

# Technoeconomic Analysis & Lifecycle Analysis to Enable Circular Plastics

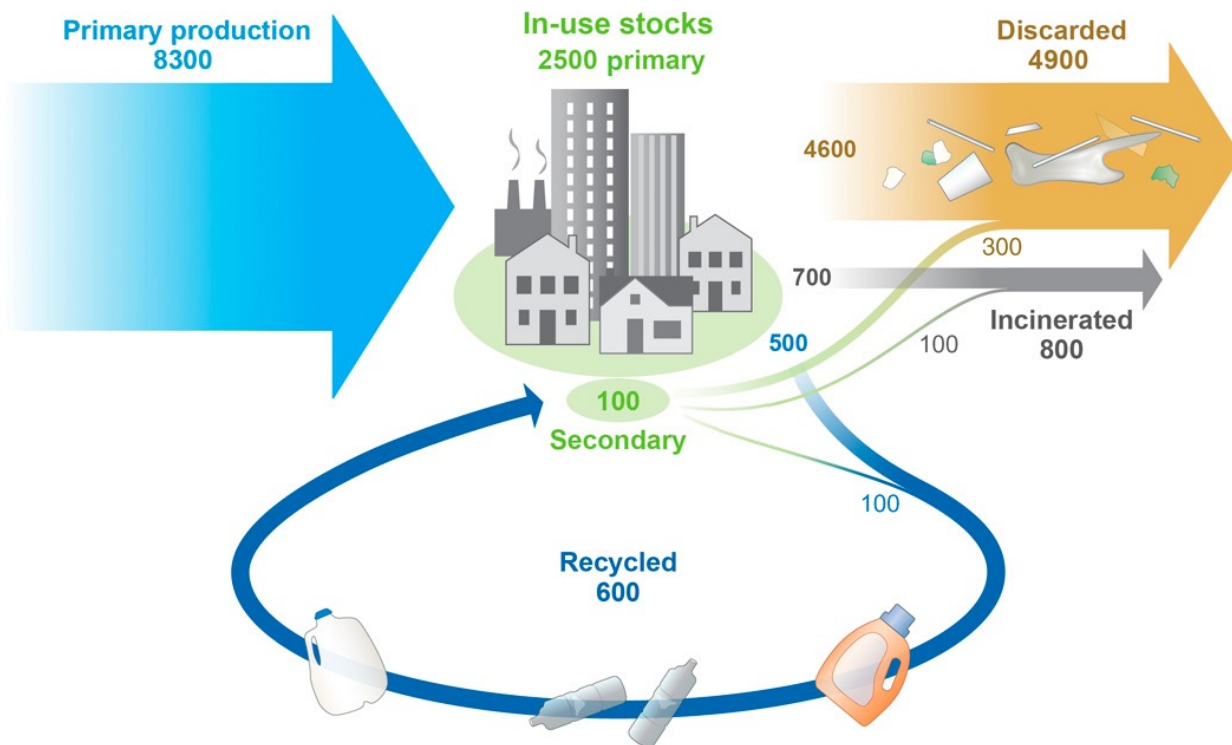
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June 10, 2021



