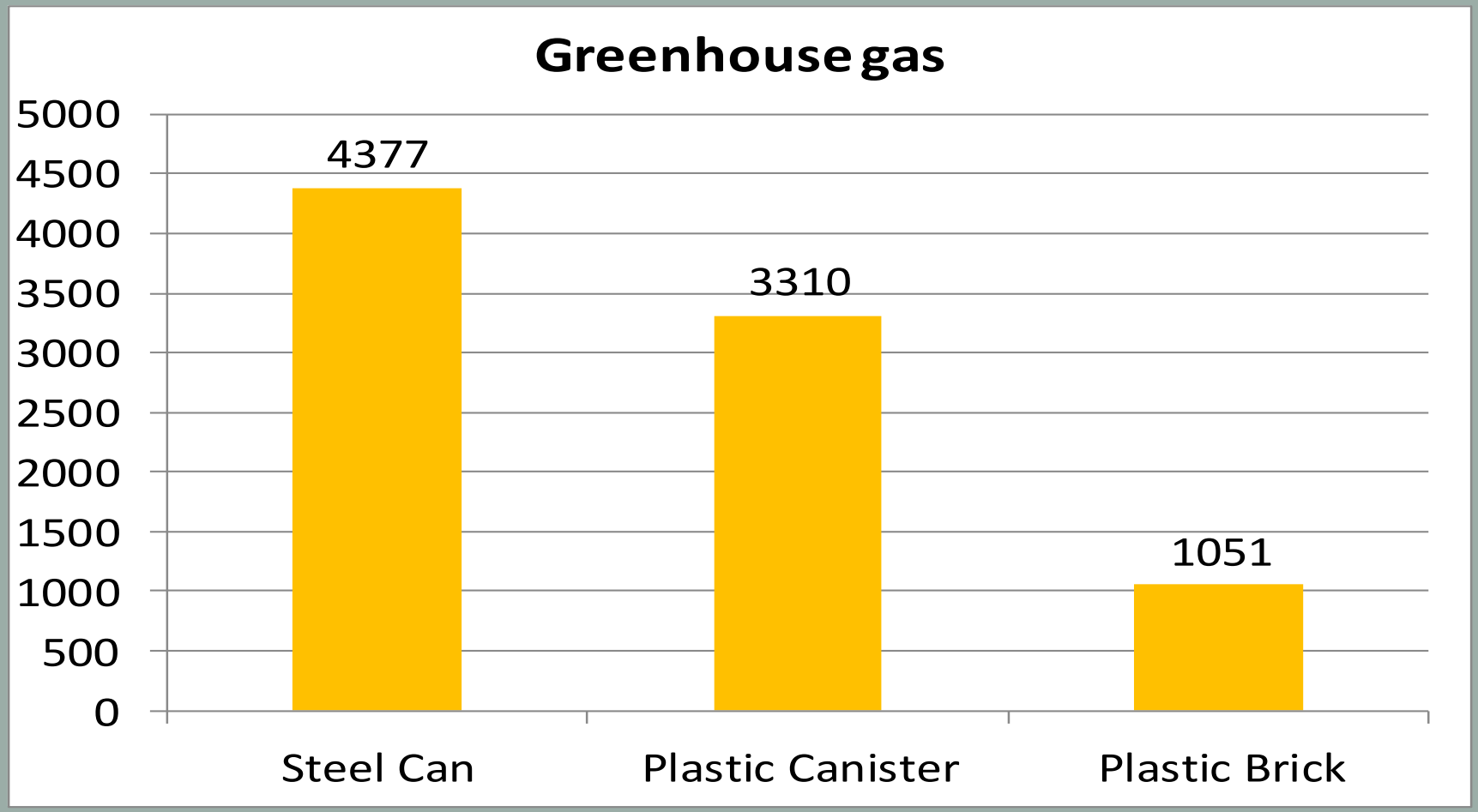
PLASTICS INNOVATION OF ADVANCED RECYCLING

