LCA as a Tool for Packaging Regulations Compliance

20 November 2025

chemical watch events & training

by enhesa.

Welcome!

A warm welcome to this webinar from Chemical Watch Events & Training – by Enhesa.

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Enabling businesses to create a more sustainable future.

Together.

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helps product **safety and** compliance professionals **avoid the risks of non-compliance and achieve market access** with regulatory data, news, analysis, events, training and expert support.

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Regulatory Summit Europe 2026

20 - 23 April 2026 I Brussels + virtual

Essential updates on European regulations

Join Industry leaders and regulatory experts to explore the latest developments in chemical regulations across Europe. Attend all four days or select sessions most relevant to your business.

20-21 April – Regulatory developments on current and emerging issues for European chemicals management.

22 April – Practical solutions to ensure organizational compliance delivered by service providers

23 April – Legislative developments and hot topics shaping the future of chemicals management for electronics

23 April – Regulations and best practice for the safe and sustainable use of chemicals in packaging materials.

Questions?

Please post any questions in the Questions box, there will be a dedicated session at the end of the session for you to ask questions.

Please note, we may not be able to answer all questions in the time we have available.

Speakers:

Elizabeth Avery

Sustainability Consultant Manager, Trayak

Mitja Brgant

Director Europe Operations, Trayak

Katie Grote

Senior Sustainability Consultant, Trayak

Topics

- Incorporation of PCR and design for recyclability in packaging
- Tradeoffs of material switching
- How packaging design aspects are being considered in regulations
- How life cycle analysis (LCA) can be used for evaluating sustainability strategies and various reportings

TRAYAK
SUSTAINABILITY STARTS HERE

LCA and Its Use in Packaging Regulations

Mitja Brgant, *Director Europe Operations*
Elizabeth Avery, *Sustainability Consultant Manager*
Katie Grote, *Senior Sustainability Consultant*

Connect with us on LinkedIn!

Agenda

- Introduction to LCA
- US Overview
- EU Overview
- Key Takeaways

Introduction

TRAYAK
SUSTAINABILITY STARTS HERE

Trayak's vision is to help companies design and manufacture their entire portfolio using sustainable strategies.

EcoImpact Sustainability Platform

COMPASS LCA

Carbon Accounting

Scope 1 & 2 Reporting

PCF

Sustainability Reporting

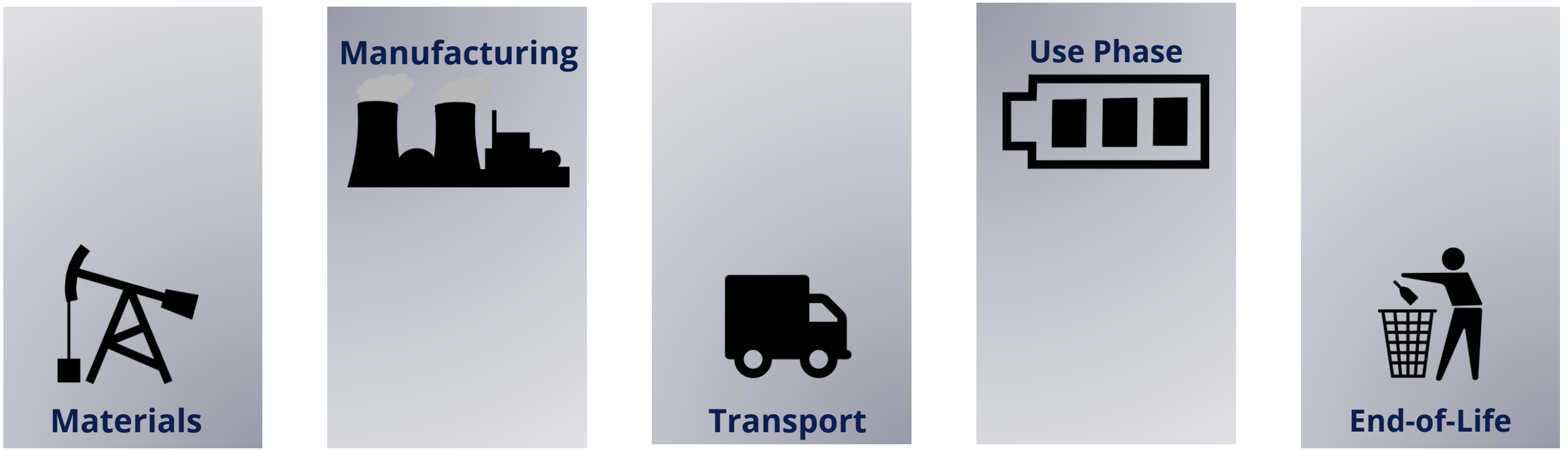
Scope 3 Reporting

EPR Fees

Sustainability Intelligence

What is Life Cycle Assessment (LCA)?

- LCA is a **standardized** and **reliable** method to calculate environmental impact
- Considers the entire **life cycle** of the product or package



Environmental Impacts of Packaging

MATERIAL

- What is the material's environmental impact?
- Is the material abundant or in short supply?
- How do the Extended Producer Responsibility (EPR) fees compare to alternatives?

MANUFACTURING

- Does the conversion process impact water or air quality?
- How much waste is generated in the production of the package?
- Does the manufacturing process utilize renewable energy?

TRANSPORTATION

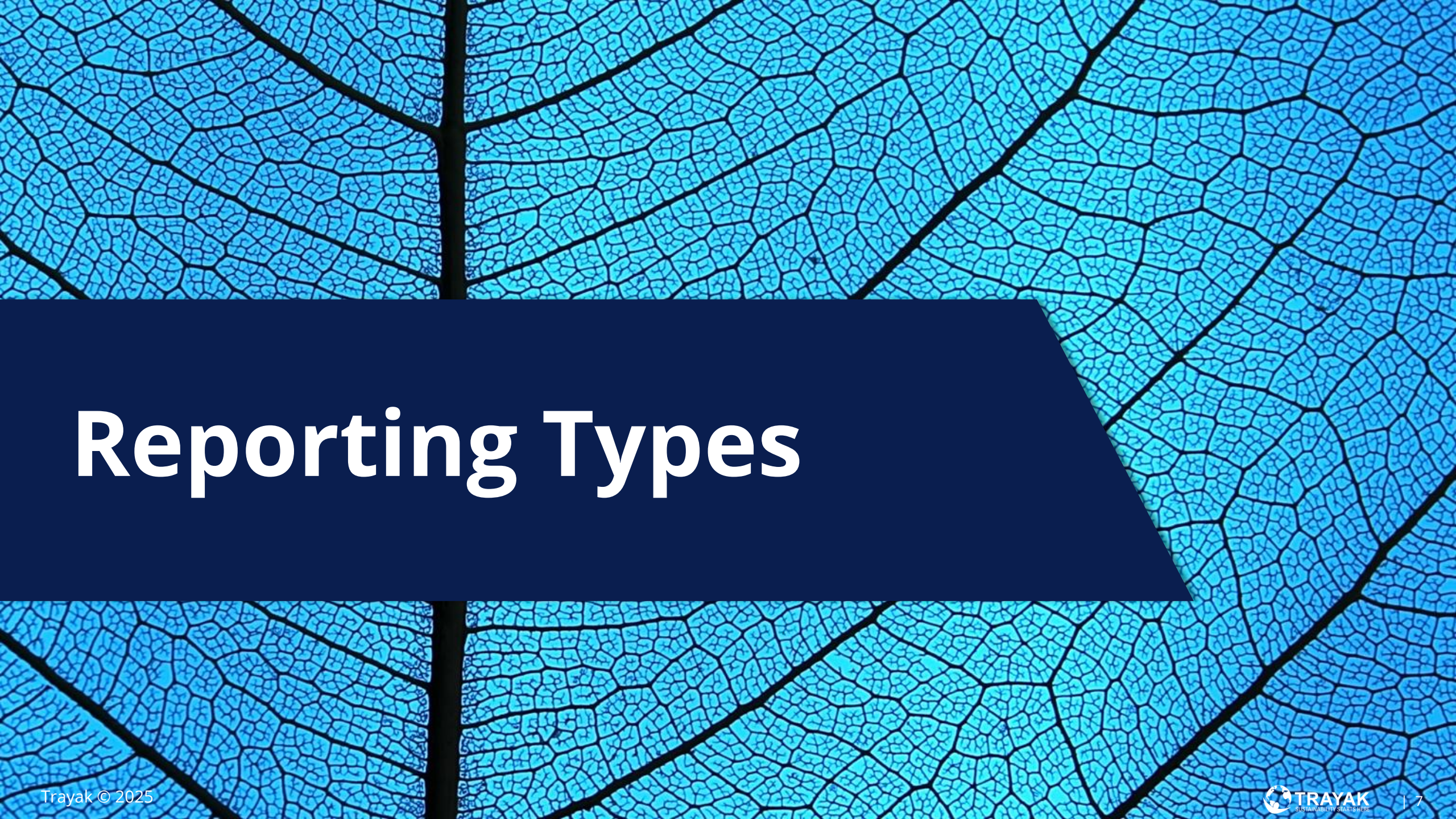
- What is the supply chain of the package?
- Where is the package being produced or sourced?

USE

- Are there any additives or coatings that are toxic to humans (i.e., PFAS, BPA)?
- Is a reuse system feasible?

END OF LIFE

- What happens to the package after its useful life?
- Is the package recyclable?



Reporting Types

Holistic View versus Global Warming Potential (GWP)

Requirements in Reporting versus Total Environmental Perspective

GWP

- Product Carbon Footprint
- Scope 1, 2, & 3 reporting

Holistic Assessment

- Life Cycle Assessment (LCA)
- Environmental Product Declaration (EPD)

