



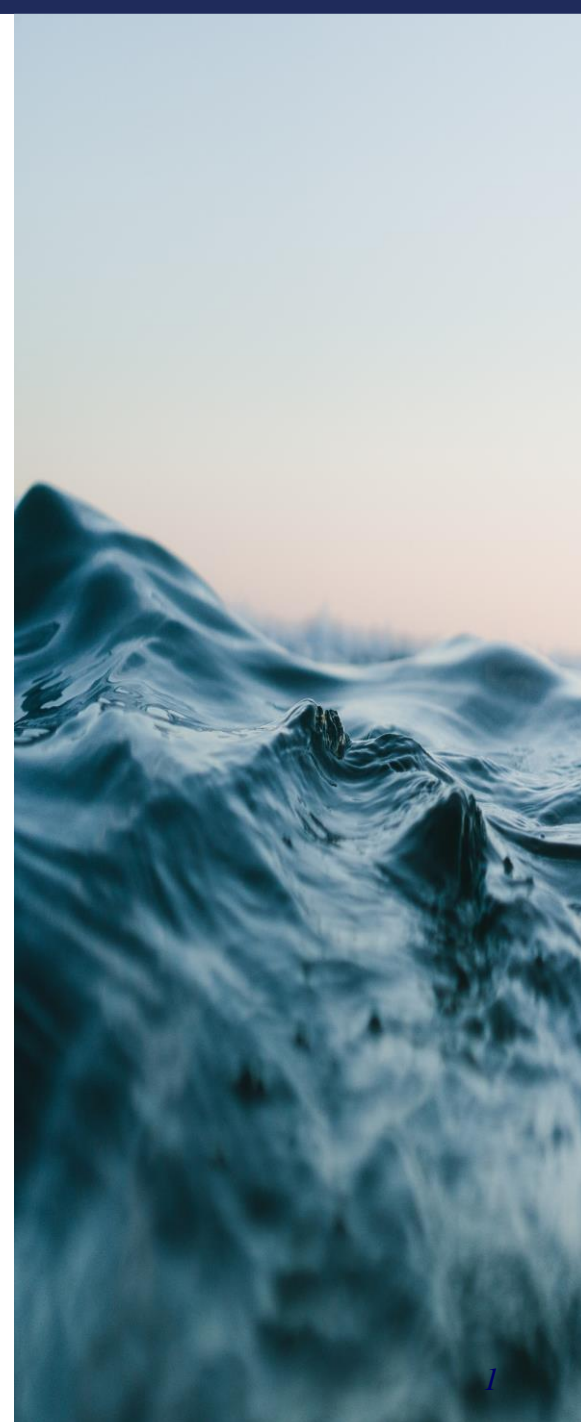
Circular Matters

Chemical Recycling Industry in the Balance

NERC/NEWMOA Chemical Recycling Committee
January 12, 2022



Circular
Matters



About Circular Matters

- Mission: to help our clients achieve their sustainable materials management and circular economy goals
- We are dedicated to bringing about the circular economy
- We assist clients with
 - Policy analysis
 - Recycling market analysis and development
 - Infrastructure analysis/needs assessments
 - Integrated solid waste management planning
 - Materials composition, capture, and MRF flow analyses