Rhode Island Pyrolysis Study Commission Meeting

March 11, 2020

American® Chemistry Council

“Reduce” via Plastics Packaging



Source: Franklin Associates, September, 2008

U.S. Resin Manufacturer Sustainability Goals

✓ **2040 Goal**

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

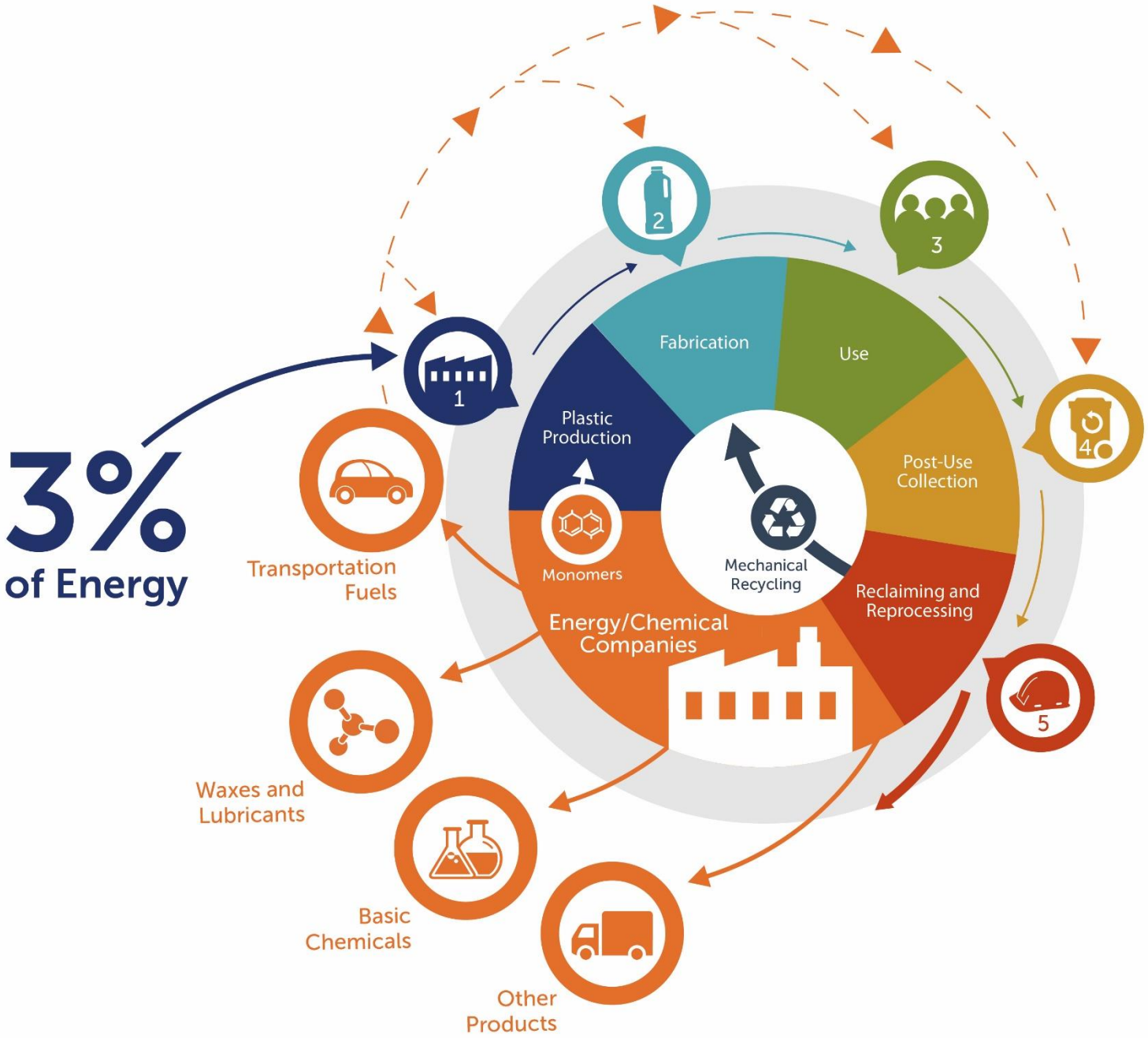
✓ **2030 Interim Goal**

- 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

Plastics in a Circular Economy



What is Advanced Recycling?

