



Welcome!

PSCI Annual Meeting Introducing a New Legacy: Advanced Recycling

September 30, 2021



Performance by design.
Caring by choice.™

Rapidly Growing Middle Class

140 MM people enter the middle class *annually*

- Middle class represents majority of world population
 - o Over 3.2 B people today
 - o Growing to 5.3 B people by 2030
- Now one third of the global economy
- 5 people enter the middle class each second
- Next 9 in 10 middle-class consumers will be from Asia



Advantages of Plastics

Still one of the most sustainable materials

- Energy efficiency compared with alternative packaging options
 - 4x lighter
 - 2x less energy to produce
 - 3x less greenhouse gas emissions
- Preserving food longer
- Enables enhanced fuel efficiency
- Clean, safe, sanitary (food, medical)

THE VALUE OF PLASTICS

ENERGY EFFICIENCY
Plastics require less energy to produce than glass, paper, wood, metal and more. Many plastics also save energy during their use.

FOOD WASTE PREVENTION
Food packed in material other than plastics such as glass or paper weighs 4 times more, has double the related energy consumption, triple the greenhouse gas emissions, and increased food waste.

TRANSPORTATION SAVINGS
Energy efficiency of modern vehicles could not be achieved without the use of plastics. This includes lighter automotive components, light-weighted packaging, reduced weight in aircraft and more.

Just 2 pounds of plastic can deliver 10 gallons of a beverage. You'd need 3 pounds of aluminum, 8 pounds of steel, or over 40 pounds of glass to bring home the same amount.

Plastics help airplanes travel lighter, using less energy thus being more fuel-efficient. Plastics also make planes more resistant to impact, bad weather and corrosion.

50% VOLUME | 10% WEIGHT

The infographic features several visual elements: a scale icon for '4x LIGHTER', a battery icon for '2x LESS ENERGY', a hand holding a cloud for '3x LESS GREENHOUSE GAS', a row of coffee containers for 'FOOD WASTE PREVENTION', and icons for a train, motorcycle, and bicycle for 'TRANSPORTATION SAVINGS'. At the bottom, a car icon is shown with a '50% VOLUME | 10% WEIGHT' reduction graphic.

