Perilous Policy: Predicting the Future Global Regulatory Landscape for Plastic Pyrolysis

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Lux Research | The Deciding Factor

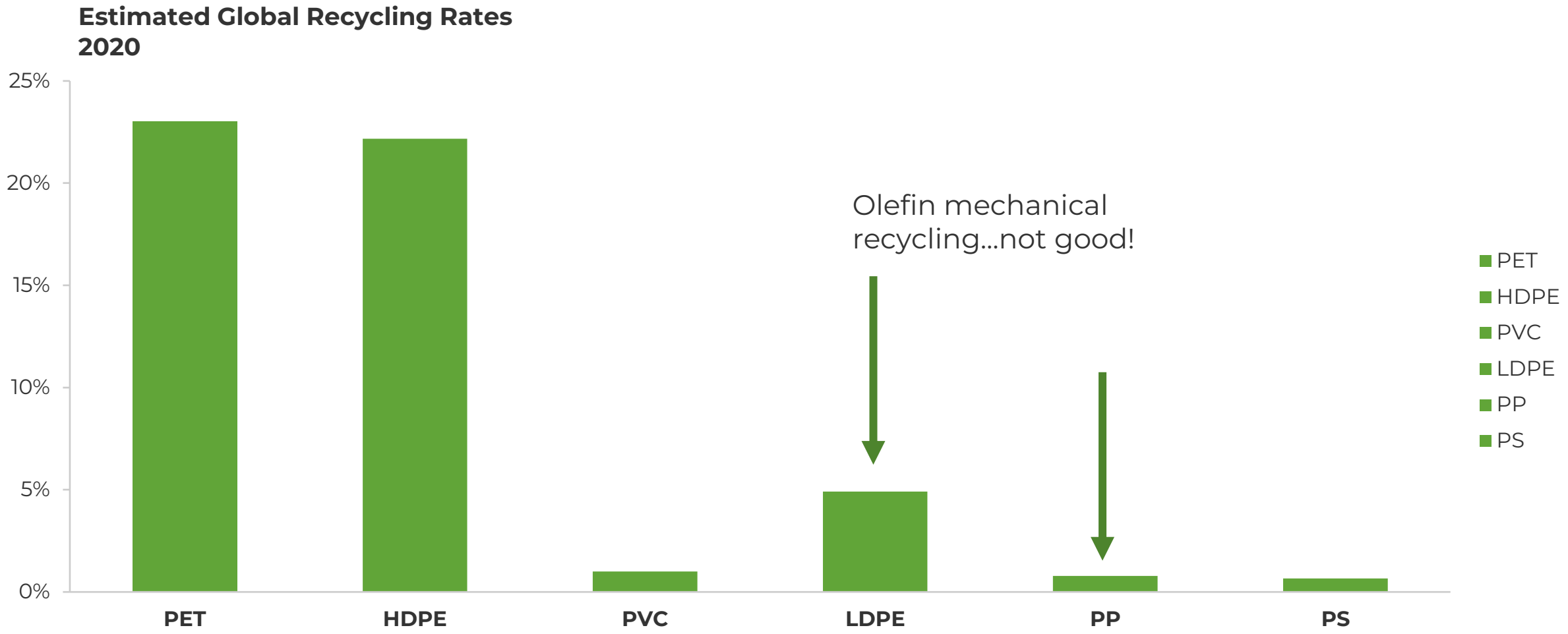
Agenda

1 **Introduction**

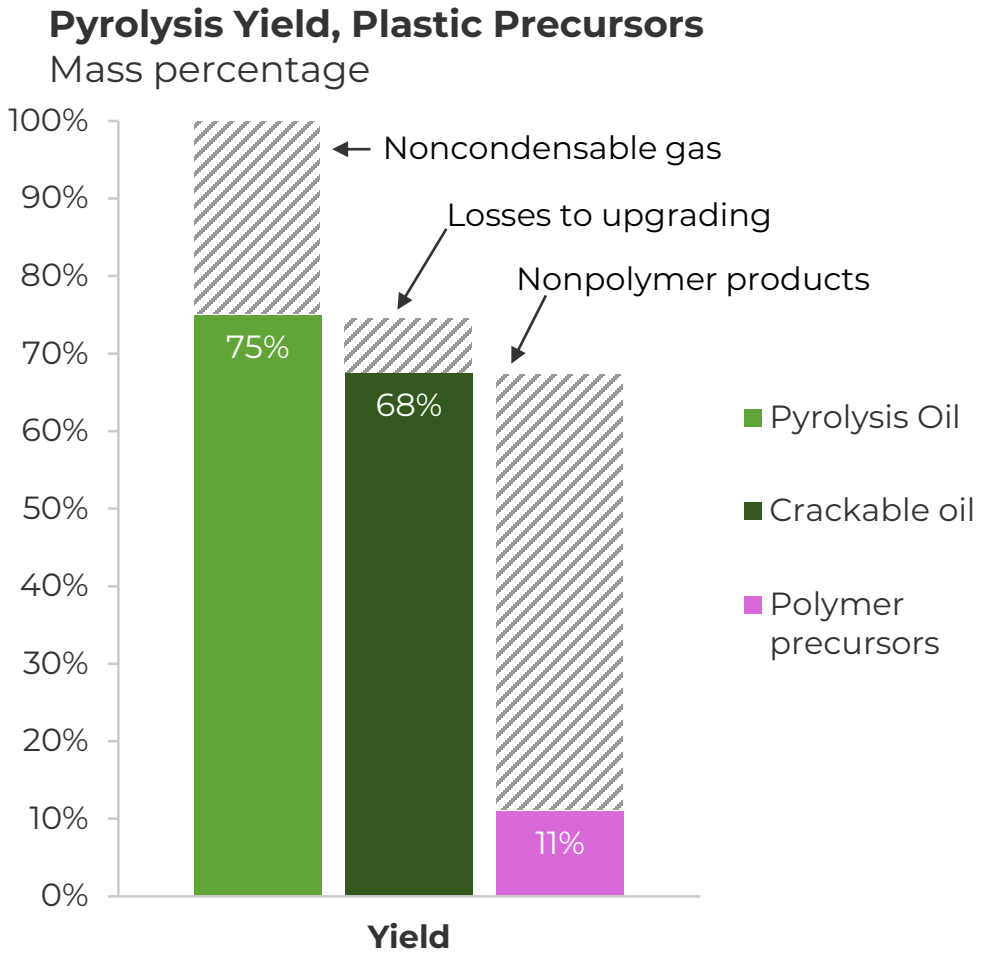
2 Key policies

3 Outlook

Why are we talking about pyrolysis?



Mass balance and energy intensity of pyrolysis is a point of contention between regulators and the chemicals industry



Mass balance in action:
10 tonne pyroil + 90 tonne crude = 20 tonne polymers + 60 tonne fuels + 20 tonne wax

Free allocation: can claim 10 tonne of recycled content in plastic

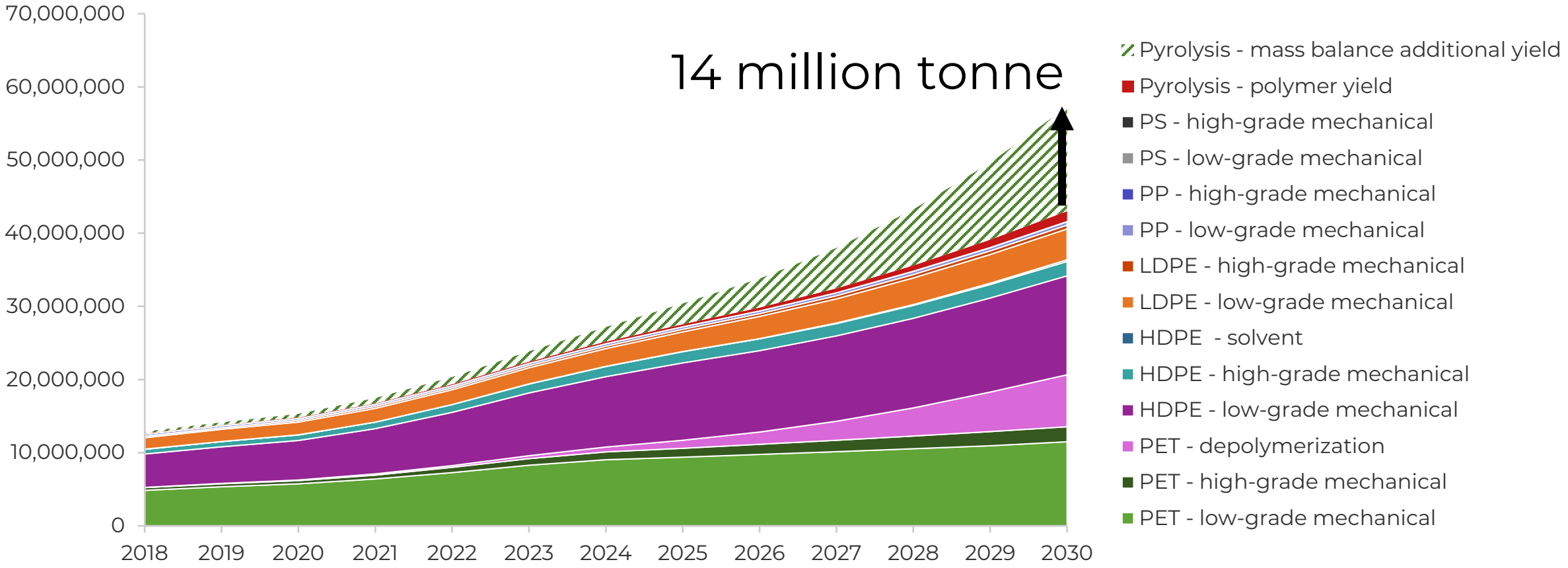
Proportionate allocation: claim 2 tonne recycled in plastic, 6 tonne recycled in fuels, 2 tonne recycled in wax

Fuel-exempt: can claim 4 tonne of recycled content in plastic

Polymers only: can claim 2 tonne of recycled content in plastic

Free-attribution mass balance would add 14 million tonne of apparent polymer output to pyrolysis systems by 2030

Recycled Plastics Output
Million tonne of polymer equivalent



Policy answers 3 key questions

1. Is pyrolysis recycling?
2. How do we track and quantify waste management via pyrolysis?
3. What's the value of pyrolysis?

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4 key areas of policy to watch

- **UN’s International Legally Binding Instrument on Plastics Pollution, including in the Marine Environment**
- **EU’s Packaging and Packaging Waste Regulation (PPWR)**
- **U.S. state-level laws and federal agency action**
- **India’s Plastic Waste Management rules**


UNEA
Deputy ED
UNEP
CS of Environment
Kenya
Executive Director
UNEP
2

The UN instrument has some extraordinarily ambitious elements…

Part II

1. Primary plastic polymers

1. Parties shall take the necessary measures to prevent and mitigate the potential for adverse impacts on human health or the environment from the production of primary plastic polymers, including their feedstocks and precursors.