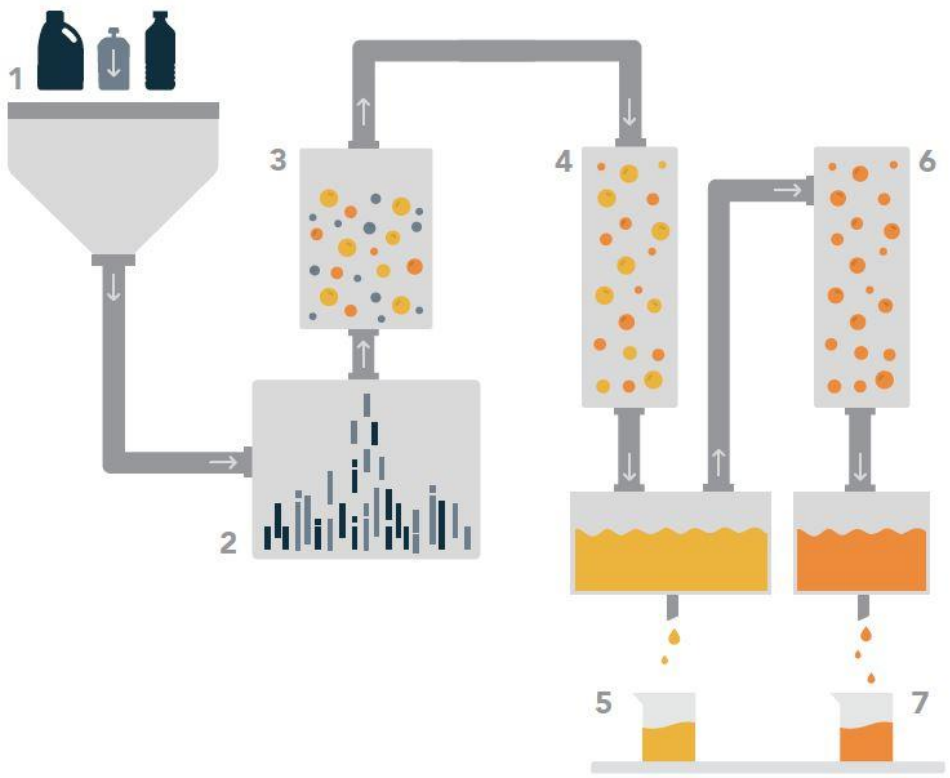
Leveraging chemistry to convert post-use plastics into valuable products which extend the life of the plastic

Outputs:

- Virgin like plastics
- Specialty chemicals
- Basic building blocks (monomers)
- Chemical feedstocks (naphtha)
- Fuels

Products are then used as alternative to fossil based products

Example of Pyrolysis Process



1. Post-use plastics received
2. Prep: Shredding, drying and pelletizing
3. Pellets extruded (solid → liquid) and fed into pyrolysis vessel
4. Material heated and vaporized (no combustion)
5. Vapor is captured and cooled into a hydrocarbon liquid
6. Hydrocarbon liquid → ultra-low sulfur diesel, naphtha (gasoline) and wax
7. Finish products shipped to offtake customer