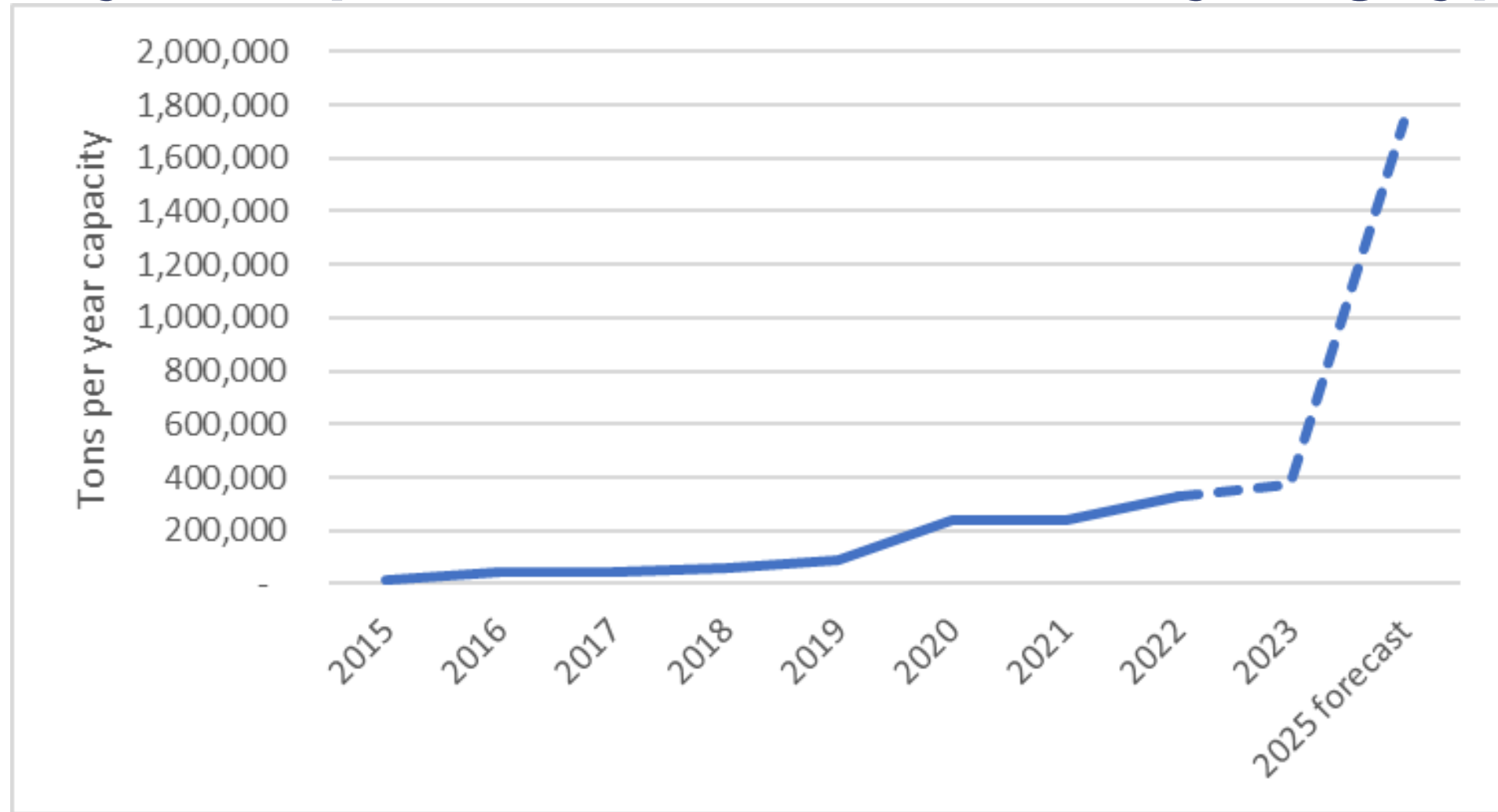
Today's Topics

- Context
- Headwinds – obstacles to advanced recycling growth
- Tailwinds – trends supporting industry growth
- Wildcards – could go either way
- Which path to take?

Wasted Plastic – An Opportunity

- 27 million tons of post-use plastics landfilled in the U.S. in 2018
 - U.S. EPA "Advancing Sustainable Materials Management"
- \$9.9 billion potential U.S. economic output from new plastics recycling and recovery operations – ACC
- \$120 billion annual opportunity including polymers, monomers, intermediates, and other chemicals – Closed Loop Partners

U.S. Project Capacities, All Advanced Recycling Types



Circular
Matters

Source: Circular Matters LLC



Circular
Matters

Headwinds: Obstacles

Sourcing Enough Plastics for Capacity Additions

- Industrial/commercial/institutional (ICI) and residential disposed plastics proportions vary by state ranging from 35% to 65% ICI
 - Impacts sourcing strategy, plant locations
 - Sourcing residential plastics for advanced recycling is currently low



Sourcing Enough Plastics for Capacity Additions (Cont'd)