Regulations Driving Sustainable Packaging Improvements in the US

US Legislation

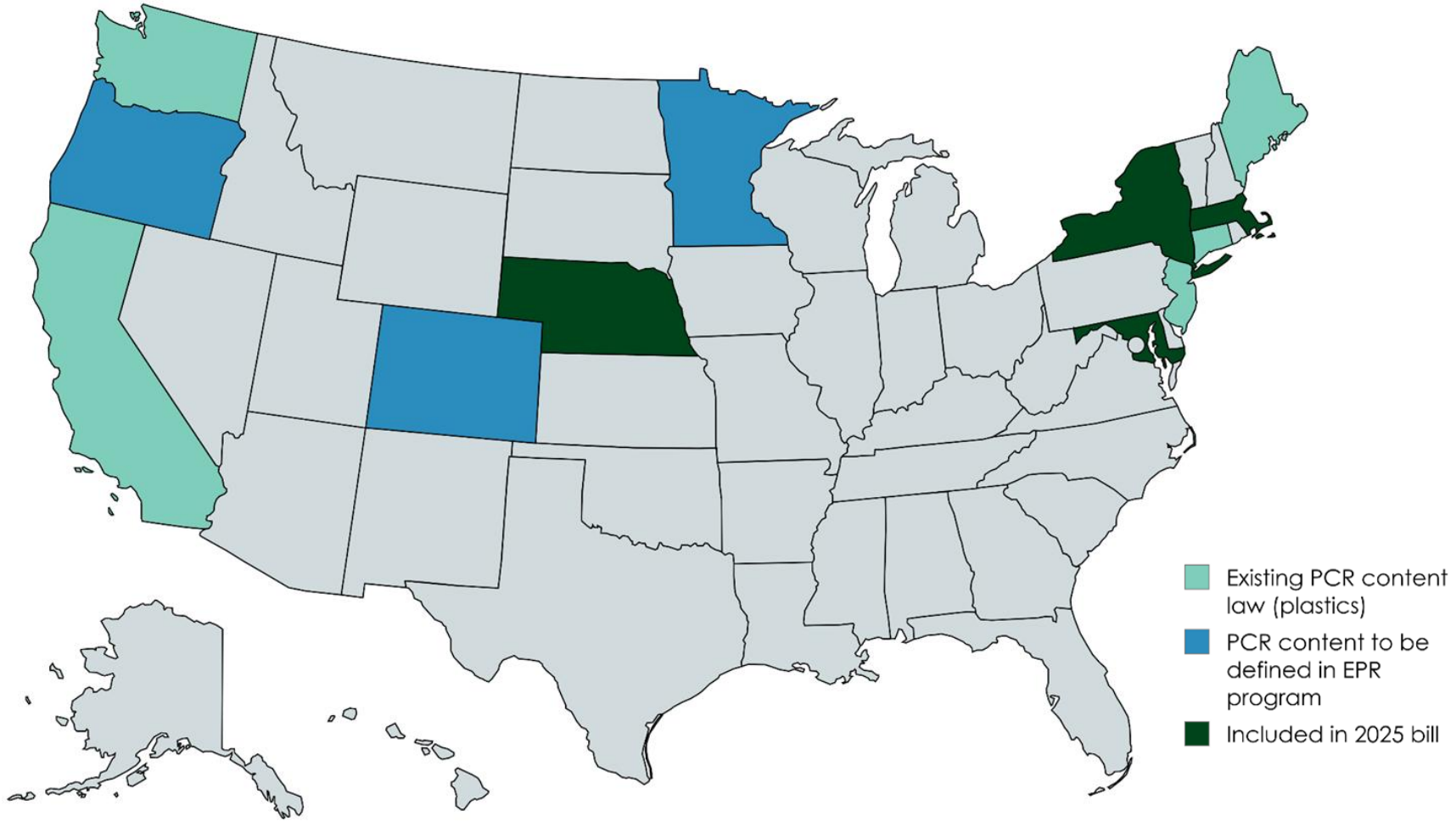
State legislation drives sustainable packaging improvements

- **Post-Consumer Recycled (PCR) Material Requirements**
- **Chemicals of Concern (CoCs)**
- **Single-Use Plastic Bans**
- **Extended Producer Responsibility (EPR)**

PCR Content and Increasing Recyclability

Incorporation of PCR

- PCR content **laws** in several states already
- May be defined in **EPR programs**
- Proposed in **bills** in several states



after https://plasticsrecycling.org/tools-and-resources/policy-hub/policy-priorities/recycled-plastic-content-requirements/

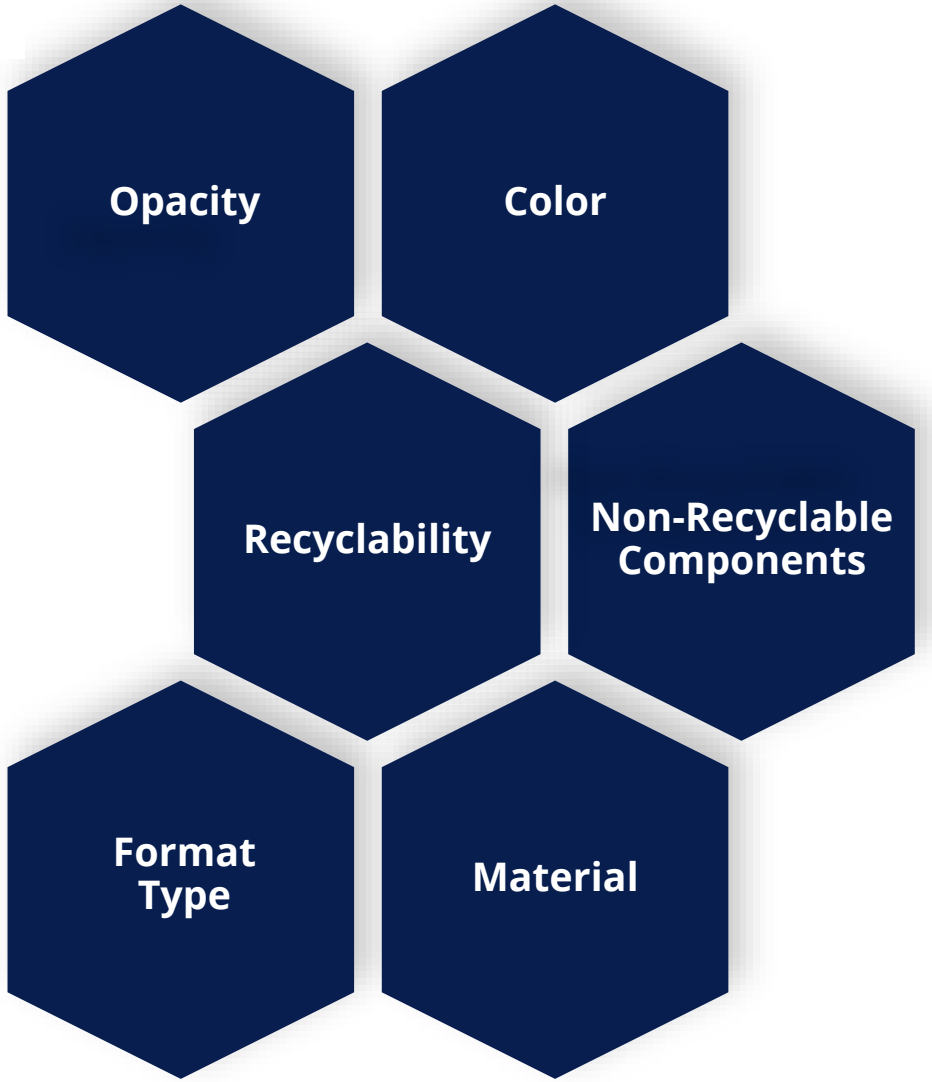
Incorporation of PCR

California	• Beverage bottles (glass and plastic) • Rigid Packaging	• Reusable grocery bags (plastic) • Trash bags
Washington	• Beverage bottles (plastic) • Wine and dairy milk containers (plastic) • Trash bags (plastic)	• Household cleaning and personal care (plastic) • Reusable carryout bags
New Jersey	• Beverage containers (plastic) • Rigid containers (plastic)	• Carryout bags (plastic) • Trash bags (plastic)
Maine	• Beverage containers (plastic)	
Connecticut	• Beverage containers (plastic)	

https://plasticsrecycling.org/tools-and-resources/policy-hub/policy-priorities/recycled-plastic-content-requirements/

Spotlight: Single-Use Recyclability

Focusing on **packaging characteristics** that can **increase recyclability** can improve end-of-life dispositions for a format



Design for Recycling

Packaging **characteristics** compatible with:

- Recycling systems
- Recycling streams

Regional differences

Demand for **recycled content**

Kristensson, 2025

Recyclability

Packaging is recyclable if it can be:

- Collected
- Sorted
- Reprocessed
- Reused

CONSIDERATIONS

- Reach of collection can be wide or limited
- Take-back programs
- Recyclability labels
- Extended Producer Responsibility (EPR) programs

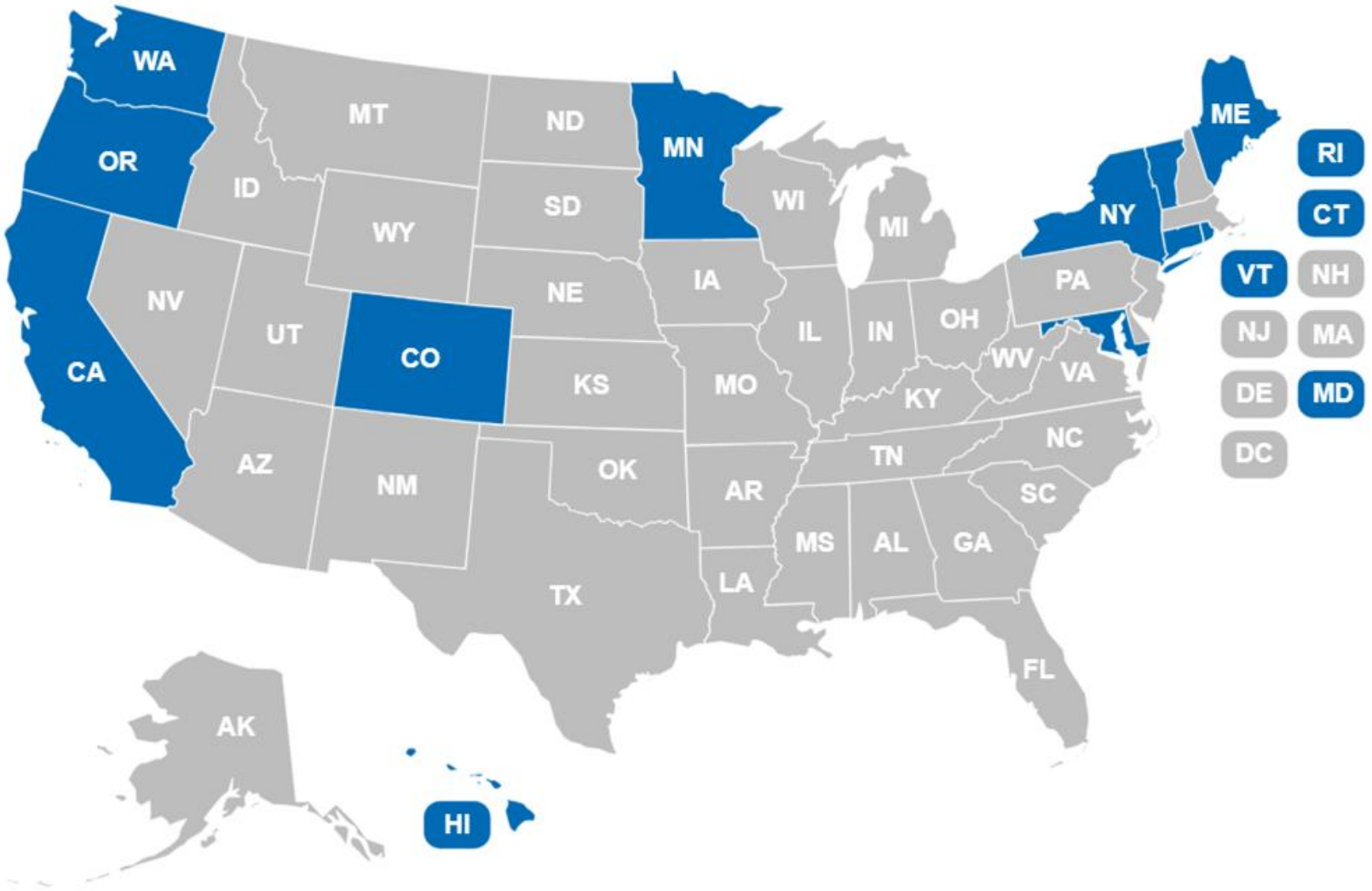
GreenBlue, 2024
Beasley, 2025

Chemicals of Concern

Chemicals of Concern (CoCs)

Packaging - Forever Chemicals

12 states have packaging bans on **PFAS** in food packaging



Map created on www.fla-shop.com based on data from (Hunter et al., 2023)