Advantages of Plastics – One Example

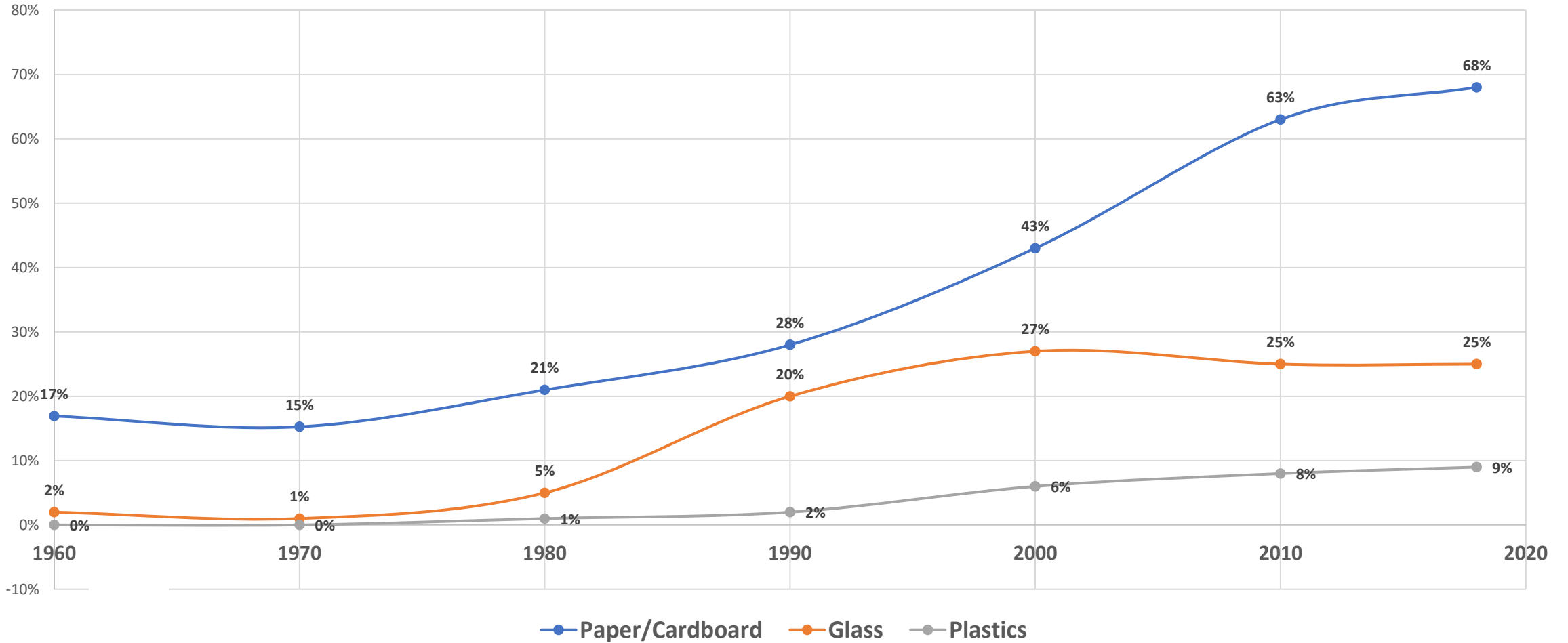


95% of gas distribution pipe in North America

A 20' length of storm water corrugated polyethylene pipe