- Composition/cleanliness needed by different technologies
 - Gasification – can accept unsorted plastics
 - Pyrolysis – sort to remove PET, PVC
 - Purification – sorted resin streams, e.g., PP
 - Depolymerization – sorted resin streams including PET, PS, nylons, PLA
- Collection and sorting infrastructure needs to be developed
- Competition from engineered fuel producers for direct combustion

Competition for Waste Plastics for Use in Fuels



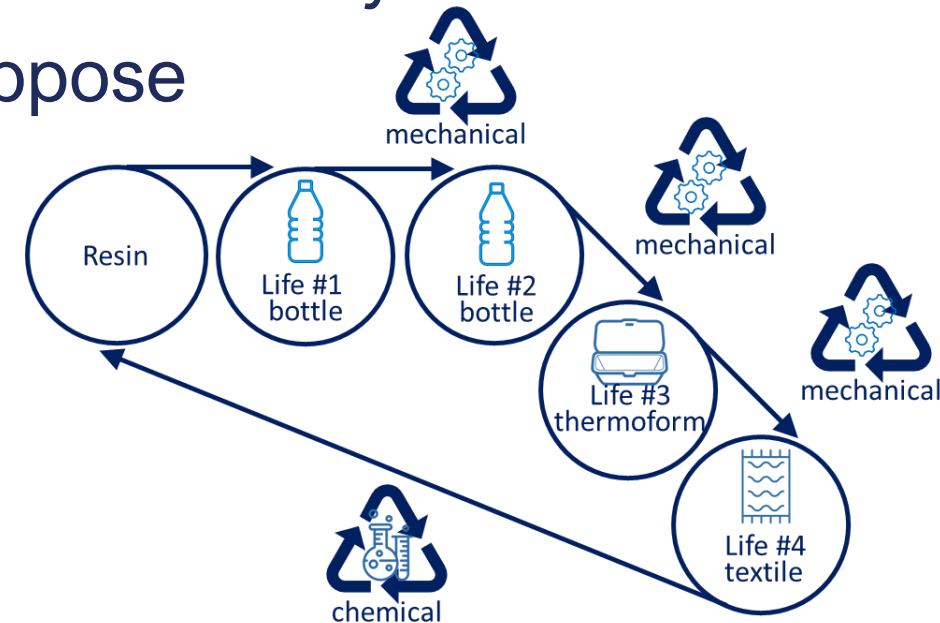
- "Replace traditional fossil fuels with biomass and waste-derived fuels"
 - Portland Cement Association "Roadmap to Carbon Neutrality"
- "Carbon neutrality by 2050"
 - Airlines for America trade group announcement March 30, 2021
- Steel industry – reduce fossil carbon emissions through use of plastics, biomass, hydrogen
 - International Recycling Group (div. GreenSteel LLC) to break ground in 2023



Circular
Matters

Limited Support from Key Stakeholders and Influencers

- Perception — most advanced recycling products go to fuel
- Lack of governmental support if going to a fuel use
- Residential materials recovery facility operators unsure of benefit or value proposition to them
- Lack of industry data available to investment community
- Environmental organizations mobilize and oppose
 - Emissions, anti-plastics point of view
- Viewed as early stage and not proven
- Is it circular? Is it best (GHG/LCA)?



LCA Greenhouse Gas Comparisons

- Lifecycle assessments (LCAs) can identify a preferred technology in comparison to other approaches – outcomes are highly variable
- Hefty® EnergyBag® Program LCA (2020) found plastic used as fuel in cement kilns to be preferred over advanced recycling (pyrolysis)
- Closed Loop Partners LCA (2021) found depolymerization to be preferred over pyrolysis/gasification
- LCAs generally show mechanical recycling to be preferred over advanced recycling



