

Unlocking the full potential of RRBO to increase circularity and reduce carbon footprint

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UNLOCKING THE FULL POTENTIAL OF RRBO TO INCREASE CIRCULARITY AND REDUCE CARBON FOOTPRINT



CONTENT

1. Context and Business Case for RRBO
2. Market Dynamics: Challenges and change drivers
3. How to unlock the full RRBO potential





WORLD VIEW

External environment is more complex, but direction doesn't change



Our society is transitioning from a linear to a circular economy



Decarbonization remains at the heart of industries



Supportive regulations are expanding (EPR, Taxonomy...)

INDUSTRY VIEW



Transport is a major contributor to global emissions



ICE is to remain relevant, with Basestock demand expected to be stable in future



Our ecosystem is following suit with circularity & decarbonization as strategic focus among stakeholders

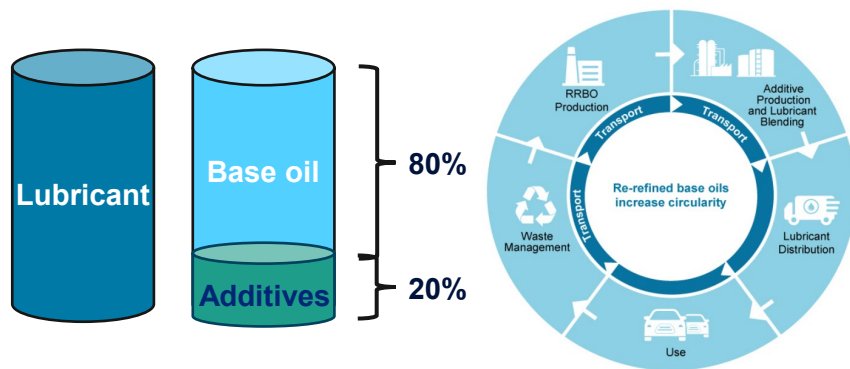


RRBO IS ONE OF THE MOST CRITICAL AND EFFECTIVE WAYS TO ACHIEVE AMBITIONS



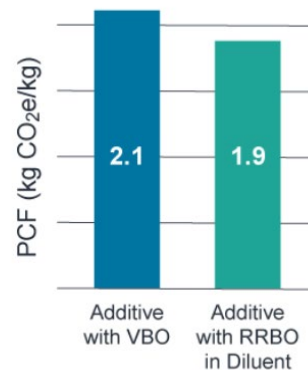
RRBO as largest contributor to INCREASE CIRCULARITY

BASE OILS FORM APPROXIMATELY 80% OF LUBRICANTS AND THROUGH USE THEY ARE LARGELY INTACT AND CAN BE RECOVERED AND RECYCLED, THUS REDUCING WASTE.



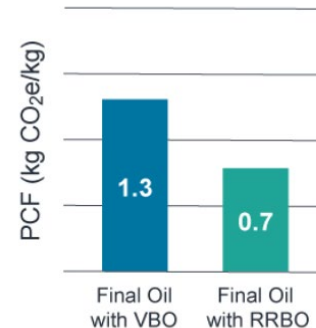
RRBO as key lever for EMISSION REDUCTIONS

Example PCF of Additives:



By replacing VBO with RRBO in additive package diluent, we can achieve on average 10% PCF reduction

Example PCF of Final Oils:



By replacing VBO with RRBO in final oil formulation, lubricant blenders could achieve 40-50% PCF reduction



RRBOs play a small part in today's lubricant formulations because of...



