

Biomaterials Session, June 17, 2022



Radical
P L A S T I C S

a radical solution to plastic pollution

Dr. Yelena Kann, Founder and CEO

Plastics – where are we today?

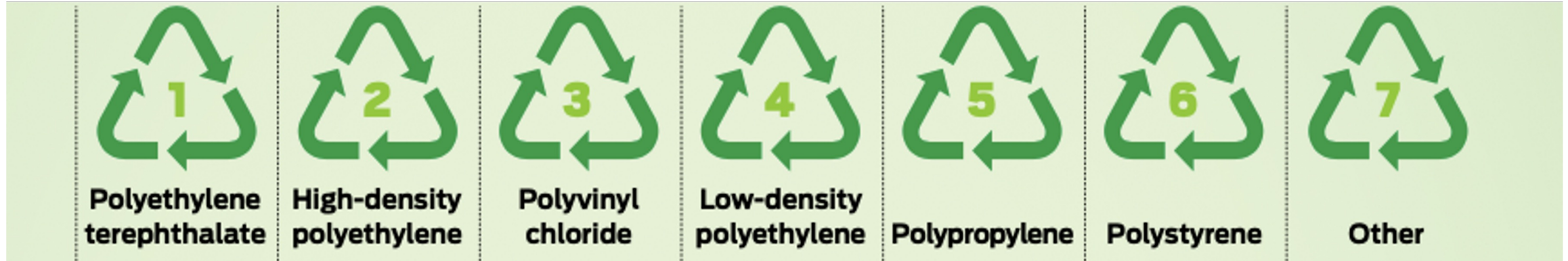
- \$650B industry with 5-8.5% growth per year
- Plastics produced (2020): 400M tons per year
 - ~5% of all oil consumption and 5% of all energy is used for plastics production
 - Only 2M tons per year are bio-based (0.5%)
- Only 9% of all plastics ever made have been recycled (<1%, closed loop recycling)
- 12B tons expected in landfill by 2050
- 8M tons leak into oceans per year

<https://purworldindata.org/faq-on-plastics#how-much-plastic-and-waste-do-we-produce>



Recycling rates of plastics are low

US recycling data, 2018*



Recycling rates

18.2%	9.4%	negligible	4.2%	0.6%	0.4%	NA
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- All polyethylenes and polypropylenes combined have lower overall recycling than even PET
- Plastics have low recycling rates compared to metals (72 - 88%), paper (65%) and glass (33%)

* American Chemical Society, *The Future of Plastic*, 2020

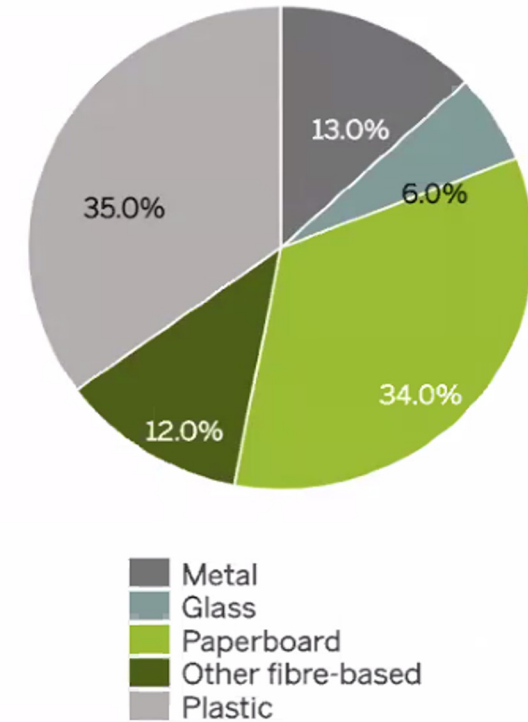
Plastics are still **greener** than other materials

