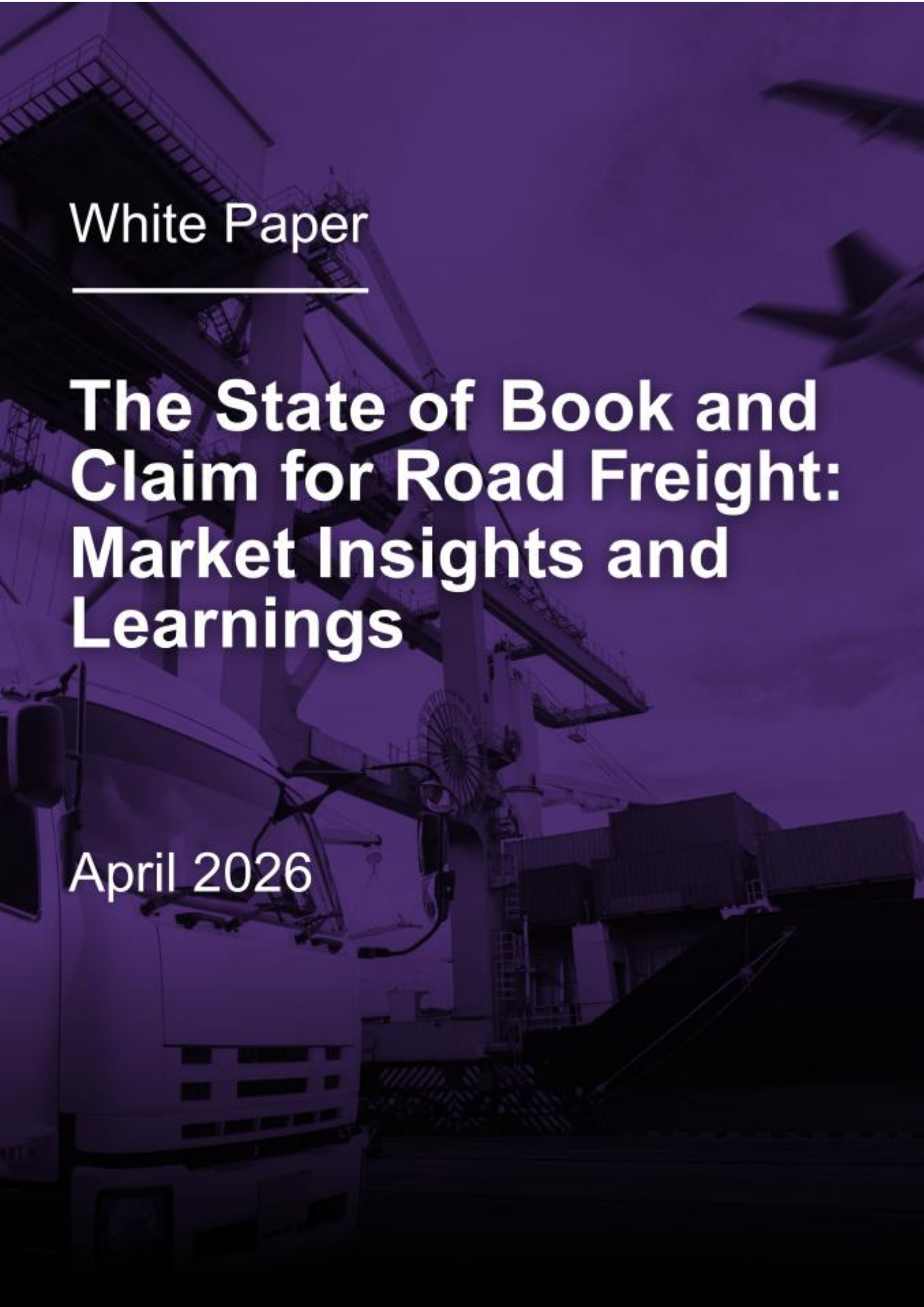




White Paper

The State of Book and Claim for Road Freight: Market Insights and Learnings

April 2026

BOOK AND CLAIM COMMUNITY — ROAD WORKING GROUP

The State of Book and Claim for Road Freight

Market Insights and Learnings

Produced by the Book and Claim Community Road Working Group

Chaired by Smart Freight Centre (SFC) and the Roundtable on Sustainable Biomaterials (RSB)

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Executive Summary

Road freight is one of the most Greenhouse Gas emissions-intensive sectors in global logistics, responsible for approximately 1.89 Gt of CO₂ in 2023 — more than international aviation and ocean shipping combined. Despite the increasing availability of low emission solutions such as hydrotreated vegetable oil (HVO), renewable natural gas, and battery-electric vehicles (BEVs), the road sector's structural complexity, coupled with the cost of implementing some of these emerging solutions, has slowed decarbonization. The diversity of carriers, fueling networks, and routing patterns creates coordination barriers that technology readiness alone cannot resolve.

Book and claim has emerged as a market-based mechanism capable of bridging this gap. By separating the administrative record of environmental attributes from the physical flow of energy, book and claim enables cargo owners, logistics service providers (LSPs), and carriers to financially support and claim the benefits of low emission transport services even where operational or geographic constraints prevent direct access to such solutions. The effectiveness of analogous models in renewable electricity (RECs/GOs) for Scope 2 and sustainable aviation fuel (SAF) markets provides proof of concept, while reinforcing the need for road freight-specific design.

Significant progress has been made in building the foundational architecture for road freight book and claim. The Smart Freight Centre's [Voluntary Market Based Measures Framework](#) (2023), the Book and Claim Community's [Principles and Best Practices](#) (2024), the [Market Based Measures Specification SFC-SPEC-001 v01](#) (2024), and the newly published ISO 22095-3:2026 Chain of Custody — Book and Claim standard together provide a robust and evolving normative basis for credible implementation. Early adopters across the value chain, including fuel providers, carriers, freight forwarders, and cargo owners, have demonstrated that book and claim is operationally viable when implemented with appropriate rigor.

This white paper, produced by the Book and Claim Community Road Working Group and drafted by Smart Freight Centre in collaboration with AllChiefs, documents the current state of road freight book and claim with four primary objectives: defining the key elements of a credible intervention; mapping implementation challenges and their solutions; showcasing best practices from leading adopters; and identifying pathways for continued market evolution. It draws on industry frameworks, normative standards, and the practical experience of carriers, LSPs, cargo owners, fuel suppliers, and registry operators across Europe and North America.