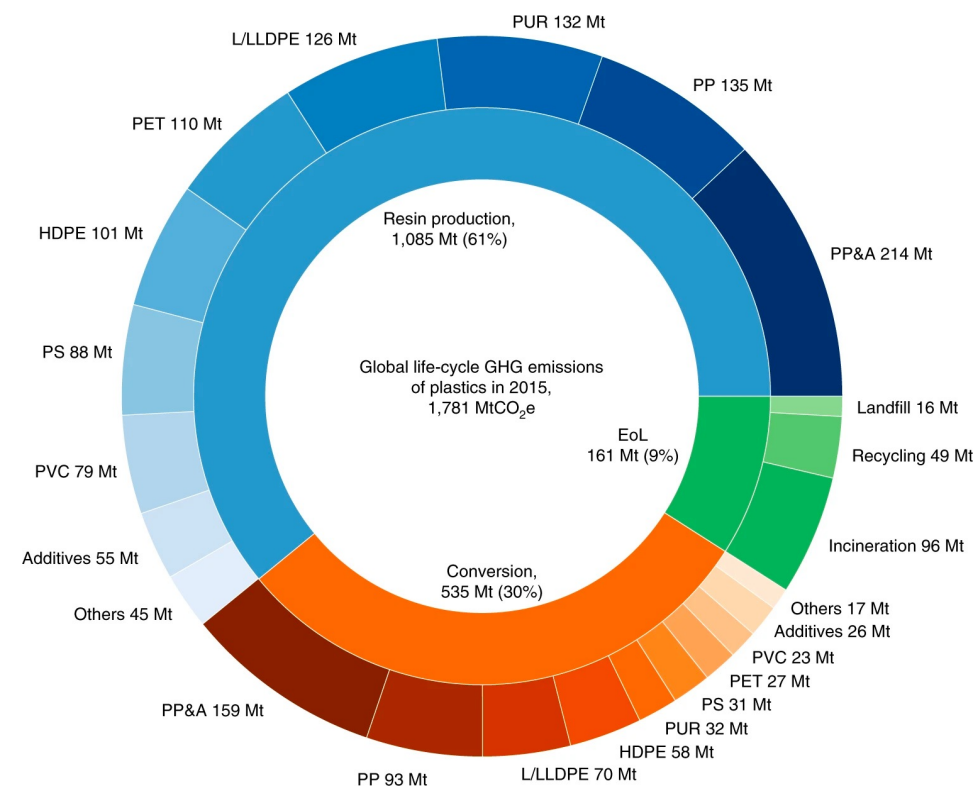
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# A Multi-Faceted Problem



Source: Geyer et al. (2017) *Science Advances*



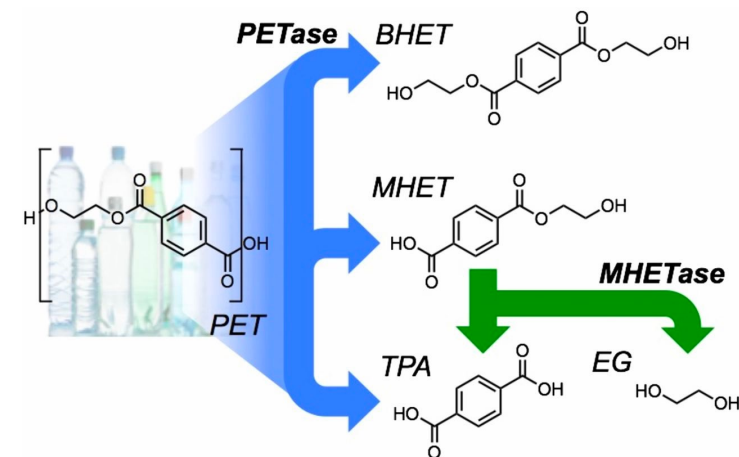
# Paths to Circularity and Waste Reduction