Single-Use Plastic Bans

Single-Use Plastic Bans

Overview

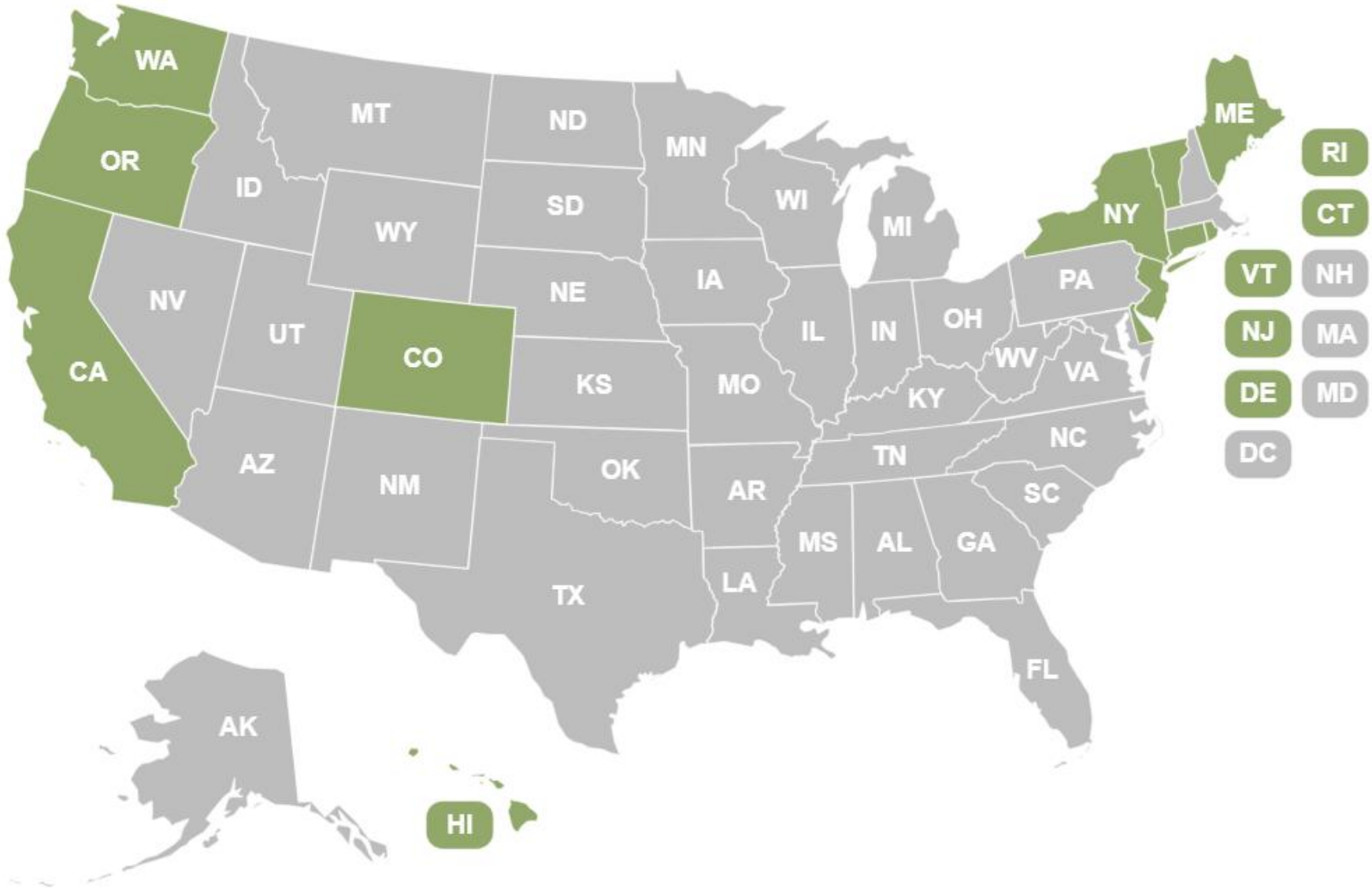
Most single-use plastic bans in the US focus on **plastic bags**.

A few local municipalities have other bans for things like **straws** and **expanded polystyrene***.

Most bans have occurred in the last **10 years**, though some data back to as early as 2008*.

*(National Conference of State Legislatures, 2021)

Single-Use Plastic Bans



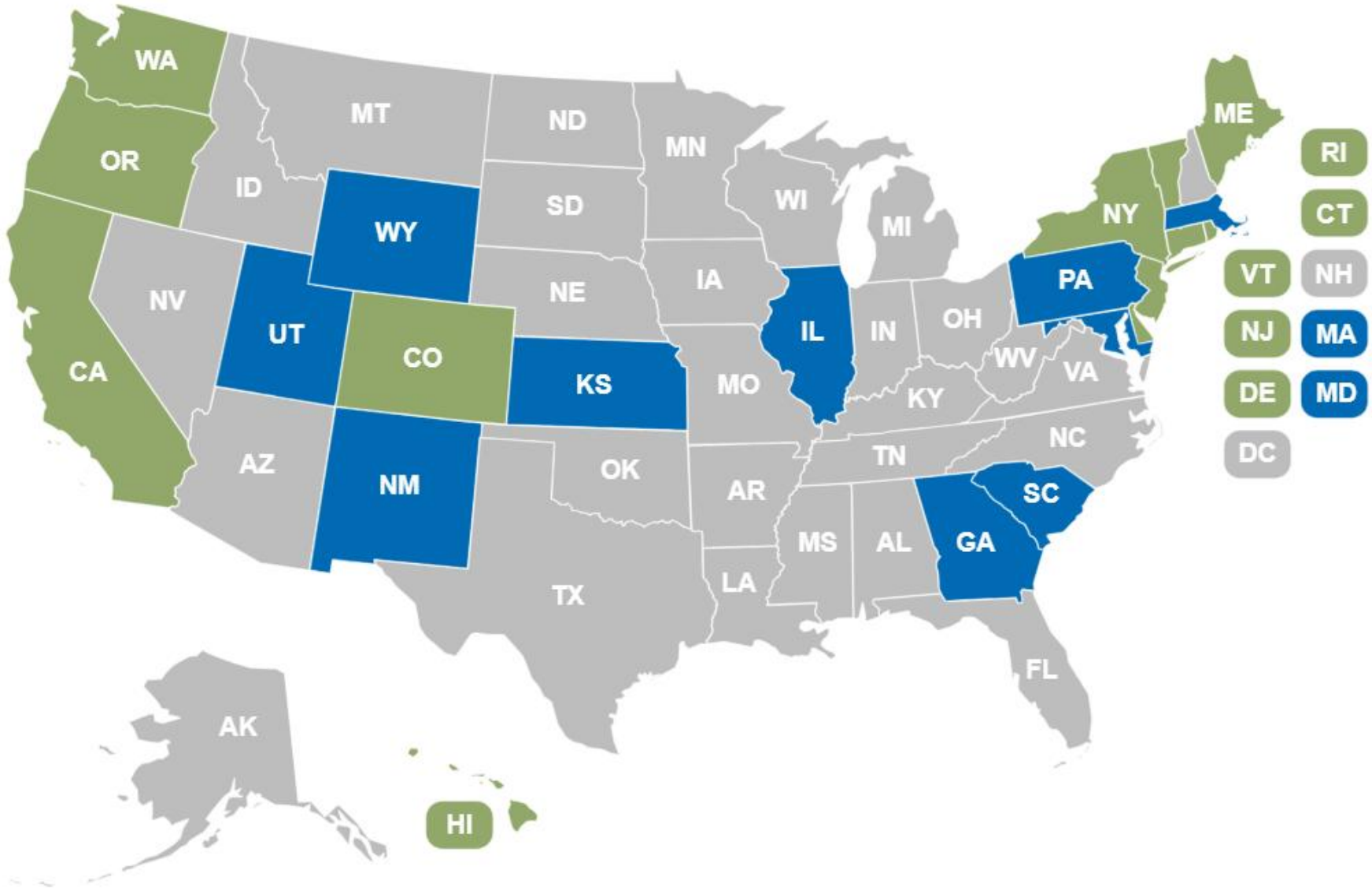
Statewide Plastic Bans

Some Local Plastic Bans

Prohibition on local plastic bans

Map created on www.fla-shop.com based on data from (National Conference of State Legislatures, 2021)

Single-Use Plastic Bans



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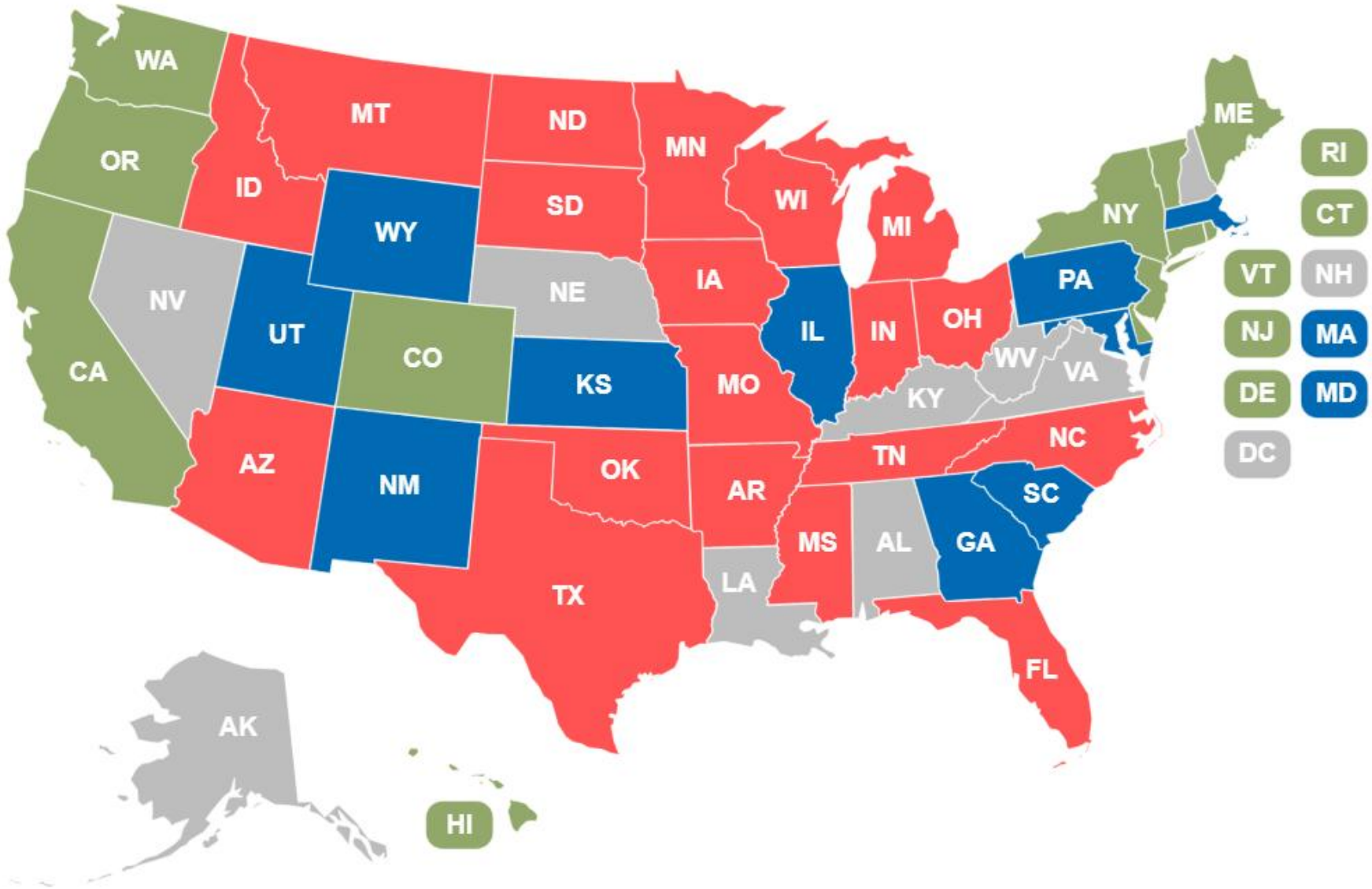