Drawing on interviews and case studies from across the value chain, the paper identifies four categories of persistent challenge:

- In documentation, variability in sustainability certification across geographies, inconsistent data provision from fuel suppliers and charge point operators, and a lack of standardized carrier-level documentation continue to create friction — though leading organizations are addressing these through internal policies¹, supplier accreditation programs, and structured booking workflows.
- In definition and calculation, divergent approaches to additionality and the treatment of modeled versus primary emissions data risk undermining the comparability and credibility of claims across market participants.
- In reporting, uncertainty around how to account for BEV electricity consumption, particularly the dual reporting of location-based and market-based methods, and the treatment of charging losses and upstream emissions, remains unresolved, alongside an immature and inconsistent verification landscape.
- Finally, in scaling, the absence of registry interoperability creates double-counting risk, while the lack of formal recognition from the Science Based Targets initiative (SBTi) and the Greenhouse

¹ Further reading: [Empowering Shippers: How Book and Claim Plus a Clear Action Plan Can Unlock Heavy Road Freight Decarbonization white paper](#) that highlights how a structured, market-based approach taken by a large cargo owner can be a blueprint to overcome limitations in road freight

Gas Protocol (GHG Protocol) limits corporate willingness of shippers to commit budgets to book and claim programs.

BEV-based interventions are roughly two years behind biofuels in market maturity, and the evidence base in this paper reflects that — readers should weigh BEV practices documented here as leading-edge pilots rather than established norms.

Despite these challenges, the market practices documented here demonstrate that progress is possible at the organizational level. Companies across the value chain are implementing pragmatic solutions: locking in standardized baselines, building multi-layered audit structures, developing internal ledgers (registries) with API connectivity, and piloting trilateral agreements to anchor additionality in indirect generation scenarios. These efforts are generating the real-world evidence needed to inform further standardization.

Closing the remaining gaps will require coordinated industry action. Four priorities stand out. First, **the development of interoperable or centralized registry infrastructure** to eliminate double-counting risk. Second, the **establishment of consistent, geography-specific additionality guidance**. Third, **clear industry conventions** for BEV emissions reporting in a book and claim context. Fourth and most consequentially for market scale, **formal recognition and guidance from SBTi and the GHG Protocol** on the eligibility, boundaries, and quality criteria of road freight book and claim.

The Book and Claim Community Road Working Group is actively working to address several of these gaps, with forthcoming publications in 2026 on the use of supplier-specific electricity GHG emission factors in transport GHG emissions accounting, end-to-end EV reporting guidance, additionality landscape mapping, and solving the point-of-sale verification gap (so-called “Gas Station Problem”). The building blocks for a credible, scalable road freight book and claim market are in place. What is needed now is the collective resolve to close the remaining gaps and accelerate the transition to low-emission logistics at scale.

List of Abbreviations and Acronyms

Abbreviation	Full Term
BCC	Book and Claim Community
BCU	Book and Claim Unit
BEV	Battery Electric Vehicle
BOL	Bill of Lading
CARB	California Air Resources Board
CCS	Carbon Capture and Storage
CI	Carbon Intensity
CNG	Compressed Natural Gas
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
CoC	Chain of Custody
COA	Certificate of Analysis
CPO	Crude Palm Oil / Charge Point Operator
EAC	Environmental Attribute Certificate
EU	European Union
FTL	Full Truck Load
GHG	Greenhouse Gas
GLEC	Global Logistics Emissions Council
GMA	Green Market Activation
GO	Guarantee of Origin
HVO	Hydrotreated Vegetable Oil
IEA	International Energy Agency
ILEAP	International Logistics Emissions Accounting Platform
IRENA	International Renewable Energy Agency
ISCC	International Sustainability and Carbon Certification
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
LCFS	Low Carbon Fuel Standard
LES	Low Emission Solution
LETS	Low Emission Transportation Service
LNG	Liquefied Natural Gas
LSP	Logistics Service Provider

LTL	Less Than Truck Load
MBM	Market-Based Measure
MJ	Megajoule
OEM	Original Equipment Manufacturer
POC	Proof of Compliance
POS	Proof of Sustainability
PPA	Power Purchase Agreement
PTD	Proof of Transport Delivery
REC	Renewable Energy Certificate
RED	Renewable Energy Directive (EU)
RSB	Roundtable on Sustainable Biomaterials
SAF	Sustainable Aviation Fuel
SBTi	Science Based Targets initiative
SFC	Smart Freight Centre
SME	Small and Medium-sized Enterprise
TERC	Transport Emission Reduction Certificate
THG	Treibhausgasminderungsquote (German GHG quota)
TIEC	Transferable Instrument with Entitlement to Claim
TKM	Tonne-Kilometre
XTL	Any-distance Truck Load
ZETc	Zero-Emission Trucking Certificates

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Section 1: Background and Context

Road freight transportation is a vital part of global logistics and a major source of greenhouse gas (GHG) emissions. Heavy-duty trucks account for close to a quarter of all transport-related CO₂ despite representing only about 9% of the global vehicle fleet (IDTechEx, 2019; IRENA, 2024). In absolute terms, this equates to roughly 1.89 Gt of CO₂ in 2023, a volume that, as IRENA notes, is “larger than those from the international aviation and [maritime] shipping sectors combined.” The road freight sector remains overwhelmingly dependent on fossil fuels, with diesel alone accounting for around 95% of energy consumption and renewable biofuels covering less than 5% (IEA, 2023). This trend highlights both the challenge and the opportunity: showing real progress in reducing road freight emissions can significantly help meet the targets set in the Paris Agreement.

Furthermore, the road sector is at a crucial juncture. Technological solutions for reducing emissions, including advanced (renewable) biofuels such as Hydrotreated Vegetable Oil (HVO), renewable natural gas, battery-electric options, and in some niche cases hydrogen vehicles, are becoming increasingly available and proven. The main barrier to using these solutions is not their readiness but the structural and economic challenges unique to the sector. Unlike the more centralized infrastructure of aviation or shipping, road freight relies on diverse networks with many carriers, widely spread fueling stations, complex logistics, and variable routing patterns (SFC, 2023). This fragmentation poses coordination challenges, but it also opens up opportunities for innovative market-based solutions that can attract investment and speed up the shift to low-emission operations.

