

ADVANCED CHEMICAL RECYCLING TECHNOLOGIES

Northeast Recycling Council (NERC) Conference

October 29, 2019

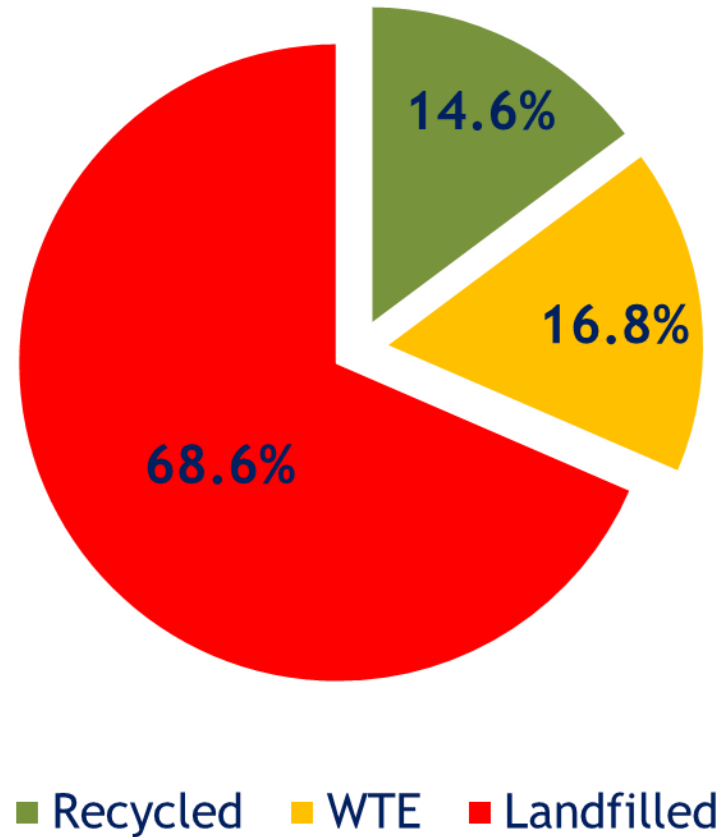


Why do we use plastics?

- Lightweight, versatile, durable
- Prevents food waste, reduces food spoilage
- Low cost
- Wide range of applications

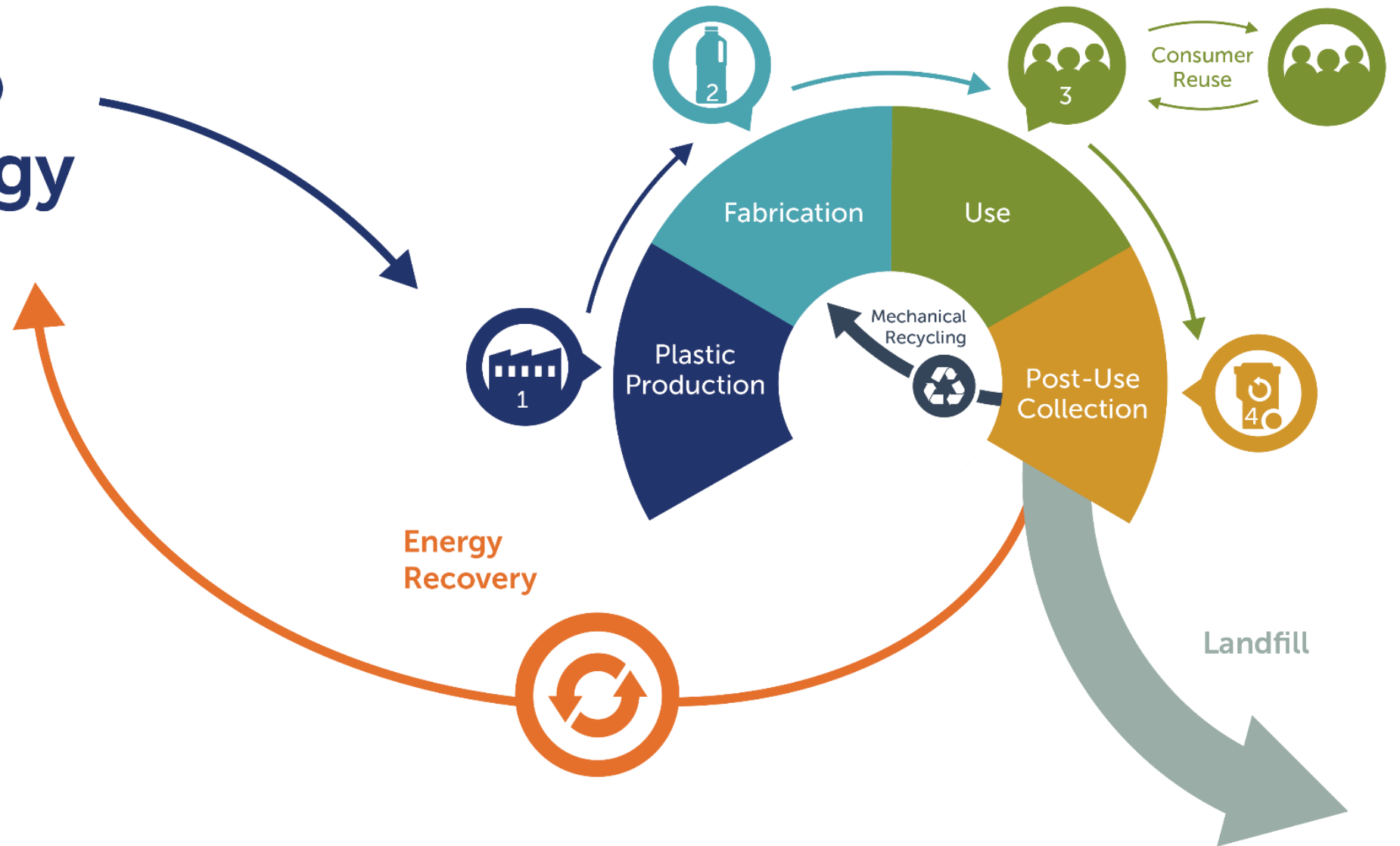
Plastics Packaging Recovery (U.S.)