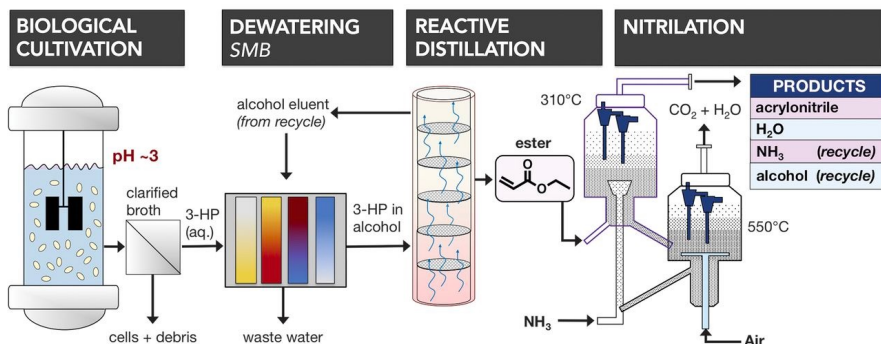
Compostable/Biodegradable Plastics



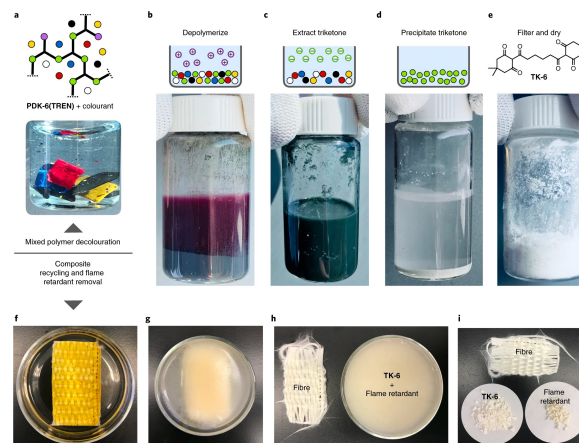
Non-Plastic Substitutes



New Methods for Decomposing Plastics



Bio-Based Drop-In or New Plastics



Easier-to-Recycle Plastics

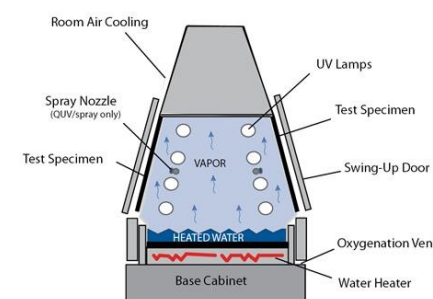
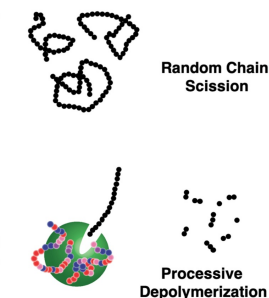
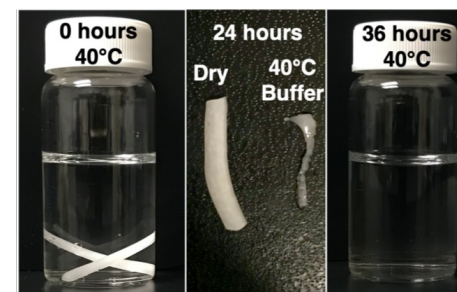
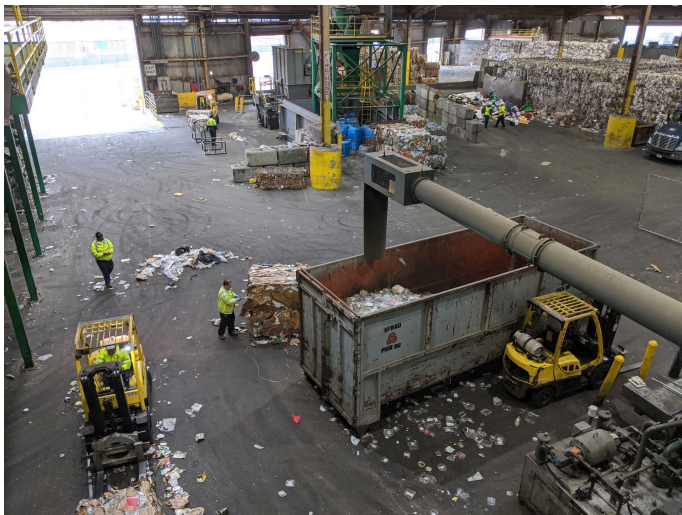


Infrastructure/Systems Changes



# Testing to Under a Variety of Conditions

Our history of partnering w/ composting facilities, dry AD facilities, wastewater treatment plants, & recycling facilities puts us at an advantage for testing under *realistic* conditions





# Ensure Good Intentions Translate to Good Outcomes



PLASTIC RECYCLING CHART						
1	2	3	4	5	6	7
PET	HDPE	PVC	LDPE	PP	PS	OTHER
POLYETHYLENE TEREPHTHALATE	HIGH DENSITY POLYETHYLENE	POLYVINYL CHLORIDE	LOW DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	OTHER PC POLYCARBONATE
COSMETIC CONTAINERS FOOD JARS JELLY AND JAM CONTAINERS MOUTHWASH BOTTLES PEANUT BUTTER CONTAINERS PLASTIC BOTTLES PREPARED FOOD TRAYS SALAD DRESSING BOTTLES SINGLE USE WATER BOTTLES SOFT DRINK BOTTLES SPORT DRINK BOTTLES	AGRICULTURAL PIPE DETERGENT BOTTLES EXTRUDED PIPE GROCERY BAGS ICE CREAM TUBS MILK JUGS JUICE JUGS OIL VINEGAR BOTTLES PAIRS PLAYGROUND EQUIPMENT SHAMPOO BOTTLES SHIPPING CONTAINERS	BLISTER PACKS BLOOD BAGS CABLE SHEATHING CARPET BACKING FLOOR TILES GARDEN HOSE MEAT WRAP MEDICAL TUBING OUTDOOR FURNITURE PAVING PIPE WINDOW FRAMES WIRE INSULATION	6-PACK RINGS BREAD BAGS DRY CLEANING BAGS GARBAGE BAGS HEAVY DUTY BAGS MOLDED LABORATORY EQUIPMENT PLASTIC FOOD WRAP RECYCLING BINS SQUEEZABLE BOTTLES TOYS	BOTTLE CAPS CEREAL LINERS COTTAGE CHEESE CONTAINERS HINGED LUNCH BOXES KETCHUP BOTTLES MARGARINE CONTAINERS MEDICINE BOTTLES MICROWAVE OVENWARE PACKING TAPE POTATO CHIP BAGS RUBBERMAID CONTAINERS STRAWS	CAFETERIA TRAYS CD AND VIDEO CASES DISPOSABLE HOT OR COLD DRINK CUPS & PAPER PLATES DRINKING GLASSES EGG CARTONS FAST FOOD CLAMSHELLS FOAM PACKING HINGED BAKERY CONTAINERS PACKING PEANUTS PLASTIC CUTLERY STYROFOAM TOYS YOGURT CONTAINERS	BABY BOTTLES CAR PARTS FIBERGLASS LARGE WATER BOTTLES NALGENE BOTTLES SIPPY CUPS TUFFWARE WATER COOLER BOTTLES