The Opportunity of Book and Claim

Market-based measures, especially book and claim, can help overcome structural barriers and direct funds toward low-emission road freight solutions. Book and claim is a chain of custody model in which the administrative record flow is not necessarily connected to the physical flow of material or product throughout the supply chain (ISO 22095:2020/Amd.1:2026). It allows for the separation of environmental attributes from the actual movement of energy carriers or goods (Smart Freight Centre, 2025; BCC, 2024). This separation offers strategic flexibility: companies can financially back and claim the benefits of the lower emission profile from low-emission transport services, like vehicles using renewable fuels or battery-electric options, even if they cannot directly use these solutions in their supply chains due to geographical or operational limitations.

The effectiveness of book and claim methods is evident in other sectors. Renewable Energy Certificates (RECs) have successfully generated billions in investment for renewable electricity², while sustainable aviation fuel (SAF) book and claim systems are beginning to expand funding for low-carbon aviation. These examples provide valuable insights while emphasizing the need for sector-specific designs: road freight needs customized approaches that consider its unique operations, data availability issues, and stakeholder landscape.

It is important to note that most proponents also assert that book and claim-based approaches should complement broader decarbonization strategies rather than replace direct action. The direct deployment of low-emission solutions such as renewable fuels or battery-electric vehicles within a company’s own fleet or with contracted carriers remains the preferred approach and should be pursued wherever it is practically and financially viable. A solution’s physical implementation must happen somewhere, even when some attributes may be booked for another entity to claim.

² This refers to the RECs market with respect to Greenhouse Gas (GHG) Protocol Scope 2 emissions from purchased or acquired electricity, steam, heat and cooling

Book and claim is most valuable where direct action is constrained: for example, where geographic limitations restrict access to sustainable fuel infrastructure, where operational realities create mismatches between carrier networks and freight requirements, where supply chain complexity reduces visibility over transport execution, or where coordination barriers prevent smaller players from accessing low-emission options. In these scenarios, an actor may have *no* physical access to a low emission solutions, and their participation in a low-emission product can greatly aid the sector as a whole versus them taking zero action, making zero investment.

Beyond these structural constraints, book and claim also addresses a commercial gap that is often overlooked. There are instances where cargo owners cannot build a sufficient business case to require their transport operators to adopt direct solutions — and, conversely, instances where transport operators who have already invested in low-emission capacity cannot find cargo owners willing to pay the green premium on the trade lanes they serve. Or there is a complex ownership of the assets — think in terms of a large container vessel with hundreds of consignment owners to manager. Book and claim creates a mechanism to unlock that latent value on both sides of the market.

Before organizations can effectively use Market-Based Measures (MBMs) like book and claim, it is essential that they establish robust GHG emissions accounting practices to accurately determine their transportation-related emissions they want to substitute. The ISO 14083:2023 standard provides a framework for accounting and reporting greenhouse gas emissions from transportation operations. This standard sets guidelines for calculating transportation activities, determining emissions intensity, and distributing emissions across complex supply chains involving multiple stakeholders.

Following that, organizations interested in book and claim are highly recommended to ensure their transportation emissions accounting meets ISO 14083 standards before pursuing Low Emission Transportation Service (LETS) claims. This foundational work requires time and resources but offers benefits beyond book and claim readiness. It enables thorough scope 3 reporting, supports science-based target setting, promotes supplier engagement on decarbonization, and creates a data foundation for informed decisions about investments in emissions reduction. In an ideal state, all of this foundational groundwork would be firmly in place, enabling stakeholders to transfer environmental attributes along the chain seamlessly, accurately, and with full confidence in their integrity. In practice, however, book and claim is not a monolithic or uniformly mature system. There are instances where the urgency of decarbonization — and the genuine willingness among stakeholders to act — outpaces the establishment of some of these underlying requirements. It is precisely this gap that initiatives such as the Book and Claim Community seek to address, working to bring alignment and harmonization to the system as it evolves toward a low-carbon business-as-usual scenario.

In the medium to long-term, all stakeholders engaged in book and claim are strongly encouraged to work toward full compliance with globally recognized standards and frameworks. Doing so is not merely a procedural formality but is what will ultimately determine the legitimacy, robustness, and market credibility of transport sector book and claim as a chain of custody mechanism.

Emerging Frameworks and Implementation

In recent years, we have seen significant progress in setting up the basic frameworks needed for reliable road freight book and claim systems. The September 2023 publication of the SFC Voluntary Market Based Measures Framework for Logistics Emissions Accounting and Reporting provided clear guidance on chain-of-custody models, additionality assessment, modal constraints, and accounting principles. Building on this foundation, the Book and Claim Community created “Principles and Best Practices for Book and Claim Systems in Heavy Transport” in June 2024. This document outlines a shared understanding among various stakeholders on key aspects of high-integrity systems, organized around three main areas: Transparency and Verification, Environmental Credibility, and Scalability and Practicality.

The October 2024 release of the MBM Specification marked an important shift from guidance to standardized requirements. It turned framework principles into clear criteria for assurance providers to verify emissions reporting. As such, it helped organizations create monitoring plans, emissions reporting procedures, and internal controls, as well as guide engagement with validation and verification bodies (VVBs). This Specification provides the necessary technical structure for consistent, comparable, and auditable book and claim implementations.

Most recently, the ISO 22095-3:2026 Chain of custody — Part 3 outlines the requirements and guidelines for book and claim allowing requirement setters to accurately attribute low-carbon fuel characteristics to specific buyers within a system, even where physical delivery of that fuel to the end user is not required.

As the frameworks and normative documents have developed, innovative organizations throughout the road freight value chain have started to put book and claim systems into action. Akin to “learning by doing”, these early efforts cover various fuel sources (HVO, renewable natural gas, electricity), types of organizations (carriers, LSPs, shippers), and geographical areas. Early adopters show that with the right systems and controls, organizations can credibly book and claim environmental attributes while being transparent and avoiding double counting. At the same time, these implementations have exposed practical challenges related to data availability, registry infrastructure, verification capacity, and stakeholder coordination that need to be addressed as the market grows.

Currently, the road freight book and claim market is marked by growing adoption, different approaches to implementation, and ongoing development of supporting infrastructure.³ Albeit still in the early stages, frameworks are maturing, with guidance documents evolving at a steady pace. The diversity in implementation reflects the different roles of organizations within the value chain and their unique operational situations. Supporting structures, including registries, verification services, and standardized contracts, are being developed but are still less advanced than those in other sectors like renewable electricity markets. Taken together, corporate climate commitments increase demand for trustworthy low-emission transportation options, creating a market pull that encourages the development of book and claim offerings.

³Further reading: International Transport Forum (2026), [Claiming the Future: Can Book and Claim Support Low-Emission Transport?](#), OECD/ITF Corporate Partnership Board Report.