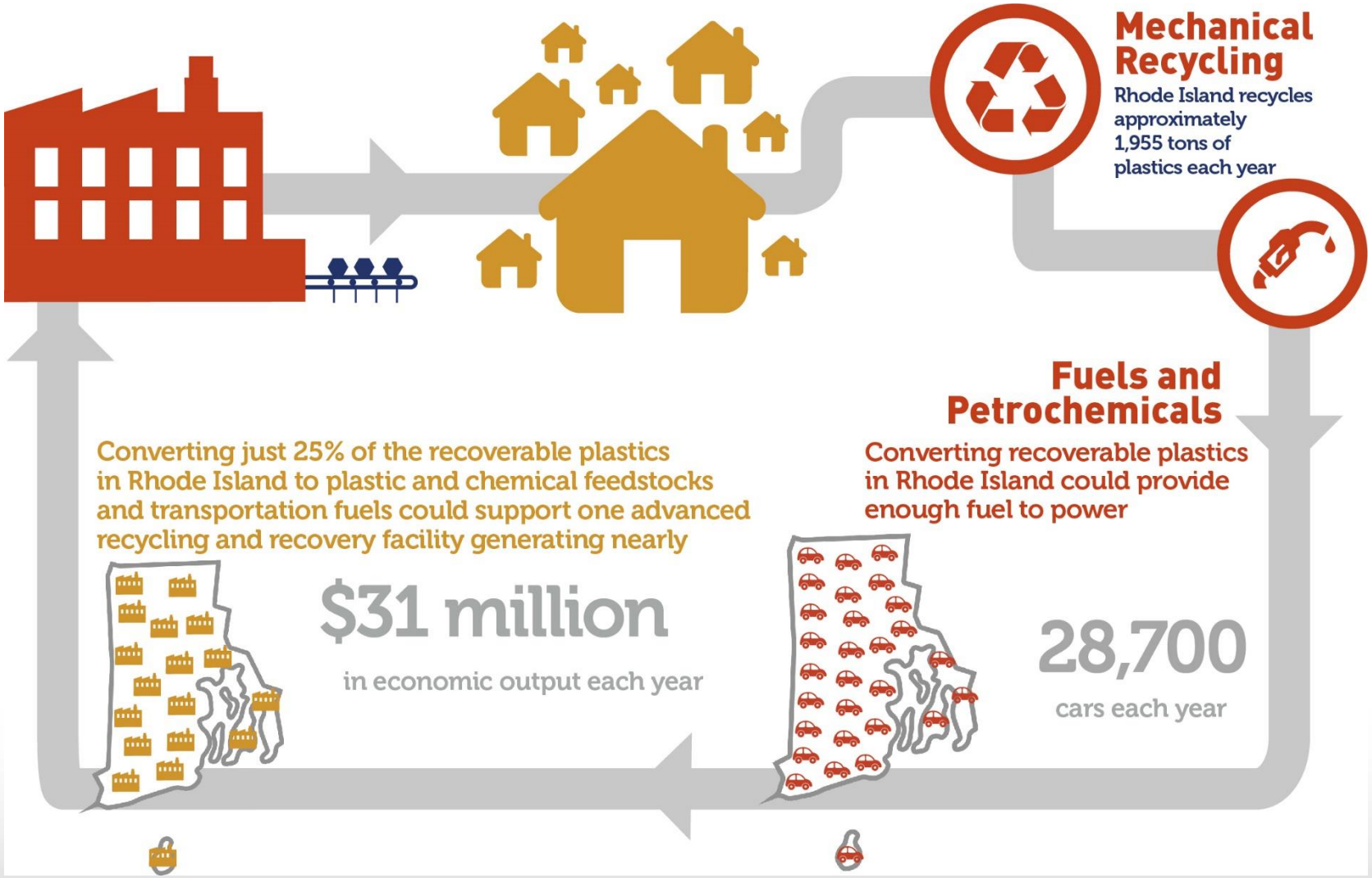
Case Example: Brightmark Energy

- Location: Ashley, Indiana
- $260M financing packaging
- Input: 100,000 tons of post-use plastics/annually
- Output: 18M gal ultra-low sulfur diesel & naphtha + 6M gal of wax
- $138.3M capital investment in Steuben County, IN
- Job creation: International Brotherhood Electrical Workers (IBEW), Union Boilermakers, International Brotherhood of Bridge Structural and Ornamental Workers, and Pipefitters