Statewide Plastic Bans

Some Local Plastic Bans

Prohibition on local plastic bans

Map created on www.fla-shop.com based on data from (National Conference of State Legislatures, 2021)

Extended Producer Responsibility (EPR)

US EPR Regulations

Driving Change

Seven states with approved legislation plus **nine** states evaluating legislation in 2025

Legislation selects the **Producer Responsibility Organization** (PRO) who creates reporting structures

Fees from EPR to support state **circularity** infrastructure

*(National Conference of State Legislatures, 2021)

EPR Regulations

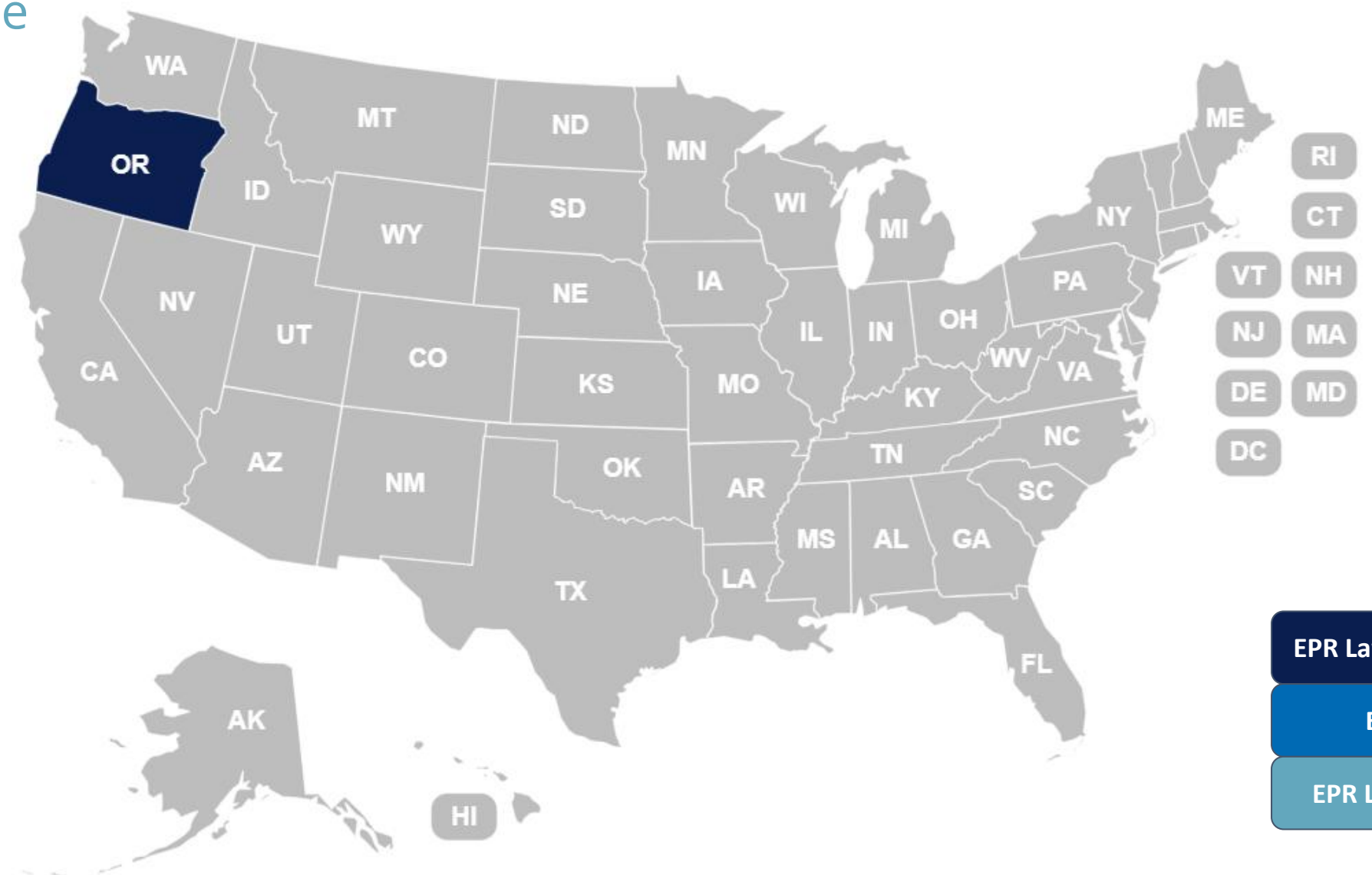
Reporting

REPORTING INPUTS

- State Sales Volume
- Material
- Weight
- Structure
- Color

EPR Regulations

By State



EPR Laws Approved + Reporting

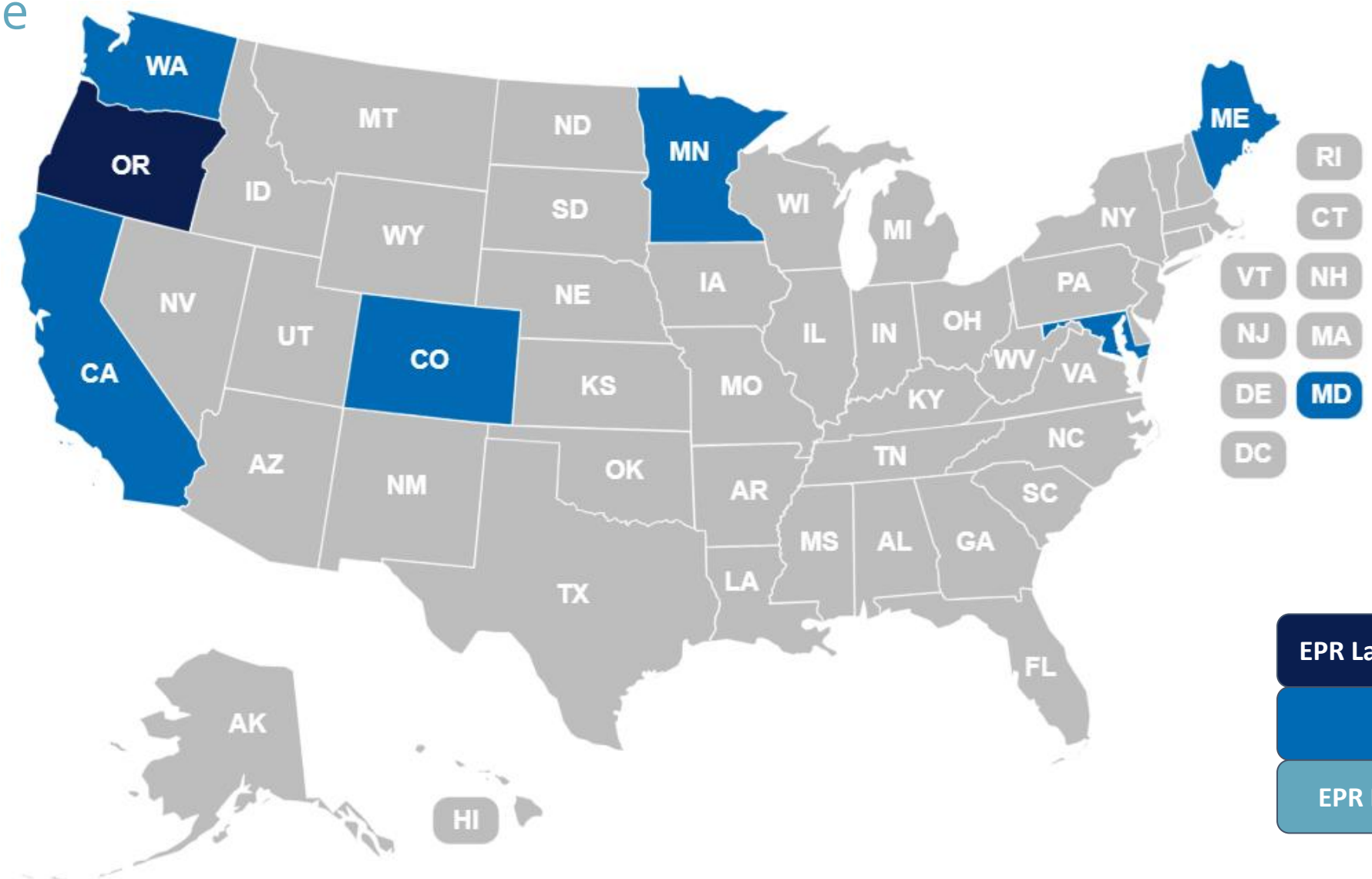
EPR Laws Approved

EPR Laws Introduced in 2025

Map created on www.fla-shop.com based on data from (Sustainable Packaging Coalition, n.d.)

EPR Regulations

By State



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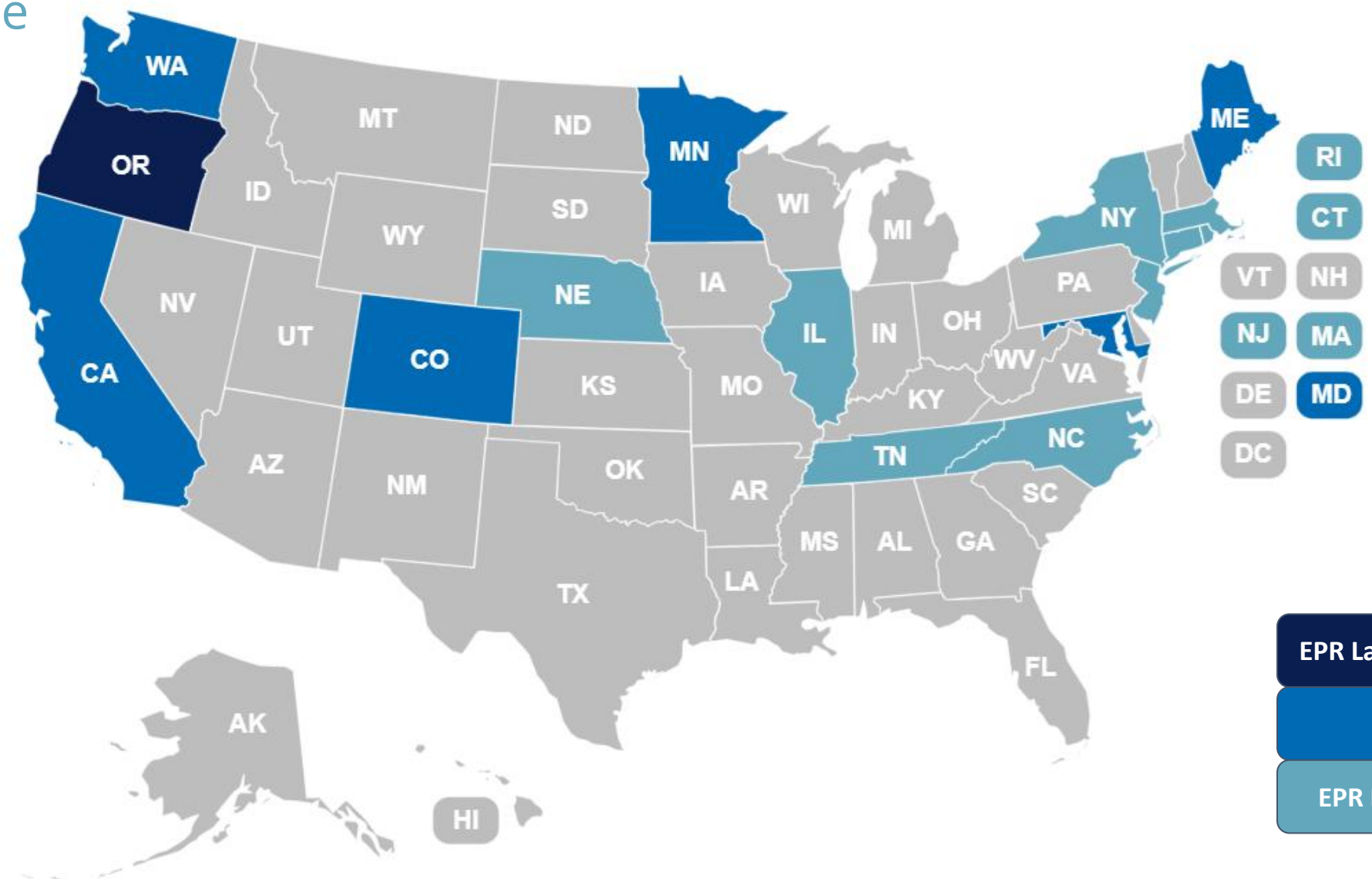