Scope and Objectives of this White Paper

This white paper examines the current state of book and claim in the road freight sector. It summarizes the frameworks that have been created, looks at the implementations that are appearing, and identifies challenges and solutions as the market matures. Our aim is to give stakeholders a fair assessment. We recognize both the progress made and the areas that still need development.

The specific objectives of this white paper are to:

- Define key elements of credible road book and claim systems: Advance clear understanding of Low Emission Solutions, Low Emission Transportation Services, chain of custody models, and the roles of different supply chain actors. This builds on well-established frameworks recognized by the industry.
- Map implementation challenges and synthesize common success factors to these challenges: Gather lessons learned from various implementations to spot recurring themes in successful approaches.
- Showcase best practices through case studies: Highlight implementations that show the practical viability of book and claim approaches. This includes documentation standards, supplier engagement strategies, and procedural safeguards.
- Identify pathways for continued evolution: Outline opportunities for refining frameworks, starting standardization initiatives, and developing infrastructure to support the ongoing growth and scaling of road freight book and claim systems.

Contributions

This white paper draws on the insights and practical experience of many experts actively engaged in road freight book and claim initiatives. Their collective objective is to support greater standardization of market-based measures in the road freight sector and to accelerate broader adoption of book and claim practices.

The contributing experts are part of the Book and Claim Community Road Working Group chaired by Smart Freight Centre (SFC) and Roundtable on Sustainable Biomaterials (RSB) and represent a diverse cross-section of the value chain, including fuel providers, road freight carriers, logistics service providers (LSPs), cargo owners, and registry operators. The findings and conclusions presented in this paper were consolidated and drafted by Smart Freight Centre in collaboration with AllChiefs and subsequently reviewed and validated by the Road Working Group captains and all contributors.

A full list of participating organizations and individual contributors can be found at the end of this white paper.

Document Structure

After this introduction, the white paper goes through three main sections:

Section 2: Definition of a successful Book and Claim Intervention establishes the key elements of credible road freight book and claim systems. It draws on industry guidance, BCC principles, as well as the newly established ISO 22095-3:2026 Standard on book and claim to define essential concepts and requirements.

Section 3: Mapping of the core challenges from solution generation through end-user claims. It describes the considerations and points of attention at a high level and synthesizes effective methods that made market-based measures in road freight possible. It also shows best practices from the industry around, for example, data management, supplier engagement, and verification.

Section 4: Conclusion and pathways forward sum up key insights, highlights opportunities for ongoing framework evolution, and outlines the steps toward broader adoption of credible road freight book and claim systems.

This white paper aims to encourage continued progress by documenting the current situation, offering practical guidance for implementation, highlighting best practices and success factors, and outlining opportunities for further development. Our goal is to inspire confidence that road freight book and claim, when implemented with the right rigor and transparency, serves as a viable and valuable tool for hastening the urgent task of decarbonizing global logistics operations.

A note on terminology. This paper uses *book and claim* to refer to the chain of custody model and *market-based measures (MBM)* as the broader category of mechanisms that includes it. *EAC/TIEC* appears throughout to mark the ongoing transition: Environmental Attribute Certificate is the term most widely used in the market today; Transferable Instrument with Entitlement to Claim is the term standardized by ISO 22095-3:2026. Where a market participant uses a brand-specific term (BCU, ZETc, inset), we note it on first use.

Section 2: Definition of a Successful Book and Claim Intervention

This section establishes the foundational concepts and requirements for credible road freight book and claim systems. It draws on the SFC Voluntary Market Based Measures (MBM) Framework and its accompanying Specification, ISO standard 14083:2023 for transport emissions accounting, the newly published ISO 22095-3:2026 Chain of Custody – Book and Claim standard, and the Book and Claim Community Principles and Best Practices. Together these documents help define what a credible intervention looks like and set the minimum bar for quality in road freight book and claim.

2.1 Foundational Concepts

2.1.1 GHG Accounting Foundations

Robust GHG emissions accounting for transport activities provides the essential foundation for credible book and claim systems. ISO 14083:2023 provides the internationally recognized framework for quantifying and reporting greenhouse gas emissions from transport chain operations. Organizations must align their transport emissions accounting with ISO 14083 prior to reporting Low Emission Transportation Service (LETS) claims under the MBM Framework — it gives organizations a reliable reference point against which low-emission alternatives can be measured and reported.

It is important to note that ISO 14083 compliance is not required simply to purchase or issue an EAC/TIEC. The requirement applies specifically where an organization seeks to report an intervention as MBM-compliant. Without this foundation, the reported emission profile risks being non-comparable across counterparties in their emissions inventories. In the medium to long term, all participants are strongly encouraged to work toward full compliance with globally recognized standards and frameworks.

2.1.2 Low Emission Solutions (LES)

A Low Emission Solution (LES) is any fuel, energy source, or technology that demonstrably reduces the lifecycle GHG emissions intensity of a road freight transport activity relative to a defined fossil fuel baseline. In the road sector, the following solution categories are currently recognized:

- Liquid biogenic/renewable fuels – principally Hydrotreated Vegetable Oil (HVO) and biodiesel blends beyond mandates, certified under recognized schemes (e.g. ISCC EU, RSB EU, etc.). These are currently the most mature and widely deployed low emission solutions in road freight.
- Gaseous biogenic fuels – renewable natural gas (bio-LNG, bio-CNG)
- Battery Electric Vehicles (BEVs) – zero-tailpipe-emission vehicles charged from electricity; the emissions profile depends on whether the electricity consumed is backed by renewable energy certificates (RECs or Guarantees of Origin) or not.
- Hydrogen fuel cell vehicles – zero-tailpipe-emission long-haul trucks; still in early commercial deployment.
- E-fuels and synthetic fuels – produced from renewable electricity and captured CO₂; promising but currently at high cost and low commercial scale.

Each LES carries a carbon intensity (CI) score – the lifecycle GHG emissions per unit of energy (gCO₂e/MJ) – which describes the emission intensity of the LES. Primary CI data is preferred; where unavailable, certified default values from recognized frameworks may be used.

2.1.3 Low Emission Transportation Service (LETS)

A Low Emission Transportation Service (LETS) is a transportation service in which a LES has been used to perform all or part of the activity. The LETS is the unit of claim and aligns with the type of unit that is commonly claimed by the cargo owner from a carrier in non-market-based scenarios – in normal freight accounting. The LETS links the environmental attribute of the LES to a specific volume of transportation activity, typically expressed in tonne-kilometres (TKM) with an associated emission intensity (gCO₂e/TKM). A LETS can be booked by any party in the logistics value chain – solution provider, carrier, LSP – and claimed

by a cargo owner. Some preparation or adjustment (i.e., math) may be necessary depending on the chain of custody model applied.