Option 1

2. Each Party shall not allow its level of production and supply of primary plastic polymers to exceed the reduction target specified in part I of annex A.[3]

Option 2

2. Parties shall manage and reduce the global production and supply of primary plastic polymers to achieve the global target set out in part I of annex A.[4]

...but organized resistance is likely to prevent the most radical proposals

HIGH AMBITION COALITION
TO END PLASTIC POLLUTION

European Union

Japan

Canada

Republic of Korea

Mexico

+57 OTHERS

THE GLOBAL COALITION FOR PLASTICS SUSTAINABILITY

Extended Producer Responsibility (EPR) is emerging as a consensus stance among member countries; other key elements are up in the air

Countries supporting EPR schemes

Brazil
China
Indonesia
Iran
Japan
Russia
South Korea
U.S.

Many elements are still up for debate

Production limits on plastics

Funding for cleanup

Bans on the most harmful waste management practices

What does this mean?

1. Is pyrolysis recycling?
   No.
2. How do we track and quantify waste management via pyrolysis?
   EPR schemes.
3. What's the value of pyrolysis?
   Up to the Member Countries.

Under the EU's current definitions, plastic pyrolysis is not recycling

"Recycling of waste…does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations."

–EU waste framework directive

The new PPWR sets targets for plastic waste reduction — and moves toward acceptance of mass balance for pyrolysis

Waste-reduction targets: 10% by 2030, 15% by 2035, and 20% by 2040

Collection targets: 90% by 2029, supported by a deposit return scheme

"The implementing act adopted pursuant to Article 11(5) shall provide a specific framework under which recycled content traced through mass balance shall be communicated."

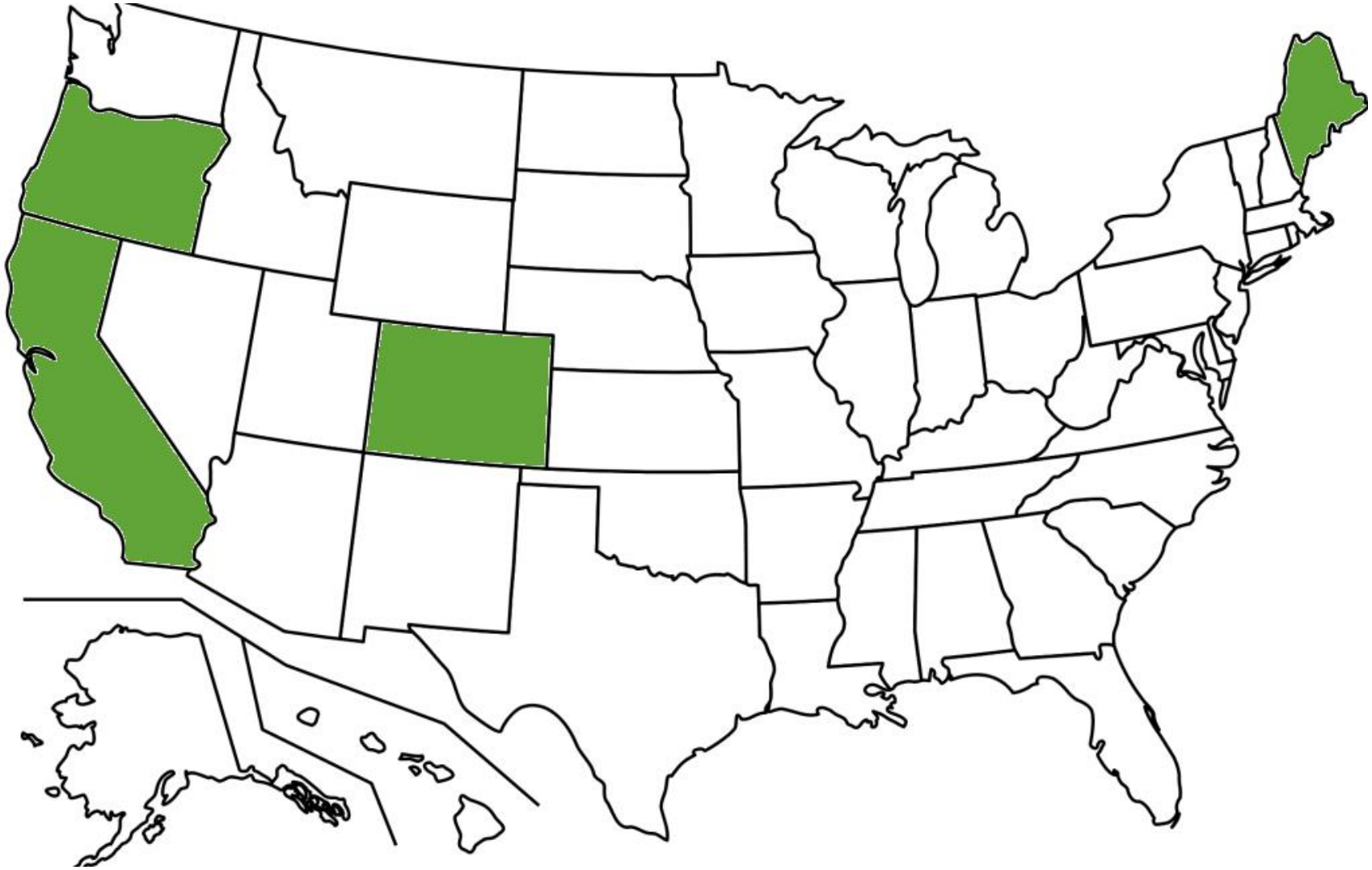
The EU is relatively hostile to pyrolysis now, but the PPWR could create a new, more favorable regime

1. Is pyrolysis recycling?
   Not today, but soon.
2. How do we track and quantify waste management via pyrolysis?
   Mass-balance approaches.
3. What's the value of pyrolysis?
   Tax of EUR 0.8 per kg on unrecycled plastic in products.