Circular
Matters

Tailwinds: Enablers

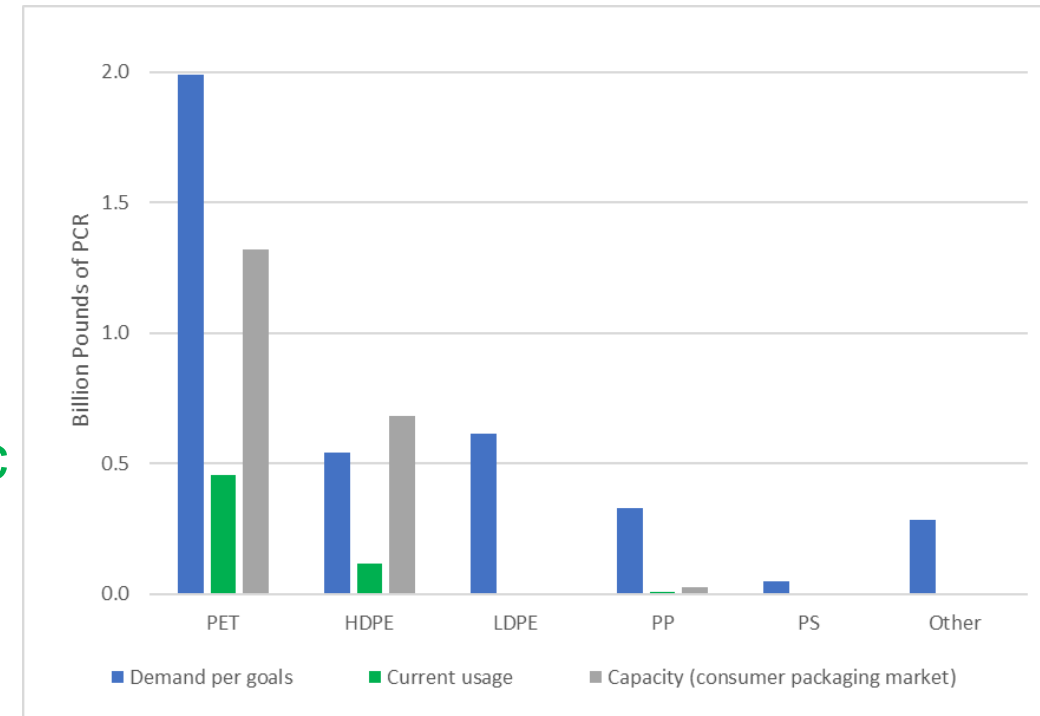
Circularity Challenges via Mechanical Recycling Alone

- Plastic used in packaging must meet high standards
- Challenging to produce virgin-equivalent quality from mechanically recycled plastics
- Resin quality diminishes with each cycle
 - Dirt, inks, pigments, labels, barrier layers build up
 - Plastic degrades each time it is melted
- Advanced recycling can overcome these challenges



Voluntary Organization / Brand Commitments

- Ellen MacArthur Foundation outlines circularity for plastics concept
 - U.S. Plastics Pact
 - Canada Plastics Pact
- Brands, retailers join plastics pacts, set goals for 2025
 - Effectively recycle or compost 50% of plastic packaging
 - 30% recycled or bio-sourced content
 - Eliminate unnecessary & problematic plastic
 - All packaging to be reusable, recyclable, or compostable
- Resin producers offering circular polymers



Source: "U.S. Company Recycled Content Goals Analysis," Circular Matters, January 2021 for AMERIPEN

Mandated Recycled Content Laws Recently Enacted

California – AB 793

Requires plastic beverage containers in bottle deposit program to achieve certain **recycled content thresholds** – up to 50% in 2030

SB 951 (1993)

Trash bags contain "at least 10 percent" post-consumer material



Mandated Recycled Content Laws Recently Enacted

Washington – SB 5022

Recycled content requirements for certain plastic packaging/product types



Year	Plastic trash bags	Beverage containers*	Household cleaner and personal care containers	Plastic wine container (187 milliliters)	Dairy milk container
2022	All producers must register by April 1, 2022				
2023	10 percent	15 percent			
2024					
2025	15 percent		15 percent		
2026		25 percent			
2027	20 percent				
2028			25 percent	15 percent	15 percent
2029					
2030					
2031		50 percent	50 percent	25 percent	25 percent
2032					
2033					
2034					
2035					
2036				50 percent	50 percent

*Excluding plastic wine and milk containers.