2.1.4 Environmental Attribute Certificates (EACs) and Transferable Instruments with Entitlement to Claim (TIECs)

An Environmental Attribute Certificate (EAC) – also referred to as a Transferable Instrument with Entitlement to Claim (TIEC) under ISO 22095-3:2026 – is the administrative record that captures, tracks, and transfers the environmental characteristics of a LES or LETS through the value chain. Key properties of a valid EAC/TIEC include:

- Unique issuance – only one TIEC may be issued for a given unit of Low Emission Solution or Low Emission Transport Service.
- Exclusive ownership – at any point in time, only one party holds the right to claim the attributed emission reduction.
- Retirement for claim – the right to claim is realized only upon retirement; prior to retirement the TIEC may be bought, sold, or transferred.
- No erroneous double counting⁴– the same emission reduction attributes cannot be claimed by more than one party for the same purpose.
- Data retention – registry operators must retain records for a minimum of three years per ISO 22095-3 guidance.

EACs in road freight use varied terminology across market participants – Book and Claim Units (BCUs), insets, certificates – but ISO 22095-3 standardizes the underlying concept as a TIEC, providing a common language for the market.

ISO 22095-3:2026 defines a TIEC as: *“an administrative record that is issued, tracked, and retired within a book and claim system, the ownership of which confers the unique right to claim consumption or use of specified characteristics upon retirement.”*

This international standard provides the sector-agnostic foundation upon which all road freight book and claim frameworks must build. Aligned sector understanding of the "requirement setter" for book and claim systems will benefit all users.

⁴ Double counting in book and claim systems refers to the erroneous, duplicate or improper accounting of emission reductions, encompassing three main scenarios: double issuance (duplicate creation of certificates for the same solution), double claiming (multiple parties claiming the same certificates), double use (repeated utilization of a single certificate by the same party for multiple purposes). Not all double counting is erroneous given one organization's direct emissions are often indirect emissions for another organization, and proper booking and claiming of the emission profiles and solutions ensures proper accounting in these instances.

2.2 Chain of Custody Models

Chain of custody (CoC) models describe how the environmental attributes of a fuel or service are tracked and transferred through a supply chain. Three CoC models are relevant to road freight, as defined under ISO 22095 and summarized below. The choice of model has significant implications for additionality, documentation burden, and registry requirements.

2.2.1 Physical Segregation (Direct Model)

Physical segregation ensures that the certified Low Emission Solution e.g. HVO is strictly separated from non-certified solutions throughout production, storage, and delivery. There is a direct, traceable link between the sustainability-certified feedstock and the vehicle that consumes it. In road freight this can typically mean:

- Renewable fuels (e.g. HVO) are delivered directly to the carrier's home depot or tank as well as dedicated public fuel stations with dedicated tanks for these drop-in fuels.
- The carrier can demonstrate via fuel card data or delivery documentation that the specific vehicles performing the transport activity consumed the Low Emission Solution.
- For BEVs, the carrier charges at its own depot and can directly link electricity consumption to specific vehicles and trips.

Physical segregation of fuel is widely regarded as the most robust mechanism for preventing fraud and double counting, since it provides direct evidence that the Low Emission Solution has been used. While this holds in theory, implementation is constrained by real-world logistics: many carriers are unable to take direct delivery of premium biofuels, and commingling with residual fossil fuel in truck tanks is often unavoidable. These constraints render the model unscalable in most operational contexts. It is also important to note that physical segregation is only meaningful where the specified sustainability characteristic is binary (e.g. biofuel vs. fossil). Where the specified characteristic is carbon intensity itself, segregation is not currently feasible because the underlying ISCC and RSB certification systems operate on a credit-based mass balance model.

2.2.2 Mass Balance (Direct Model)

Mass balance allows materials or products with specified characteristics to be mixed or co-processed with conventional materials according to defined criteria, such that the certified attributes are not able to be physically linked to any specific output – but is likely present in all outputs – and are tracked as TIECs/EACs/credits across the pooled system. When set up correctly, the LES is, for all intents and purposes, recognized as having been physically delivered to the specific vehicle (e.g., to a single plane at an airport despite being part of a commingled hydrant system). In road freight practice:

- A fuel provider, carrier, or LSP maintains a pool of certified Low Emission Solution (e.g. HVO) into which volumes are booked, and from which LETS are allocated to customers.
- Carriers may fuel at standard fueling stations or depots, but the equivalent volume of Low Emission Solutions is tracked in the pool of the energy carrier and allocated to their activity.
- A rolling balance is generally employed to ensure that the total volume of LETS allocated never exceeds the total volume of Low Emission Solution physically introduced into the system.
- Users who receive the LES via mass balance are balanced by users who do *not* receive the LES administratively. These users, instead, receive the "residual mix". (Note: it is, of course, apparent that in a basic mass balance scenario, all users are receiving the same physical mix or blend of product)

Mass balance occupies the middle ground between physical segregation and book and claim. It maintains a connection between physical Low Emission Solution use and claims, but permits pooling across multiple

parties, sites and routes. Safeguards against over-issuance – such as invoice-level declarations and rolling balances – are essential to prevent the volume of LETS booked from exceeding physical LES consumption.

2.2.3 Book and Claim (Indirect Model)

In the book and claim model, as defined by ISO 22095-3:2026, the administrative record flow (the EAC/TIEC) is fully decoupled from the physical flow of the Low Emission Solution. A producer or supplier of Low Emission Solutions books the environmental attributes into a registry at the point of production or supply, and any eligible party downstream may claim those attributes by purchasing and retiring the corresponding EAC/TIEC, regardless of whether that party physically used the Low Emission Solution.

It is important to note that a Low Emission Solution — such as a low emission fuel or a battery electric vehicle — can enter the book and claim system in two distinct ways, depending on where in the supply chain it is applied⁵:

- **Direct generation** occurs when a carrier physically uses the Low Emission Solution in its own fleet, generating a LETS that is then booked into a registry and made available for a shipper or LSP to claim. Here, there is a physical tie between the solution and the carrier generating the service, even though the claiming party may not have been the one whose freight was physically transported on that service.
- **Indirect generation** occurs when a shipper, LSP or carrier purchases the environmental attributes of a Low Emission Solution directly from the solution provider and applies those attributes to their transport activity as if the solution had been used by their carriers (or themselves) — without a physical tie between the solution and the transport operation.