weighs 600 lbs; the concrete equivalent weighs 22,500 lbs

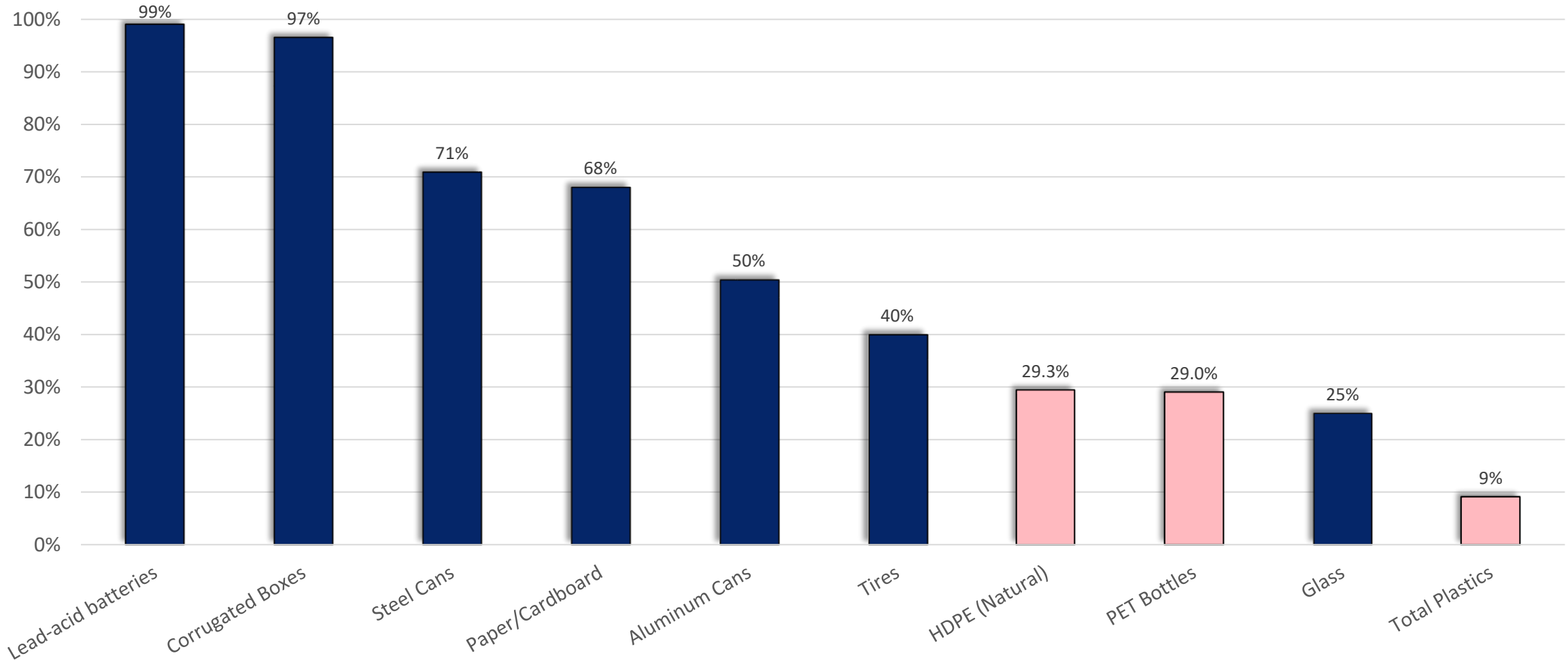
A 10-mile PE water pipe can save nearly 450,000 gallons of water from leaking per year