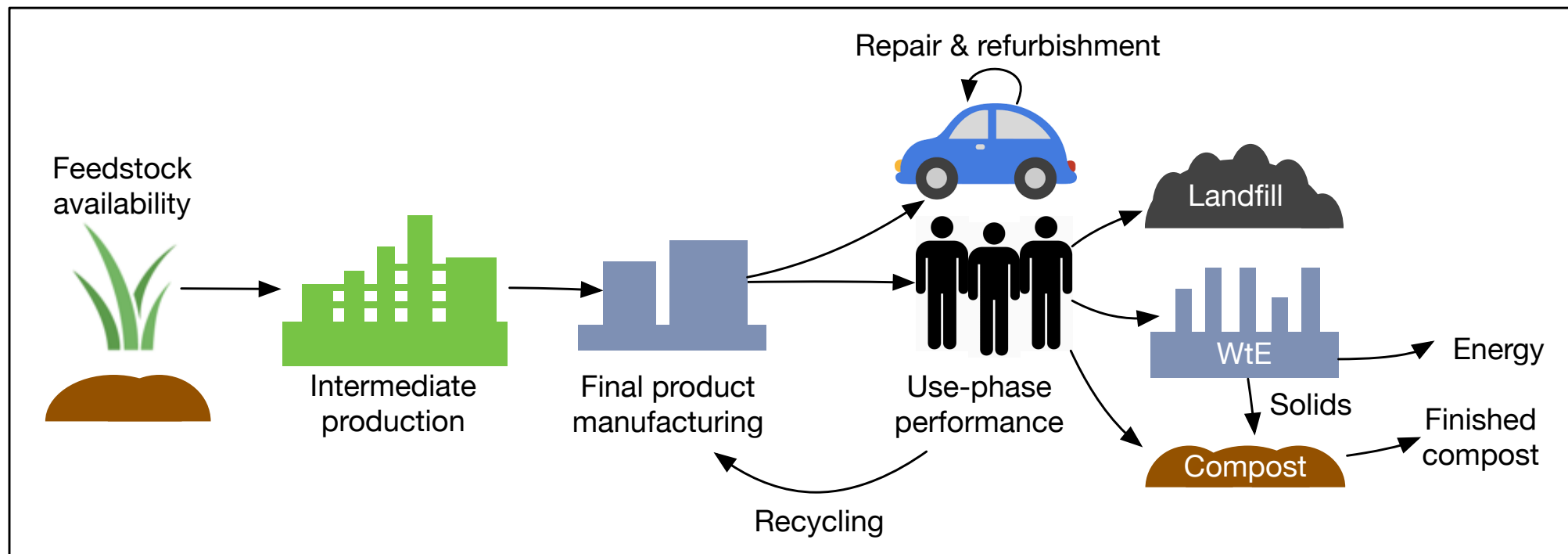
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# Research w/ an Eye Towards Large-Scale Impact

- Modeling helps us understand how economics, environmental impacts will change over time