Both pathways result in an EAC/TIEC that can be claimed by an eligible downstream party, such as a cargo owner, but they differ in the robustness of that physical link and, consequently, in the additionality requirements that apply.

An important principle: there should never be a claim by a shipper or LSP (in Scope 3, category 4) without a corresponding claim being made by the carrier or operator (in Scopes 1 or 2) using the actual solution or solution profile.

Book and claim is the most flexible model and is suited to a wide range of contexts — from complex, multi-party logistics networks where direct fuel traceability is not practicable, or where cargo owner relationships are highly-complex, to high-capital-expenditure interventions where decoupling administrative and physical flows reduces investment risk and enables long-term contracting. It is particularly relevant for:

- Large cargo owners seeking to decarbonize Scope 3 transport emissions across a fragmented, multi-carrier supply chain.
- LSPs operating networks too large to enforce direct Low Emission Solution delivery to every carrier.
- Interventions where the Low Emission Solution can most efficiently be injected at the fuel production or distribution point, rather than at the point of transport activity.
- High-capex Low Emission Solution projects — such as battery electric vehicle fleets or alternative fuel infrastructure — where book and claim reduces offtaker risk exposure and supports the long-term revenue certainty needed to unlock investment that would not otherwise occur.

Because the physical and administrative flows are decoupled, book and claim places the highest demands on additionality⁶: the SFC's Voluntary MBM Framework, for example requires that indirect generation interventions demonstrate that the emission reduction goes beyond what is already mandated by regulation.

⁵ Further Reading on Direct & Indirect LETS [SFC MBM framework](#): Section 5 Applying chain of custody concepts to transport supply chains (Pg 21 – 27)

⁶ A metric for evaluating whether the emissions reductions or profile associated with an intervention (e.g. certificate purchase) would have occurred absent the intervention. In particular, regulatory additionality assesses whether the activity is already required by and used toward a regulatory obligation.

2.3 MBM Models in Road Freight: A Comparative Overview

In practice, road freight book and claim implementations span both liquid/gaseous biogenic (renewable) fuels and battery electric vehicles and apply one or more of the CoC models described above.

Table 2.1a: Comparison of MBM Model Configurations — Biogenic Fuels

Applies to HVO, bio-LNG, bio-CNG, and other biogenic fuel-based Low Emission Solutions (LES).

Criterion	Physical Segregation	Mass Balance	Book and Claim
Physical link to Low Emission Solution?	Yes — biofuel (e.g. HVO, bio-LNG) physically delivered to carrier depot, tank, or dedicated public fueling station	Partial — attributes tracked through pooled supply; physical link to specific delivery not required	Not guaranteed — attributes are typically fully decoupled from physical fuel flow
Chain of Custody Model	Physical segregation	Mass balance	Book and Claim
TIEC / EAC Required?	No (optional for reporting purposes)	Yes (credit method)	Yes — TIEC issued, traded and retired
Additionality Risk	Low to Medium — physical proof reduces risk, but mandated biofuel blends can still be non-additional	Medium	High — must demonstrate low emission profile beyond regulatory mandates (Indirect Generation)
Erroneous Double Counting Risk	Low	Medium — requires tracking controls and volume caps to prevent over-crediting	High — requires stringent documentation and tracking
Suitable For	Own fleet or contracted direct delivery; simpler supply chains	Multi-party supply chains and fuel blending contexts	Complex logistics networks; global shippers without geographic access to LES/LETS
Registry?	Recommended for reporting (some sort of "ledger" ⁷ or tracking/tracing is almost always present)	Recommended; not yet universally required (internal ledger solutions accepted by some frameworks)	Yes — mandatory for TIEC lifecycle management
Verification Complexity	Low — clear physical audit trail via delivery records and fuel cards	Medium — pooled volumes require audit controls and reconciliation System owner (e.g., solution provider) may certify system for all users' benefit	Medium–High — decoupled system requires robust registry and third-party verification

⁷ **Internal Ledger:** System an organization uses to assume the responsibility for recording the tracking/ tracing of the characteristics of the booked unit.

Table 2.1b: Comparison of MBM Model Configurations — Battery Electric Vehicles (BEV)

Applies to carriers operating battery-electric trucks claiming low-emission attributes based on renewable electricity sourcing. The three CoC models mirror those for biogenic (renewable) fuels but are applied to electricity rather than fuel.

Criterion	Direct supply (off-grid)	RE Attribution (grid connected / on-site supply)	Book and Claim (RECs / EACs)
Physical link to Renewable Electricity?	Yes — truck charged exclusively at on-site or dedicated renewable energy source	Partial — truck charges from mixed grid, but RE share attributed to specific transport activities	No — carrier or CPO purchases RECs/EACs separately; physical charging may use grid mix
Chain of Custody Model	Physical separation	Mass balance	Book and Claim
TIEC / EAC Required?	No (optional for reporting)	Yes — RE share attributed via EAC issuance and allocation	Yes — RECs or equivalent purchased and retired
Additionality Risk⁸	Low — direct physical link to RE source. Note: the BEV drivetrain may be regulated in some markets, making it non-additional as a decarbonization lever	Medium — depends on attribution methodology and grid carbon intensity	Medium — depends on grid mix, temporal matching, and certificate vintage
Suitable For	Carriers with depot-based charging and on-site renewable generation	Carriers with mixed charging infrastructure wanting to attribute RE to specific routes or trucks on one RE-supplied route (depends on the system boundaries chosen)	Shippers via CPO or carriers unable to directly access renewable electricity at charge points
Registry Needed?	Recommended for reporting	Yes — to track RE attribution across charging events; internal ledger solutions may apply	Yes — recommended for claiming; mandatory if issuing TIECs from BEV activity
Verification Complexity	Low to Medium — charge records and RE procurement evidence required	Medium — requires metering data and attribution audit trail	Medium — REC/EAC audit trail; complexity increases with multi-load BEV allocation

⁸ *Additionality risk for BEV reflects both electricity sourcing requirements and regulatory context for vehicle deployment.*

2.3.1 Biofuel – Direct Model

The biofuel direct model can be taken as the lowest-risk approach to avoid double counting. A fuel provider delivers certified Low Emission Solution volumes directly to the carrier's depot, tank, or designated fueling location. Proof of delivery and fuel card data (proof of use) create a clear audit trail linking the Low Emission Solution to the transport activity. This model can theoretically be seen as a straightforward route, and it is generally preferred by customers who expect a direct, verifiable connection between their purchase and the fuel physically used on their freight. In practice, however, carriers often find it operationally burdensome. While procurement of the low-emission solution is easy to prove, demonstrating that the fuel was actually and exclusively used on a specific service remains challenging. Paradoxically, the trust customers place in the physical model often means fewer checks are performed, which can make it more vulnerable to omissions, errors, and even fraud than book and claim systems, where traceability is embedded by design.