U.S. Recycling Rates



Source: EPA "Advancing Sustainable Materials Management 2018 Fact Sheet", (Dec, 2020)

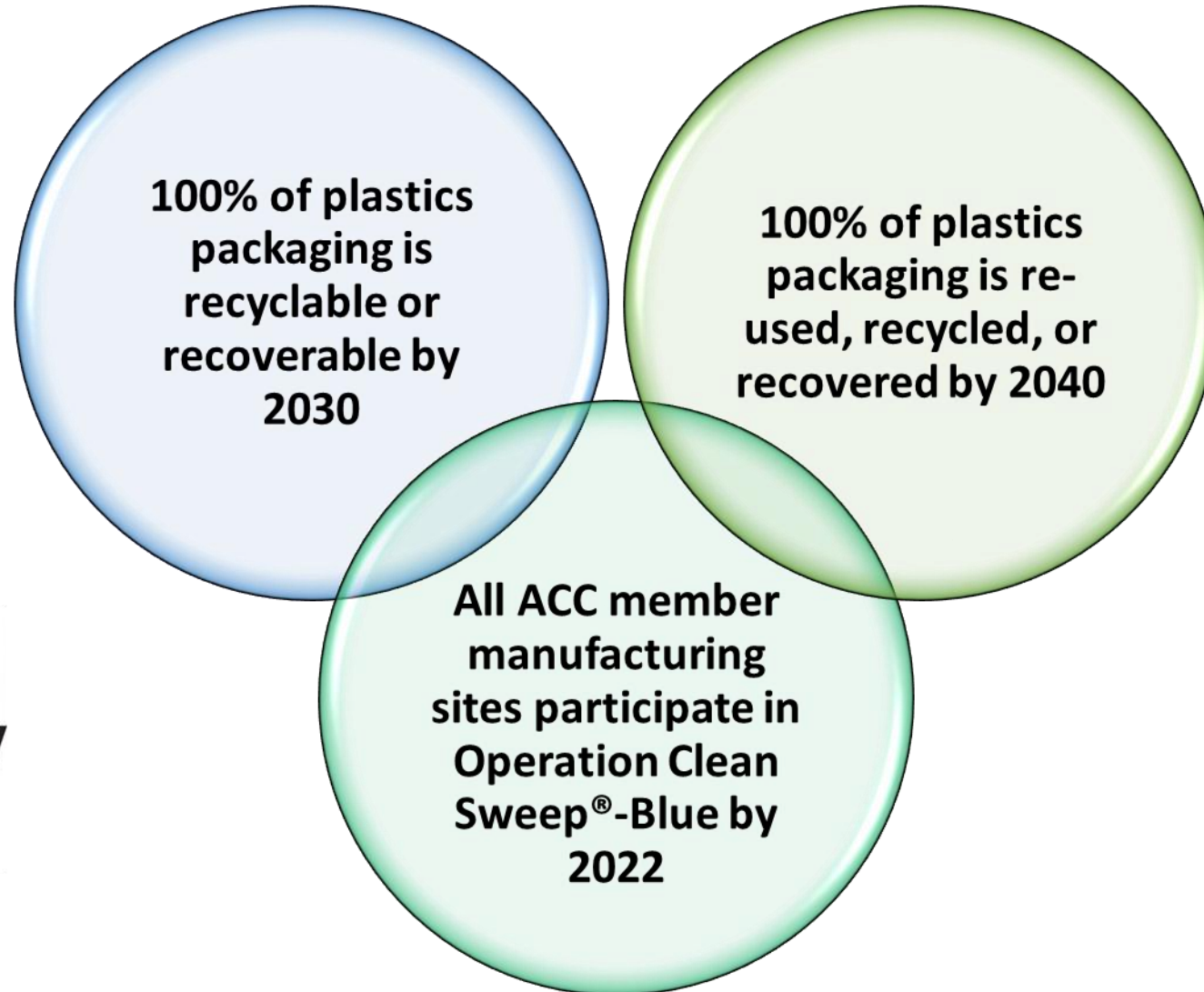
U.S. Recycling Rates



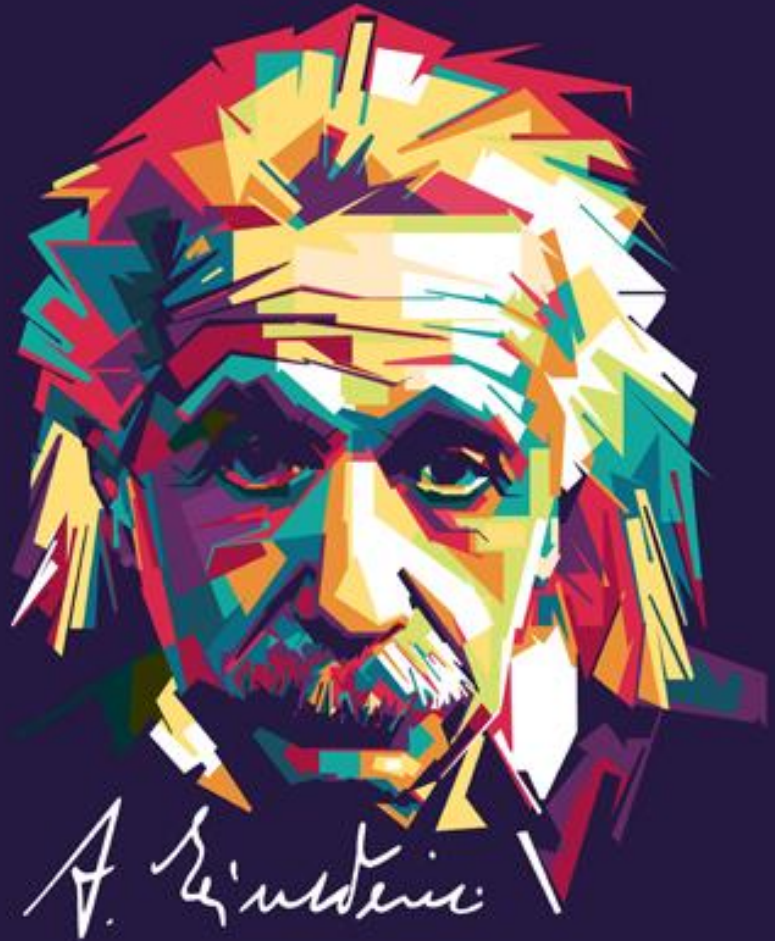
Source: [EPA "Advancing Sustainable Materials Management 2018 Fact Sheet", \(Dec, 2020\)](#)

