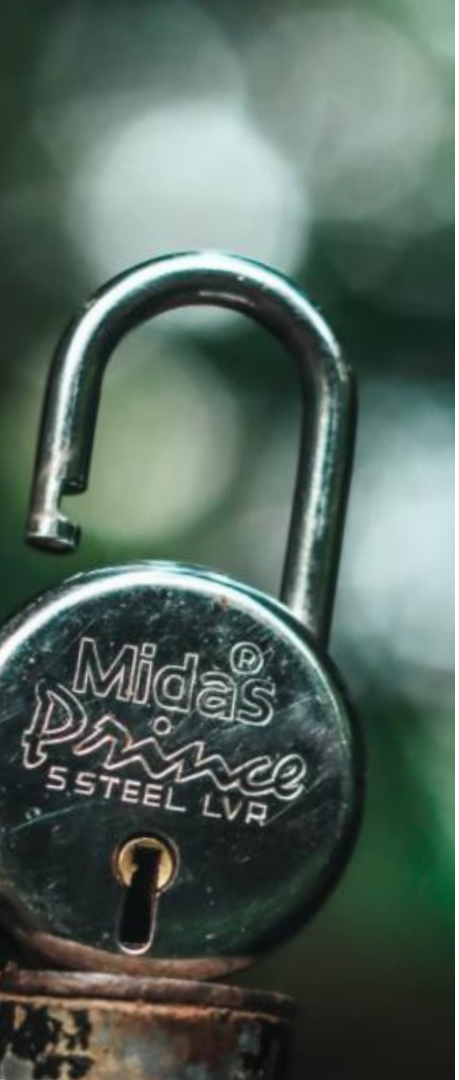

Unlocking the Power of Mass Balance for Mechanical Recycling

Laura M Thompson, PhD
GreenBlue, Program Director
Recycled Material Standard

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www.RMScertified.com
@RMSCertified

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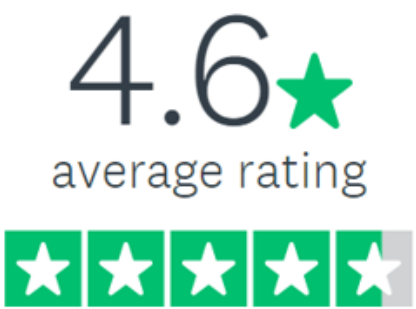
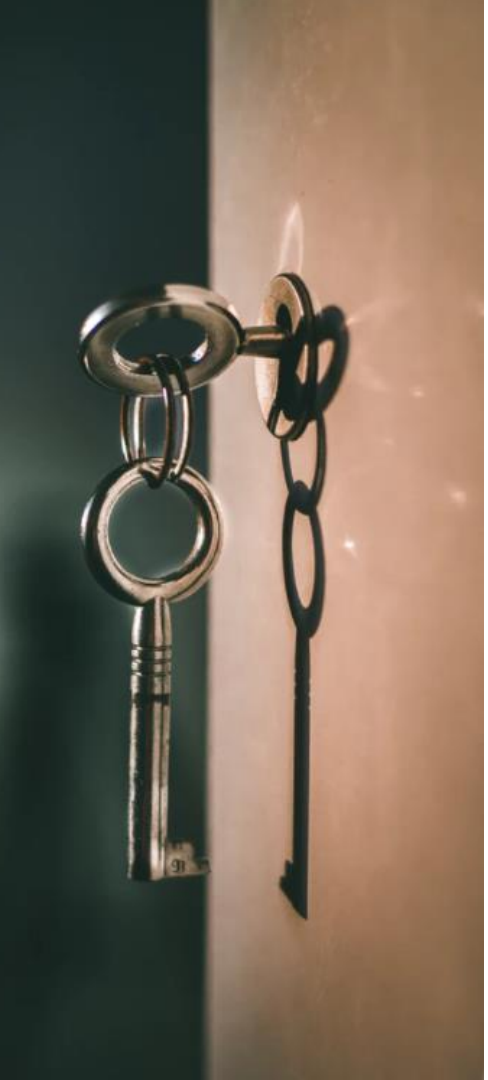
Converter messaging

The flexibility to use mass balance allocation for both chemically and mechanically recycled plastics will allow my organization to position recycled content in our portfolio to create the most value.





Key Topics

ABOUT THE RMS

MASS BALANCE BASICS

MECHANICAL RECYCLING

RMS
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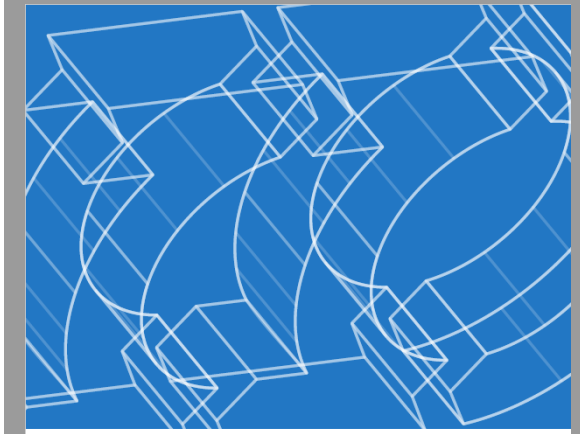
The RMS is unique
We built a framework –supported by material modules