2.3.2 Biofuel – Mass Balance Model

Under the biofuel mass balance model, a fuel provider, carrier, or an LSP manages a pool of certified biofuel volumes. Carriers fuel normally; Low Emission Solution volumes injected at the pool level are tracked and LETS are allocated to customers based on their share of transport activity (measured in TKM). A rolling balance – or other mass balance system rigor – safeguards against credit over-allocation. This model scales more readily than the direct model and is well-suited to LSPs operating large, multi-carrier networks, but requires robust registry infrastructure (or internal ledger) and regular reconciliation.

2.3.3 Biofuel – Indirect / Book and Claim

In the indirect model, LES producers or fuel providers issue EAC/TIECs into a registry at the point of supply. Cargo owners or LSPs purchase and retire these EAC/TIECs to claim the low emission profile in their Scope 3 inventory, without any physical link to the specific vehicles or routes operated. This model offers the greatest flexibility but carries the highest additionality and documentation burden and is most appropriate in markets where direct delivery is genuinely impractical and where additionality can be robustly demonstrated (e.g. fuels certified beyond regulatory mandates, or in geographies without blending requirements). It is worth noting that while the claim itself is always indirect under book and claim, the underlying LETS may be generated in two different ways: directly, where a carrier physically uses the Low Emission Solution in its own fleet and books the resulting LETS into a registry for a shipper, LSP or another carrier to claim; or indirectly, where a shipper or LSP purchases the environmental attributes directly from the solution provider (e.g. a fuel producer) and applies them to their transport activity with no physical tie to any specific operation.

2.3.4 Battery Electric Vehicles (BEV) (Book and Claim)

For battery electric vehicles, the MBM model centers on the transition to a zero-tailpipe-emission drivetrain. The electricity source and its associated emission factor are a critical component of the calculation, but the fundamental aim is to incentivize the deployment of BEV trucks and to attribute the resulting lower emission profile attributes of the transport service to cargo owners. Two accounting methods apply to the electricity consumed:

- **Location-based:** uses the average grid emission factor for the country or region of charging – more simple and broadly comparable but does not capture the benefit of renewable energy procurement.
- **Market-based:** uses contractual instruments like renewable energy certificates (RECs or Guarantees of Origin) to claim a lower emission factor for the renewable portion of electricity, with the residual grid mix applying to the remainder.

Under a BEV book and claim arrangement, a carrier procures battery electric trucks, secures access to depot or public charging infrastructure(CPO), and contracts for the renewable electricity needed to operate the

fleet through their on-site charging. In practice, when accessing public charging infrastructure, the CPO sits between the grid and the carrier and it is the CPO that procures and retires the RECs against the charging activity, rather than the carrier itself. The carrier calculates the emission profile of the resulting transport service in gCO₂e/TKM in line with ISO 14083 and the [GLEC Framework](#), and books the corresponding EAC/TIECs — sometimes referred to in the market as Zero-Emission Trucking Certificates (ZETc) — into a registry at the point of generation. Cargo owners, or LSPs acting on their behalf, purchase and retire those EAC/TIECs to claim the associated low emission profile in their Scope 3 inventory. To prevent erroneous double counting, the carrier reports the residual fossil-baseline emission factor to the physical shipper (non-book and claim party) whose freight actually moved on the trucks, so that the low emission profile is not claimed by both parties.

BEV deployment faces structural barriers that biofuel interventions do not. The capital cost of a Class 8 battery electric truck for example is significantly higher than its diesel equivalent; charging infrastructure is geographically uneven and slow to build out; carriers cannot easily match individual cargo owner routes to corridors where battery range, payload, and charging access align; and multi-year contracts are typically required to amortize the upfront investment. Book and claim addresses each of these constraints. By decoupling the environmental attribute from the movement of any specific shipment, it enables carriers to deploy BEVs on the corridors where they are most operationally efficient - typically high-density routes with predictable backhauls - while still channeling cargo owner funding to those projects. This in turn maximizes vehicle and charger utilization, which is the single largest lever for reducing the per-unit cost of zero-emission trucking services and therefore the green premium passed through to buyers. Aggregated buyer demand, where multiple cargo owners pool their purchasing through a shared procurement vehicle, can amplify these benefits further by providing carriers with the multi-year revenue certainty needed to commit to high-capex assets.

Section 3: Core Challenges and Solutions

A note on BEV maturity. The market practices in this section are weighted toward biofuels because that is where the operational evidence base sits today. BEV-based book and claim is roughly two years behind: fewer carriers have deployed at scale, charge point operator (CPO) data infrastructure is still hardening, and several methodological questions (charging loss treatment, upstream emissions, residual mix reporting) remain open. Readers should treat BEV practices documented here as leading-edge pilots rather than established norms, and watch for the Road Working Group’s 2026 EV-specific publications.

As outlined in Section 2, various market-based measure models are gaining traction in the road freight sector, spanning both liquid and gaseous biofuels and BEVs. While these models vary in design and features, common challenges persist across implementation models. This chapter addresses the core challenges identified in Table 3 across Documentation, Definition & Calculation, Reporting, and Scaling. For each, the core challenge is described alongside solutions and best practices from leading adopters of biofuel and BEV market-based measure systems.

It is important to note that several challenges are not unique to market-based measures alone but reflect broader barriers to road freight decarbonization and GHG reporting, regardless of whether a physical or certificate-based solution is applied.

The challenges identified below are grouped by type:

1. Documentation gathering for EAC/TIEC proof of sustainability information
2. Definition and calculation of EAC/TIECs for booking and claiming
3. Reporting emissions using EAC/TIECs
4. Scaling and expanding market-based measure adoption in road freight

The overview in Table 3 provides a snapshot of these challenges, noting whether they apply specifically to biofuel (liquid and gaseous) (violet), BEV (turquoise), or both (mutual) (blue). Challenges that originate in road freight decarbonization more broadly are indicated with a circle (o) in Table 3 to distinguish them from those specific to market-based measures.

