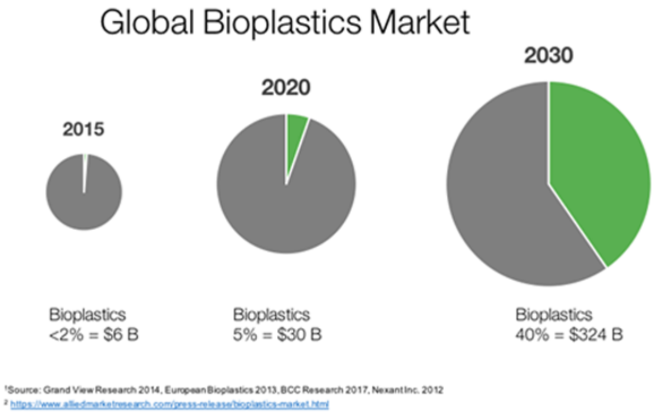
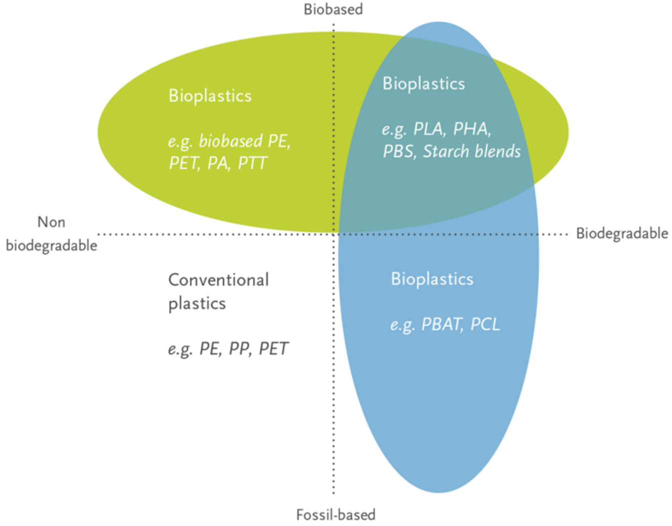


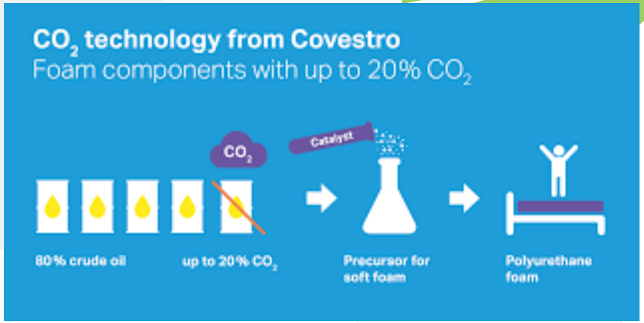
Global plastic production...
Million tonnes, 2013
North America 49
Latin America 12
EU 50
Middle East and Africa 18
Commonwealth of Independent States 7
Asia (excluding China and Japan) 41
China 62
Japan 11
...and future trends
Million tonnes
1 800
1 500
1 000
800
600
400
200
1950
1970
1990
2010
2030
2050
Source: Ryan, A Brief History of Marine Litter Research, in M. Bergmann, L. Gutow, M. Klages (Eds.), Marine Anthropogenic Litter, Berlin Springer, 2015; Plastics Europe



Global Bioplastics Market
2015
2020
2030
Bioplastics
<2% = $6 B
Bioplastics
5% = $30 B
Bioplastics
40% = $324 B
[1]Source: Grand View Research 2014, European Bioplastics 2013, BCC Research 2017, Nexant Inc. 2012
[2] https://www.alliedmarketresearch.com/press-release/bioplastics-market.html



Biobased
Bioplastics
e.g. biobased PE, PET, PA, PTT
Bioplastics
e.g. PLA, PHA, PBS, Starch blends
Non biodegradable
Biodegradable
Conventional plastics
e.g. PE, PP, PET
Bioplastics
e.g. PBAT, PCL
Fossil-based



The Beginning: Feedstocks

Current: Conventional industrial agriculture

PLA: high fossil fuel inputs (pesticides, fertilizers), some GMO; potential competition for feed, fuel, high land impacts

Transition: Use of valorized waste

Landfill methane, bagasse, wood pulp, food waste, even CO2

(PHA, fiber replacements, polyols)

Potential: Regeneratively produced feedstocks

Sugar (glucose), starch, cellulose, lignin, plant oils from **perennial plants** can all be bio-based green chemistry feedstocks

US Department of Energy (2004)

Top Value Added Chemicals from Biomass Volume 1: Results of Screening for Potential Candidates from Sugars and Synthesis Gas