Low recovery rate driving concerns about plastics packaging and waste



The Plastics Economy Today

3%
of Energy



Plastics Division Members



BAYPOL



ExxonMobil



Shell Chemicals



TOTAL



U.S. Resin Manufacturer Sustainability Goals

✓ 2040 Goal

- 100% of plastics packaging is reused, recycled or recovered

✓ 2030 Interim Goal

- 100% of plastics packaging is recyclable/recoverable

✓ Best Practice Goal

- 100% of Division's U.S. manufacturing sites participate in Operation Clean Sweep Blue by 2020, with all North American sites by 2022

Seven Initiatives to Achieve Commitments



1) Define, Inventory, and Target



3) Create Circular Business Models



5) Invest in New Disruptive Technology



7) Expand Stakeholder Partnerships



2) Design Packaging to Enable Recovery



4) Invest in Access and Infrastructure



6) Educate Consumers and Change Behavior

Plastics in a Circular Economy

3%
of Energy



The Buzz Around Chemical Recycling

GreenBiz

The 5 things you need to know about chemical recycling

 CBS THIS MORNING

Chemical recycling could be the answer to our single-use plastic problem

Solving the recycled plastics puzzle

Rob Kaplan

Thursday, September 21, 2017 - 1:35am



Raw plastic pellets for use in manufacturing.

What is Chemical Recycling?