Input  
cost

Logistics

Facility  
OPEX &  
CAPEX

Logistics

Facility  
OPEX &  
CAPEX

Logistics

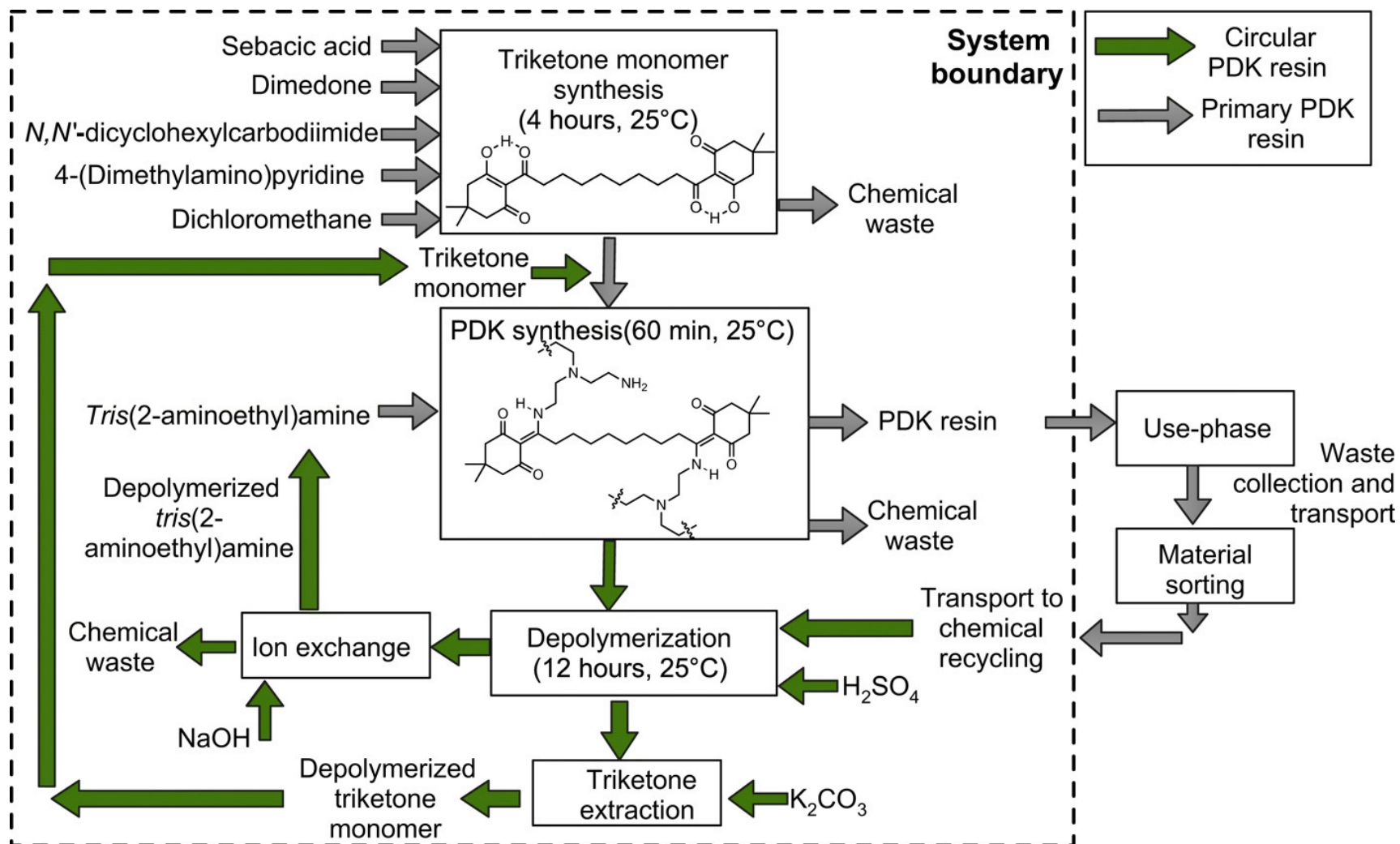
Use-phase  
performance,  
cost of  
ownership