EPR Laws Approved + Reporting

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Oregon Eco-Modulation Bonuses

Bonus A

Performing and disclosing an LCA on primary packaging materials

Currently available

Bonus B

Comparative LCA to show a reduction in impact as a result of primary packaging improvements

Currently available

Bonus C

Comparative LCA to show a reduction in impact as a result of switching to reusable or refillable packaging

Available in 2026

Oregon Mandatory LCA Reporting

TOP 25
PRODUCER LCAs

Oregon's EPR Program will require the top 25 packaging producers in the state to provide LCAs on the top 1% of their SKUs

More guidance in 2026

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Oregon LCA Reporting: Mismanaged Waste Index & Plastic Leakage

Mismanaged Waste Index (MWI)

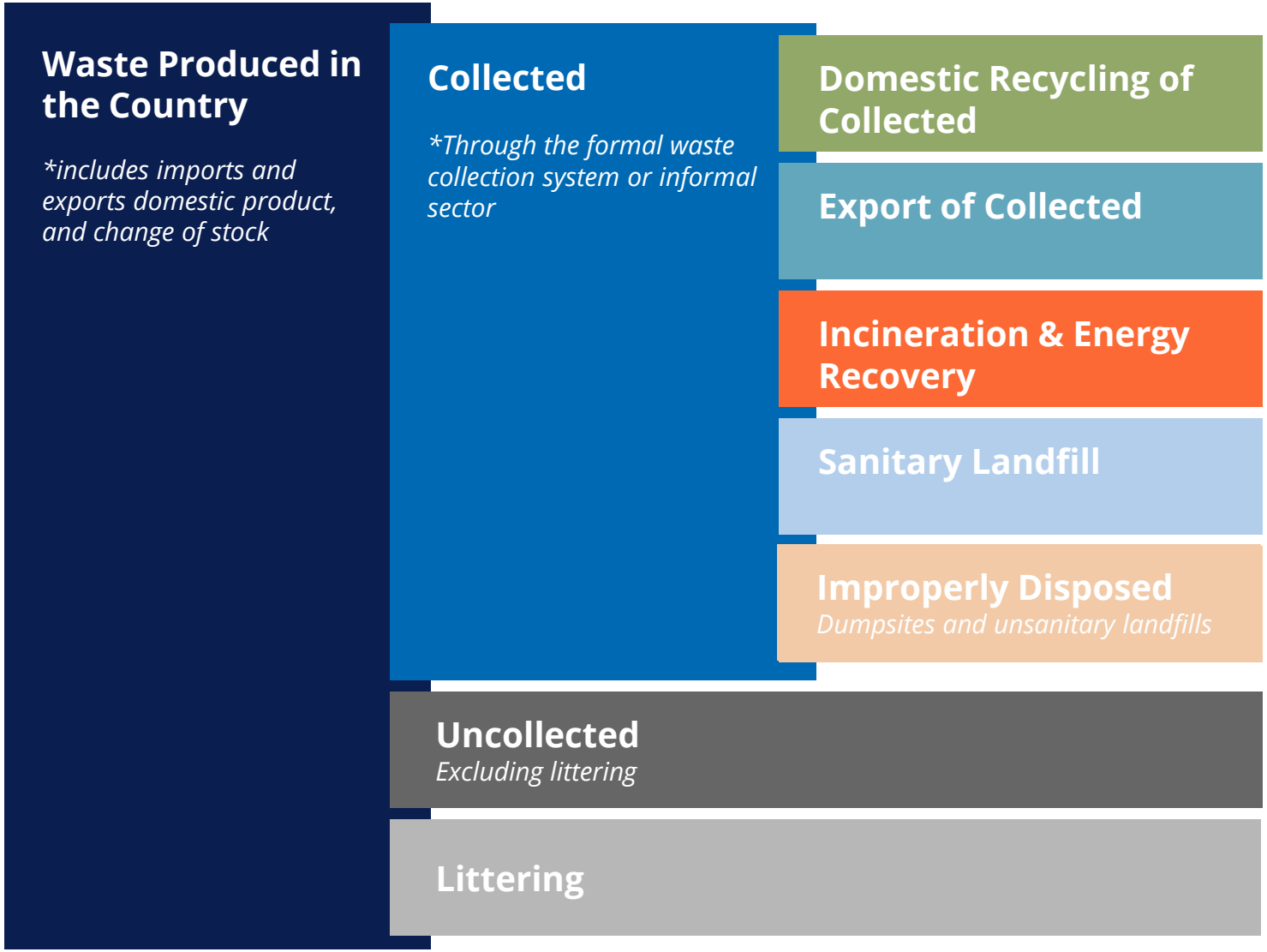
Required for Oregon EPR LCA Reporting

**** Box sizes are not to scale***

Adapted from Plasteax

Mismanaged Waste Index (MWI)

Required for Oregon EPR LCA Reporting



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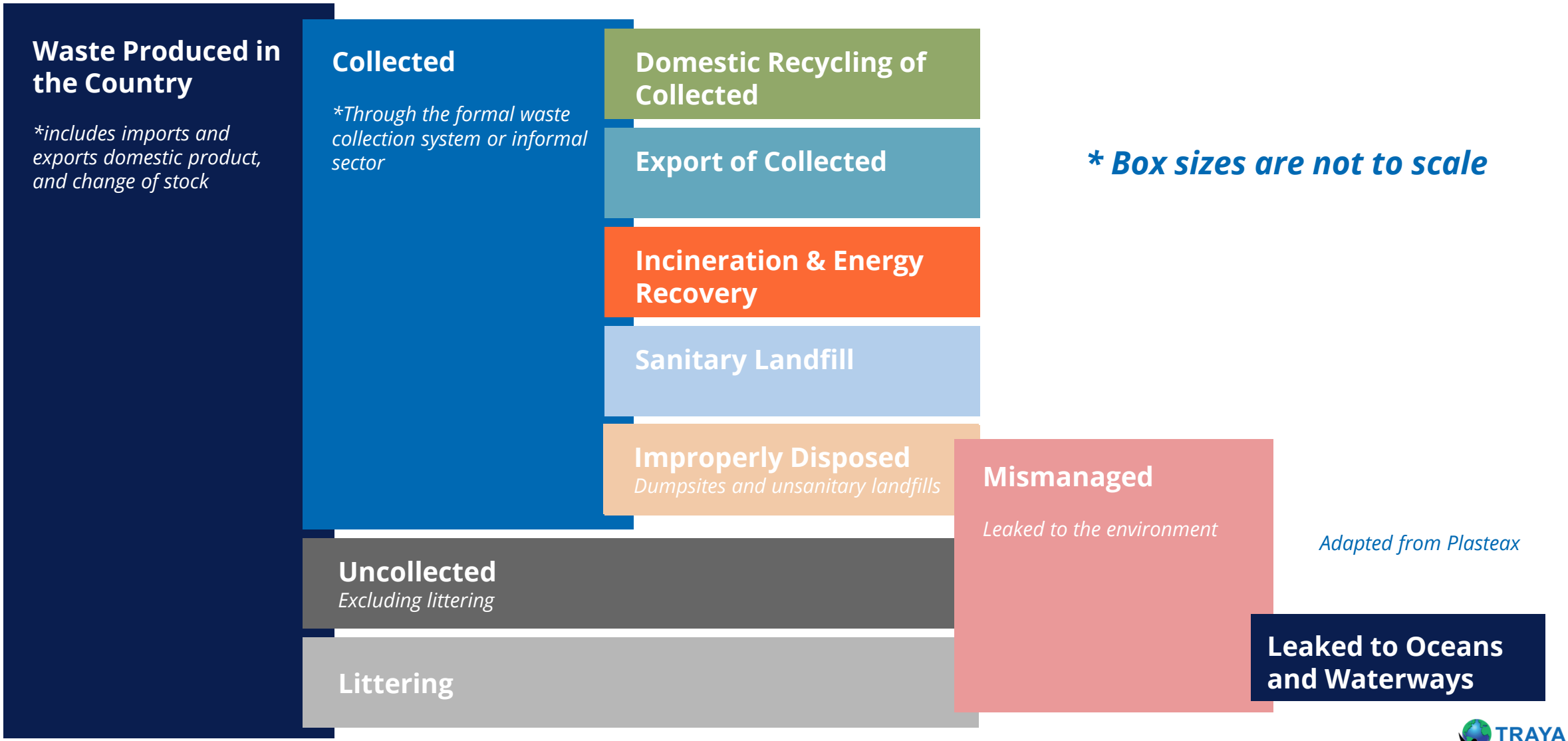
Adapted from Plasteax

Mismanaged Waste Index (MWI)



**** Box sizes are not to scale***

Adapted from Plasteax

Calculating Mismanaged Waste

$$MW\ (t) = \sum_{Country,category} M_{packaging}(t) * share_{category}(\%) * MWI_{country,category}(\%)$$

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$$MW\ (t) = \sum_{Country,category} M_{packaging}(t) * share_{category}(\%) * MWI_{country,category}(\%)$$

- Country of sale
- Rigidity/flexibility
- Material

Total packaging weight

Breakdown of polymer by share % per item

Primary Data

Calculating Mismanaged Waste

Required for Oregon EPR LCA Reporting

$$MW\ (t) = \sum_{Country,category} M_{packaging}(t) * share_{category}(\%) * MWI_{country,category}(\%)$$

- Country of sale
- Rigidity/flexibility
- Material

Total packaging weight

Breakdown of polymer by share % per item

Mismanaged packaging waste index from Plasteax

Primary Data

Calculating Plastic Leakage

$$Leak_{compartment}\,(t) = MW(t) * RR_{compartment}(\%)$$

	Ocean and freshwater	Terrestrial	Ocean and freshwater	Terrestrial	Ocean and freshwater	Terrestrial
Release Rate Matrix	Small Size (<5cm)		Medium Size (5-25cm)		Large Size (>25cm)	
Low residual value	40%	60%	25%	75%	5%	95%
Medium residual value	25%	75%	15%	85%	5%	95%
High residual value	15%	15%	10%	5%	1%	1%