The U.S. remains a hodgepodge of state- and local-level legislation

Only a handful of states have adopted EPR schemes so far:

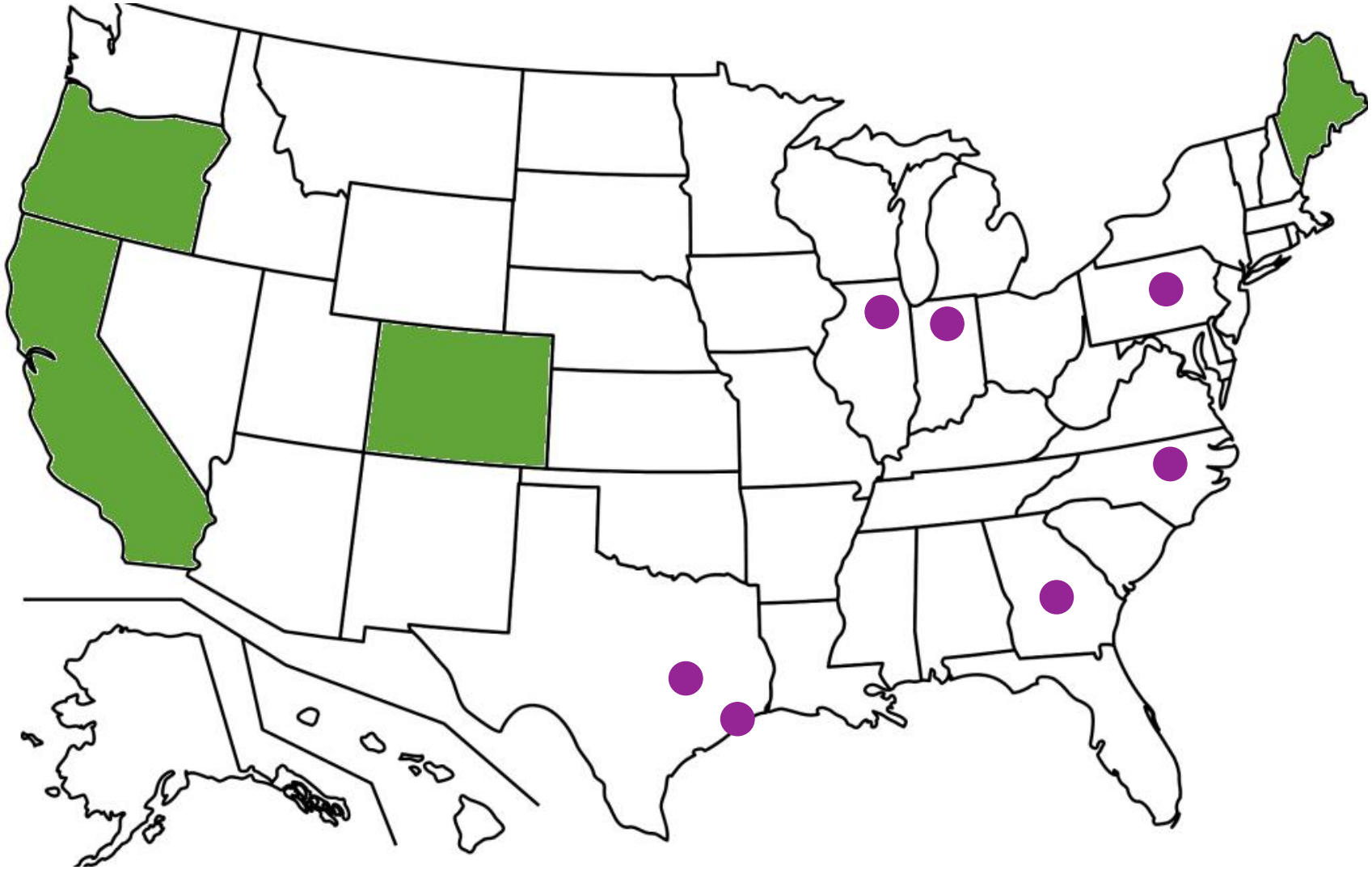
California
Colorado
Maine
Oregon



Plastic pyrolysis is scaling in the absence of policy, not because of it

States with major pyrolysis projects

Georgia
Illinois
Indiana
North Carolina
Pennsylvania
Texas



2023 had more successes than failures for new state-level laws regulating plastics

May 8, 2023

Oregon governor signs foam food container ban

SB 543

July 27, 2023

Connecticut adopts tire recycling EPR program

HB 6486

June 29, 2023

Vermont governor vetoes bottle bill update that would have established a PRO and added more types of containers