THE RECYCLED MATERIAL STANDARD

Framework

Issued May 6, 2021

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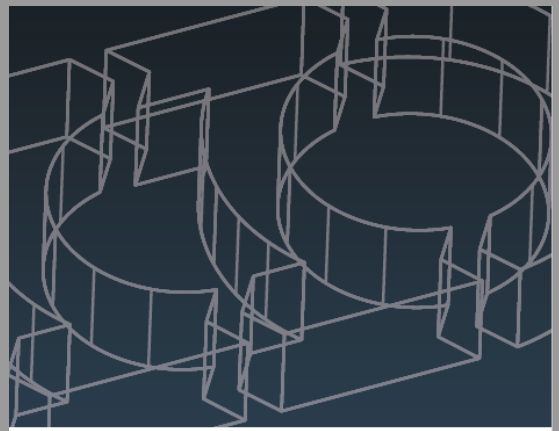

THE RECYCLED MATERIAL STANDARD

Plastics Module

Issued May 6, 2021

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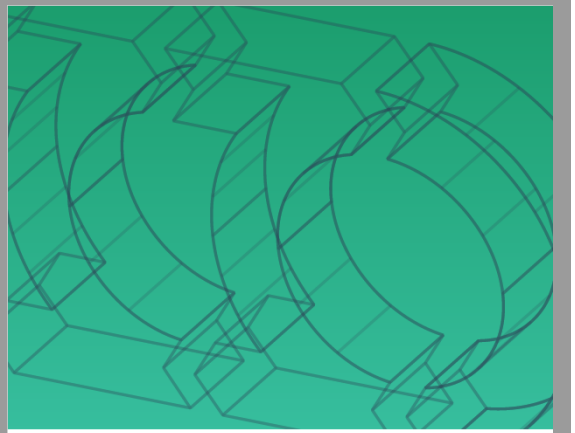

THE RECYCLED MATERIAL STANDARD

Plastic Material Classification

Issued May 6, 2021

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Three party certification systems are the most robust

Standard development and maintenance

Adheres to standard and provides certified materials

Audits participants for compliance with standard

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Chain of custody

An unbroken chain of organizations, **independently certified**, covering every change in legal ownership – from the point of origin up to the point where a product is finished (and labeled if desired).

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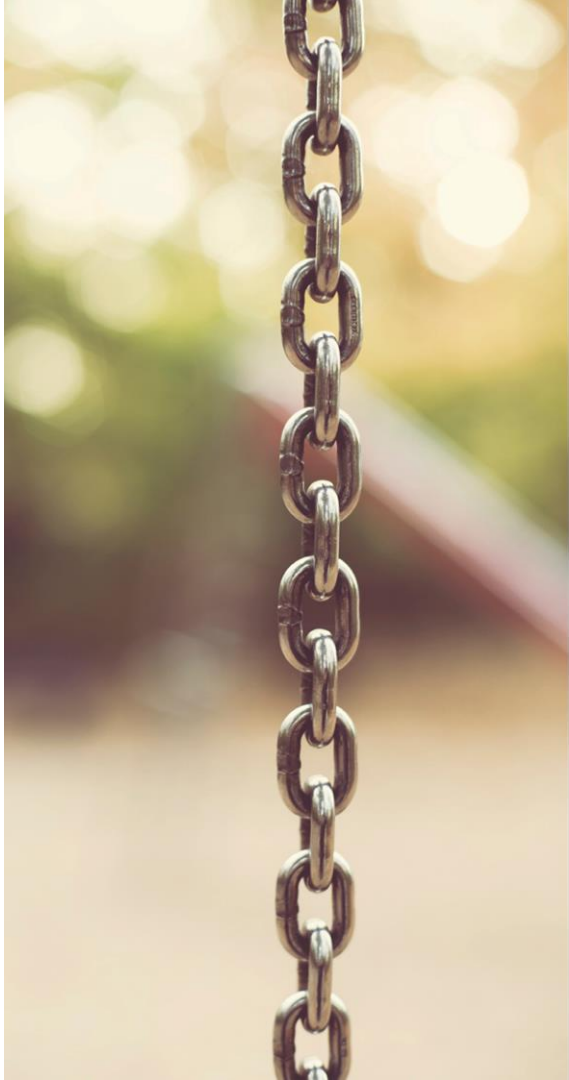

There are many potential benefits of certification

Revenue Drivers

Cost Savings

SUPPLIER BENEFITS

Satisfy customer needs

Competitive differentiation

Regulatory opportunities

New revenue stream (ARCs)

Manufacturing flexibility

Reduce audit fatigue

Improve business practices

Mass balance

BRAND OWNER BENEFITS

Brand differentiation (labels and claims)

Confidence in claims

Consistent definitions and rules for suppliers

Achieving sustainability goals

Regulatory requirements (e.g. content mandates or EPR)

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Accounting systems defined in standard

Physical Separation	Single % (batch level)	Rolling Average	Single Site Mass Balance	Multi Site Mass Balance	Book & Claim (certificates)