Cradle-to-Grave LCA of Single-serving Soft Drink Containers

2016 EPA, Franklin Associates, August 2009

Container Type	Energy (M BTU)*	Solid Waste (per 100K ounces drink)		Tons of CO2 eq/ton of Container
		Wt (lb)	Vol. (cu yard)	
Aluminum Can	16	767	0.95	11.1
Glass Bottle	26.6	4,457	2.14	19.4
Plastics Bottle	11	302	0.67	2.2

Packaging: breakdown by materials



Source: Smithers Pira

Plastics save energy, produce less waste and emissions compared with alternative materials

Plastics are still **greener** than other materials

Cradle-to Grave LCA of Grocery Bags

2014 R. Kimmel et al, Clemson University

https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=1006&context=cudp_environment/

C. DeArmitt, *Plastics Paradox*, 2020

	Impact Summary of Various Bag Types		
	(Carrying Capacity Equivalent to 1000 Paper Bags)		
	Paper (30% Recycled Fiber)	Compostable Plastic	Polyethylene
Total Energy Usage (MJ)	2622	2070	763
Fossil Fuel Use (kg)	23.2	41.5	14.9
Municipal Solid Waste (kg)	33.9	19.2	7.0
Greenhouse Gas Emissions (CO2 Equiv. Tons)	0.08	0.18	0.04
Fresh Water Usage (Gal)	1004	1017	58



Paper bag requires 2.7x more energy, 17x more water and emits 1.6x more carbon dioxide. For the same LCA as a single plastic bag, a paper bag has to be reused at least 4x and a cotton bag at least 173x.

Image courtesy of Perfectpackaging.org

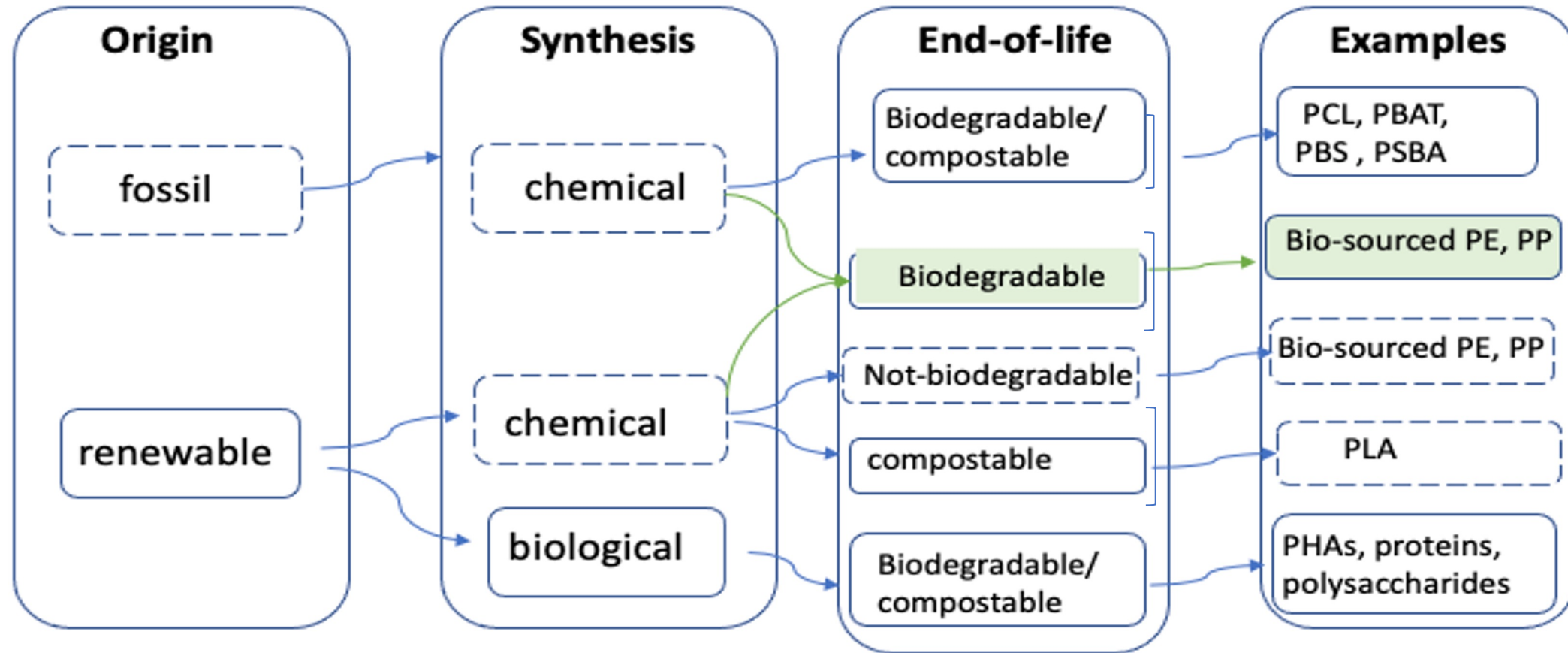
We cannot build sustainable society without plastics!