Adapted from PLP

Marine Impact in LCA (MarILCA)

$$\sum_{microplastic\ type\ (polymer.shape.size)} Leakage_{compartment} * Midpoint\ CF_{compartment.microplastic\ type}$$

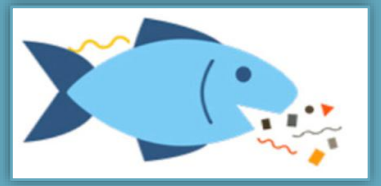
Fate Factor

Environmental distribution and longevity

Measured in days

×

Exposure Factor

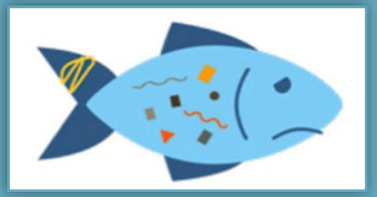


Amount of pollutant that is encountered

$kg_{bioavailable\ microplastic}$ / $kg_{microplastic\ in\ compartment}$

×

Effect Factor



Concentration at which 10% of species are being impacted

$PAF*m3/kg_{pollutant}$

Adapted from Corella-Puertas (2023)

Limitations of MarILCA

MarILCA data is currently only available for 11 plastics:

PET

HDPE

PP

LDPE

EPS

PS

PVC

PHA

PLA

PA

TRWP

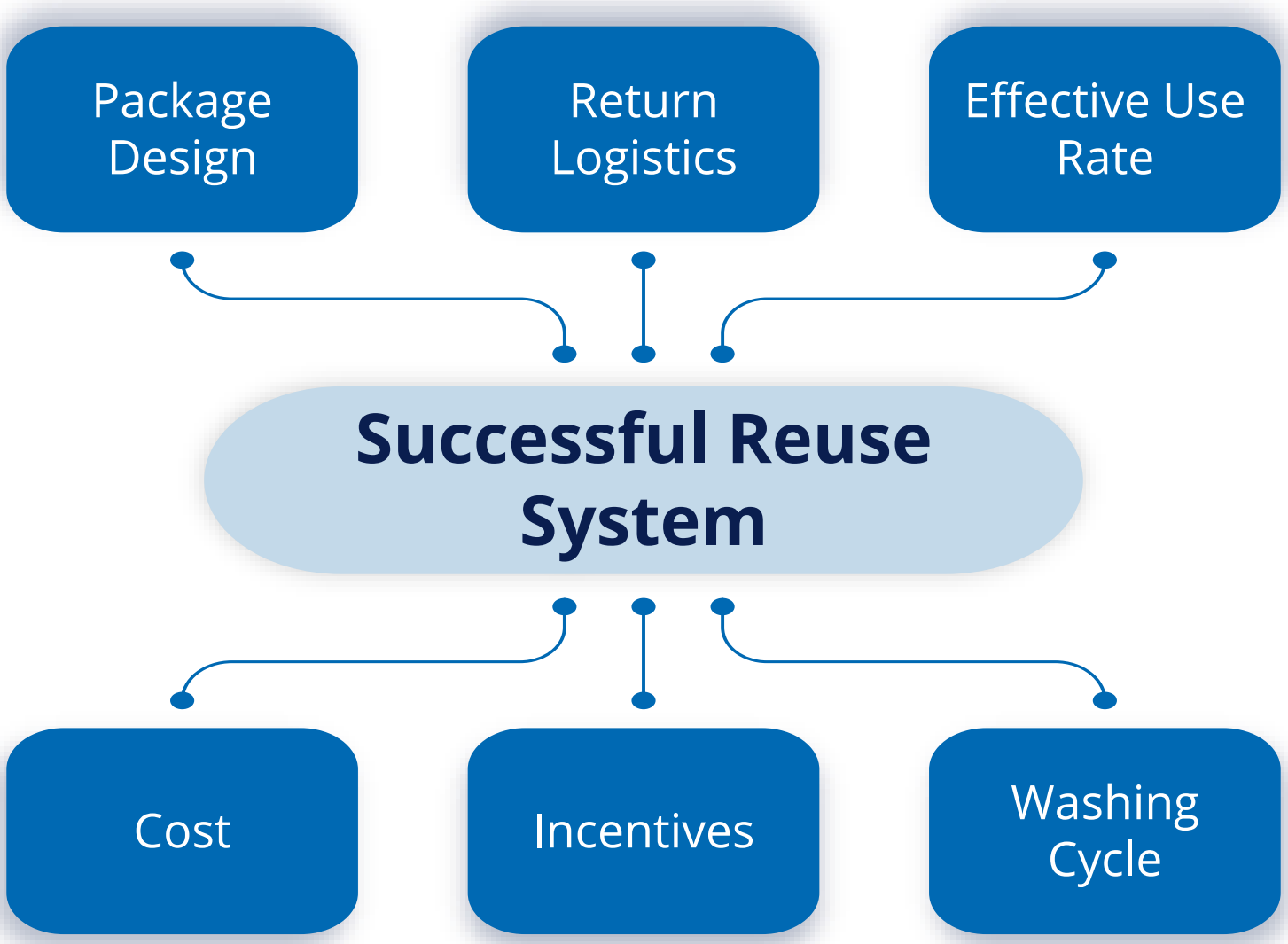

Reusability

Reusability

Single-Use versus Reusable

Single-Use	Reusable
Less material	More material
Lower initial impact	Higher initial impact
Less durable	More durable

Key Levers for Reuse Systems



TRAYAK
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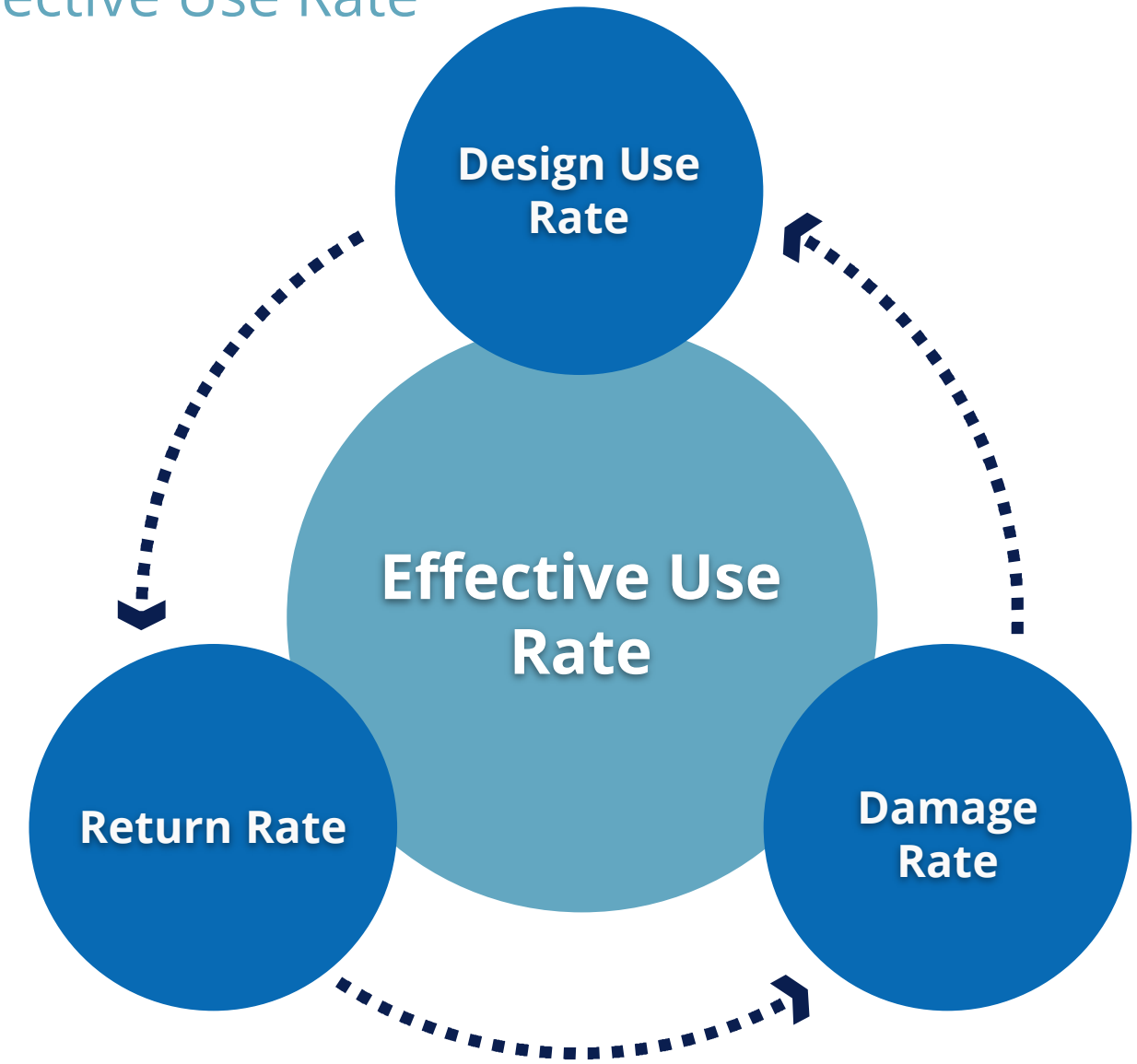
Reusability

Effective Use Rate



Design Use Rate of 100

Return Rate + Damage Rate	Effective Use Rate
50%	2.0
60%	2.5
70%	3.3
80%	5.0
85%	6.7
90%	10.0
95%	20.0
97.5%	37.0
99%	63.0

Adapted from (Kachook, 2022)

European Market

Sustainability in Europe

Navigating the maze of bureaucracy and abbreviations

EUROPEAN GREEN DEAL

CEAP – Action Plan for the Circular Economy

- Sustainable Products Initiative (SPI)
- EcoDesign for Sustainable Products Regulation (ESPR)
- Packaging and Packaging Waste Regulation (PPWR)
- Green Public Procurement (GPP)
- EU Taxonomy
- EU Ecolabel
- Corporate Sustainability Reporting Directive (CSRD)
- Battery Regulation
- Single-Use Plastics Directive
- Product Environmental Footprint (PEF)
- Organizational Environmental Footprint (OEF)
- …

Sustainability in Europe

Environmental impact assessment methodologies

1. Life Cycle-Based Methodologies

- Life Cycle Assessment (LCA) (ISO 14040/44)
- Environmental Product Declaration (EPD) (LCA)
- Product Environmental Footprint (PEF) (LCA)

2. Footprint Approaches

- Carbon Footprint (CFP): (GHG) Scope 1 (direct), Scope 2 (indirect energy), Scope 3 (supply chain / LCA)
- Water Footprint: (ISO 14046) (LCA)
- Material Footprint: Raw material extraction, consumption, circular economy assessments (LCA)
- Land and Biodiversity Footprint: Land occupation and biodiversity impact (LCA)

3. Indicator-Specific and Sector-Specific Methods

- Life Cycle Energy Assessment (LCEA)
- Material Flow Analysis (MFA)
- Social Life Cycle Assessment (S-LCA)
- Circularity Metrics (Material Circularity Indicator - MCI)