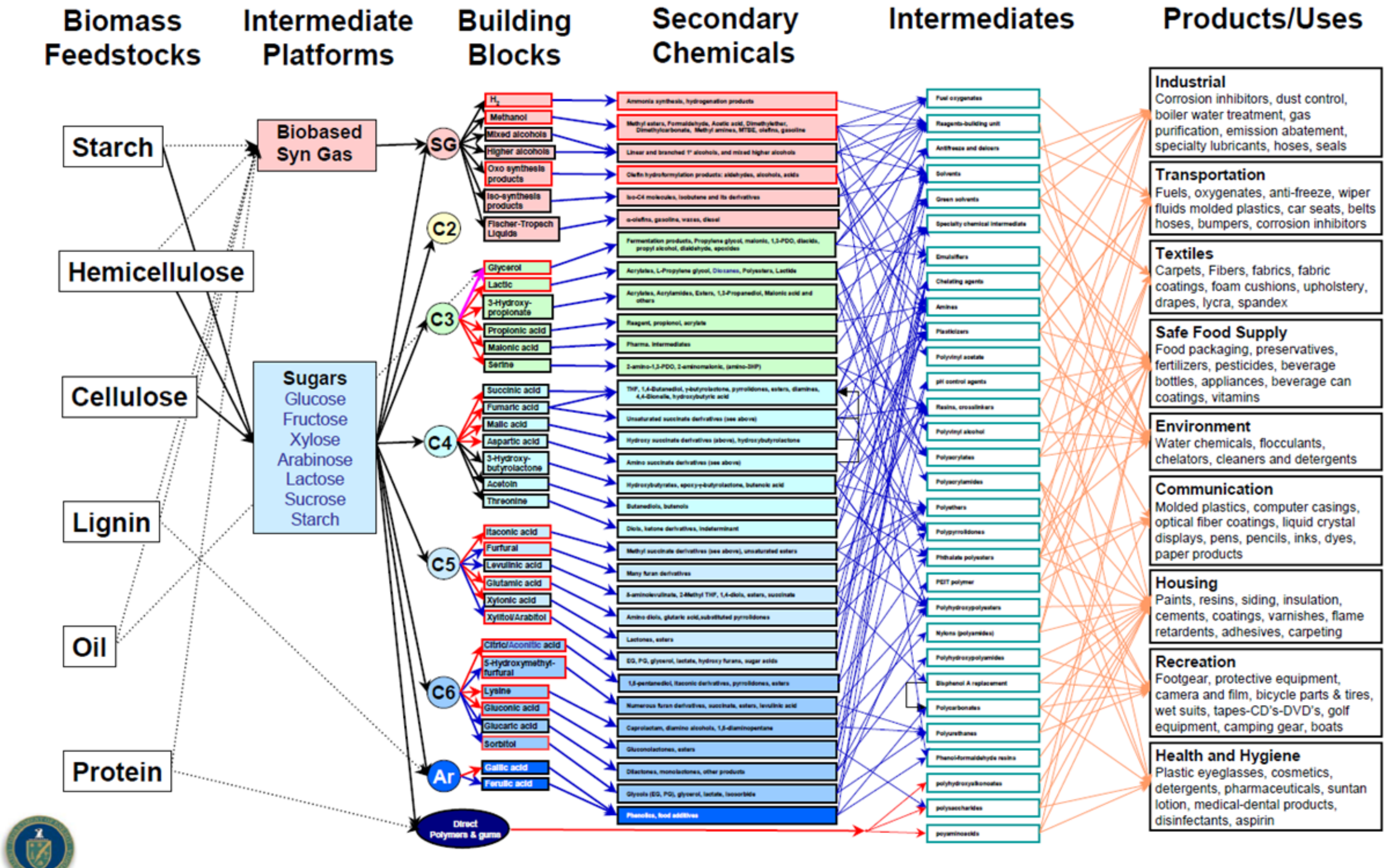


Figure 3 – Analogous Model of a Biobased Product Flow-chart for Biomass Feedstocks

The Middle: Biomaterials Production

Outstanding questions/ concerns:

Better data needed for:

Land use impacts for increased biomaterials production

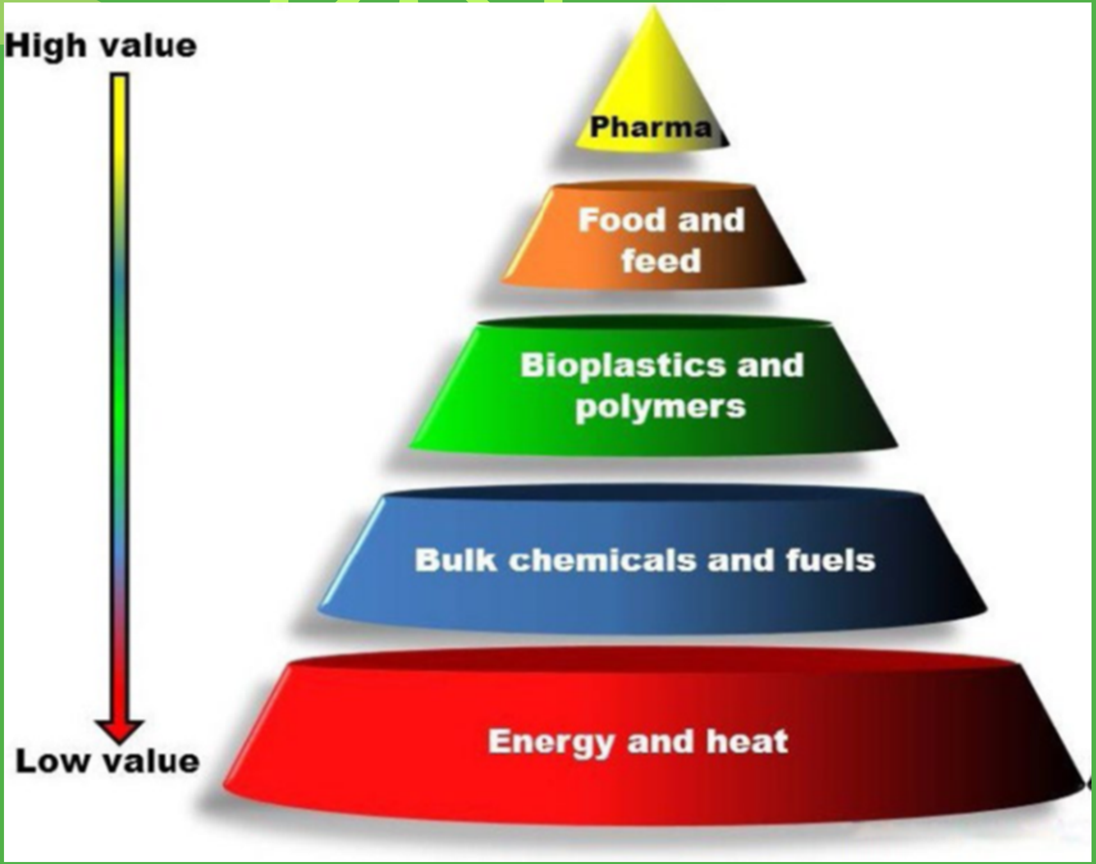
Efficiency of processes converting biomass to usable raw material

Environmental benefits from **biodegradability**

"**Bioplastics from conventional feedstocks are not necessarily more sustainable** (as measured by GHG) due to direct and indirect emissions from land use)"

(Escobar et al., *Land use mediated GHG emissions and spillovers from increased consumption of bioplastics*, Environmental Research Letters, December 2018)

EU Bioeconomy Blueprint: Biomass Value Pyramid



Perennial Industrial Crops: An Opportunity

Perennial crops, grown under regenerative agriculture practices (agroecology, agroforestry) are available globally

Co-benefits: restore vastly degraded global soils, increase water retention, addressing global drought.

A 2% increase of global soil carbon content could offset all global emissions (Rattan Lal, The Ohio State University)

Urgent Need for Robust Life-cycle Criteria for Biomaterials

Is it necessary? Redesign; eliminate single-use packaging.

FEEDSTOCK: should utilize an existing waste (as a transition approach) OR be **regenerative.**

MANUFACTURING : Non-toxic: should not simply make the same toxic chemical feedstocks from bio-based sources.

Achieve function without toxic additives (see: redesign)

END OF LIFE: Truly **biodegradable** and accurately labeled for home, industrial composting, or marine environments.

Develop appropriate waste management infrastructure.

SBC

SUSTAINABLE BIOMATERIALS COLLABORATIVE

Sustainable Biomaterials Collaborative* in 2009 published: **Guidelines for Sustainable Bioplastics**

* Clean Production Action, Healthy Building Network, Institute for Local Self Reliance

Proposal:

Expand and update existing criteria.

Create a certification with global scope.

What next?

LIFE CYCLE CRITERIA

Agree on robust third-party criteria for biomaterials: **regenerative feedstocks, non-toxic manufacturing, and truly biodegradable**

CASE STUDIES

Generate on-the-ground **data** on impacts of biomaterial production through entire life cycle.

ROADMAP

Which material sectors are ripe for transformation (hint: packaging)

GOAL:

Thriving, equitable local economies with bio-based materials that restore soil fertility, sequester carbon and improve public health.