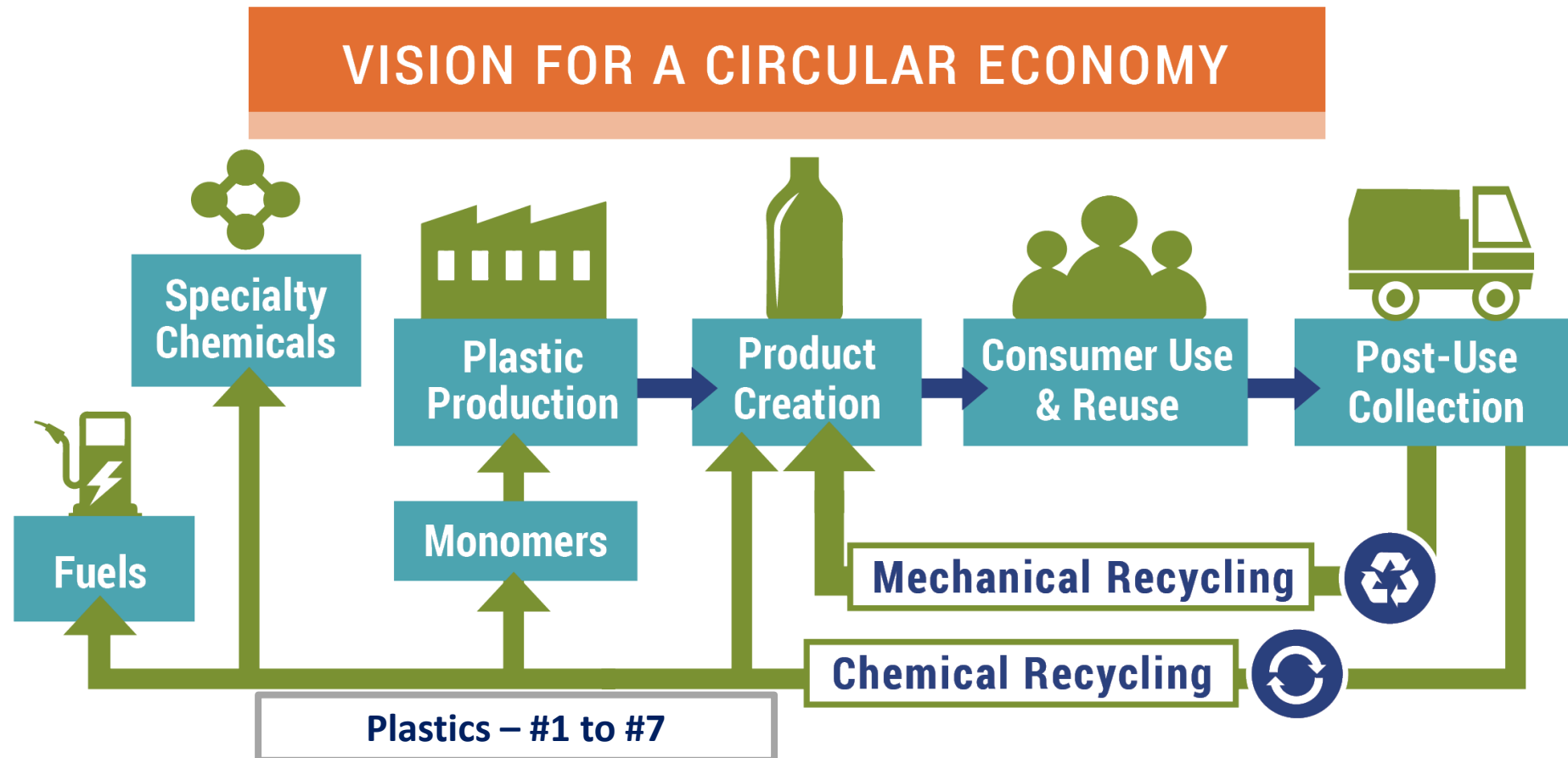
Leveraging chemistry to convert post-use plastics into valuable next generation products which extend the life of the plastic

Outputs:

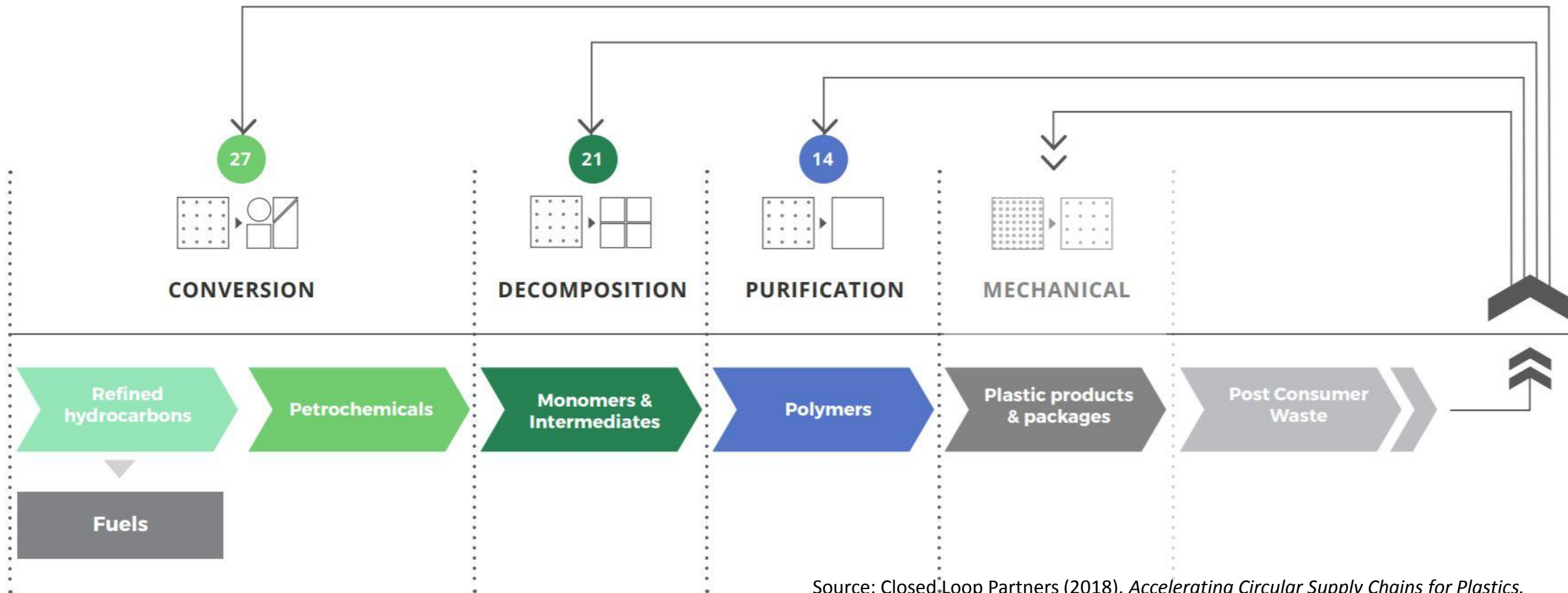
- Virgin Like Plastics
- Specialty Chemicals
- Basic building blocks (monomers)
- Chemical feedstocks (e.g. naphtha)
- Fuels