← Higher Control

Systems vary in level of control and supply chain flexibility

Higher Flexibility →

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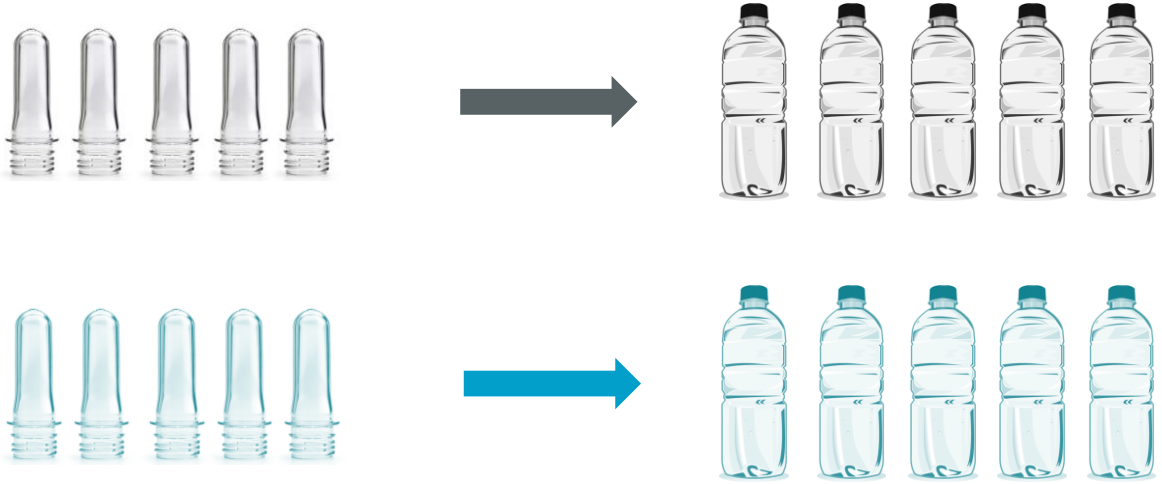
Physical Separation

Some systems may also refer to this as a “transfer” system

By maintaining separate inventory, materials are passed along **without mixing** and the claim is simply “transferred”

This is routinely applied by distributors and converters if they are able to keep their inventory separated

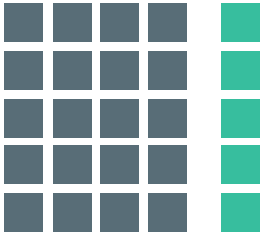


RECYCLED MATERIAL STANDARD

Single Percentage (batch level)

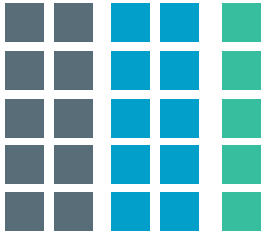
Sometimes called “controlled blending” and within the RMS we use the term “Average Content”
This is the most traditional type of claim and is covered by most standards

20 virgin +
5 recycled
25 total units



Average content claim:
5 units each with
20% recycled content

10 virgin +
10 post industrial
5 post consumer
25 total units



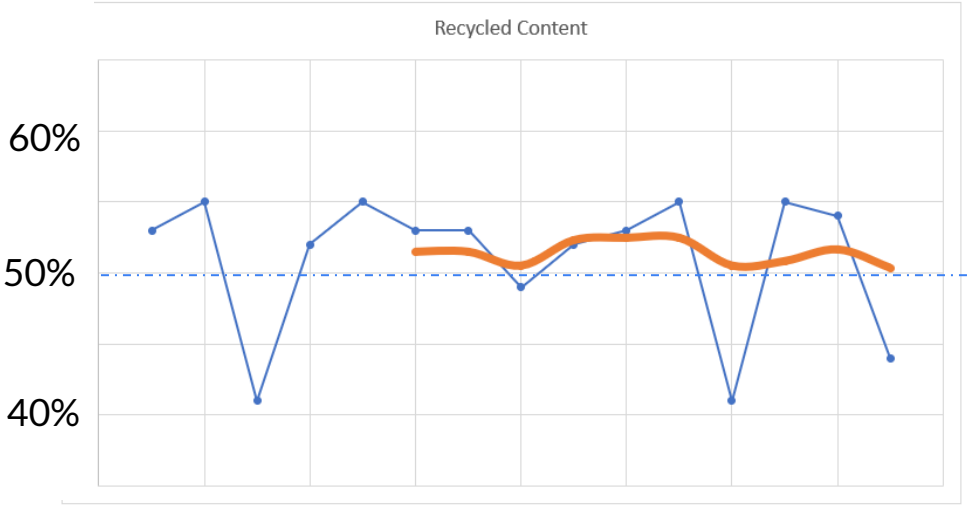
Average content claim:
5 units each with
40% post industrial
20% post consumer
- or -
60% recycled content

Rolling Average

Instead of reporting the actual percentage of each batch, some facilities will opt to use a rolling average percentage method

This approach can help “flatten out” inventory fluctuation (e.g. due to seasonal variations in availability of supply)

Period	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Monthly Avg	53	55	41	52	55	53	53	49	52	53	55	41	55	54	44
Rolling Avg						51.5	51.5	50.5	52.3	52.5	52.5	50.5	50.8	51.7	50.3



This example employs a six month rolling average

The facility is able to maintain an average 50% claim even though some months drop below 50%

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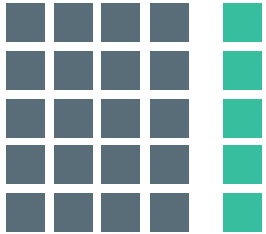
Single Site Mass Balance