HB 158

Aug. 22, 2023

Delaware governor signs foam food container ban

SB 51

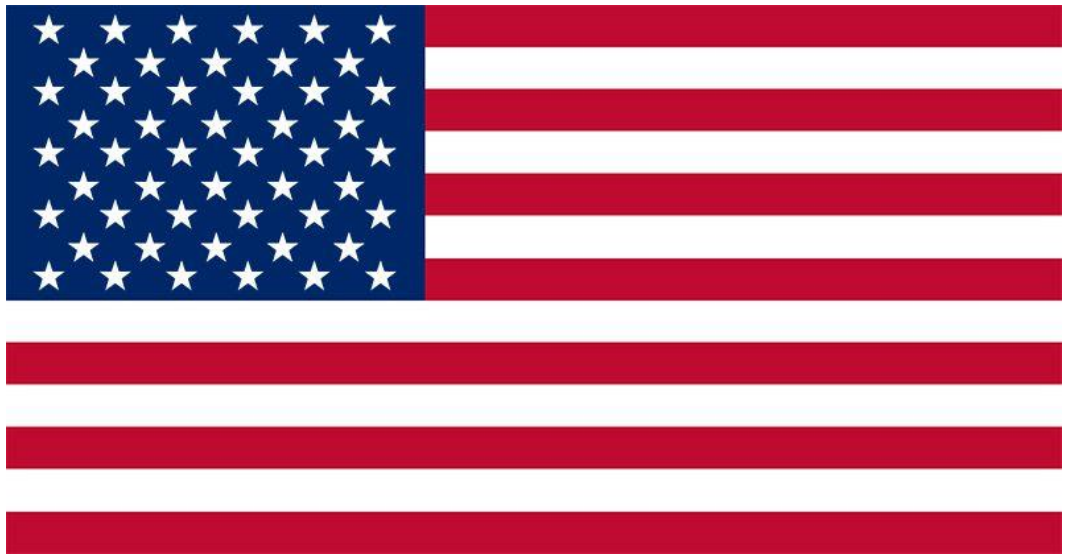
The Federal Trade Commission's green guides could be hugely disruptive for companies already using mass balancing

Lots of terms are currently undefined:

Circular
Renewable
Sustainable
Mass balanced

Many companies are already using these terms:

The U.S. is likely to become more hostile to pyrolysis as states and federal regulators take action but is unlikely to become more favorable



1. Is pyrolysis recycling?
   No.
2. How do we track and quantify waste management via pyrolysis?
   Third-party certifications.
3. What's the value of pyrolysis?
   Whatever you can get people to pay for it — when it's not labeled as recycled.

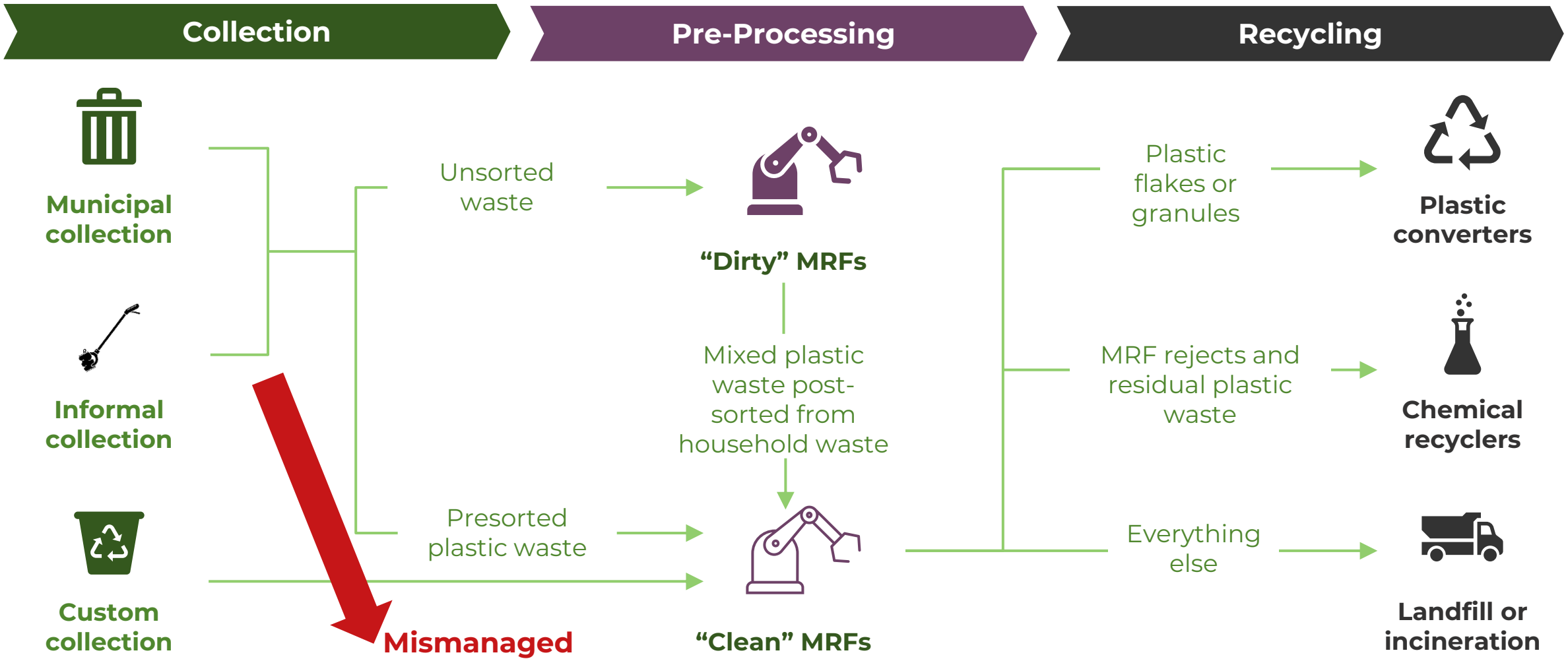
India’s 2022 plastic waste rules have set extraordinarily ambitious targets, which they will almost certainly fail to meet