EcoImpact COMPASS / PPWR

PPWR Primary Steps

Re-evaluate and Redesign Packaging for Recyclability and Reuse

Update Labeling and Ensure Transparency

Fulfill Extended Producer Responsibility (EPR)

Implement a Compliance Program

EcoImpact COMPASS / PPWR

PPWR Review Steps

Re-evaluate and Update Labeling and Ensure Transparency

Harmonized Labels

2028 Target
Material Composition
Disposal Instructions (EU Pictograms)

Avoid "Greenwashing"

Strict Rules for Environmental Claims
“Eco-Friendliness” MUST be Proven with Data
Revision of All Marketing Claims

Digital Product Passport

PPWR coexistence with DPP
Access to Information
Wider Frame of Disclosures

EcoImpact COMPASS / PPWR

Fulfill Extended Producer Responsibility (EPR)

Financial Responsibility

Extended Producer Responsibility (EPR)
Responsibility for Complete Life-Cycle
Plan Before Place

Eco-modulated Fees

Usage of Recycled (PCR) content
Simplification of Material Composition
Design for ReUse & ReCycle

EcoImpact COMPASS / PPWR

Implement a Compliance Program

Audit and Assessment

Audit ALL Packaging
> Primary, Secondary & Tertiary Packaging
Identify Non-Compliant Materials & Designs

Supply Chain Collaboration

UpStream of Compliant Materials
Correct & Appropriate Designs
DownStream Management Protocol

Technical Documentation and Declarations

Declaration of Conformity
Maintain Technical Documentation
Access to Wide Scope of Documentation & Data

EcoImpact COMPASS / PPWR / Article 5

Minimize and Restrict Hazardous Substances

Hazardous Substances	Thorough Review to identify substances of concern, such as lead, cadmium, mercury, amongst others.
PFAS	Restrictions on Per- and Polyfluoroalkyl Substances (PFAS) in food-contact packaging.
Supplier Collaboration	Close work with UpStream chain to ensure materials in the value chain being compliant.

Ensure Packaging Does Not Impede Recycling

Chemical Compatibility with Recycling	Ensure that components can be easily separated to prevent the contamination of recycled base.
Evaluate Inks and Labels	Labels and Inks must be evaluated, without hazardous ingredients, and compliant for recyclability.

EcoImpact COMPASS / PPWR / Article 5

Maintain Technical Documentation and Declarations of Conformity

Conduct Conformity Assessments

EVERY Packaging Placed in the EU Market must undergo Conformity Assessment.

Prepare a Declaration of Conformity

Based on the Assessment, EU Declaration of Conformity needs to be created and signed.

Maintain Technical Documentation

Detailed documentation related to the Assessment must be kept and provided upon request.

EcoImpact COMPASS / PPWR / Article 6

Specific Recycling Target percentages

Material	Threshold	Deadline
Recycled at scale – wood packaging	≥ 30% recycled annually	by 2030 & ongoing
Recycled at scale – all other packaging materials	≥ 55% recycled annually	by 2030 & ongoing
Recyclability performance class – min (Grade C)	≥ 70 % recyclability	from 1 Jan 2030
Recyclability perform class – higher (Grade A/B)	≥ 80 or 95 % recyclability	from 1 Jan 2038
Recycled content – PET contact-sensitive (non-bottle)	30% by 2030 → 50% by 2040	2030 / 2040
Recycled content – other plastic packaging	10% by 2030 → 50% by 2040	2030 / 2040
Recycled cont. – single-use plastic beverage bottles	X% by 2030 (30% noted) → 65% by 2040	2030 / 2040
…	…	…

EcoImpact COMPASS / PPWR / Article 7

Specific PCR Content percentages

Identify & Categorize (Plastic) Packaging

Contact-sensitive > PET, other than PET,...
Single-use packaging
Other plastic packaging

Mandatory Recycled Content Targets

01/01/2030
30% for CSP if PET main component
10% if non-PET main component
35% for all other plastic packaging

01/01/2040
50% for CSP if PET main component
25% if non-PET main component
65% for all other plastic packaging

Find Exemptions

Packaging for medical devices and in vitro diagnostic medical devices, Packaging for dangerous goods, Compostable plastic packaging,..
Less 5% plastic packaging weight

Traceability and Documentation

Supplier Collaboration
Technical Documentation Maintenance

EcoImpact COMPASS / PPWR / Article 11

Reuse/Refill / B2B & Transport Packaging

Identify & Categorize (Plastic) Packaging

Single Use Pallets & Wrapping
Internal Returnable Packaging Systems
Intermediate Bulk Containers

Mandatory Reuse Targets

01/01/2030
40% of transport packaging must be reusable

01/01/2040
70% of transport packaging must be reusable

Implement Reusable Packaging System

Durability & Design
Logistics Channels, Trace & Track
Hygiene

Define Exemptions

Dangerous Goods
Flexible Packaging >>> Monitor other PPWRs' & CEAP goals

EcoImpact COMPASS / PPWR / Article 12

Harmonized Mandatory Labeling / Aug 2028

Adopt Harmonized Labels

Artwork Updates
Removal of Old Markings
Visibility for End-users

Digital Marking for Substances of Concern

DPP Repository
Complete Disclosure
Internal & External
Documents

Transparency, no Greenwashing

Review Statements &
Markings
Analyze & Alternate
Adopt or Remove Claims

Provide Information Digitally

QR code & Access Token
DPP Repository
API, xml, json,...

EcoImpact COMPASS / PPWR / Annex VII

Extended Data Disclosure Frame with Unified Format Approach

Comprehensive Technical Documentation Repository

Detailed Packaging Description
Information on the substances used
Documentation on recyclability

Relevant tests & reports
Compliance with all PPWR articles

Internal Production Control System

Quality Management System
Regular Audits
Change Control

EU Declaration of Conformity – Draft & Sign

Legal Responsibility
Content of the Declaration

Maintain and Provide Documentation

Complete Compliance Documentation

EcoImpact COMPASS / PPWR / Annex VIII

Standardized Declaration Template

Single Document or Set of Documents - Still in Review for Confirmation

Mandatory Elements

- Packaging Identification
- Manufacturer/Importer Information
- Statement of Responsibility
- Compliance with PPWR
- References to Harmonized Standards
- Details on Recycled Content
- Date, Place, Validity, Title, Signature

Declaration Maintenance

- Records
- Retention
- Accessibility
- Languages

PPWR / EPR @ Trayak

EcoImpact COMPASS / PPWR

EPR Fees

Material Utilization Details

Material	PCR %	PCR Mass	Mass
Container Glass	25 %	63,63 kg	254,54 kg
Corrugated	0 %	0 g	32,92 kg
Polypropylene (PP)	0 %	0 g	2,27 kg
Steel (unalloyed)	0 %	0 g	46,31 g
Steel	0 %	0 g	4,21 kg
Wood - Sawn hardwood, raw, air dried	0 %	0 g	3,1 kg
Wood - Sawn softwood, raw, air dried	0 %	0 g	616,33 g
Total	**21,38 %**	**63,63 kg**	**297,7 kg**

EcoImpact COMPASS / PPWR

EPR Fees

COUNTRY LEVEL

Material	Mass	EPR Fee	Eco Modulation	
Container Glass	254,54 kg	1.54 € cts/kg	Grade A	Reduced Fee
Corrugated	32,92 kg		Grade B	Base Fee
Polypropylene (PP)	2,27 kg		Grade C	Surcharge
Steel (unalloyed)	46,31 g			
Steel	4,21 kg			
Wood - Sawn hardwood, raw, air dried	3,1 kg			
Wood - Sawn softwood, raw, air dried	616,33 g			
Total	**297,7 kg**			

EcoImpact COMPASS / PPWR

EPR Fees

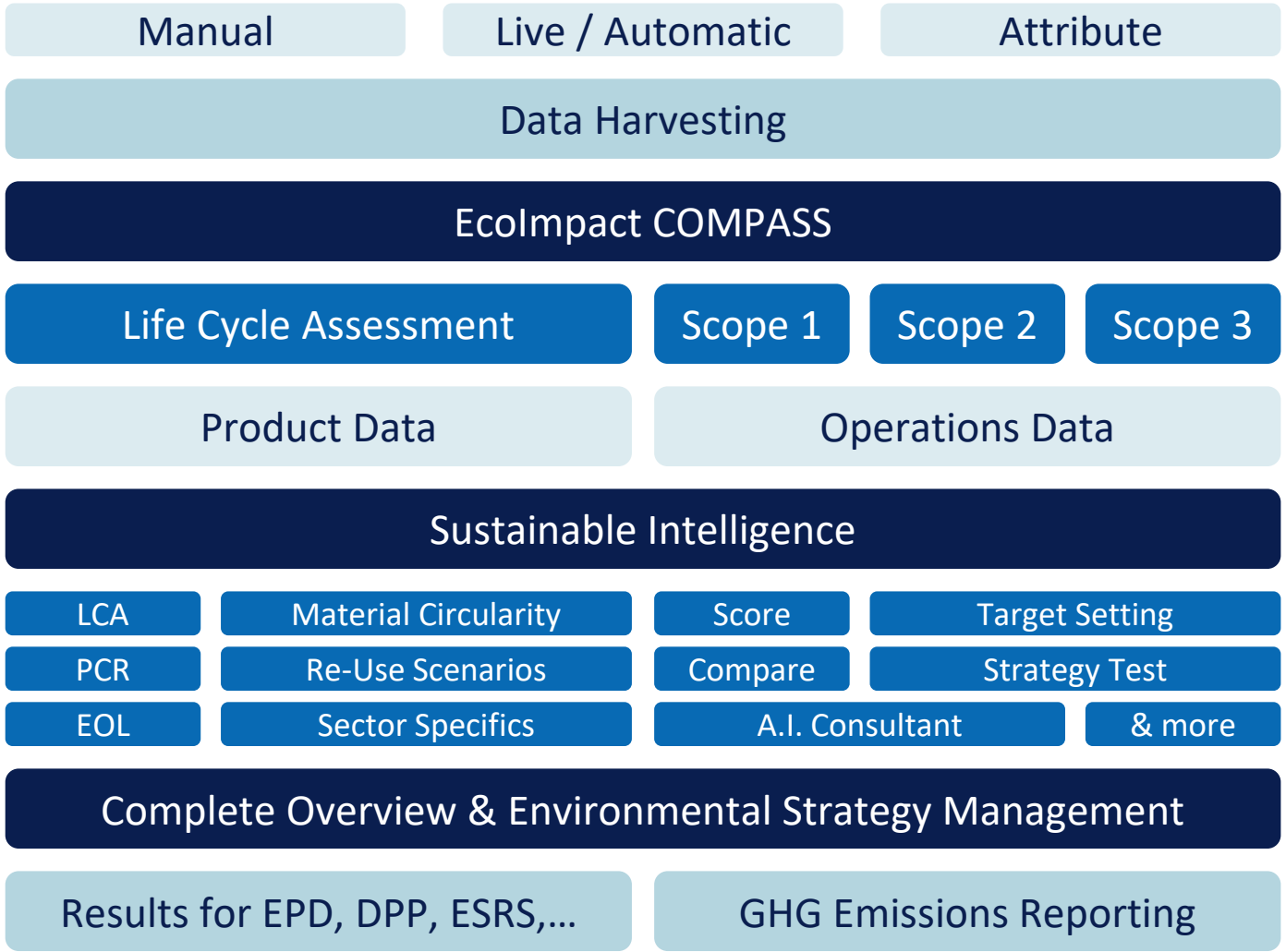
COUNTRY LEVEL

Material	Mass	EPR Fee	Eco Modulation		Final Fee
Container Glass	254,54 kg	1.54 € cts/kg	Grade A	Reduced Fee	Weight (x) EPR Fee (-) EM (=) Final Fee
Corrugated	32,92 kg		Grade B	Base Fee	Weight (x) EPR Fee (=) Final Fee
Polypropylene (PP)	2,27 kg		Grade C	Surcharge	Weight (x) EPR Fee (+) EM (=) Final Fee
Steel (unalloyed)	46,31 g				
Steel	4,21 kg				
Wood - Sawn hardwood, raw, air dried	3,1 kg				
Wood - Sawn softwood, raw, air dried	616,33 g				
Total	**297,7 kg**				

