“Chemical recycling”of plastic

A burning issue

Veena Singla, PhD | Senior Scientist | Natural Resources Defense Council

Natural Resources Defense Council

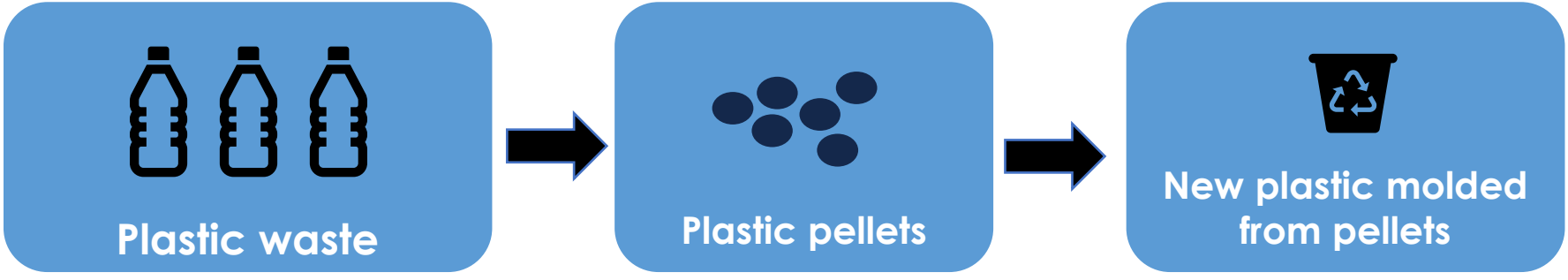
MISSION STATEMENT

To safeguard the Earth: its people, its plants and animals and the natural systems on which all life depends.

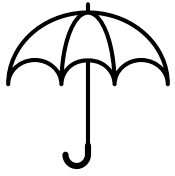
Trail map

- Conventional recycling and “chemical recycling”
- “Chemical recycling” basics
- Our research on U.S. “chemical recycling” facilities

Mechanical recycling: plastic → plastic



Chemical recycling terminology



“Umbrella terms”