Availability:

Low used oil collection rates; limited capacity; gap vs. market's growing need for Group II and III base oil



Market fragmentation:

Scale; regional nature; access to used oil feedstocks



Industry guidelines:

Compliance with API Grouping, and familiarity with interchange guidelines



Performance data:

Less Industry experience with RRBOs



OEM acceptance:

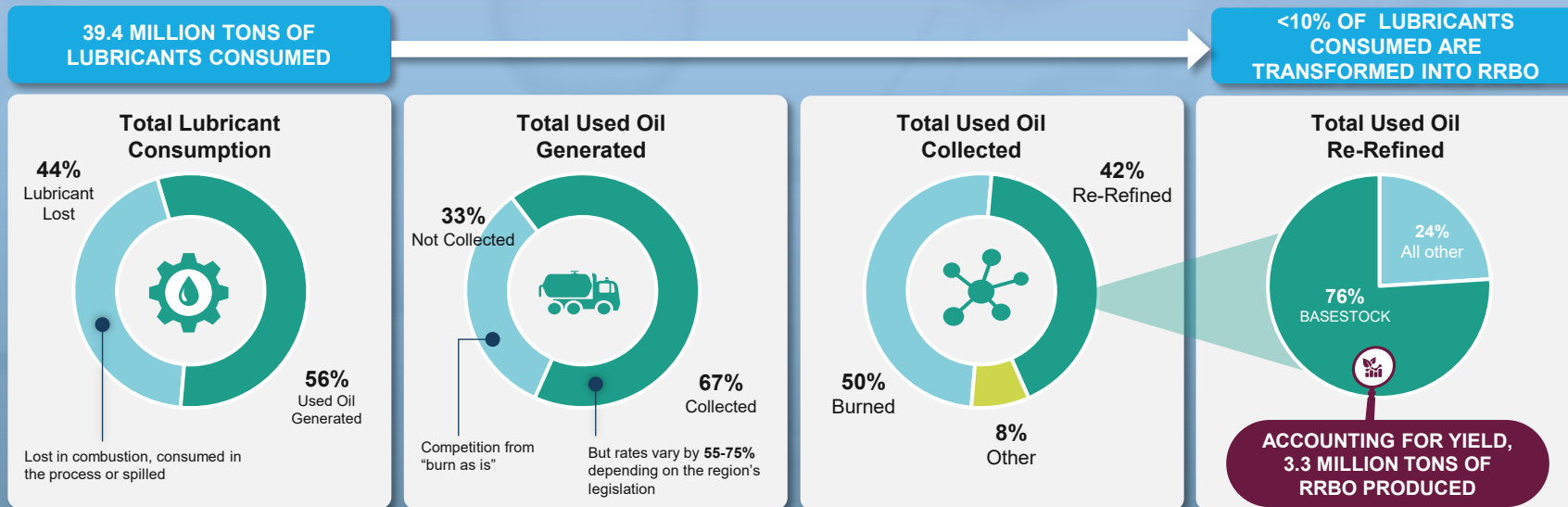
Relatively lower degree of awareness and knowledge

... but this is changing as described in the following slides



Global Used Oil Material Balance 2023

Source: adapted from Kline Global Used Oil and Re-refined Lubricants Market Report, 2024



EPR (Extended Producer Responsibility) schemes:

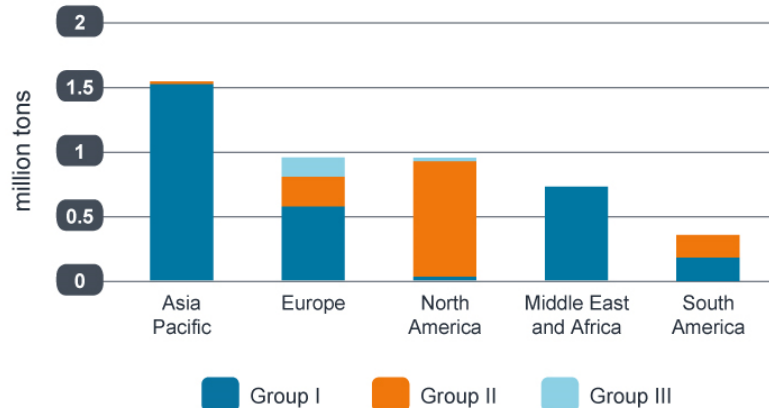
- 1) ban the burning of used oil;
- 2) incentivize the collection of used oil;
- 3) incentivize the regeneration (re-refining) of used oils;
- 4) impose mandatory quotas on the RRBO % of lube sales.*