Logistics

Landfilling  
costs, energy  
and material  
recovery



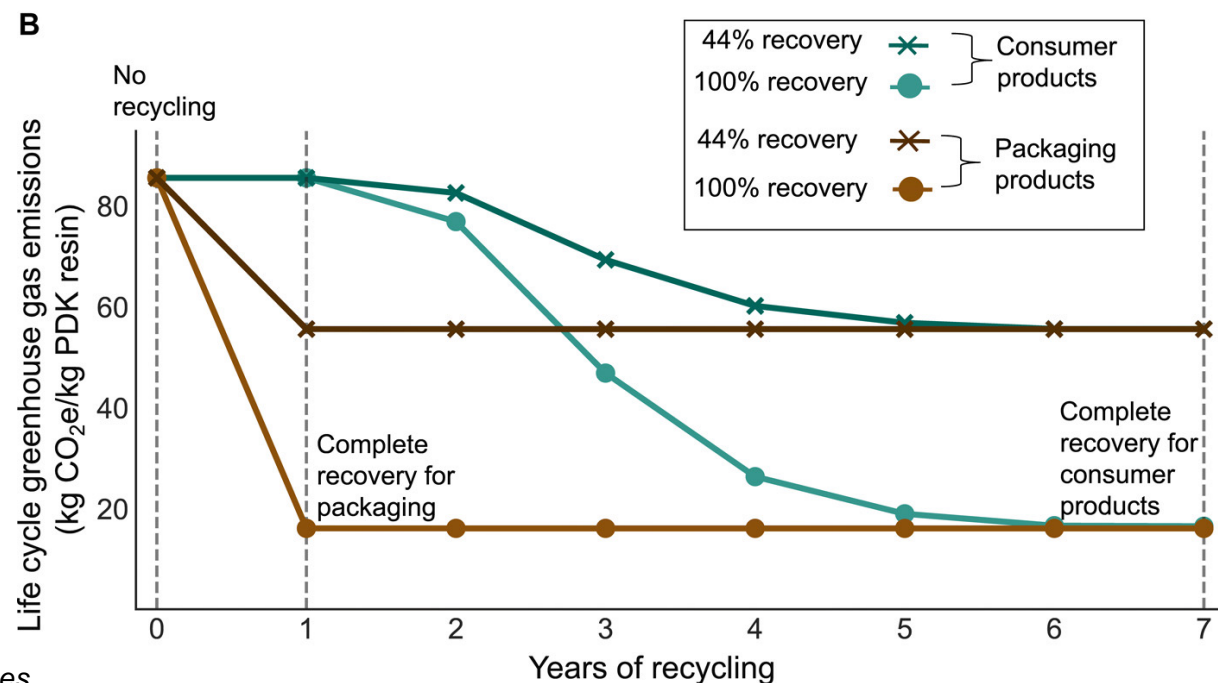