To further improve sustainability we need to:

- Promote **Circularity** (extend carbon utilization, prevent manufacturing of low-quality plastic). Cannot decarbonize plastics.
- **The most critical issue is End-Of-Life options for plastics**, which should be the primary focus
 - Possible solutions:
increasing recycling (physical, chemical, and biological) – **biodegradable plastics**
- Reduce and eliminate **Environmental Pollution**



Expansion of current bioplastics space with Radical Plastics technology



Starting with polyolefins, next addressable polymers are acrylics, styrenics, vinyls

Compostable: biodegradable at composting conditions. Biodegradable: biodegradable in soil, marine (natural environment)

Radical Plastics Technology: A Simple Formulated Solution Providing Environmental Bio-degradability



Readily available mineral by-product of mining industry



Catalyst and inhibitors



Fossil fuel and bio-polymers

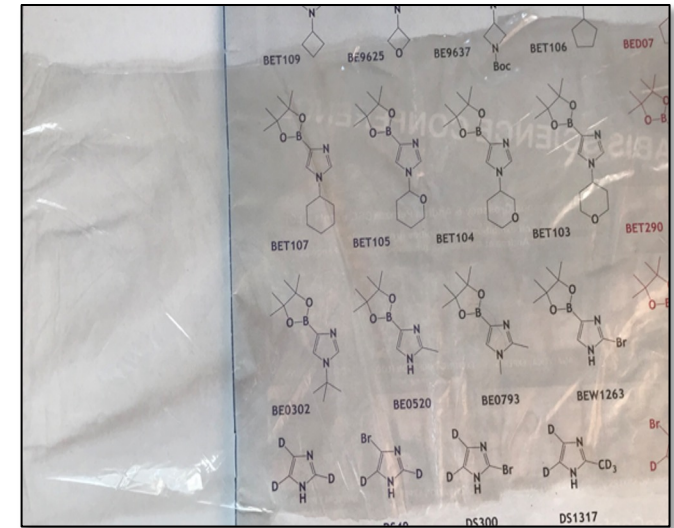


FULLY BIODEGRADABLE in the natural environment

- Fully formulated pellets
- Controlled onset and rate of degradation (4 months – 2 years)
- Fully recyclable along with conventional plastics
- Patented technology translatable to different plastic types

The Radical Plastics Solution

- Drop-in replacement for conventional plastics
- Built-in tuneable trigger initiates chemical degradation so that length of service life is controlled
- Complete end-of-life environmental biodegradation
 - Carbon sequestration in soil
 - No toxic by-products
 - Beneficial effect on the soil microorganisms and plants
- Mineral additive: a zero-waste initiative, economical
- Easy processability
- Economical
- Initial focus on Ag films (\$4B market)
- Longer term: flexible packaging (\$150B market)