Mass balance allocation accounts for the portion of inputs (or feedstocks) and assigns claims to particular outputs (or products)

20 virgin +
5 recycled
25 total units



Average content claim:
5 units each with
20% recycled content

- OR -

allocation

Mass balance claim:
1 unit 100% recycled status
4 units with no status

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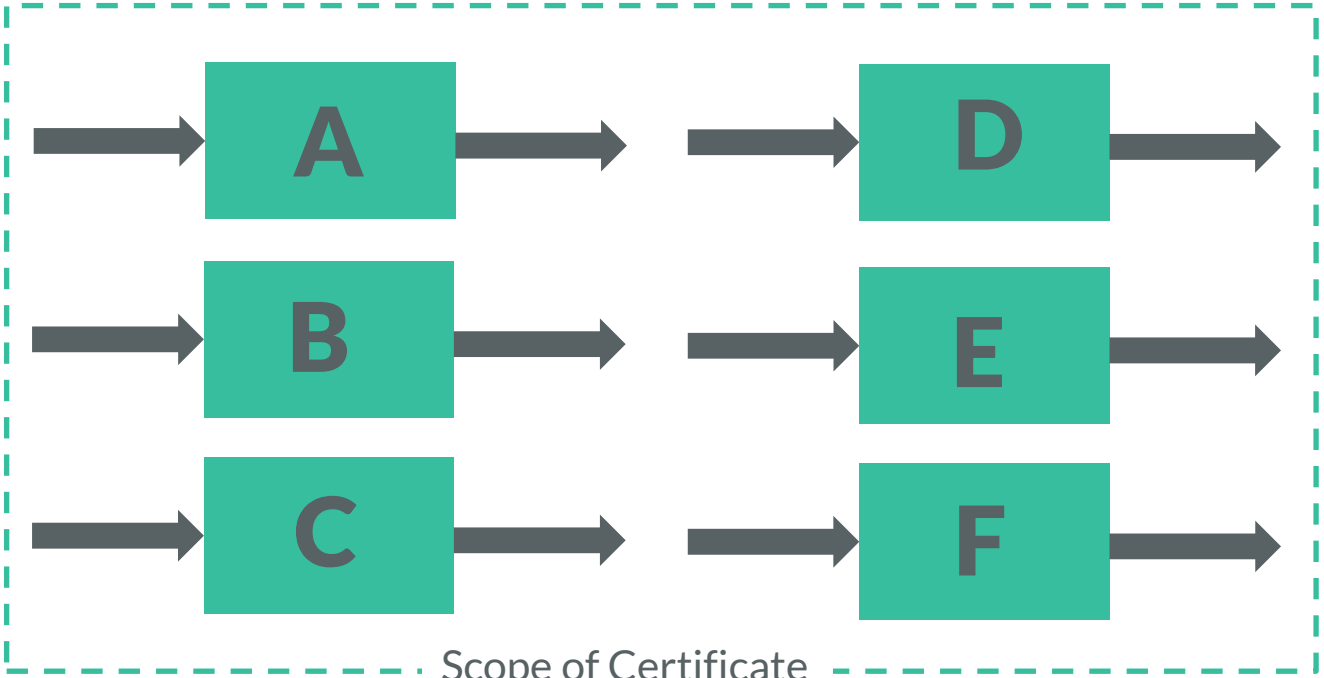
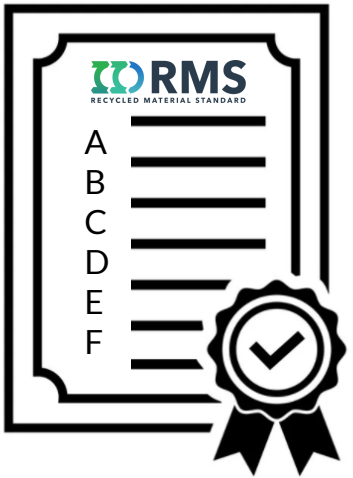
Multi - Site Certification

A single certificate covers multiple facilities under the same ownership
This lowers cost of participation and can reduce audit fatigue





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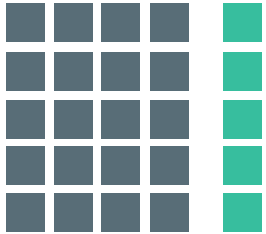
Multi - Site Mass Balance

The RMS allows for **credit transfers** between sites making the same product
This can eliminate the need to ship materials or products long distances to satisfy a sale

20 virgin +
5 recycled
25 total units



FACILITY A

Mass balance claim:
2 units 100% recycled status
3 units with no status

credit transfer from B to A

20 virgin +
5 recycled
25 total units

FACILITY B

Mass balance claim:
0 units with recycled status
5 units with no status

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ACC issued mass balance certification principles in May of 2020

"…mass balance certification standards will trace and help increase plastics recycling and support markets for the outputs from **advanced plastics recycling**…

…resin manufacturers recognize that standards for traceability will maximize confidence in **advanced plastics recycling**….