Plastic Packaging Category	2024–25	2025–26	2026–27	2027–28 and onward
Category 1	50%	60%	70%	80%
Category 2	30%	40%	50%	60%
Category 3	30%	40%	50%	60%
Category 4	50%	60%	70%	80%

Current recycling rates ~8%

Source: *The Gazette of India*

Implementation is a major hurdle; integrating the informal sector is crucial to success



India recognizes plastic-to-fuels and plastic-to-oil as viable end-of-life options — but not recycling

(c) End of life disposal (refer examples 1 to 3 in Annexure):

(i) Only those plastics, which cannot be recycled will be sent for end of life disposal such as road construction, waste to energy, waste to oil, cement kilns (for co processing) etc. as per relevant guidelines issued by Indian Road Congress or Central Pollution Control Board from time to time.

(ii) The producers shall ensure end of life disposal of the plastic packaging waste only through methodologies specified in Rule 5 (1) (b) of Plastic Waste Management Rules, 2016,

This could drive significant volumes of waste to plastic pyrolysis as India seeks to move away from landfilling and mismanaged waste.

Source: The Gazette of India

India is carving out a role for pyrolysis, but it’s likely a low-value one

1. Is pyrolysis recycling?
   No.
2. How do we track and quantify waste management via pyrolysis?
   Local ministerial offices.
3. What’s the value of pyrolysis?
   Unclear — ministers will likely set a value lower than recycling’s, however.

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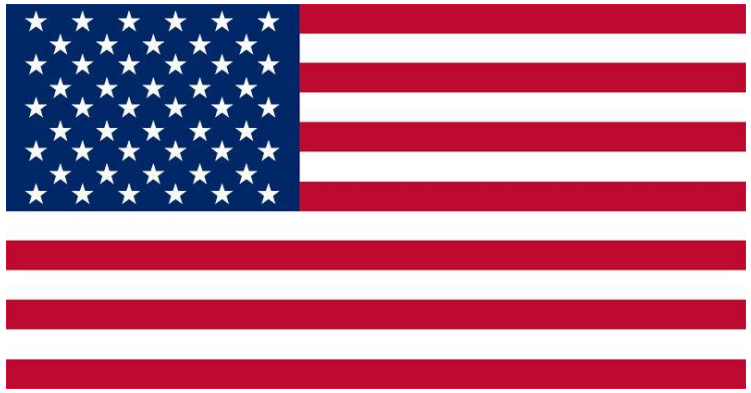
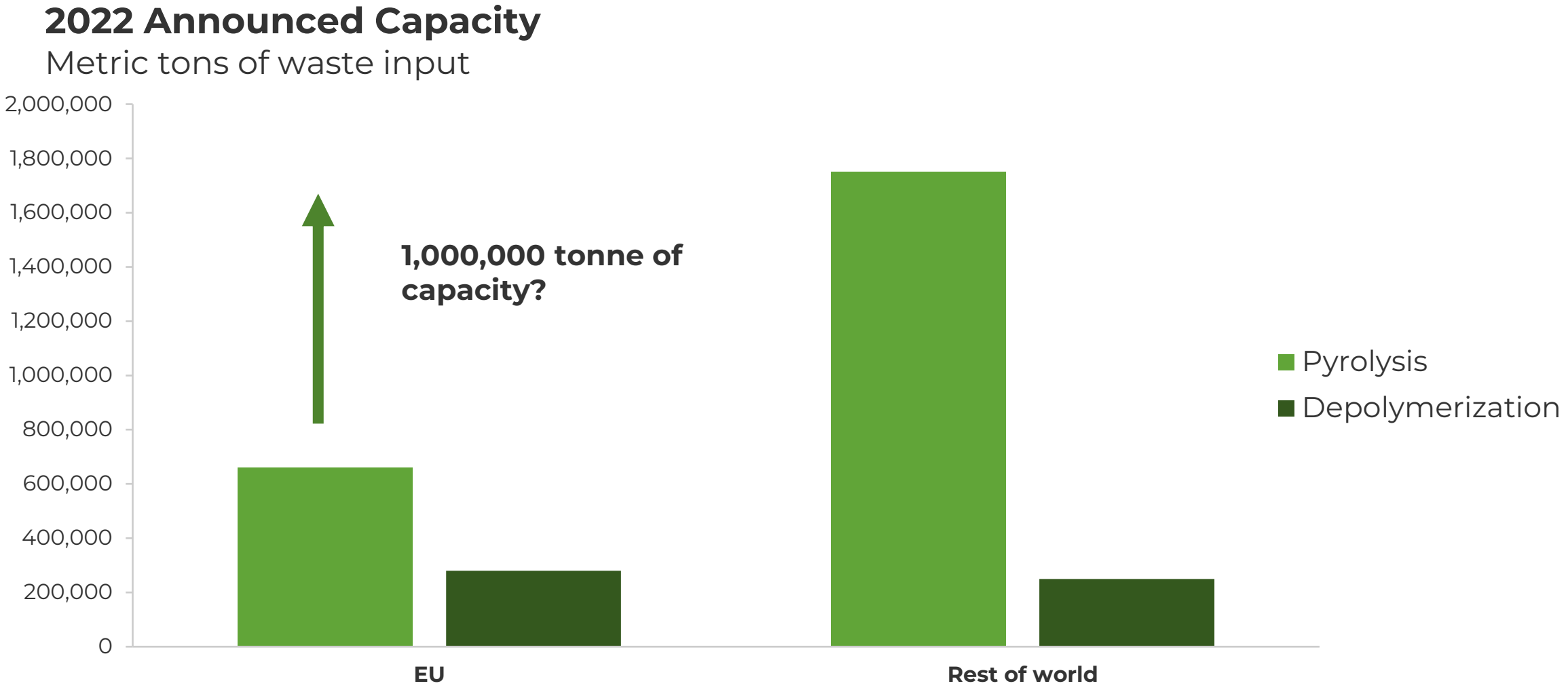
We are not moving toward global recognition of pyrolysis as recycling