* Source: adapted from Kline's Nov 16th 2023 post: "The Role of EPR in the Used Oil Value Chain"

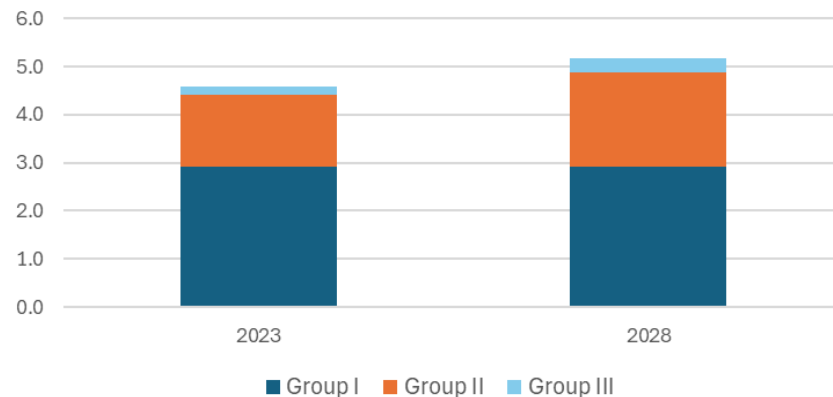


NEW CAPACITY MAINLY IN GROUP II AND III

Regional RRBO production capacity 2023



Forecasted capacity increases focused on Groups II and III
Figures in Million Tons



Source: Adapted from Kline Global Used Oil and Re-refined Lubricants Market Report, 2024

RRBO is produced in all regions:

- Mostly Group II in North America
- Mostly Group I in the developing world, in many cases from less robust manufacturing processes
- Split in Europe between Group I from older plants, and Groups II/III from newer facilities

Investment in new capacity, expansions and upgrades are focused on Group II and III, aligned with future demand



STRONG CONSOLIDATION TRENDS

-  **Investors interest** → ... increasing ownership stakes in selected RRBO producers
-  **Plant expansions and upgrades** → ... with new initiatives focused on Group II and III
-  **Geographic diversification** → ... via direct investment, associations and acquisitions
-  **Upstream value chain integration** → ... strengthening access to reliable sources of used oil
-  **Circularity partnerships** → ... developing closed-loop value chains
-  **Broad range of new entrants** → ... including established lube companies and VBO producers



Market Dynamics and Change Drivers: API Grouping and BOI Guidelines

RRBO DEPLOYMENT ENABLED BY INDUSTRY GUIDELINES AND IMPROVING CONSISTENCY WITH API BASE OIL GROUPS



API 1509 and ATIEL Code of Practice make no distinction between VBO and RRBO. BOI guidelines apply equally to both.