American Chemistry Council

Circular Economy Commitments



NORTH AMERICA REGION



*WE CANNOT SOLVE OUR
PROBLEMS WITH THE SAME
THINKING WE USED WHEN
WE CREATED THEM*

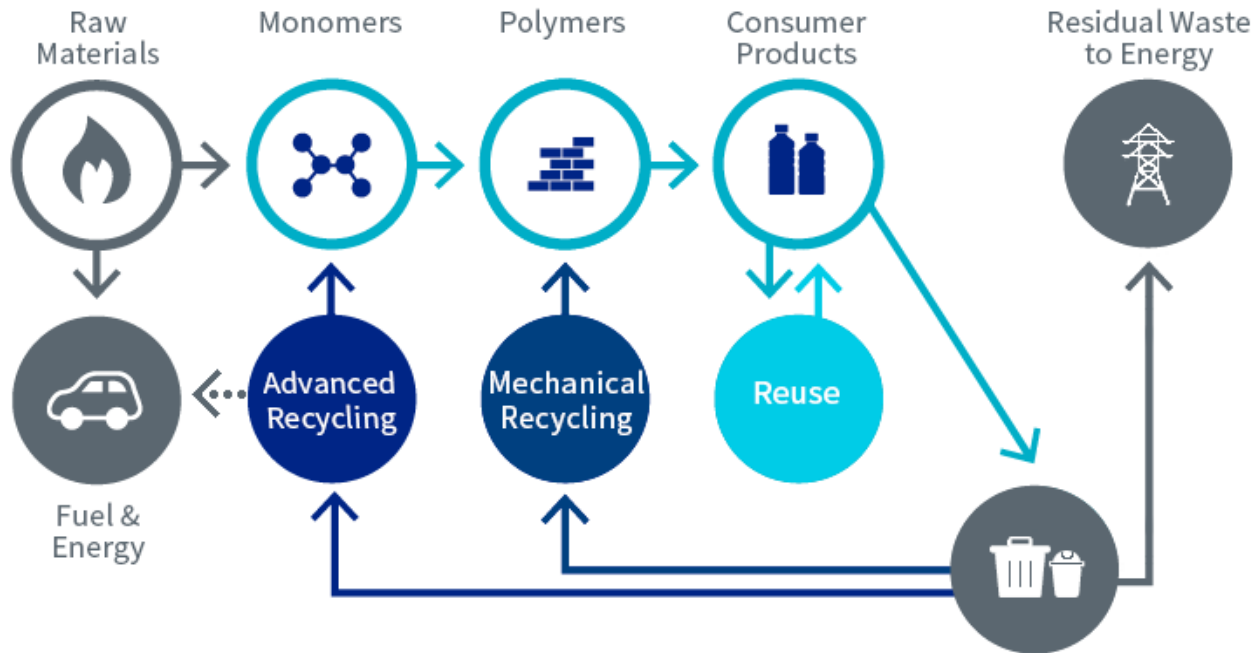
- Albert Einstein

Circular Economy

Multiple approaches – one goal



Advancing the Circular Economy



Mechanical Recycling

- Shred / wash / remold polymers
- Primarily #1 & 2 plastics
- Simple structures
- Mostly non-regulated applications

Advanced Recycling

- Shred / wash / convert to liquids or gases
- Broad range of polymers
- Simple or complex structures
- Broad applications including food / pharma

Mechanical Recycling



“Melting down and remolding plastic is sort of like reheating pizza in the microwave — you get out basically what you put in, just not as good. That limits the number of times plastic can be recycled before it has to be landfilled.”