…converters, brand owners and retailers will be able to use outputs from **advanced plastics recycling** technologies with added confidence by relying on these standards for supporting circular economy marketing claims…"

APR position statement issued in May of 2021 only addresses chemical recycling of post consumer materials

"**APR supports a mass balance** and/or corporate averaging methodology for resin manufacturers that produce recycled content resin in a **chemical recycling** system in which materials are not segregated by material type"

"Mass balance and corporate averaging help create demand markets for **post consumer** material."

"Claims on mass balance should be restricted to the utilization of **post consumer** resin"

Mass balance and chemical recycling are not joined at the hip

Some chemical recycling pathways will not be able to make claims without MB

however

Some chemical recycling pathways will not likely use MB to make claims

and

MB can also create opportunities for mechanical recyclers and converters

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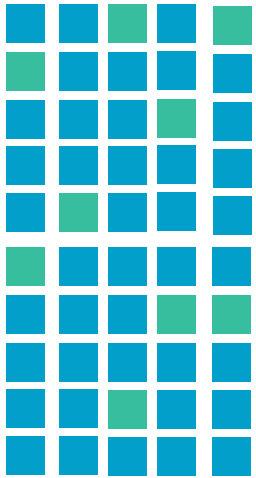
Example 1: Recycling mixed plastics

Recycler converts mixed plastics to flower pots

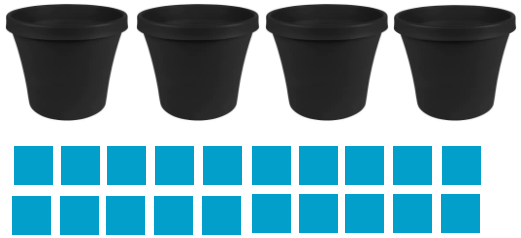


Input is composed of:

- 80% post industrial (PI)
- 20% post consumer (PC)

(materials are unsegregated)