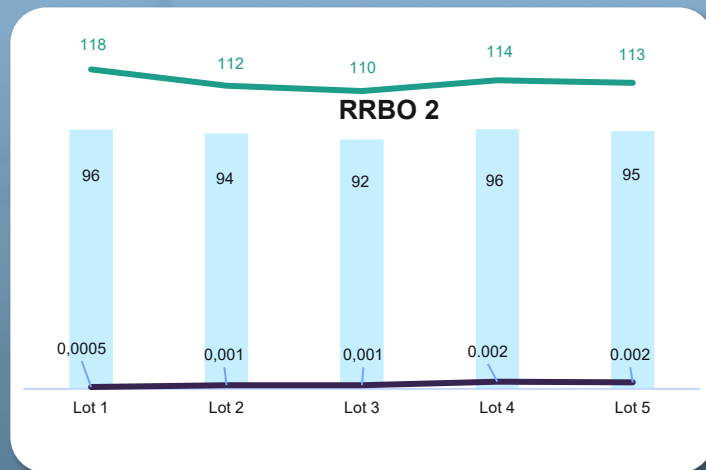
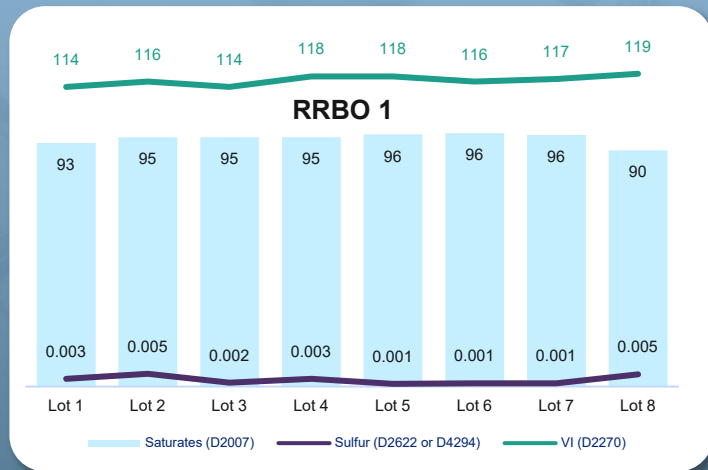
RRBO manufacturers are responsible for producing materials consistent with existing API groups. API base oil group is defined based on physical and chemical properties, not feedstock for manufacturing.



Due to variability in used oil feed, segregation practices, and manufacturing robustness, some RRBOs may exhibit variability in key inspections, including those defining classification into API base oil groups.



Quality and consistency of RRBOs have significantly improved, and today many RRBOs consistently meet API base oil group definition





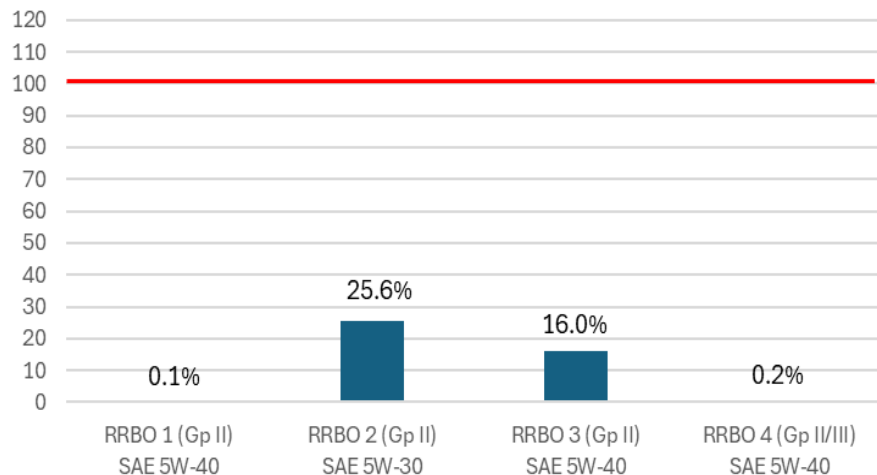
Market Dynamics and Change Drivers: Increasing Experience with RRBOs