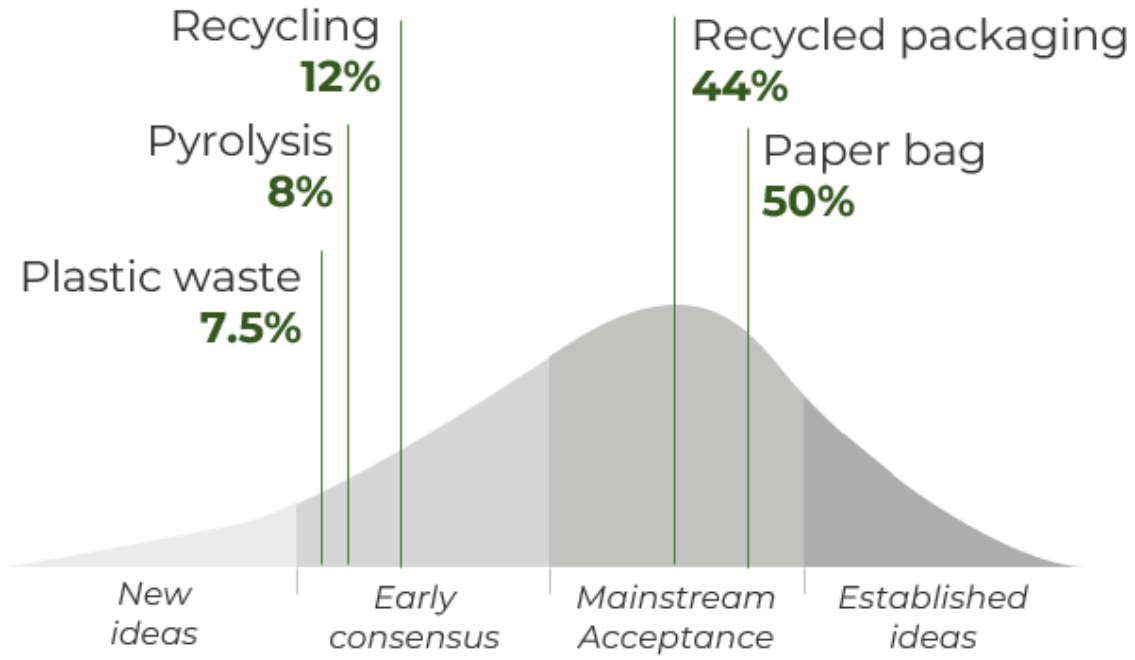


Adoption of mass balance could dramatically accelerate development of European pyrolysis capacity

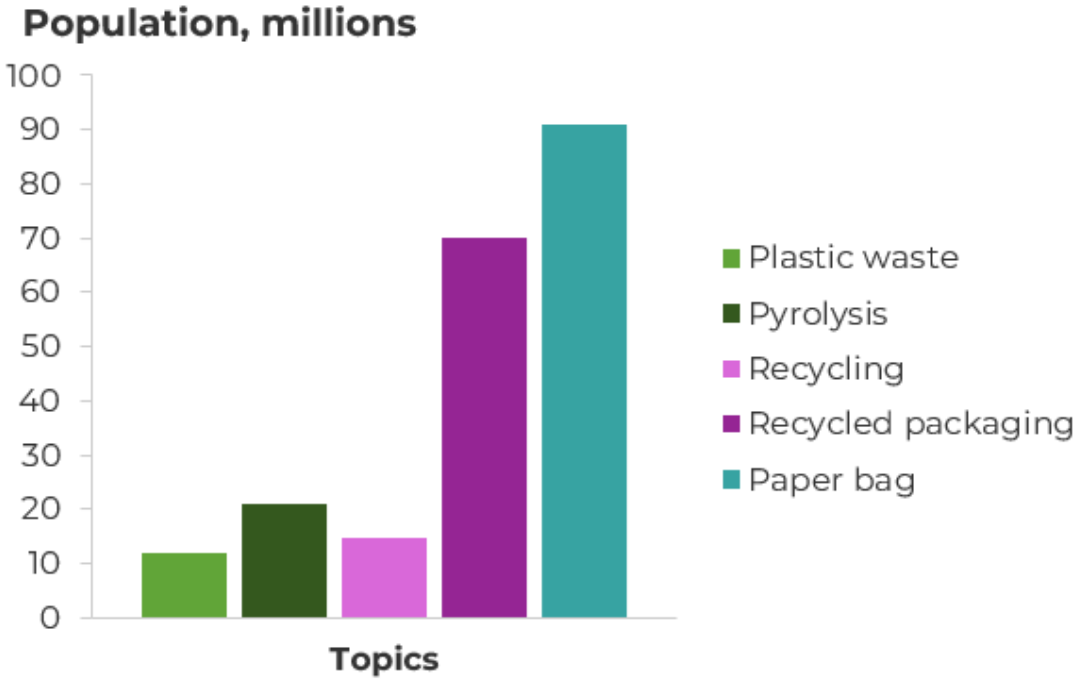


Plastic pyrolysis doesn't have much consumer salience...so building a business model on a "green premium" will be an uphill battle

Maturity Curve



Population Assessment



Next-generation pyrolysis enables more direct plastic-to-chemicals conversion — moving closer to the established definition of recycling

SYNOVA

Synova

Low-temperature gasification with pyrolysis reactor conditions

Lux Take

Synova has the advantage of greater feedstock flexibility and chemical-rich outputs. But commercial viability depends on local factors like feedstock composition.