These products are then used as alternative to fossil based products

Complementary to Mechanical Recycling

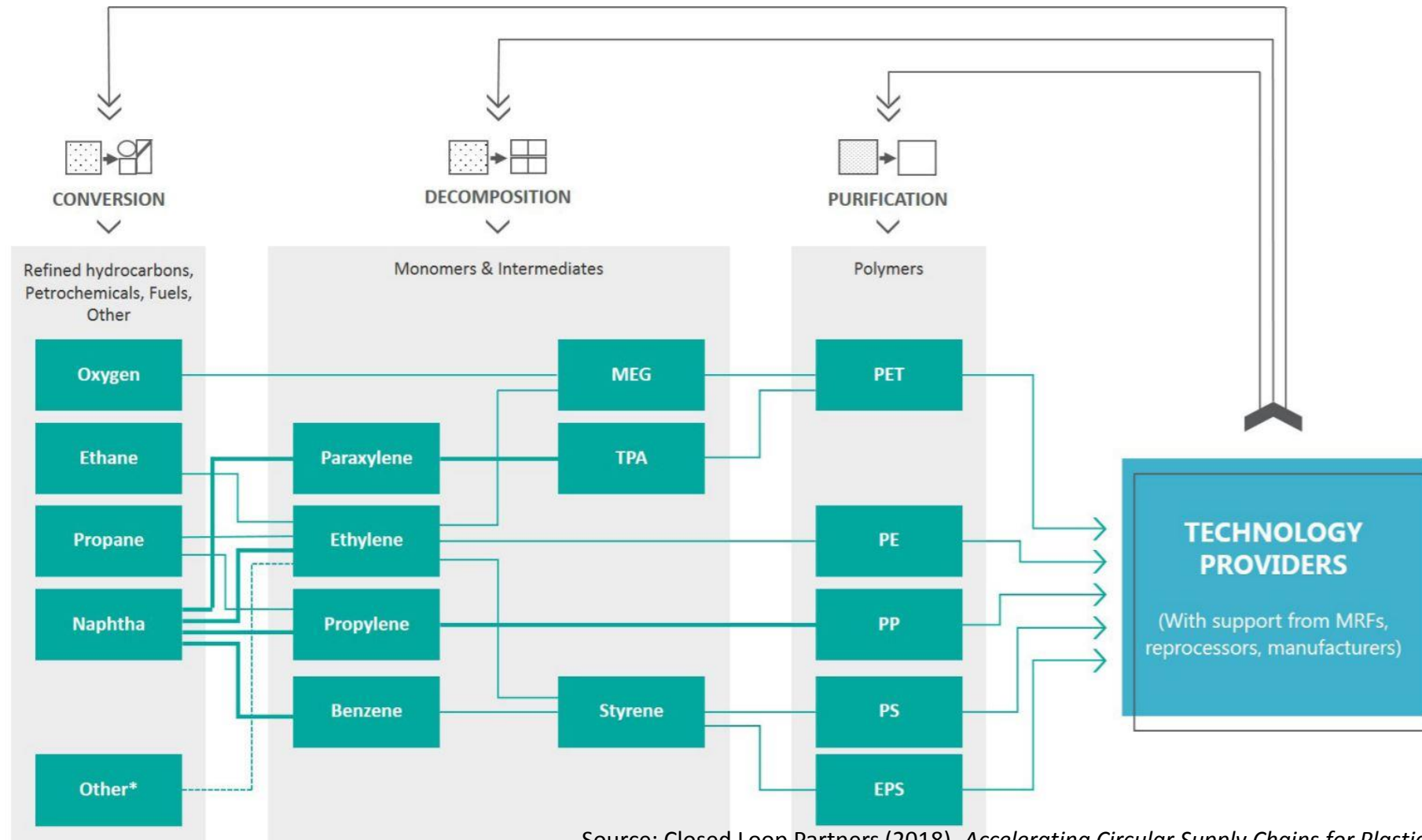


Types of Chemical Recycling



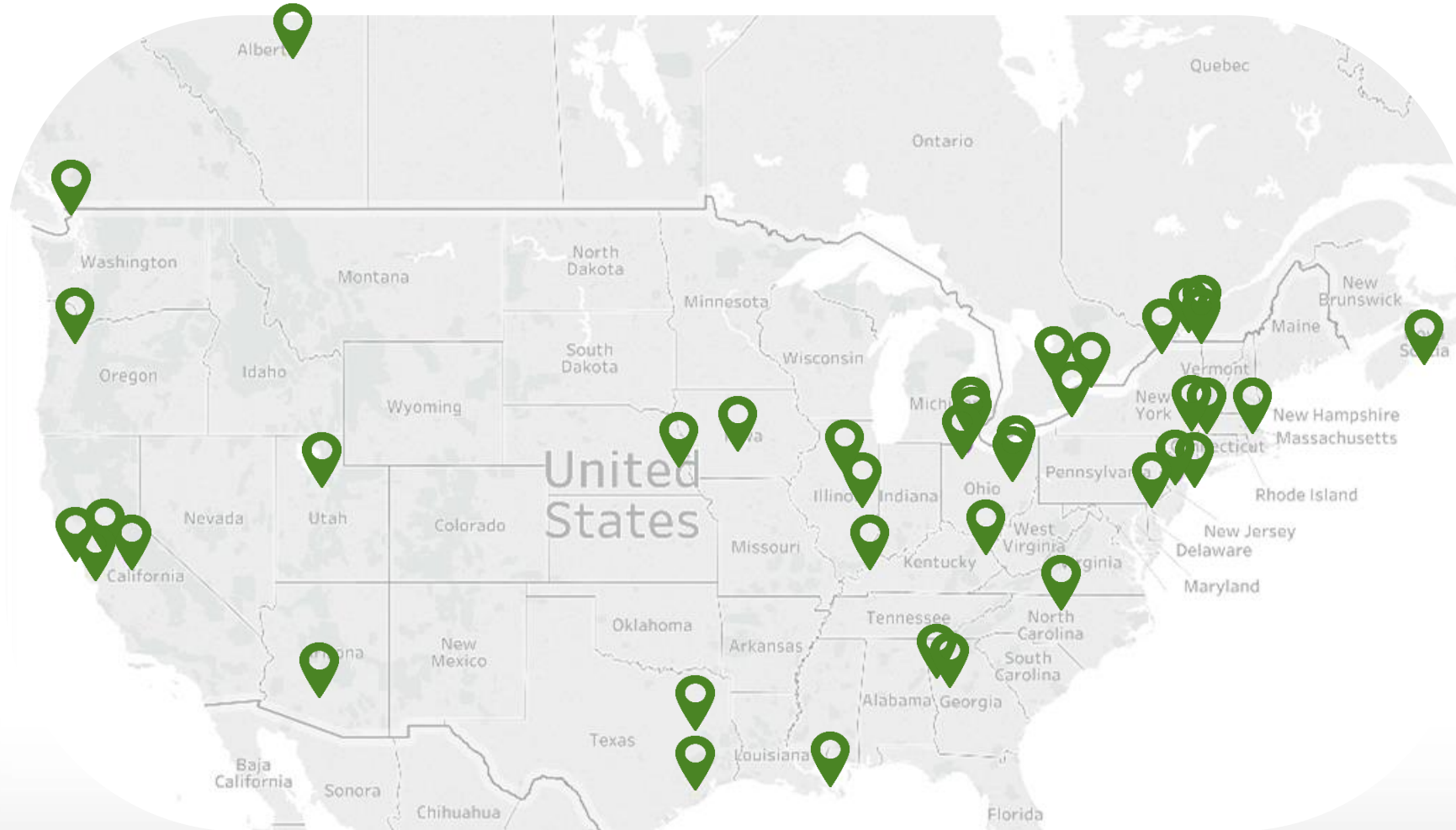
Source: Closed-Loop Partners (2018). *Accelerating Circular Supply Chains for Plastics*.