Lot A: (80% of sales)
sold as 100% PI



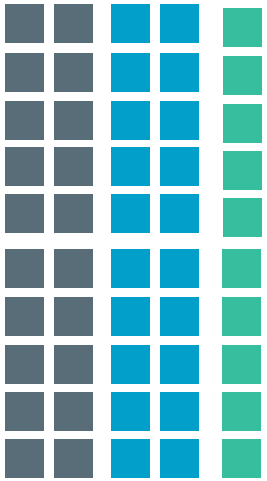
Lot B: (20% of sales)
sold as 100% PC

OR

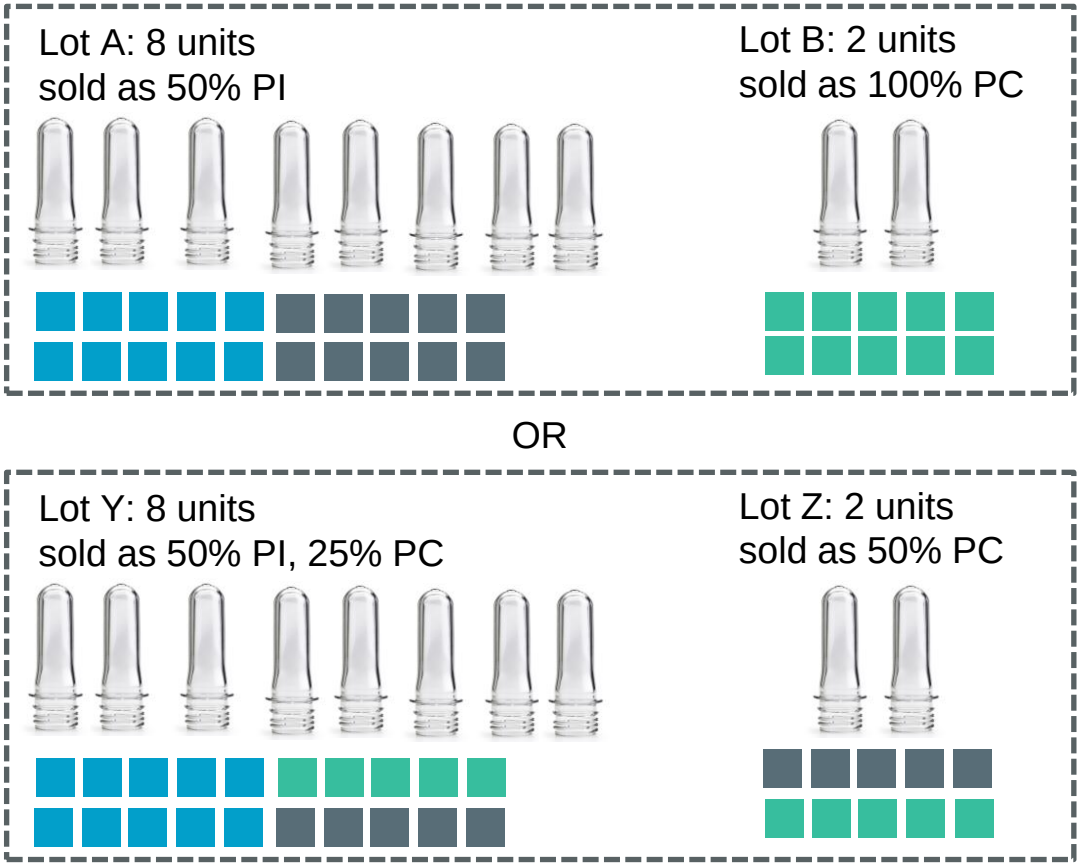
Lot Y:
sold as 75% PI, 25% PC

Lot Z:
sold as 50% PC,50% PI

Example 2: Manufacturing bottle pre-forms from resin pellets

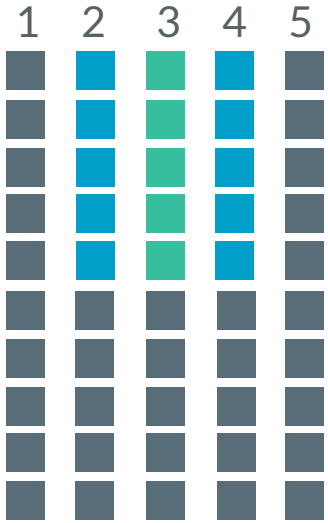


Pellet blend is composed of:
- 40% virgin (V)
- 40% post industrial (PI)
- 20% post consumer (PC)

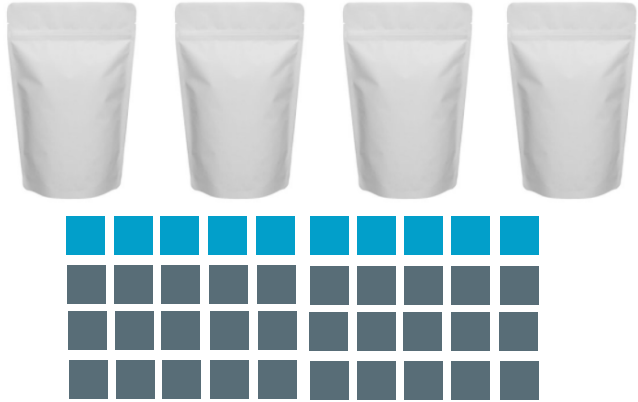


Example 3: Multi material film pouch (five layers)

In this case, the outer two levels are virgin and the inner layers use a portion of recycled materials



Sales Lot A
50% Post Consumer



Sales Lot B
25% Post Industrial

Pellet blend is composed of:
- 70% virgin (V)
- 20% post industrial (PI)
- 10% post consumer (PC)

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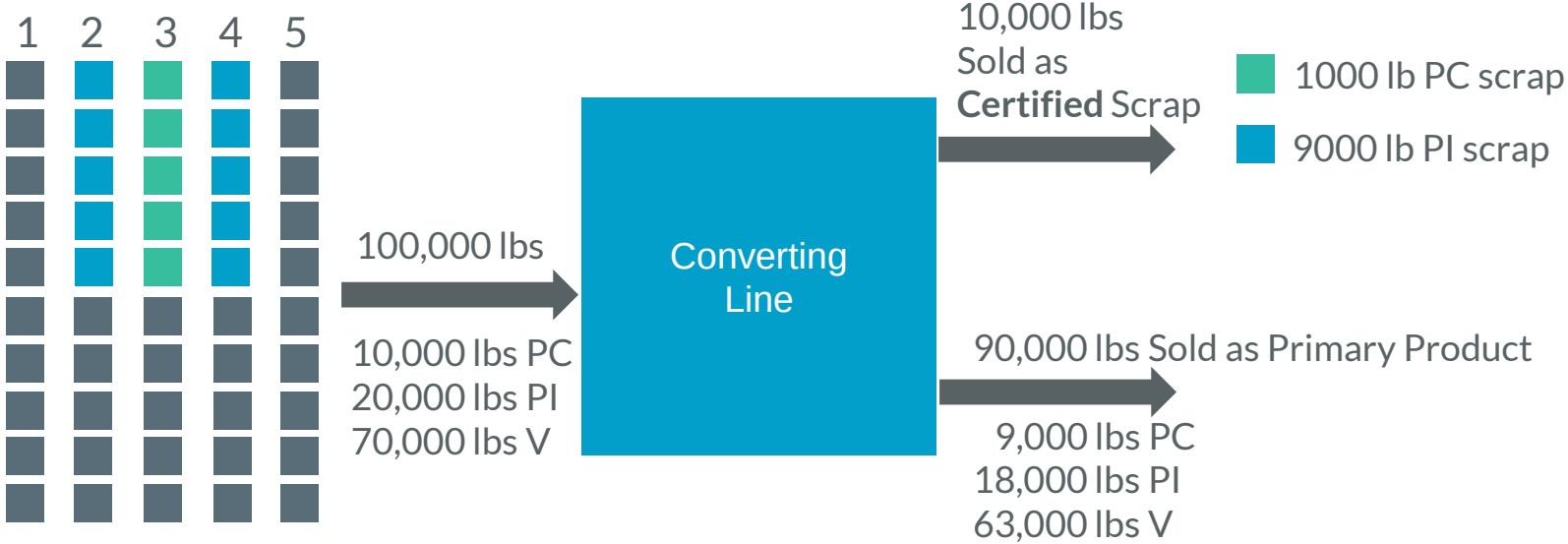
Example 4: Adding value to converter scrap

In this case, the converter generates 10% trim scrap which is sold to **certified** recyclers
For mechanical recycling, converters must apply **proportional allocation** to co-products



Pellet blend is composed of:
- 70% virgin (V)
- 20% post industrial (PI)
- 10% post consumer (PC)

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Unlocking the power of mass balance

Supply Chain Flexibility + Robust Assurance Mechanisms = Advancing The Use Of Recycled Materials

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Mass balance claims require clear documentation between certified participants

- Requires specific information to support the chain of custody
- Invoices & Shipping Documents
- RMS allows mass balance claims between certified participants at any percentage level
- Consumer labeling is optional and has a threshold for eligibility

Claims shown on labels are tied to the accounting system

Average Content

Mass Balance

ARC Certificates

Mass balance claims to avoid

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Many standards use a “Mix” claim

Products that bear this label are made using a mixture of materials from FSC-certified forests, recycled materials, and/or FSC controlled wood.