Anellotech

Anellotech

Thermocatalytic conversion of lignocellulosic material and plastic waste to renewable chemicals and fuels

Lux Take

Anellotech's direct mixed-plastic-waste-to-BTX technology is attractive, but processing cost and contamination tolerance will play a larger role in Anellotech's success.

ENCINA

Encina

Catalytic pyrolysis of polypropylene (PP)-waste-to-benzene, toluene, xylene, and propylene.

Lux Take

Encina will mainly process pure PP waste, so feedstock supply is a concern. Despite claiming to build a 450,000-tonne/y plant, Encina hasn't disclosed many details of its plans.

Companies need to build a strategy that includes waste logistics and mechanical recycling

LAST UPDATED: JANUARY 09, 2024

Borealis to acquire Bulgaria-based plastics recycler Integra Plastics AD

LAST UPDATED: JULY 28, 2023

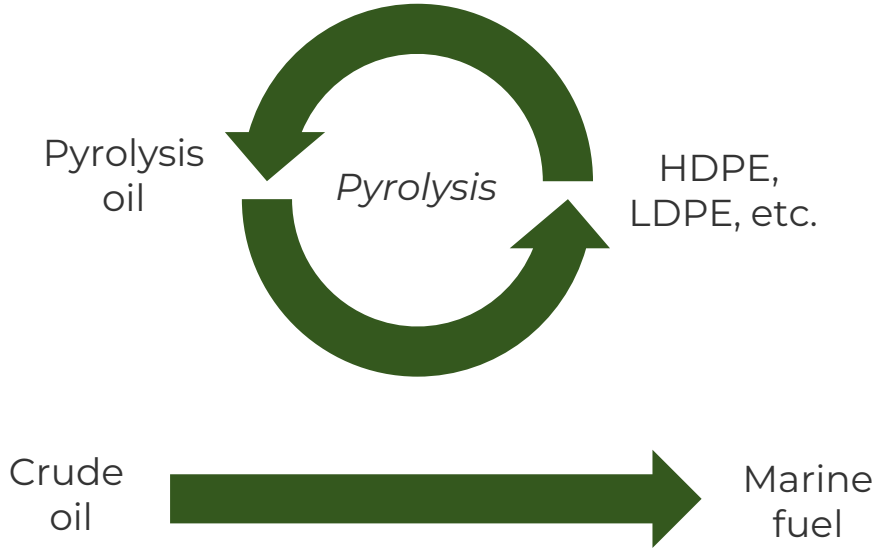
LyondellBasell and others continue shopping spree of plastics mechanical recycling companies

LAST UPDATED: APRIL 11, 2023

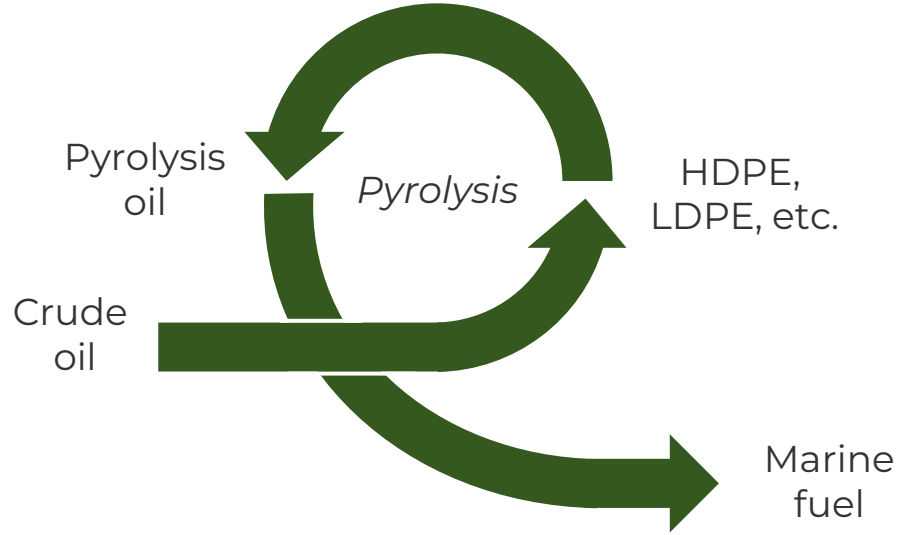
LyondellBasell taps into incineration waste streams for plastic recycling feedstock with EEW partnership

What is the right role for plastic pyrolysis?

A (partially) circular economy



A “loop-the-loop” economy



Key Takeaways

1. Expect the global rollout of EPR schemes for plastics — but don't count on the definition of recycling changing to include pyrolysis.

2. EU policy has been hostile to pyrolysis — but in the next few years, it may become the most favorable region in the world.

3. Mechanical recycling, logistics, and advanced plastic pyrolysis tech will all be key pillars to chemicals companies' circular economy strategy.

Thank you

A link of the webinar recording will be emailed within 24–48 hours.

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The Future of Sustainable CPG Must Include Digital Agriculture

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