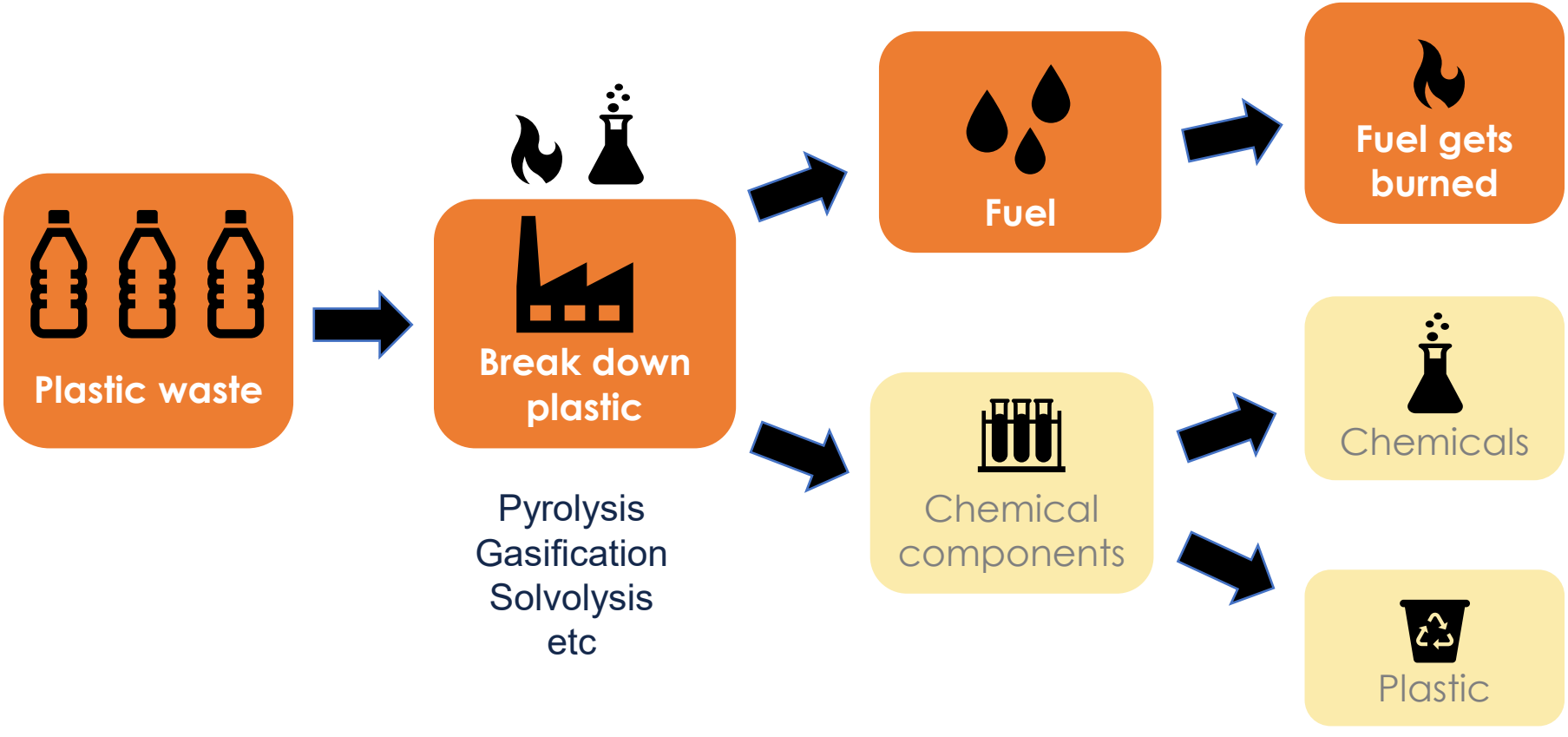
Advanced recycling
Molecular recycling
Plastics renewal
Carbon renewal
Plastics upcycling
Chemically advanced molecular recycling
…*next greatest thing…*