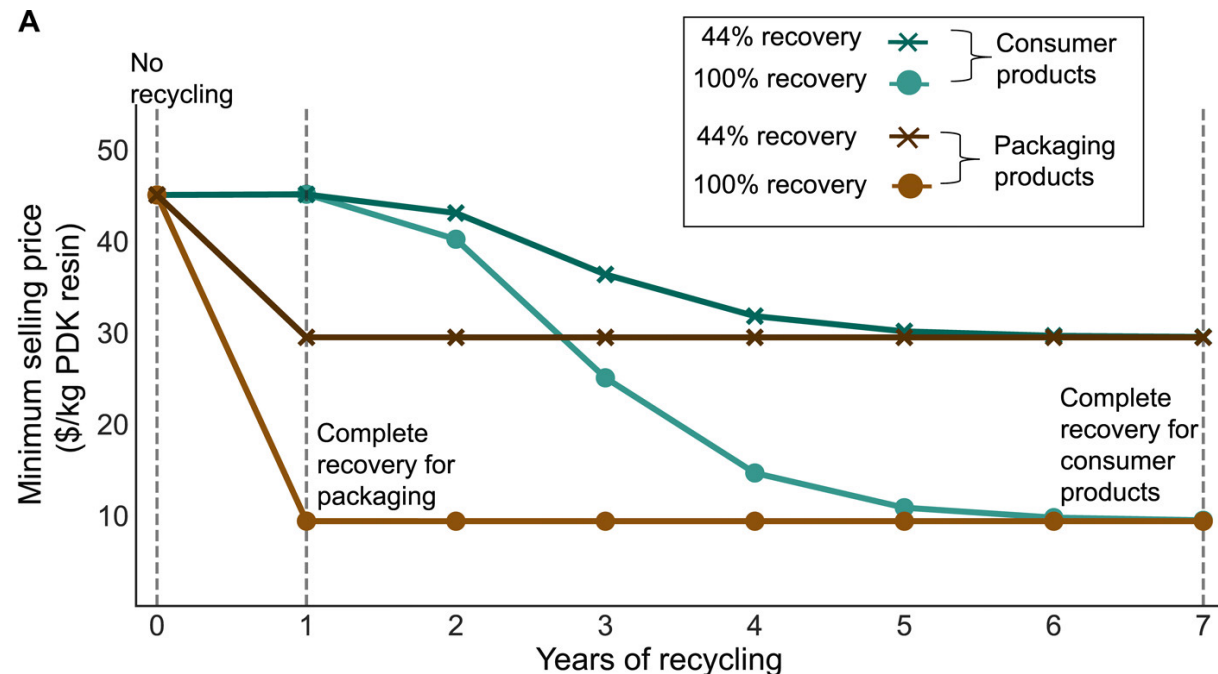
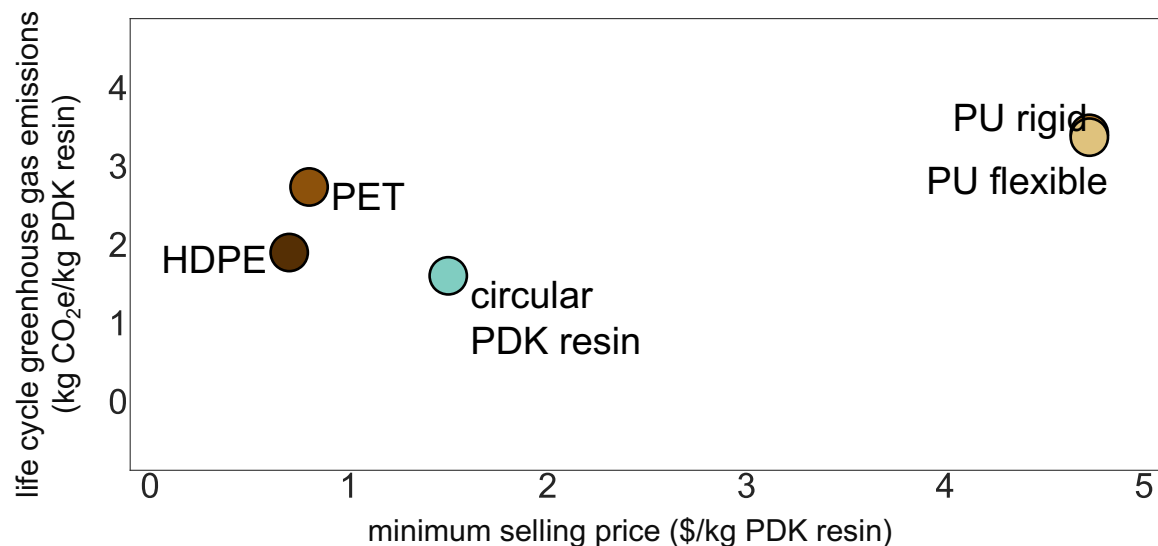
# PDKs as Circular Plastics