[FSC Labels]

For RSB compliant material produced under the “Mass Balance” chain of custody models, the RSB short claim shall be: “Product mix contains RSB certified material”.

[RSB Procedure for Claims]

In the case of recycling or reuse of materials the following on-product logo can be used for mass balance supply chains:

[ISCC System Logos and Claims]

The RMS approach to key mass balance criteria

Criteria	Recycled Material Standard
Eligible Inputs	■ Post-consumer and post-industrial sources ■ Status supported by risk based due diligence
Temporal boundaries	■ Materials “expire” after two years ■ Negative balances are not allowed
Physical boundaries	■ Multi-site claims allowed within North America (Canada, Mexico, US) ■ Each site making a claim must also use recycled materials
Accounting for losses	■ Conversion factors must be supported with evidence ■ Fuel is treated as a loss
Allocation rules	■ Chemical recycling may use non-proportional allocation as long as material converted to fuel is treated as a loss
Product claims	■ Any % level within B2B transactions ■ Specific “content” claims are not allowed for on product labels ■ Non-recyclable products should be labeled as such

The RMS Promise

GreenBlue's Recycled Material Standard (RMS) promises to be the most comprehensive standard for recycled materials

Developed through voluntary consensus process
- Multi-stakeholder advisory group
- Field testing
- Public comment

Material specific definitions
- Post consumer
- Post industrial
- Product group designations

Multiple accounting systems
- Single %
- Rolling average %
- Mass balance
- Commodity trading (ARC system)

Scope boundary options
- Single site
- Multi site
- Group certification

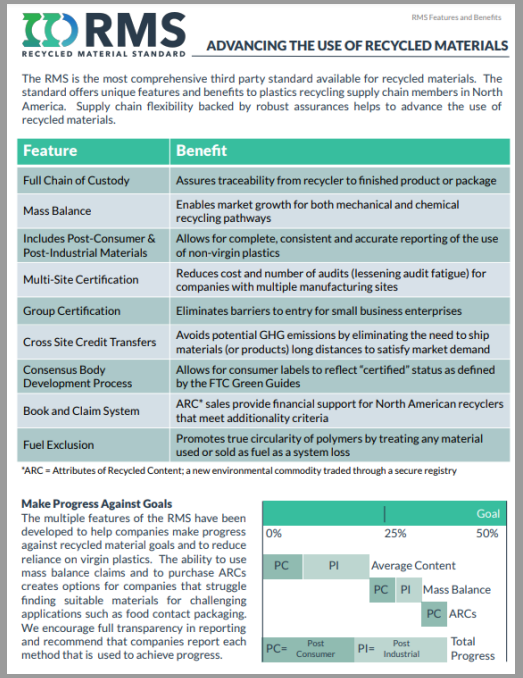
Resource Recycling: *Setting the Standard*

About RMS

RMS
RECYCLED MATERIAL STANDARD

New Resources Available at RMScertified.com

RMScertified.com > About > The Standard > Additional Resources



RMS Features and Benefits

RMS RECYCLED MATERIAL STANDARD

ADVANCING THE USE OF RECYCLED MATERIALS

The RMS is the most comprehensive third party standard available for recycled materials. The standard offers unique features and benefits to plastics recycling supply chain members in North America. Supply chain flexibility backed by robust assurances helps to advance the use of recycled materials.

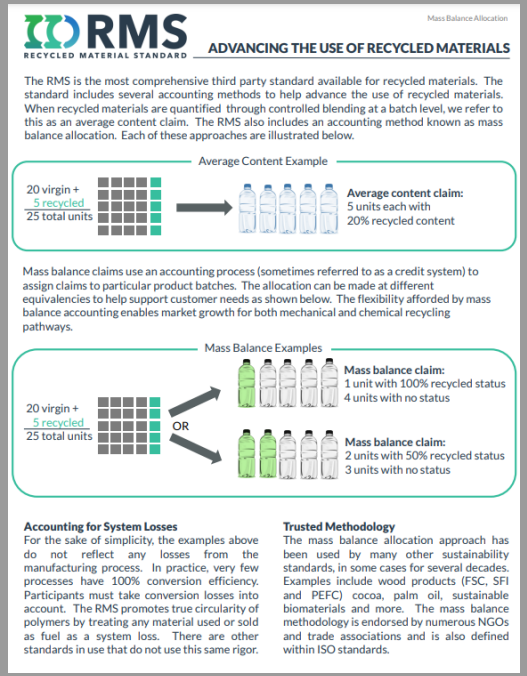
Feature	Benefit
Full Chain of Custody	Assures traceability from recycler to finished product or package
Mass Balance	Enables market growth for both mechanical and chemical recycling pathways
Includes Post-Consumer & Post-Industrial Materials	Allows for complete, consistent and accurate reporting of the use of non-virgin plastics
Multi-Site Certification	Reduces cost and number of audits (lessening audit fatigue) for companies with multiple manufacturing sites
Group Certification	Eliminates barriers to entry for small business enterprises
Cross Site Credit Transfers	Avoids potential GHG emissions by eliminating the need to ship materials (or products) long distances to satisfy market demand
Consensus Body Development Process	Allows for consumer labels to reflect "certified" status as defined by the FTC Green Guides
Book and Claim System	ARC* sales provide financial support for North American recyclers that meet additionality criteria
Fuel Exclusion	Promotes true circularity of polymers by treating any material used or sold as fuel as a system loss