Different processes

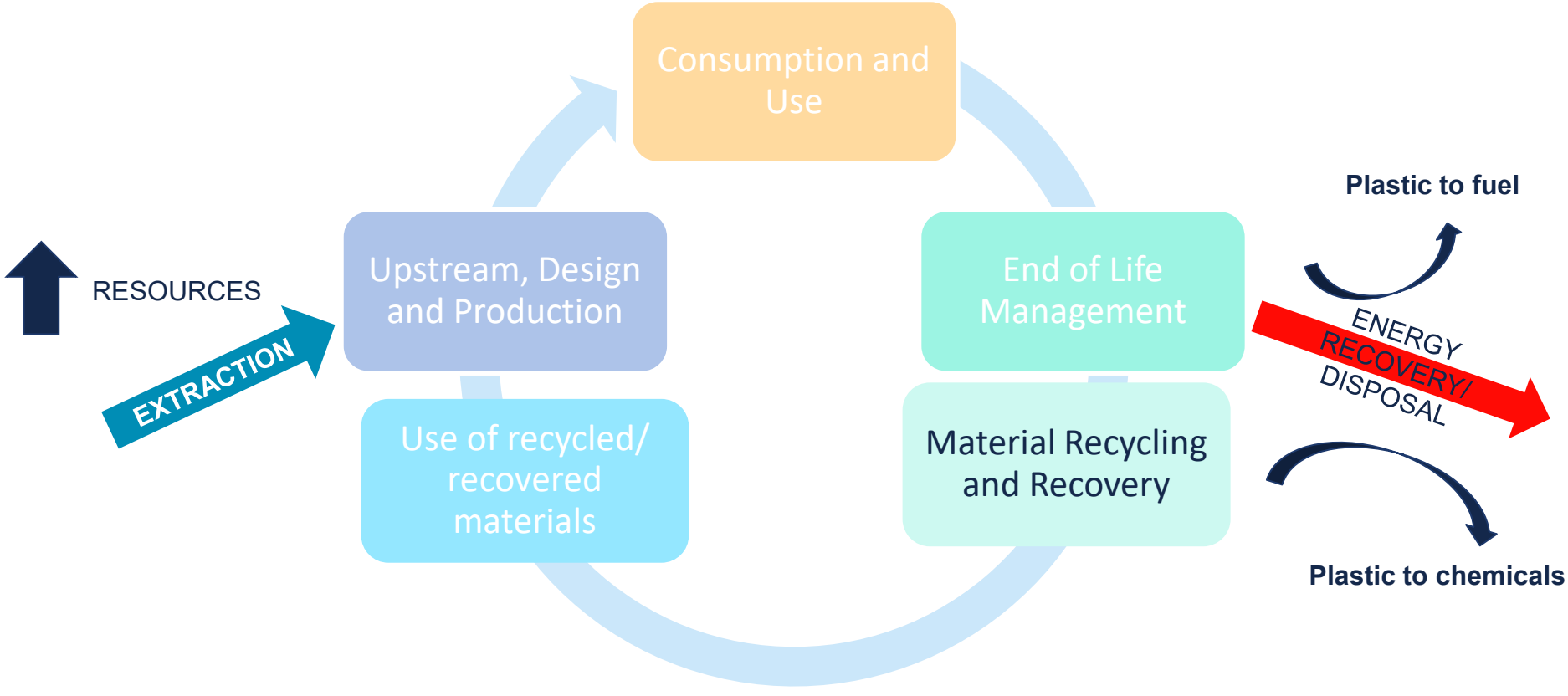
- Pyrolysis and Gasification
- Depolymerization
- Solvent purification
- Solvolysis
- Methanolysis
- Glycolysis
- *---XYZolysis--*