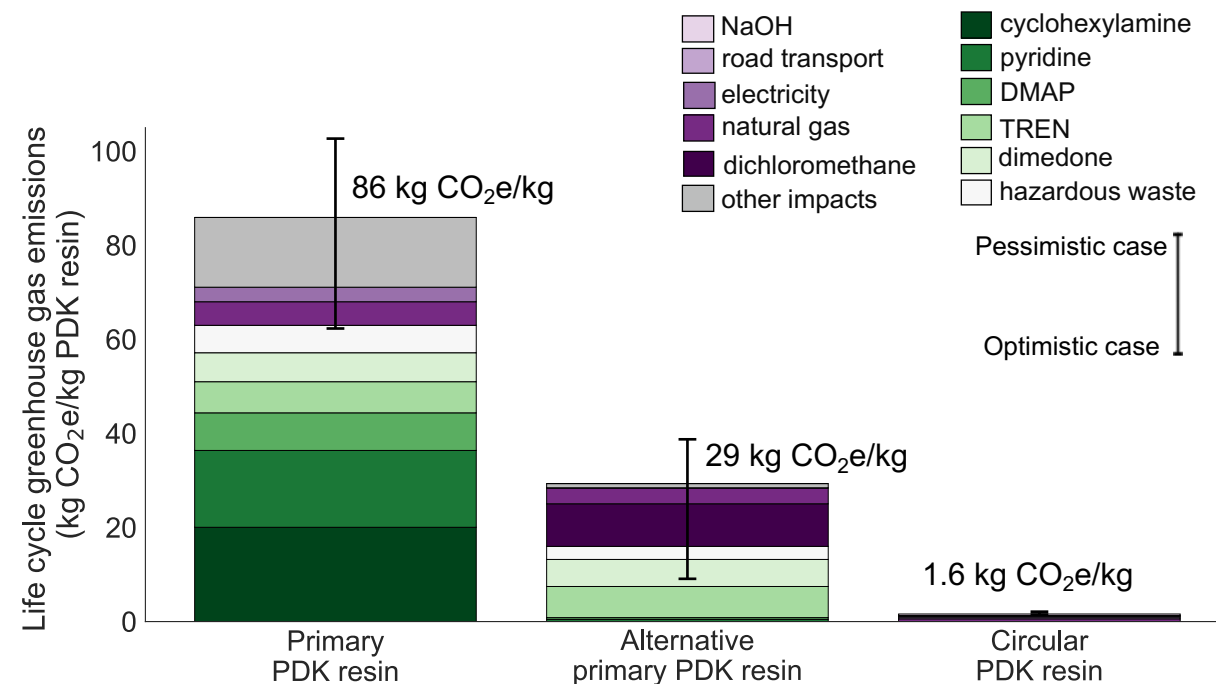
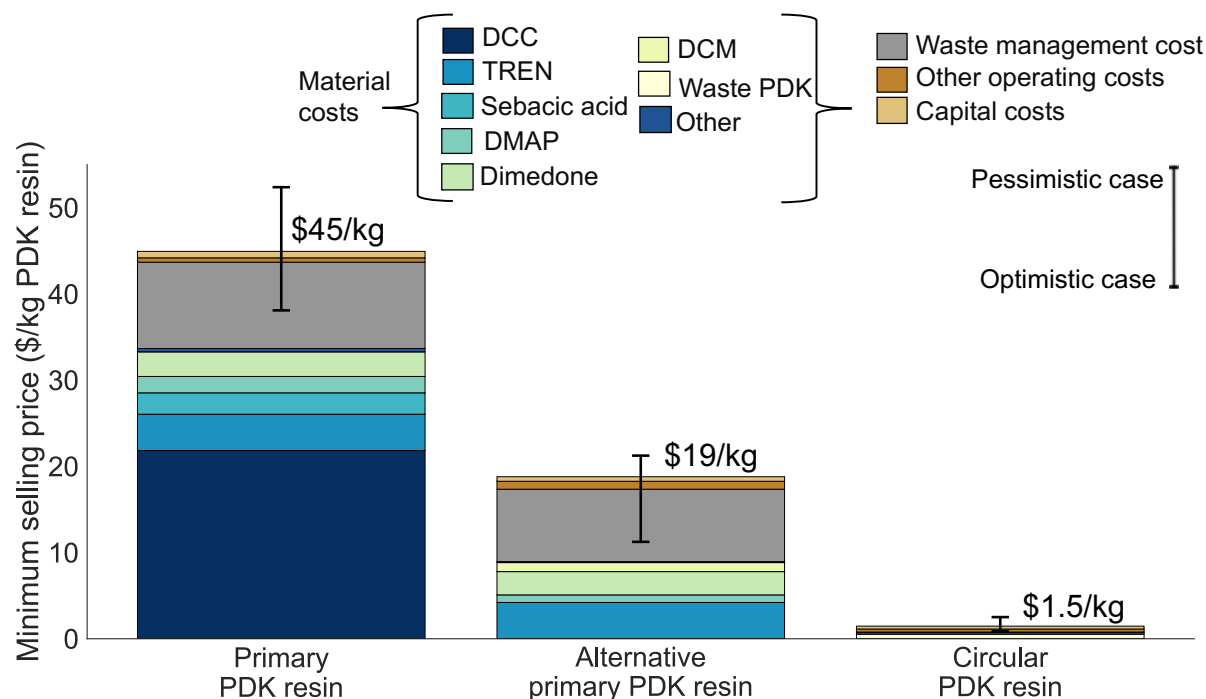
# Long-Term Outlook for Circular Plastics

- Cost of PDK recycling comparable with commodity polymers
- GHG footprint of recycling lower than virgin production of competitors



# TEA & LCA as Powerful Tool for Improvement

- Helms group used feedback to reduce costs and emissions dramatically in a matter of months by eliminating use of DCC





# Questions?



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