PROGRAM-SPECIFIC AND BOI TESTS PROVE RRBO PERFORMANCE IN OXIDATION AND DEPOSIT PROTECTION

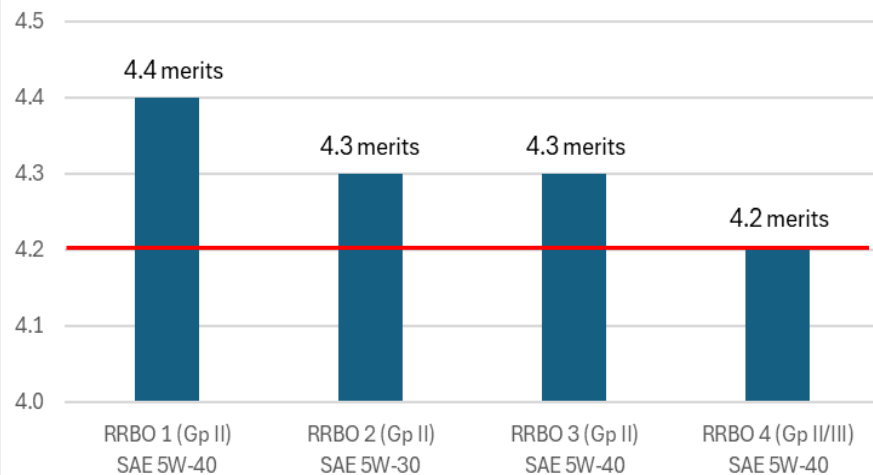


SEQUENCE IIH RESULTS IN INFINEUM API SP/ILSAC GF-6 TECHNOLOGY

Viscosity Increase at 40 C, %
Pass/Fail Limit ≤ 100



Weighted Piston Deposits, merits
Pass/Fail Limit ≥ 4.2





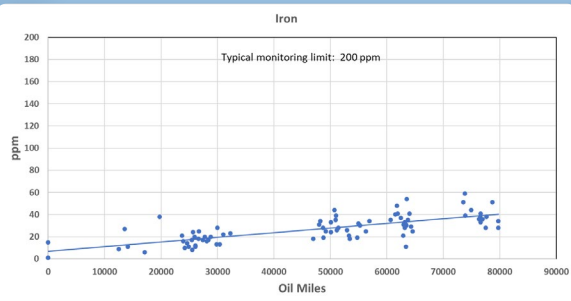
Market Dynamics and Change Drivers: Increasing Experience with RRBOs

INFINEUM ACCRUED 24 MILLION MILES IN 72 VEHICLES IN WIDELY-AVAILABLE GROUP II RRBO



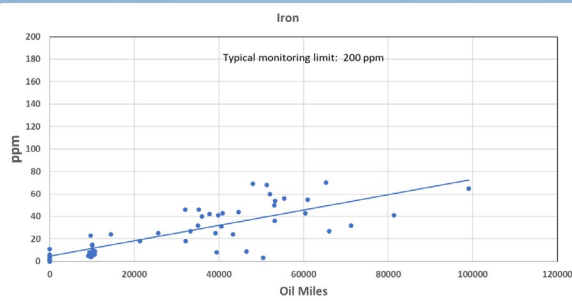
Detroit Diesel

2015 DD15 on FA-4 SAE 10W-30



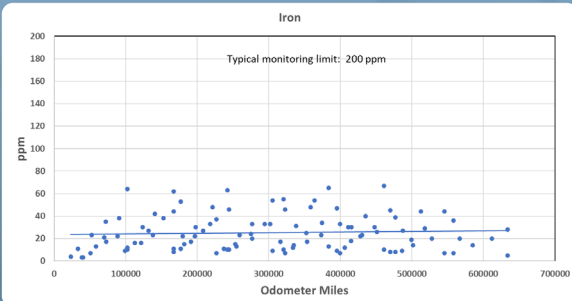
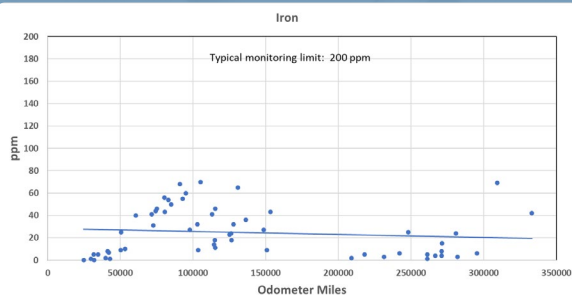
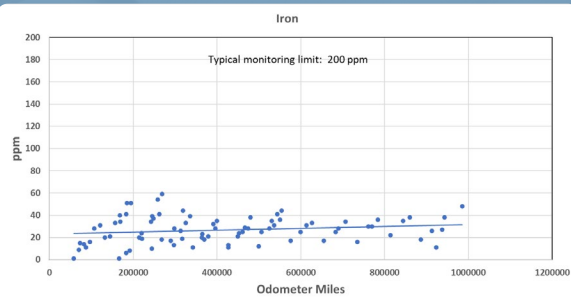
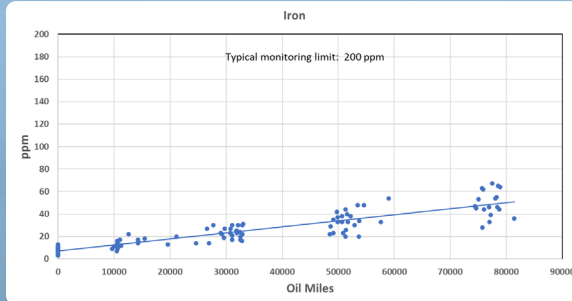
Mack