*ARC = Attributes of Recycled Content; a new environmental commodity traded through a secure registry

Make Progress Against Goals

The multiple features of the RMS have been developed to help companies make progress against recycled material goals and to reduce reliance on virgin plastics. The ability to use mass balance claims and to purchase ARCs creates options for companies that struggle finding suitable materials for challenging applications such as food contact packaging. We encourage full transparency in reporting and recommend that companies report each method that is used to achieve progress.

Features and Benefits



Mass Balance Allocation

RMS RECYCLED MATERIAL STANDARD

ADVANCING THE USE OF RECYCLED MATERIALS

The RMS is the most comprehensive third party standard available for recycled materials. The standard includes several accounting methods to help advance the use of recycled materials. When recycled materials are quantified through controlled blending at a batch level, we refer to this as an average content claim. The RMS also includes an accounting method known as mass balance allocation. Each of these approaches are illustrated below.

Average Content Example

20 virgin + 5 recycled / 25 total units

Average content claim:
5 units each with
20% recycled content

Mass balance claims use an accounting process (sometimes referred to as a credit system) to assign claims to particular product batches. The allocation can be made at different equivalencies to help support customer needs as shown below. The flexibility afforded by mass balance accounting enables market growth for both mechanical and chemical recycling pathways.

Mass Balance Examples

20 virgin + 5 recycled / 25 total units

OR

Mass balance claim:
1 unit with 100% recycled status
4 units with no status

Mass balance claim:
2 units with 50% recycled status
3 units with no status

Accounting for System Losses

For the sake of simplicity, the examples above do not reflect any losses from the manufacturing process. In practice, very few processes have 100% conversion efficiency. Participants must take conversion losses into account. The RMS promotes true circularity of polymers by treating any material used or sold as fuel as a system loss. There are other standards in use that do not use this same rigor.

Trusted Methodology

The mass balance allocation approach has been used by many other sustainability standards, in some cases for several decades. Examples include wood products (FSC, SFI and PEFC) cocoa, palm oil, sustainable biomaterials and more. The mass balance methodology is endorsed by numerous NGOs and trade associations and is also defined within ISO standards.

Mass Balance

Post Industrial Plastics

RMS RECYCLED MATERIAL STANDARD

ADVANCING THE USE OF RECYCLED MATERIALS

The RMS is the most comprehensive third party standard available for recycled materials. By including both post-consumer and post-industrial materials within the standard, the RMS enables complete, consistent and accurate reporting of the use of non-virgin plastic. RMS labels can be applied to plastic products or packages to help celebrate the use of recycled materials.

Post-Industrial Plastics Recycling in North America

Source: 2020 data compiled from Plastics News Rankings

- 92 of the top 100 plastic recyclers process post-industrial plastics
- Only 8 of the top 100 recyclers report using post-consumer only
- Both types of materials are significant contributors to the circular economy – reducing the need for virgin materials

Definitions Matter The parameters around post-industrial materials have been loosely defined for decades. In writing the RMS Plastics Module we started with ISO definitions and added clarity. We created material-specific definitions with numerous supporting examples. The standard establishes a level playing field that does not favor (or disfavor) integrated facilities using post-industrial materials. In other words, all certified companies are subject to the same rules and audited to assure the accuracy of claims.

rmscertified.com
RMS RECYCLED MATERIAL STANDARD
35% post-industrial recycled content
RMS - 00001

We Need Holistic Approaches Life cycle thinking tells us that post-industrial materials often have less impact than post-consumer sources. Recycling post-industrial materials tends to result in higher yields (displacing more virgin material) and there is often less processing required (less need for transportation, sortation, cleaning, etc.) The RMS provides tools to advance the use of all recycled materials.

Contact Us
rms@greenblue.org
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@rmscertified

Developed by GreenBlue, an environmental nonprofit dedicated to the sustainable use of materials in society. In addition to the RMS, GreenBlue is responsible for the Sustainable Packaging Coalition, How2Recycle, CleanGredients and more. www.greenblue.org

Post-Industrial Plastics

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Advisory committee members

- Tiffani Burt, Sealed Air Corporation
- Edith Cecchini, Ocean Conservancy
- Kate Davenport, Eureka Recycling
- Jennifer McCracken, HAVI
- Tom McKay, BASF
- Matthew Realff, Georgia Tech
- Daniel Sanders, Printpack
- Andy Smith, King County, Wash.
- Emily Williams, TC Transcontinental

Advancing the use of recycled materials!