Image source: Washington Department of Ecology

Mandated Recycled Content Laws Recently Enacted

New Jersey – SB 2515

Recycled content requirements for certain plastic packaging/product types

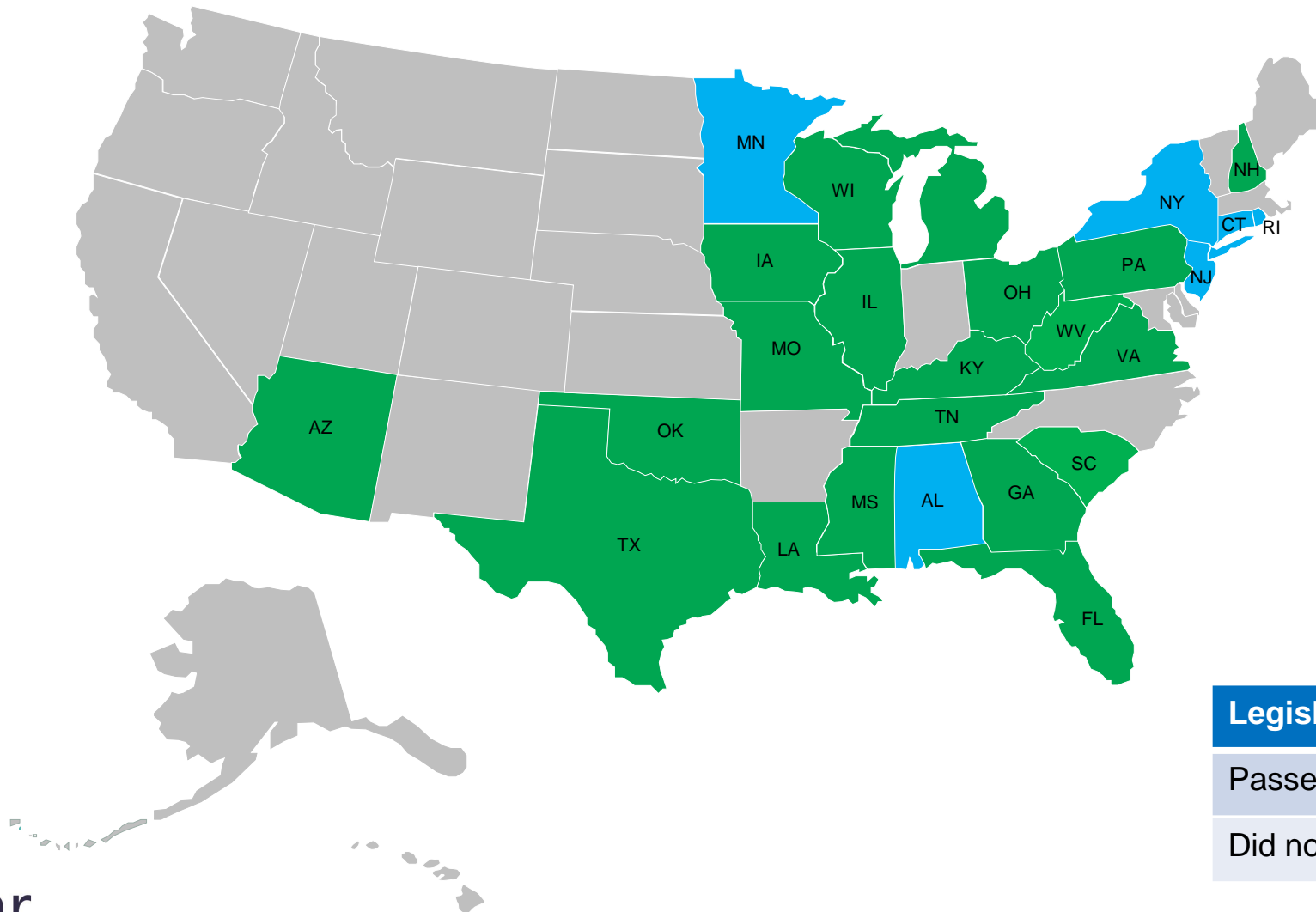
- **Rigid plastic containers (non-beverage):** 10% PCR two years after the bill's effective date. Every three years thereafter, the percentage increases by 10 percentage points until reaching 50%.
- **Rigid plastic beverage containers:** 15% PCR after two years. Every three years thereafter, the requirement increases by 5 percentage points until reaching 50%.
- **Plastic carryout bags:** 20% PCR after two years, and 40% PCR three years later.
- **Trash bags:** Varying requirements/dates based on bag thickness.