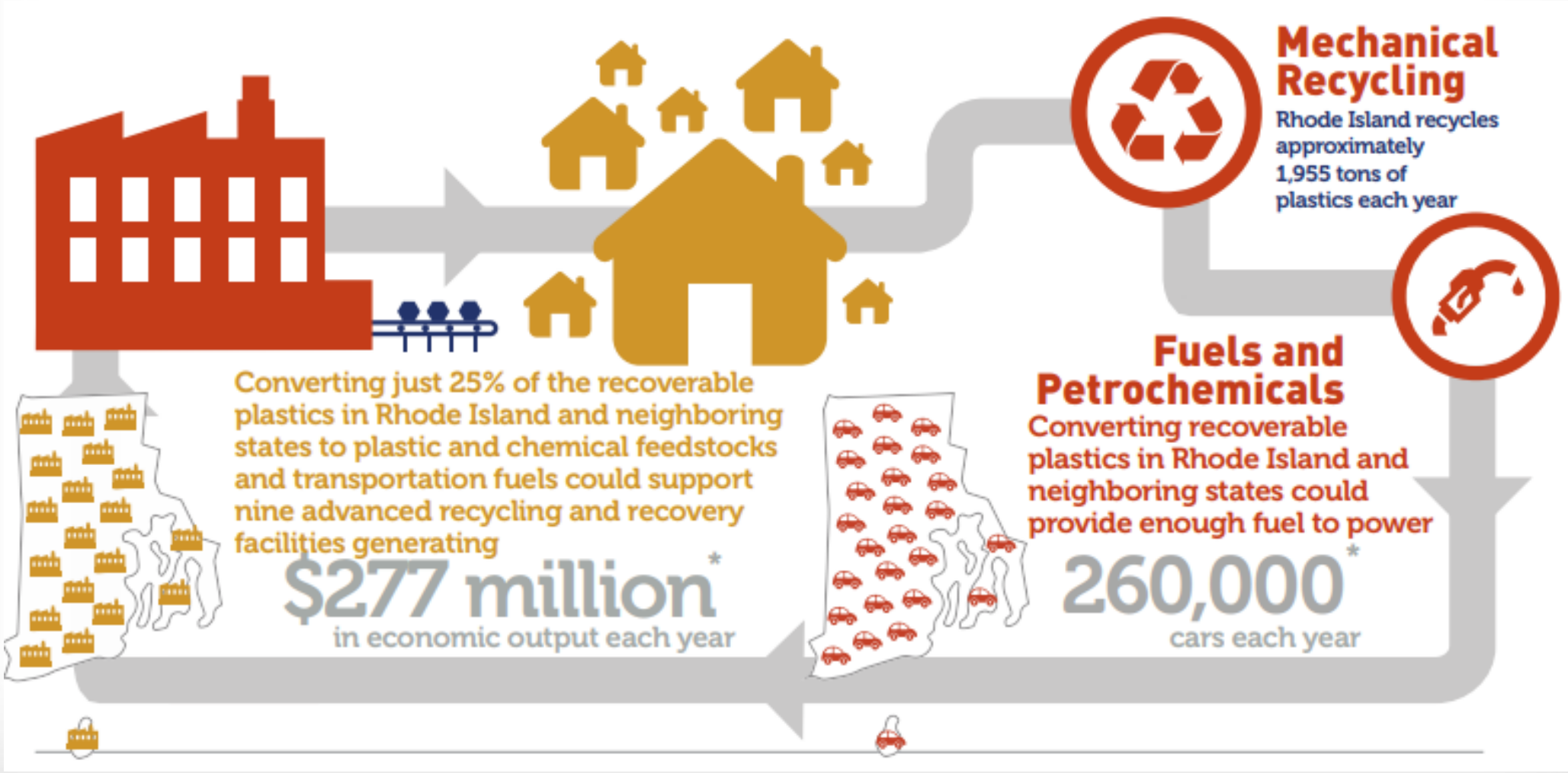
Case Example: Enerkem

- Location: Edmonton, Alberta, Canada
- Input: post-use plastics & recovered feedstock
- Output: methanol & ethanol (10M gal/yr)
- Over C$350M venture capital-backed financing
- C$13.3M equity ownership from Government of Québec

Boosting the Economy in Rhode Island



Expanded Economic Opportunity



*Post-use, recoverable plastics sourced from a 100 mile radius from the state

Investments in Traditional & Advanced Recycling

New Investments in U.S. Plastics Recycling

Announced since July 2017

35

projects in the U.S.

Combined projects valued at

$4.2

billion

Potential to divert

2.7

million tons of waste* from landfills

*Mostly plastic, but includes other waste (MSW, cartons, electronics, etc.)