Susannah Scott of the University of California, Santa Barbara

Advanced Recycling

Converting difficult to recycle plastics to viable feedstock



Advanced Recycling Technologies

- Dissolution (extracting plastic)
- Depolymerization (breaking down to basic building blocks)
- Conversion (turning into raw materials)
 - Pyrolysis
 - Gasification

Circular Polymers – Advanced Recycling

Simplified overview - Pyrolysis Process

Production Process

- Feedstock

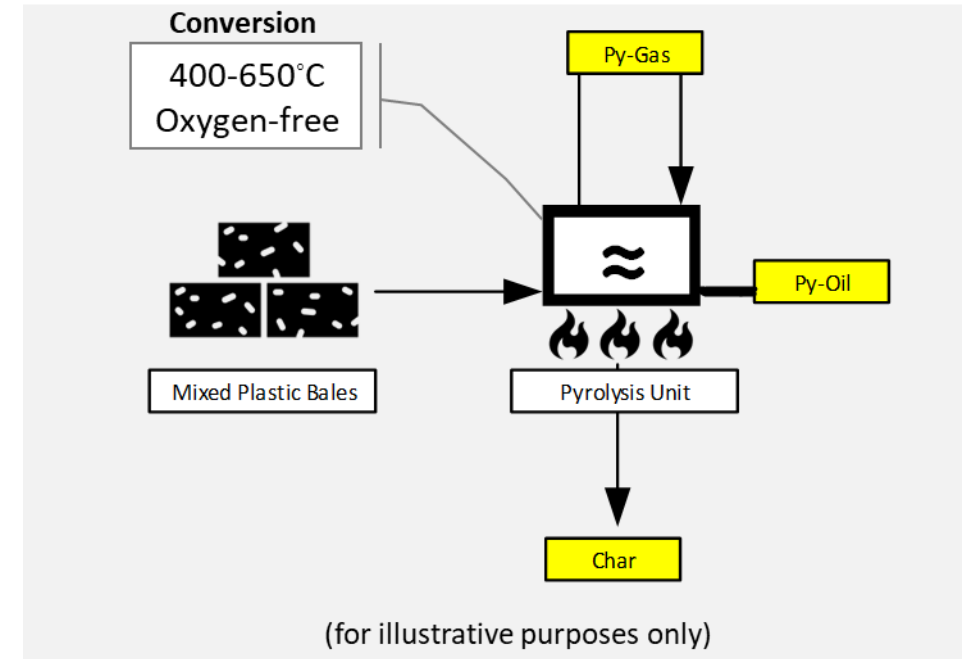
*Any mixed plastic waste, including difficult-to-recycle plastics
#1 (PET), #3 (PVC) & #7 (Other) require additional steps
Paper, organic material, aluminum, ... in very small quantities*

- Output

*~70% Pyrolysis Oil
~20% Pyrolysis Gas recuperated to furnace
~10% Char to roads/bricks and other industrial products*

Advantages

*Lower sorting requirements (compared to mechanical recycling)
Converts plastic waste to basic hydrocarbon building blocks
Output can be upgraded into virgin plastics*



Advanced Recycling - Pyrolysis



	Europe										
Announcement	December, 2018	February, 2019	July, 2019	January, 2021	October 2020	August, 2019	April, 2020	September, 2020	October, 2020	December, 2020	March, 2021
Circular Product	PE, PP, Polyurethanes	PE, PP, Polycarbonates	PE, PP	Renewable Propane		PE, PP	PE, PP	PE, PP	TBA	PE, PP	PE, PP
Pyrolysis Oil Suppliers	Recenso Quantafuel	Plastic Energy (2022)	OMV	Alterra Energy (const 2021)	Plastic Energy	Fuenix Mura Technology	Plastic Energy (2023)	Karlsruhe Institute of Technology	Plastic Energy (2023)	TBD	Plastic Energy (2023)
Certification	Ecoloop ISCC PLUS	ISCC PLUS	ISCC PLUS		ISCC PLUS	ISCC PLUS	ISCC PLUS RBS	ISCC PLUS	ISCC PLUS	ISCC PLUS	ISCC PLUS