Thermal conversion processes- classified as incineration

“Chemical recycling”: plastic → fuel, chemicals



Plastic to fuel, chemicals: not closed loop, not recycling



Finding facilities that are near-operational

Industry and NGO reports

100's of companies

- In U.S.
- Still in business

- Reporting in EPA databases
- State permit data
- Other info

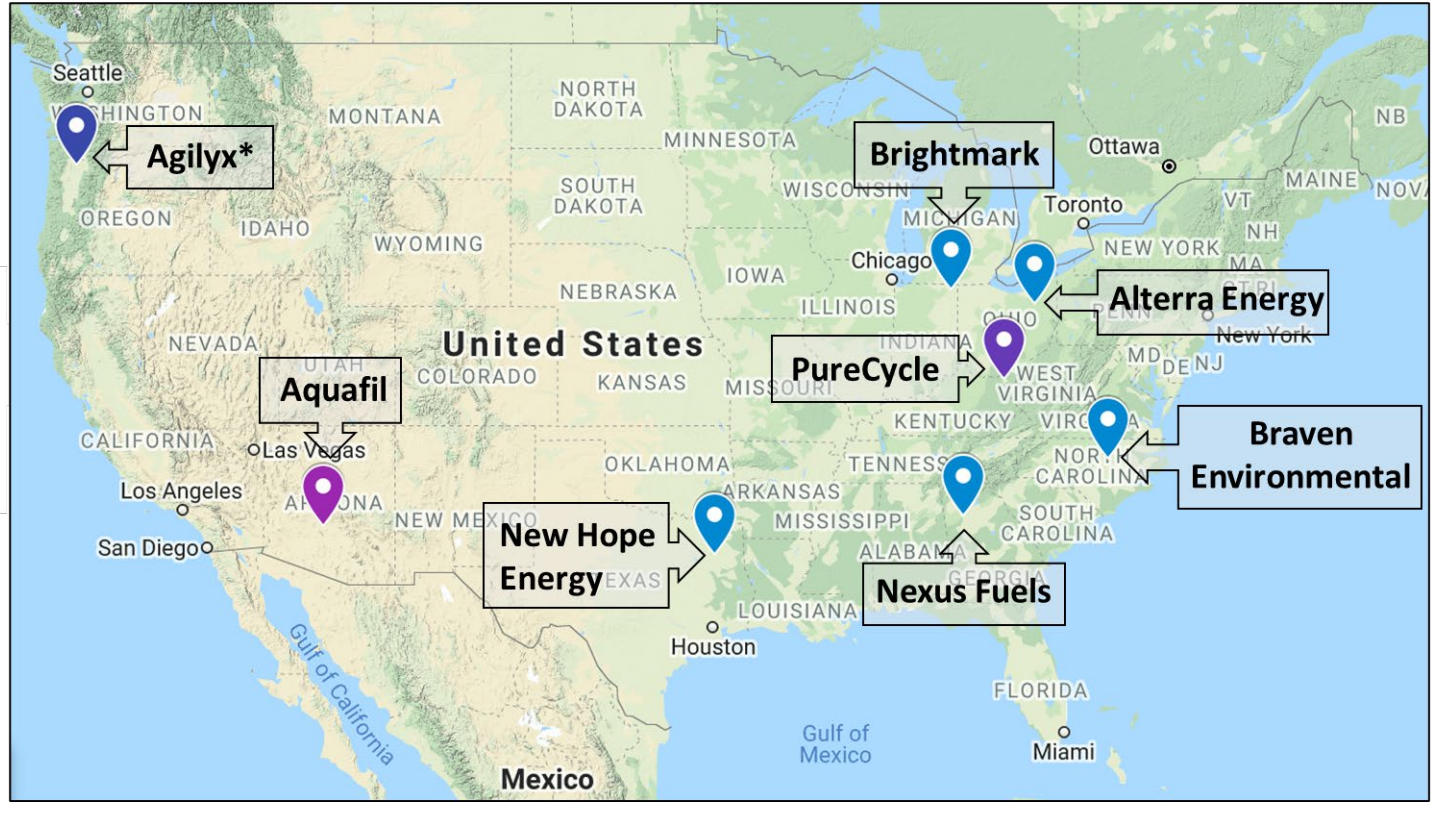
8 facilities

Reporting data available for facilities (August 2021)

Facilities	State Permit Data	EPA ECHO Data	EPA TRI Data	EPA RCRA Data	EJ SCREEN Demographic Analysis
Agilyx	X	X	X	X	X
Nexus Fuels	X	X			X
Alterra Energy	X	X		*	X
Brightmark	X				X
Braven Environmental	X			*	X
PureCycle	X			X	X
New Hope Energy	X				X
Aquafil					X

Majority of facilities are plastic-to-fuel

- Plastic-to-Fuel (pyrolysis)
- Plastic-to-Chemical Components (pyrolysis)*
- Carpet-to-Nylon (depolymerization)
- Plastic-to-Chemical Components (solvent-based)



Air permits allow release of hazardous air pollutants

Chemical	Carcinogen	Reproductive toxicant	Developmental toxicant	Neurotoxicant	Persistent	Bioaccumulative	Liver toxicant	Cardiovascular toxicant	Respiratory toxicant	Kidney toxicant	Skin toxicant	Eye toxicant		
Styrene	X	X	X	X			X					X		
Benzene	X	X	X	X			X	X	X					
Toluene			X	X			X	X	X	X		X		
Mercury	X			X	X	X	X	X	X		X			
Arsenic	X		X	X			X	X	X		X			
Dioxins	X	X			X	X	X				X			
Ethyl benzene	X		X	X			X		X	X		X		
Xylenes			X	X			X		X	X		X		
Naphthalene	X			X	X	X	X		X			X		
Acetaldehyde	X								X		X	X		
Formaldehyde	X						X		X			X		
Hydrochloric acid									X		X	X		
Methanol			X	X										
Hexane		X		X										

State permit data: OR, OH, NC, IN, GA, OH

7 of 8 facilities sited in communities that are disproportionately people of color, low income or both