**Transparent with slight
earth tone tint**

2020 - 2021 Film Field Test for Watermelon Farming

Univ. of Florida, Institute of Food and Agricultural Sciences

Watermelon production



**Radical Plastics
Formulated PE Film**



Bed Preparation



Harvest

Radical Plastics Formulated PE Film*



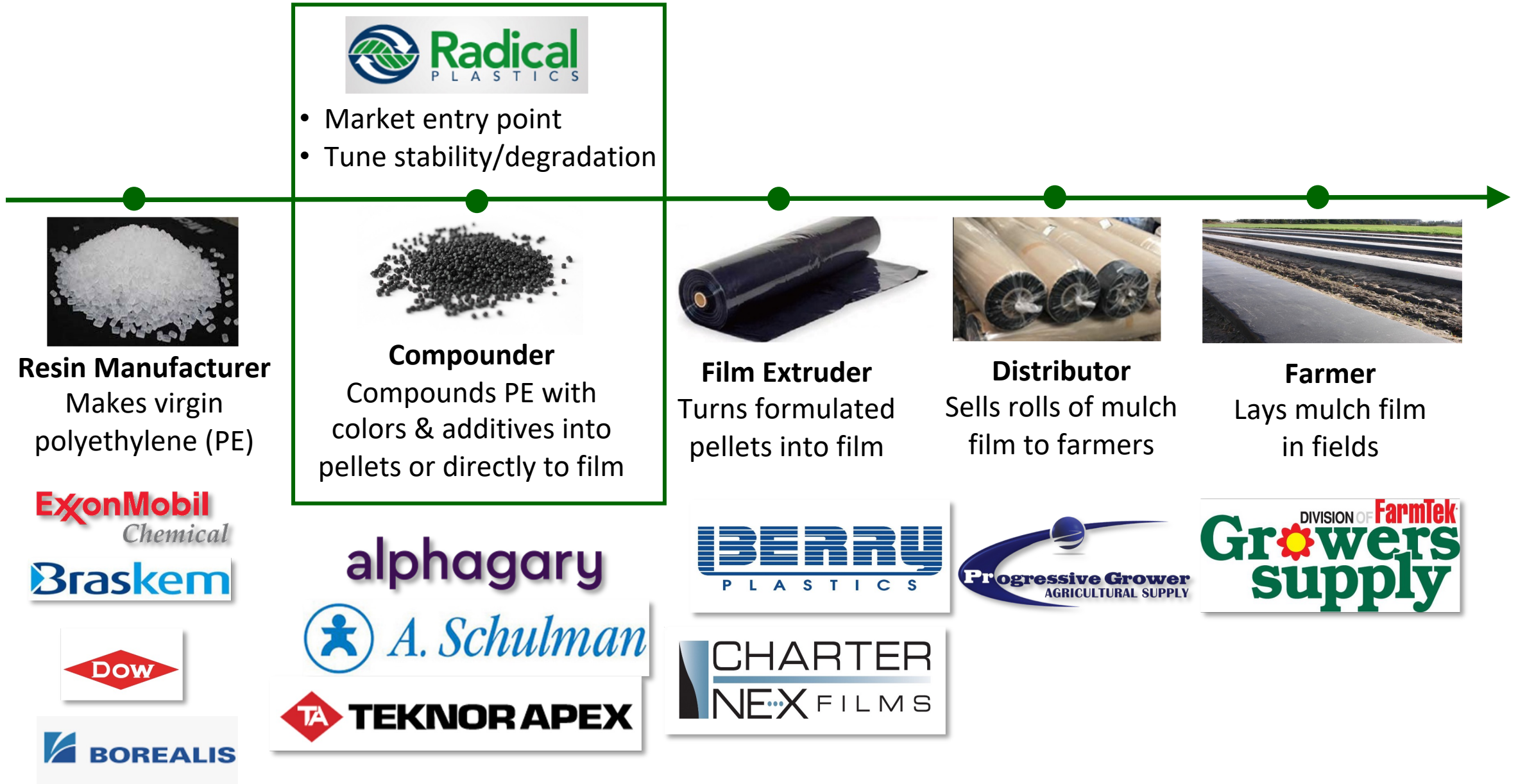