Products of Chemical Recycling



Source: Closed Loop Partners (2018). *Accelerating Circular Supply Chains for Plastics*.

40 Facilities Already in Operation



Source: Closed Loop Partners (2018). *Accelerating Circular Supply Chains for Plastics*.

More Engagement Needed

250 partners and investors are already engaged with technology providers

Brands

**Private
Capital
Providers**

**Petro-
chemical &
Plastics
Industry**

**Gov't &
NGOs**

The Environmental Benefits Are Significant

By converting post-use plastics into ultra-low-sulfur diesel, we reduce:^{2,3}



² Life-cycle analysis of fuels from post-use non-recycled plastics. A study conducted by Argonne National Laboratory. <http://www.sciencedirect.com/science/article/pii/S0016236117304775>

³ When compared to traditional manufacturing processes.

Debunking Emissions Myths

How chemical recycling prevents dioxin formation

- Material is heated in a closed, oxygen-deprived environment
 - i.e. Not combustion
- No atmospheric oxygen or halogens
- Products spend virtually no time at the dioxin formation temperature

Economic Benefits

- \$120B addressable market in North America
 - Technology owners can profitably transform post-use plastics
- Moderately developed markets in the U.S.
 - Alabama, Florida, Georgia, Louisiana, Texas => high-potential market for pyrolysis

Recent Announcements (N.A.)

Agilyx, Delta Refinery Subsidiary Sign Deal to Convert Waste Plastics into Jet Fuel

BP deal will help RES Polyflow open first commercial plastics-to-fuel plant

Brightmark Energy Closes \$260M in Financing for Plastics-to-fuel Plant

Renewlogy Converting Landfill-Bound Plastics to Fuel

Regenyx Process Recycles 'Throw Away' Polystyrene

ReVital Polymers, Pyrowave and INEOS Styrolution partner to launch polystyrene recycling consortium

GreenMantra and INEOS collaborate on chemical recycling

Eastman announces second chemical recycling technology

Recent Announcements (Global)

SABIC And Customers Launch Certified Circular Polymers From Mixed Plastic Waste

Polystyvert, Total partner to recycle post-consumer polystyrene

Shell to Invest in Rotterdam Green Methanol Plant

BASF hits milestone with 'chemically-recycled' prototypes

Plastics company LyondellBasell has announced plans to drive chemical recycling of plastic materials forward.

Unilever Joins Partnership to Turn PET Waste into Virgin Grade Material

Tupperware to debut products made from Sabic's certified circular polymers

Dow, Fuenix Ecology Group partner on plastics recycling project

The Chemical Recycling Alliance

Advocating on behalf of technologies that convert post-use plastics to monomers, chemical feedstocks, transportation fuels and other valuable products of advanced plastics recycling and recovery technologies