	US							Asia
Announcement	April, 2019	January 2021	November, 2020	August, 2020	October, 2020	December, 2020	February, 2021	January 2021
Pyrolysis Oil Suppliers	Agilyx (Regenyx JV)		Nexus Fuels	Plastic Energy	Nexus Fuels New Hope Braven Env'tal	Encina Agilyx (TBD)	XOM Technology; Cyclix*	Brightmark
Certification	ISCC PLUS	ISCC PLUS	ISCC PLUS	-	ISCC PLUS	ISCC Plus	ISCC Plus	

Announced Investments

- Dow: Mura Technology
- Sealed Air: Plastic Energy
- Neste: Alterra Energy
- Ravago: Alterra Energy

Sources

<https://www.businesswire.com/news/home/20210422005594/en/Dow-and-Mura-Technology-announce-partnership-to-scale-game-changing-new-advanced-recycling-solution-for-plastics>

<https://www.neste.com/releases-and-news/circular-economy/neste-acquires-minority-stake-alterra-energy-companies-partnering-commercialize-alterras-waste>

<https://www.sealedair.com/company/media-center/press-releases/sealed-air-invests-plastic-energy>

<https://finance.yahoo-com.cdn.ampproject.org/c/s/finance.yahoo.com/amphtml/news/ravago-acquires-equity-interest-leading-070000283.html>

Circular Polymers – Mass Balance Approach

High-level explanation

- Accredited Chain of Custody approach
- Used to trace the flow of material through value chain
- Product claims shall be verified & certified by 3rd party
- Mass Balance Approach is gaining global recognition

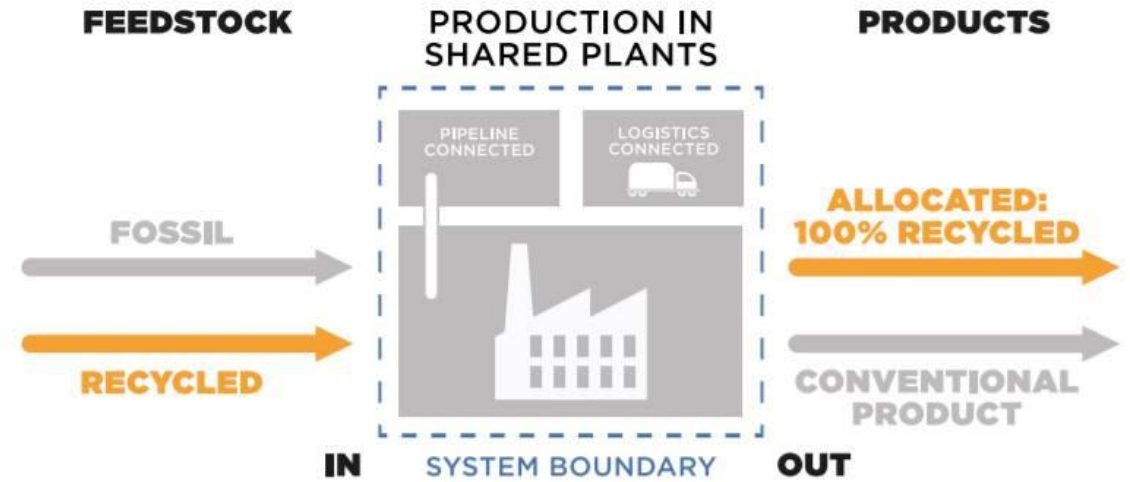


Figure 6. The system boundary can comprise various elements of an integrated chemical production system with potential physical substance stream between the recycled feedstock and the selected product including multi-site transfer in global manufacturing supply chains.