2020 MP8 on FA-4 SAE 10W-30



Cummins

2018 X15 on CK-4 SAE 10W-30



Used oil Iron results shown as proxy for engine protection. Full used oil analyses available.

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OEM PERSPECTIVES

CO₂ reduction targets

Fuel economy mandates

Net-zero ambitions



OEMs introducing Sustainability objectives that cascade to all functions, and their suppliers, including lubricants companies

OEM APPROACHES COVER A BROAD RANGE:

- Add PCF reduction targets into their specifications
- Request PCF reduction as a “rate & report”
- Ask for lubricant formulations with RRBO content
- Reach out for advice on PCF / circularity options
- Co-develop products containing RRBO with circular claims

PRESS RELEASES

12 Jul 2024

Stellantis introduces in its SUSTAINera RECYCLE range the first sustainable engine lubricant made from 100% regenerated oil designed by TotalEnergies Lubrifiants

📄 DOWNLOAD 📌 🔄 🔒



Source: www.media.Stellantis.com



Garages/Oil collectors:

- Improve collection and segregation practices

Re-refiners:

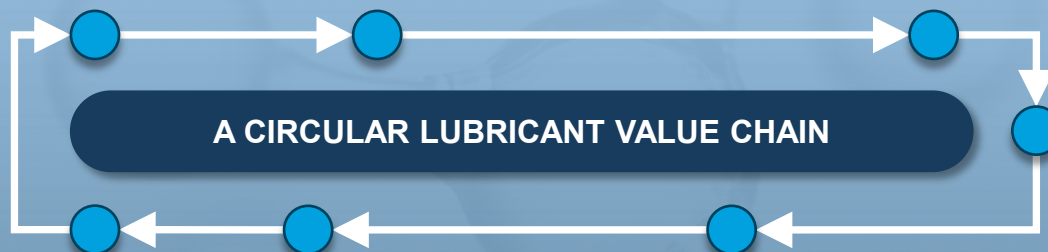
- Improve robustness in manufacturing process, and accuracy of PCF calculations

Additive Companies:

- Facilitate introduction of RRBO in their plants
- Support lubricant developments with RRBO

Industry and Governments:

- Develop common methodology to calculate RRBO carbon footprint
- Develop independent certification scheme for low-carbon and circular content.



Lubricant Companies and Distribution Channels:

- Promote circular products containing RRBO
- Educate end users

Governments:

- Incentivize collection and regeneration of used oils

OEMs:

- Be flexible to introduction of RRBO in formulations supported by the appropriate performance data
- Key role to play in supporting Mass Balance and forging new, lower PCF lubricant specifications

Unlocking the full potential of CO2 reductions from RRBOs requires harmonized actions by **all stakeholders** along the **lubricant value chain**.