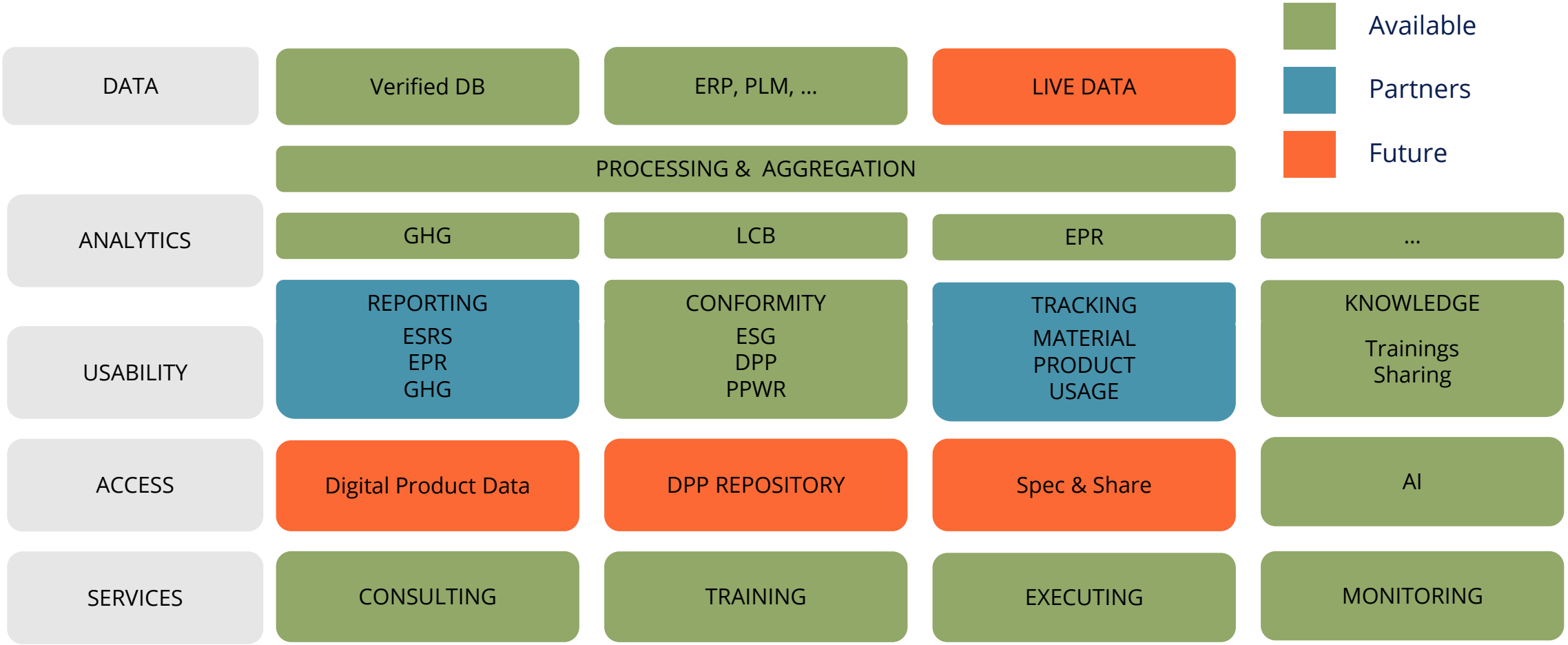
CURRENTLY EU COUNTRIES HAVE DIFFERENT STRUCTURES & PROCESSES

The Trayak Approach

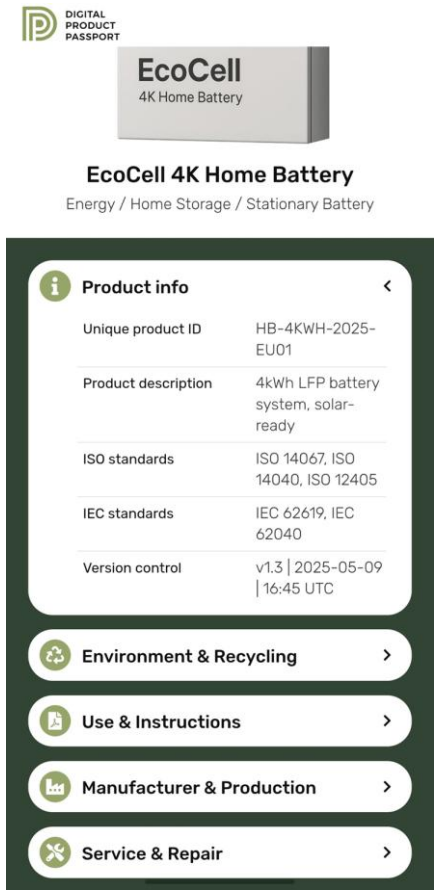
Single Source of Truth

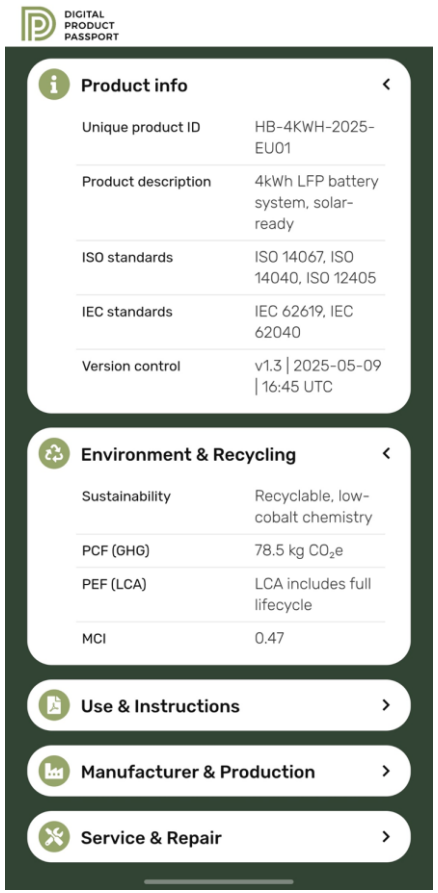


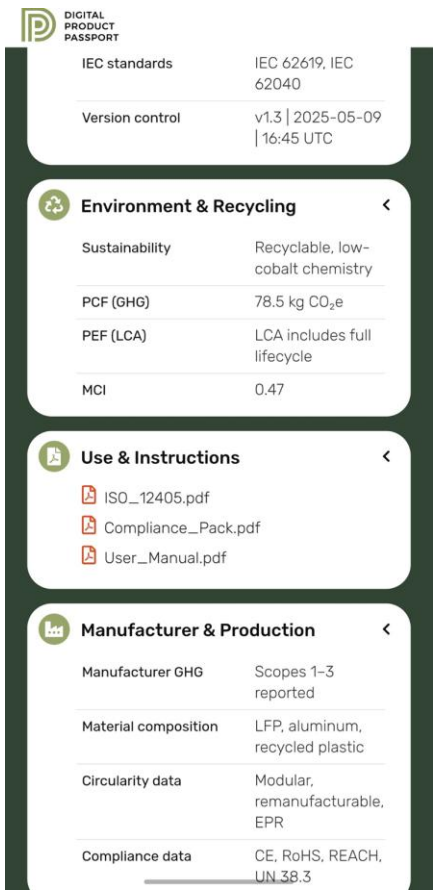
Future Proof Architecture

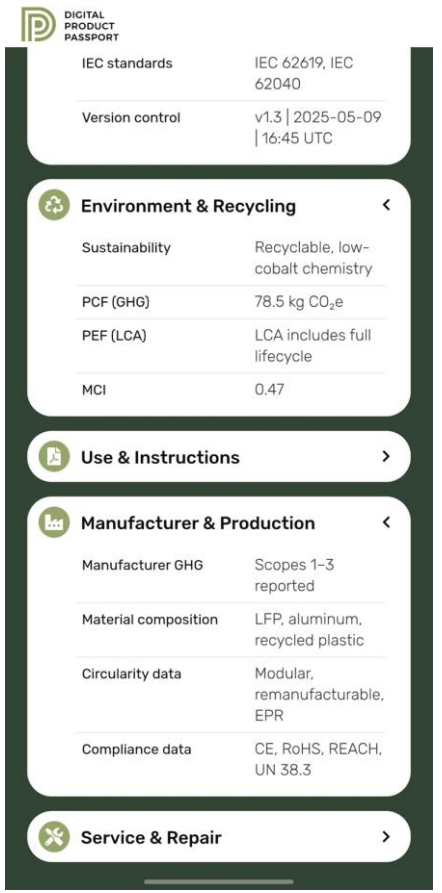


Digital Product Passport









Minimum Requirements

01 **Materials & Mass of the Materials**

02 **Manufacturing processes**

03 **Upstream data: location /material**

04 **Downstream data: location /product**

Standards Mapping

Life Cycle Phase Mapping		
ISO 14024 (Ecolabel phases)	**EN 15804 (EPD modules)**	**ISO 14040/44 (LCA stages)**
Raw material acquisition	A1 – Raw material supply	Goal & Scope: define functional unit and boundaries; Inventory: resource extraction (minerals, biomass, water, land use)
Manufacturing & production	A2 – Transport to manufacturer	Inventory: energy inputs, emissions, waste from production processes
	A3 – Manufacturing	
Packaging	Part of A3 (manufacturing)	Inventory: material use, waste, recyclability, emissions
Distribution & logistics	A4 – Transport to site/market	Inventory: fuel use, emissions, transport modes
Construction / installation (if relevant)	A5 – Installation into building	Inventory: installation energy, on-site waste, emissions
Use phase	B1 – Direct use impacts	Impact assessment: emissions in use, energy/water demand, maintenance cycles; durability performance
	B2 – Maintenance	
	B3 – Repair	
	B4 – Replacement	
	B5 – Refurbishment	
	B6 – Operational energy use	
	B7 – Operational water use	
End-of-life	C1 – Deconstruction/demolition	Inventory & impact: recycling, energy recovery, landfill burdens
	C2 – Waste transport	
	C3 – Waste processing	
	C4 – Disposal	
Reuse / recycling potential	D – Beyond system boundary (credits from recovery, recycling, reuse)	Interpretation: allocation of avoided burdens, system expansion

Process Standardization

LIVE

API

XLSX

EcoImpact Process Standardization

Data Collection & Verification

Analysis & Strategy Testing

Reporting & Disclosing

DPP Repository

Conclusions and Takeaways

Conclusions and Takeaways

- Globally, sustainable legislations are requiring more **holistic environmental evaluations**
- LCA follows a **rigorous method** to understand where improvements and tradeoffs can happen
- LCA is an **iterative process**
- Regulations use LCA to **identify areas of improvement** & **assess impacts**

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20-23 April| Brussels, Belgium + virtual
Book here

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