**Chemical
Recycling
Alliance**

SUSTAINABLE SOLUTIONS FOR PLASTICS

agilyx

BME
BRIGHTMARK ENERGY

Golden
Renewable
Energy

 **GREENMANTRA[®]**
TECHNOLOGIES

 **NEW HOPE**
ENERGY

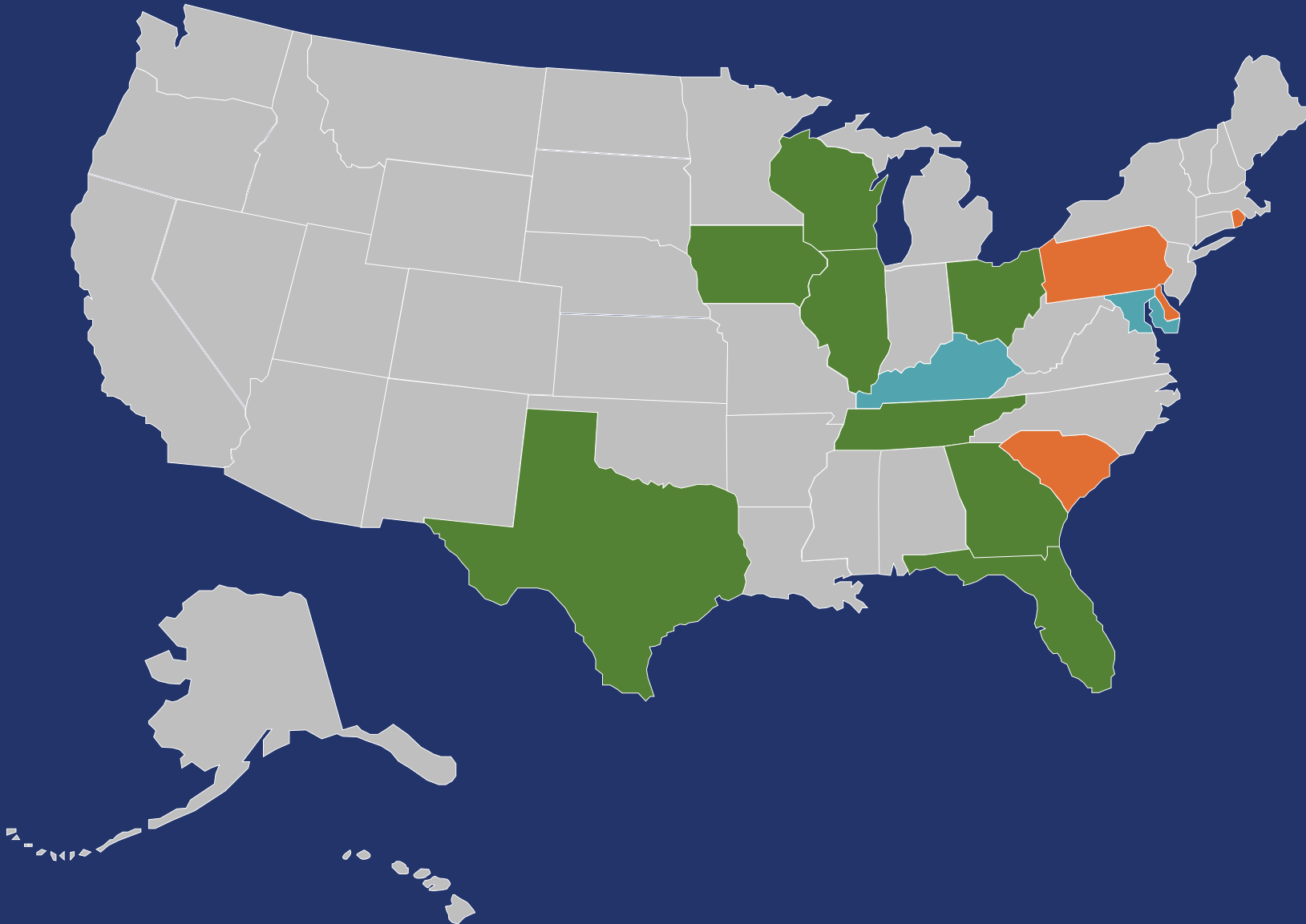
 **RENEWLOGY**

 **AmSty** **Sealed Air[®]**

 **Ravago**

 **TETRA TECH**

Removing Barriers to Chemical Recycling



Legislation
enacted (8)

Legislative
activity (4)

Regulation
in progress (2)

Legislative Momentum

HOUSTON★CHRONICLE

Texas part of national push for laws promoting fledgling chemical recycling industry

Plastics News

ACC pushes chemical recycling legislation

PLASTICS
RECYCLING UPDATE

A Resource Recycling, Inc. publication

State lawmakers give chemical recycling a boost

Stay Connected



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Chemical Recycling Alliance



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