Trade Association Actions to Remove Barriers

- American Chemistry Council engagement with state legislators to classify advanced recycling as manufacturing and not waste disposal or incineration
 - Bills have passed in 21 states
 - Did not become law in 6 states
- Association of Plastic Recyclers
 - Investigating standardized model bale specifications – potentially different specifications for pyrolysis, gasification, and depolymerization markets

Advanced Recycling Bills in the U.S.



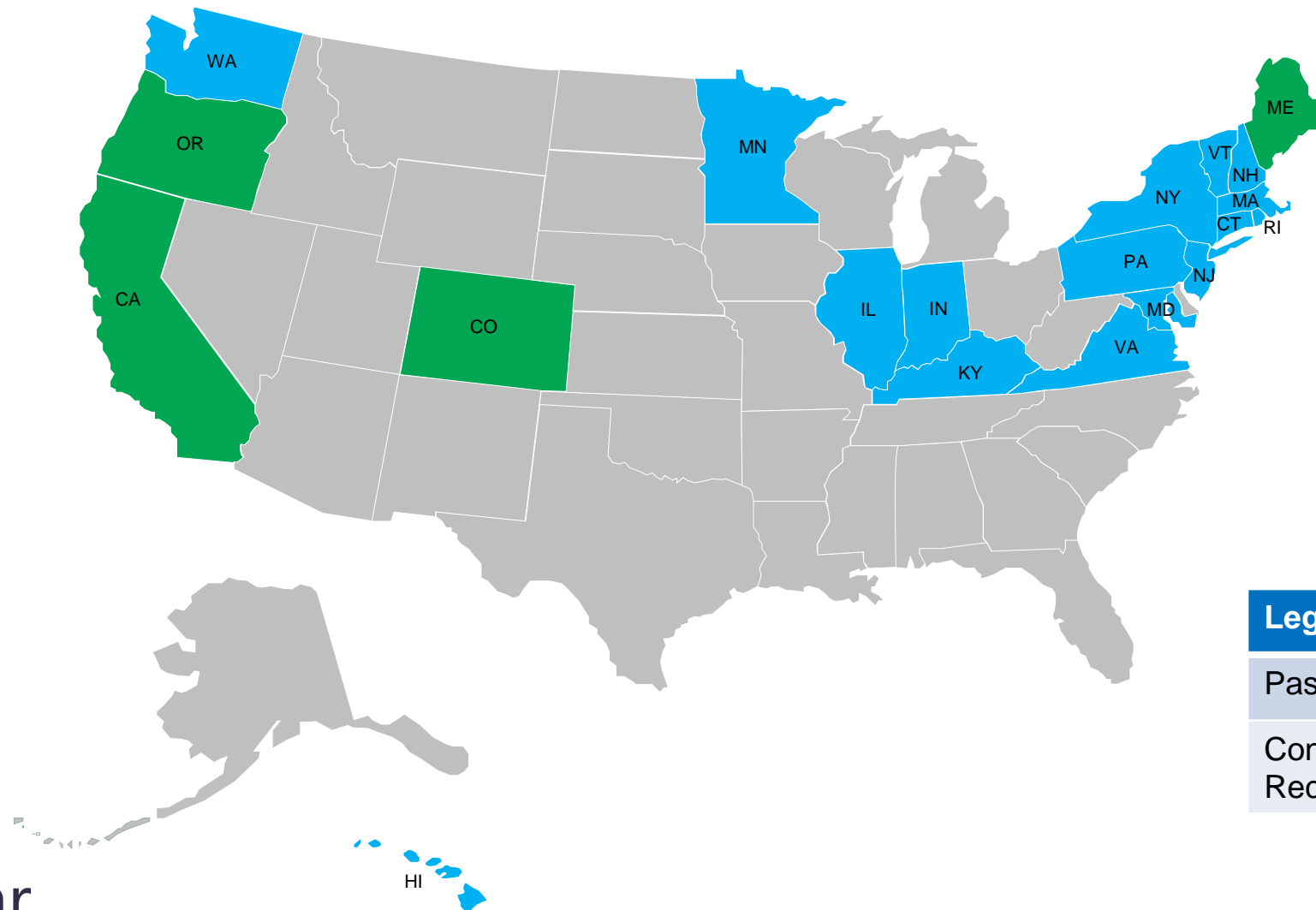
Legislation Status	
Passed and now law	
Did not pass or vetoed	



Circular
Matters

Wildcards: Can Go Either Way

EPR for Packaging Bills in the U.S.