Facility	Agilyx	Alterra	Aquafil	Braven	Brightmark	New Hope	Nexus Fuels	PureCycle	U.S. Average
Location of facility	Tigard, OR	Akron, OH	Phoenix, AZ	Eagle Rock, NC	Ashley, IN	Tyler, TX	Atlanta, GA	Hanging Rock, OH	
Population within 3-mile radius of facility*	119,130	63,396	97,114	13,072	2,499	38,275	50,100	3,602	
Percentage with household income below $25,000	15%	31%	38%	17%	17%	37%	29%	29%	20%
Hispanic or Latino	10%	2%	79%	14%	2%	41%	13%	2%	18%
Non-Hispanic or Latino									
White alone	77%	70%	12%	60%	96%	26%	8%	91%	61%
Asian/ Pacific Islander	7%	2%	1%	0%	0%	0%	1%	0%	5.6%
Black or African American alone	2%	21%	5%	23%	0%	31%	77%	4%	12%
American Indian	>1%	>1%	2%	0%	0%	0%	>1%	0%	>1%
Other/multiracial	4%	4%	1%	2%	1%	1%	1%	4%	2.4%

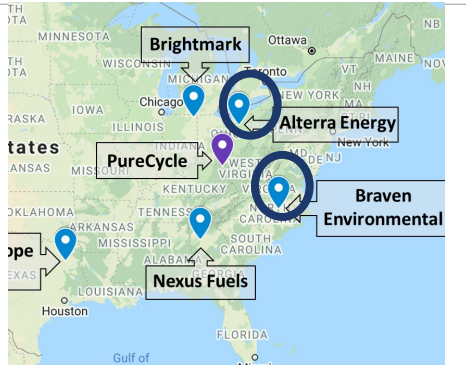
EPA EJSCREEN

Data available in “Recycling Lies” issue brief

https://www.nrdc.org/resources/recycling-lies-chemical-recycling-plastic-just-greenwashing-incineration

Plastic to fuel: Alterra and Braven

- Akron, OH and Eagle Rock, NC
- Pyrolysis of mixed plastic waste for fuel
- Alterra: **63,000 pounds** hazardous waste in 2021
- Braven: **19,000 pounds** hazardous waste in 2021
  - Hazardous waste violation 2022- imminent and substantial endangerment order issued



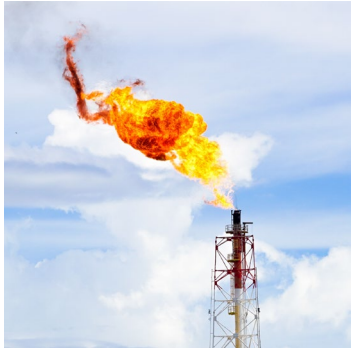
Agilyx produced ~500,000 lbs hazardous waste in 2019

Chemical	Pounds sent offsite (2019)	Disposal involves burning
Ignitable waste, benzene	474,242	Fuel blending, energy recovery
Ignitable waste, corrosive waste, cadmium, chromium, benzene, 1,2-dichloroethane	6,472	Energy recovery
Ignitable waste	2,160	Fuel blending
Ignitable waste, corrosive waste, cadmium, chromium, benzene, vinyl chloride	990	Incineration
Ignitable waste, benzene, corrosive waste	420	Energy recovery
Barium, cadmium, chromium, lead, selenium	340	Energy recovery
Benzene, 1,2-dichloroethane	66	Fuel blending
Total	**484,744**	

Source: EPA RCRA Data 2019

Summary: Problems with “chemical recycling”

- All “chemical recycling” technologies:
  - Lack transparency
  - Generate harmful air pollution
  - Do one or more of the following: (1) Use hazardous chemicals, (2) produce hazardous chemicals, and/ or (3) generate hazardous waste
  - Are not operating at scale (process and product problems)
  - Are generally sited in communities that are disproportionately low income, people of color, or both
- Pyrolysis and gasification
  - Incineration
  - Energy intensive and inefficient; hazardous waste
  - Mostly used for plastic-to-fuel (not recycling)



Thank you!

vsingla@nrdc.org