Films at 21 Days after Harvest

Conventional PE

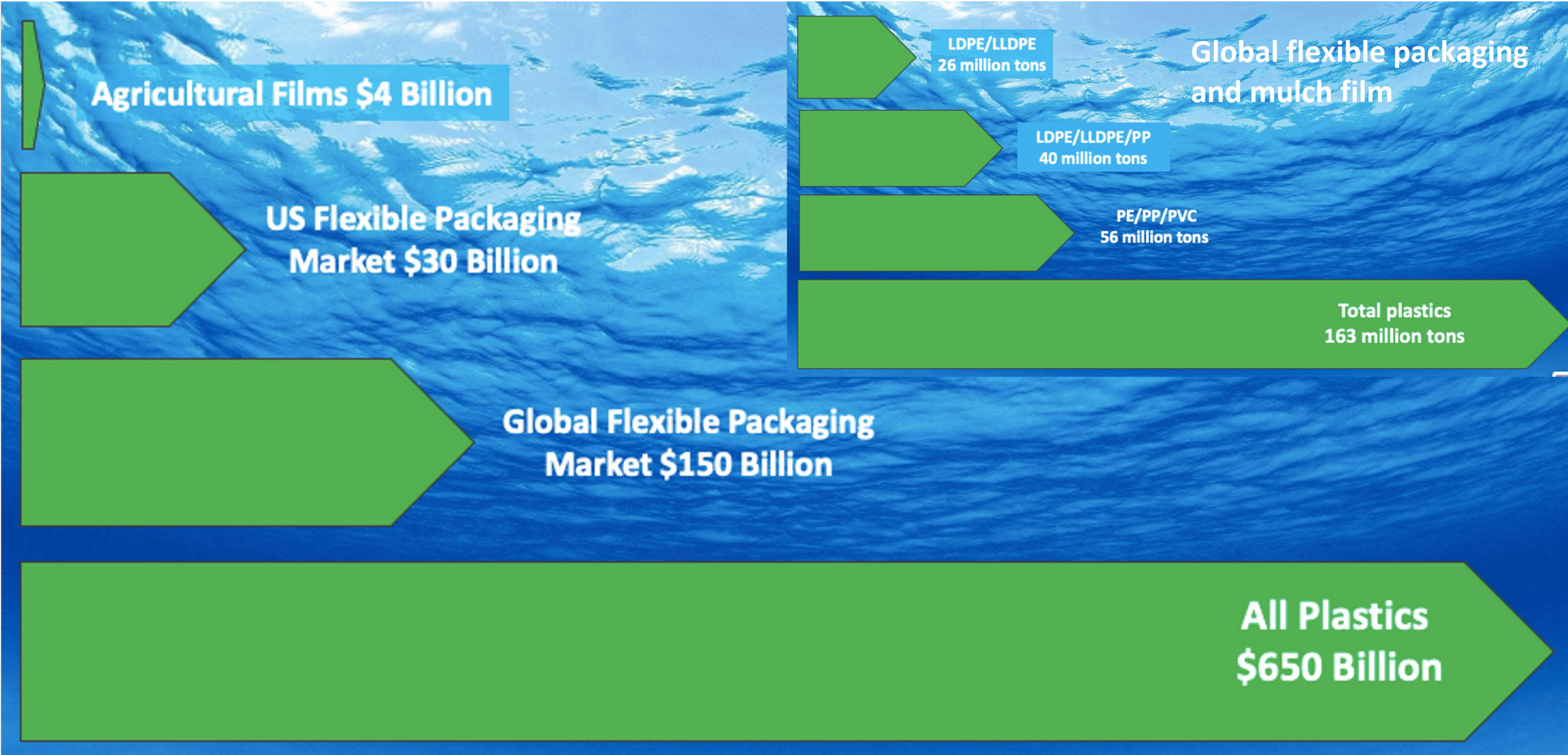


* 22 microns, 21" width, funded in part by USDA phase 1 and phase 2 SBIR grant

Mulch Film Supply Chain: Go-to-Market Partnerships



Cleaner, Greener Future



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Thank You!