Infrastructure Investments, Circular Solutions

Examples

Manufacturing vs. Solid Waste Management

	Manufacturing Facility	Solid Waste Management Facility
Facility Equipment	Extruders, high temperature reactors, distillation columns, condensers, piping	Equipment to sort, separate, size, and grind incoming materials; feed conveyors
Products of facility activities	Crude oil, diesel, gasoline, fuels, chemicals, waxes, lubricants, chemical feedstocks, diesel and gasoline blendstocks	Baled, containerized, and packaged materials
Potential environmental impacts	Air emissions, water discharges, product storage, raw material storage	Waste handling; odor, dust, nuisance, vector, fire hazard, etc.
Regulated by Department of Environmental Management	Yes	Yes

Requirements Applicable to Advanced Recycling

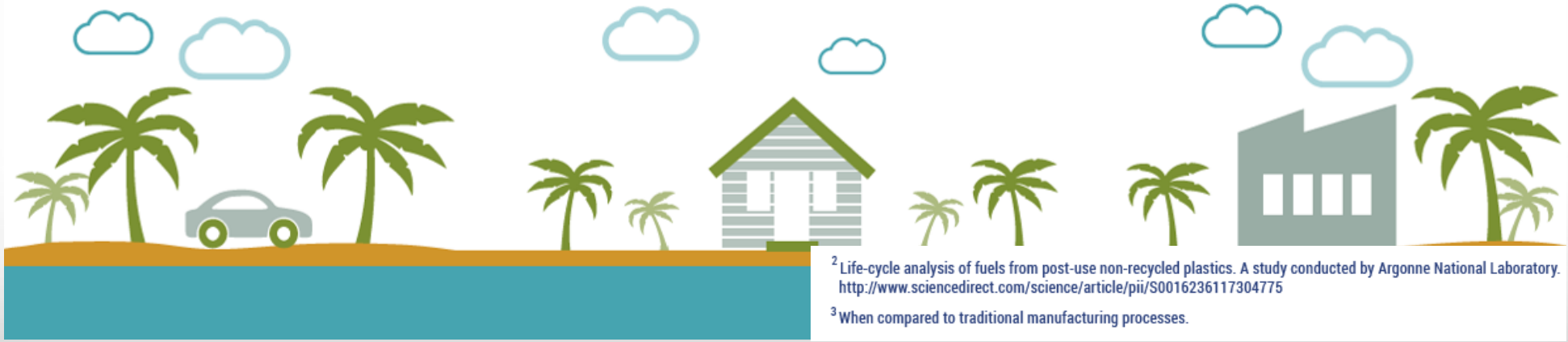
	Code	Description
Air	• 250-RICR-120-05-9 *et seq.* • 250-RICR-120-05-29 *et seq.* • 250-RICR-120-05-01 through 27	• Pre-construction permit requirements • Operating permit requirements • Limits on and requirements for emission of various pollutants, recordkeeping and reporting
Water	• 250-RICR-150-10-1 *et seq.* • 250-RICR-150-10-1.16 • 250-RICR-150-10-1.32	• Water discharge permit requirements • Effluent limitations and requirements • Stormwater discharge requirements
Land	• 250-RICR-140-05-1	• Prohibition against storing solid waste without required permits

Environmental Benefits Are Significant

By converting post-use plastics into ultra-low-sulfur diesel, we reduce:[2,3]

WATER CONSUMPTION
-58%

TRADITIONAL ENERGY USE
-96%



[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.

Craig Cookson
Senior Director, Recycling and Recovery
ACC Plastics Division
craig_cookson@americanchemistry.com
(202) 249-6622

Appendix

Addressing Environmental Concerns

Emissions

- Fewer emissions than a food processing facility, university campus or auto manufacturer

Dioxins

- Material is heated in a closed, oxygen-deprived environment
- No atmospheric oxygen or halogens

Improved Efficiency of Gasification

↑ Increase in plastics feedstock = ↑ Performance of gasification

- Up to 28% improvement in thermal efficiency
- Up to 42% more methanol production
- Decreased char/ash to landfill by up to 76%