Legislation Status	
Passed	<div></div>
Considered in Recent Years	<div></div>

Regulatory

- Environmental Protection Agency (EPA) sought input regarding whether to regulate pyrolysis and gasification units as solid waste incineration units subject to section 129 of the Clean Air Act
- Federal Trade Commission Green Guides scheduled for revision in 2023
- Environmental Justice concerns (siting approvals)





Circular
Matters

Which Path to Take?

Implications of Policy Approaches

Laissez-Faire

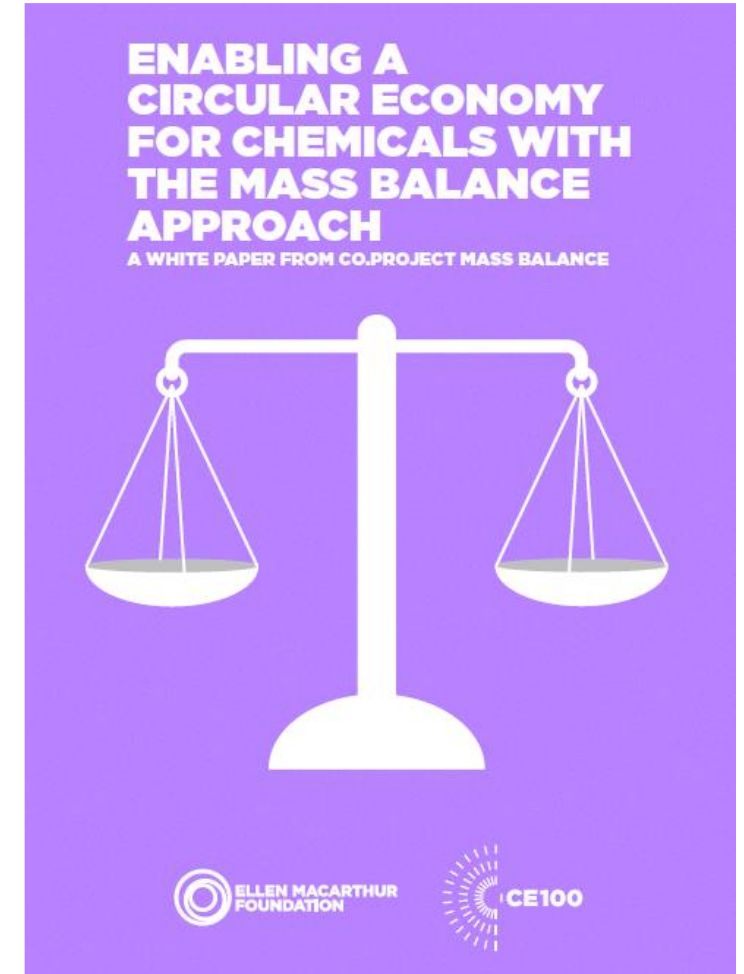
- Company commitments provide "pull"
- Support from zero waste cities
- Few households or governments pay for service
- Limited supply
- Result – primary reliance on commercial sources

Policy Supported/Driven

- Policies with sustainable financing – e.g., EPR
- Bans and mandates without EPR
- Collection and sorting infrastructure is enhanced
- Result – significantly greater plastics recovery

Mass Balance Accounting

- CPGs broadly accept for voluntary commitments
- States can accept where recycled content is legislated
- Enablers
 - Certifications – RMS, ISCC PLUS, APR Postconsumer Resin (PCR) Certification Program
 - Tradable credits
 - Federal Trade Commission Green Guides



Other Enablers

- Collaboration to increase both mechanical and advanced recycling
 - Advanced recycling for non-residential streams alone is not circular or sustainable
- Continued technology innovation
- Incentives/legislation to support demand
- Accepting policy/regulatory/permitting environment





Circular Matters

Thank You

Tim Buwalda
Circular-Matters.com



Circular
Matters