ISCC PLUS - International Sustainability & Carbon Certification

Logo use and Claims

- Since achieving ISCC PLUS certification, CPChem is authorized to use the ISCC PLUS logo and make claims related to the certification of the product (subject to ISCC approval)
 - Customers should be aware that use of the ISCC logo and any claim directly invoking the ISCC name may be strictly controlled by ISCC
 - General sustainability-related claims, which do not directly reference ISCC, are not subject to approval by ISCC
 - *Per ISCC, any indirect reference to ISCC, which could cause confusion, should be avoided.*
-
- **Customers should consult ISCC directly, or their legal counsel, for guidance on use of logo/claims and certification for customer's processes/product(s)**

Advanced Recycling - Pyrolysis

Developing a Circular Economy

- Utilizes difficult-to-recycle waste plastics to feedstock
- Redirects plastic waste from landfill
- Reduces fossil fuel-based feedstock requirements
- Fills unmet demand
 - Predictable processability
 - Regulatory compliance
 - No taste, odor or color issues
 - No additional product silos required
- Validation through ISCC* certification
- First supply agreement announced with Nexus Fuels

* "International Sustainability and Carbon Certification", Cologne, Germany

06/21/2021

Chevron Phillips Chemical earns top honors from PLASTICS Industry Association for launch of Marlex® Anew™ Circular PE



See www.cpchem.com/advancedrecycling

Questions

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Circular Polymers – Market Drivers

What is causing the high demand for circular polymers?

- Legislative and brand owner pressure making participation in circular economy a global requirement
 - Europe: frontrunner with “EU Green Deal” and initiation of plastic waste tax in 2021*
 - US: closely following EU, new state & national legislation being debated*
 - Asia: early signs in Australia, Japan and China*
- Polymer producers prioritizing resources to achieve sustainability goals and accelerate supply
- Core focus is “plastic waste reduction” and “lowering carbon footprint”
- Packaging converters and brand owners reaching out for guidance and supply of circular polymer

Circular Polymers – Plastic waste feedstock

How to define Post-Consumer Recyclate?

ISO

- *Post-Consumer Recyclate has been generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain*

[*Source: ISO 14021:2016 modified (section 7.8.1.1.a), Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling), Usage of terms, modified (focus on post-consumer recycled material)*]

EPA

- *Post-consumer material means a material or finished product that has served its intended use and has been diverted or recovered from waste destined for disposal, having completed its life as a consumer item.*
- *Recovered material means waste materials and byproducts that have been recovered or diverted from solid waste, but does not include materials and byproducts generated from, and commonly reused within an original manufacturing process.*
- *Post-consumer material is a subset of recovered material.*

[*Source: United States Environmental Protection Agency (EPA), Comprehensive Procurement Guideline (CPG) Program, FAQ*]

Marlex® Anew™ – Value Proposition

Providing circular polyethylene for a sustainable future

- Advanced recycled resin 100% sourced from (mixed) plastic waste *
- Fully circular product: unlimited recycling, without quality loss
- ISCC PLUS certified
- Flexibility
- Increasing regulatory and legislative acceptance
- Molecular structure same as virgin resin

Plug & Play solution

FDA Approved/Regulatory compliance

100% prime resin

Consistency



*Based on Mass Balance Attribution

Marlex[®] Anew[™] – Key Milestones

Accelerating efforts to meet 1 B lbs / 450 kMT target in 2030

Estimated

- Oct. 2020** – First commercial production of PE from pyrolysis oil
- Nov. 2020** – Cedar Bayou receives first ISCC PLUS certification
- Dec. 2020** – First certified commercial scale production
- Jan. 2021** – Supply agreement with Nexus Fuels announced
- Apr. 2021** – CPChem appoints first VP with exclusive focus on Sustainability
- Apr. 2021** – Supply agreement with New Hope Energy announced
- 4Q 2021** – Marlex[®] Anew[™] scale up
- 2H 2022** – ISCC PLUS Certification of other polyethylene plants
- 2H 2022** – Expansion of product offering
- 2H 2030** – **Achieve 1 B lbs / 450 kMT of annual sales of Marlex[®] Anew[™]**



Chevron Phillips Chemical

Resources

CPChem Homepage

www.cpchem.com

CPChem Sustainability

www.cpchem.com/sustainability

CPChem Advanced Recycling

<https://www.cpchem.com/AdvancedRecycling>

CPChem News

<https://www.cpchem.com/media-events>



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