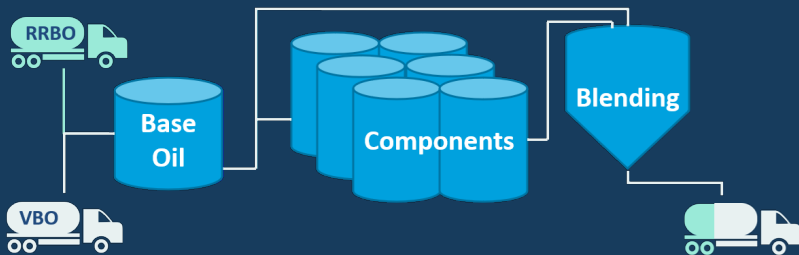
Unlocking RRBO Potential – Mass Balance in Practice

MASS BALANCE AS ENABLER

CHALLENGE STATEMENT:



- Industry requires a way to meet growing demand for sustainable products
- Without having fully segregated supply chains and high infrastructure costs
- With tracking of sustainable feedstocks along chain of custody



Mass Balance

- Enables **co-processing** of sustainable and conventional feedstocks.
- Designed to **trace** the flow of materials through complex value chains.
- Trusted, **certified** and auditable accounting system (ISSC PLUS certification).
- Used **widely** in fuels (SAF), agriculture and energy industry, growing in chemicals.

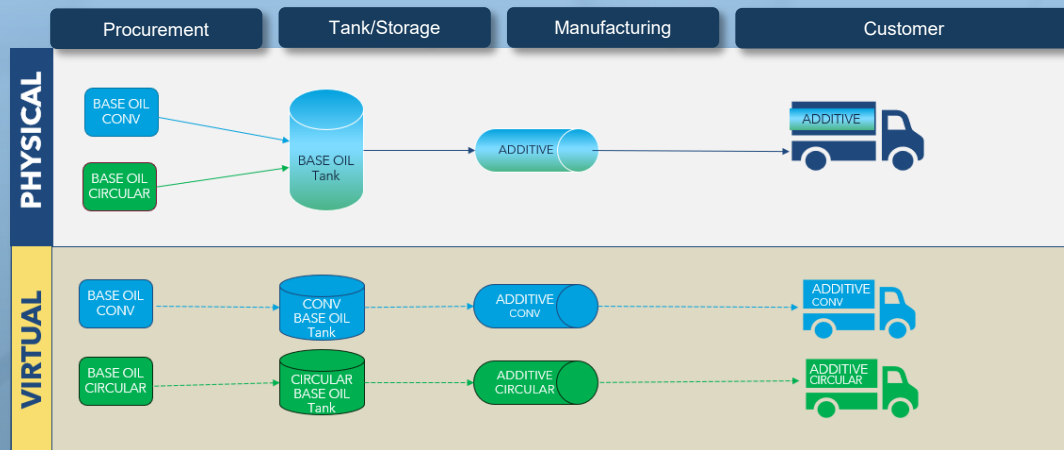


Unlocking RRBO Potential – Capturing and Quantifying the Value

CERTIFIED MASS BALANCED RRBO



Mass Balance Chain of Custody and ISSC PLUS certification



Similar approach can be used to apply mass balance concept to the production of lubricants using RRBO's

ISSC Plus Certification

Voluntary certification to verify and certify process and allocation of circular content to product characteristics

*Certifications required
for all sites along chain
of custody*

BENEFITS

- ✓ **Quality**
 - Drop-in solution with the same performance
- ✓ **Affordability**
 - No segregated assets nor infrastructure
- ✓ **Scalability**
 - Flexible RRBO content according to needs
- ✓ **Transparency**
 - Verified supply chain traceability
- ✓ **Assurance**
 - Globally recognized methodology



1. **RRBO is one of the most effective ways** towards meeting emissions and circularity targets of our value chains in the short to mid-term
2. **RRBO market dynamics are changing** with previous challenges being addressed (including convincing technical data and OEM acceptance) to enable mass adoption
3. **All stakeholders need to work together** and do their part for successful implementation
4. **Mass Balance and Certifications as approach** to track and capture value of RRBO along all stakeholders and in marketplace

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