Table 3: Challenges in Road Market-based Measures

	1. Documentation	2. Definition & Calculation	3. Reporting	4. Scaling
A	Variability in feedstock tracking across geographies ○	Unclear in determining additionality across regions and intervention types	Unclear market- location-based reporting practices ○	Double counting risk from EAC/TIECs being registered on multiple registries
B	Lack of (standardized) documentation at fuel/energy provider ○	Lack of standardized transfer units	Immature verification process / landscape	Lack of formal recognition and consistent language
C	Complex data collection process from multiple (public) charging touchpoints ○	Baseline selection unclarity		
D	Delay in booking EACs due to delayed certificate provision	Emission inventory differences between carrier and LSP or Shipper ○		
E	Lack of (standardized) documentation at carrier level ○			

Biofuel
 BEV
 Mutual
 General challenge

1. Documentation

A functioning market-based measure system depends on robust, verifiable documentation at every stage of the value chain. Across the interviews, documentation emerged as the most frequently cited area of friction - not only around what data is required, but who provides it, in what format, and how consistently. For renewable and biofuels, progress is being made through collaborative efforts between buyers and fuel providers, but standardization remains incomplete. For BEVs, the landscape is significantly less mature, with value chain actors still navigating which documentation is necessary and how it should be collected and shared. The following challenges address the key documentation gaps identified across both intervention types.

Challenge 1A. Variability in feedstock tracking across geographies (Biofuel)

Challenge description

Sustainability certification of biofuels is often a key requirement for buyers of alternative fuels and associated EACs/TIECs. Such certification provides transparency on feedstock origin, LCA, CI scores, and volumes supplied.

However, certification practices differ by region. In Europe for example, biofuels are commonly certified under schemes such as International Sustainability and Carbon Certification (ISCC) or Roundtable on Sustainable Biomaterials (RSB). In contrast, these certification schemes are less prevalent in the United States, where Carbon Intensity scores under the California Air Resources Board (CARB) framework are more commonly referenced for road fuels used in LCFS states.

A specific challenge arises with biomethane (Bio-CNG/Bio-LNG), where sustainability certificates sometimes report negative carbon intensity values based on lifecycle assessments that credit avoided emissions. ISO 14083:2023 does not permit accounting for avoided emissions; avoided-emissions credits are therefore not recognized by the MBM Framework⁹.

For fuel providers, carriers, and LSPs, differing customer requirements across markets create complexity in procurement, documentation, and allocation of the biofuel EACs/TIECs.

Solutions

- **Leverage existing voluntary certification schemes.** Recognize established frameworks such as International Sustainability and Carbon Certification (ISCC EU), Roundtable on Sustainable Biomaterials (RSB EU), and the California Air Resources Board (CARB) framework to avoid unnecessary dual certification requirements for fuel providers.
- **Request proof of sustainability (POS) with disaggregated CI score if avoided emissions are included in biomethane (Bio-LNG/Bio-CNG) CI score.** Where this is not available, a suitable alternative fully attributional CI value - such as default CI figures from the GLEC Framework — should be used.
- **Apply credible voluntary certification where regulatory schemes are absent.** In markets where regulatory sustainability certification is not available, ensure fuels are certified under a recognized sustainability certification scheme.
- **Ensure transparent documentation practices.** Fuel providers should be able to share relevant sustainability certification information with customers, either by providing the underlying

⁹ Read SFC's [Interpretation Request](#) on Negative Carbon Intensity (Technically, ISO 14083 allows attributional carbon intensity figures, albeit Negative CI falling in the 'extreme' of the spectrum)

certification, the proof of sustainability (POS) or proof of compliance (POC) as per the ISCC “Proof of Compliance Guidance Document”¹⁰ published in 2024, or by issuing a verified EAC/TIEC that clearly references the applicable sustainability certificate.

- **Establish a biofuel policy.** Organizations should define and communicate minimum feedstock sustainability criteria to provide transparency to customers and suppliers and reduce case-by-case negotiations.
- **Have a registry allocation mechanism in place.** Registries should maintain an overview of EAC/TIECs by certification scheme and feedstock type, enabling volumes that meet more stringent customer requirements to be allocated accordingly before assigning remaining volumes to customers with standard requirements.

Market practices

- sennder reports that certain customer requirements for HVO go beyond existing regulatory standards, for example, exclusions of animal fats, requirements for waste-based feedstocks only, or requiring European origin, requiring extra informative documentation from the fuel provider. Leveraging its broad carrier network across European markets, sennder aggregates eligible volumes accordingly. It sorts available environmental attributes based on feedstock and certification characteristics and allocates HVO volumes first to customers with the most stringent requirements before assigning remaining volumes to customers with standard criteria.
- FincoEnergies procures only ISCC-certified biofuels in response to increasingly specific feedstock requirements from customers (in line with RED Annex 9a and 9b lists); the company has developed its internal ledger to record transactions together with the underlying documentation. The platform (branded as Decarb Desk) functions as an inventory management tool, enabling the allocation of different biofuel types and related certificates to customers based on their requirements, while also allowing access for independent verification parties to review the supporting records.
- When carriers encounter bio-LNG documentation reporting negative carbon intensity values, pacemaker.ai advises them that CI values below zero are not permitted under the MBM Framework, referencing Smart Freight Centre’s published interpretation on this point as a basis for engaging fuel providers and requesting corrected documentation or using zero as opposed to a negative CI value.
- DHL has developed internal guidance specifying the minimum documentation requirements for proof of sustainability when purchasing biofuels per single batch. Mandatory: Emission intensity in gCO₂e/MJ (WtW) of the residual emissions of the supplied sustainable fuels (excluding avoided emissions or CCS). If applicable: Emission intensity in gCO₂e/MJ (WtW) of the overall resulting emissions of the supplied sustainable fuel (including avoided emissions and CCS, stated separately).

¹⁰ [ISCC Proof of Compliance Guidance Document Version 1.0](#)

Challenge 1B. Lack of (standardized) documentation at fuel/energy provider (Biofuel and BEV)

Challenge description

Fuel (solution) providers, particularly smaller market participants, may lack the technical expertise or administrative infrastructure required to generate documentation that fully aligns with the requirements of market-based measure frameworks.

In cases of direct, one-to-one deliveries, such as deliveries to a specific customer site or a single fuel station, documentation can more easily be provided with relative clarity.

However, some market participants report receiving documentation in adaptable or editable formats, which may allow intermediaries to modify data fields, thereby weakening data integrity controls.

When fuels are blended or distributed across multiple locations, the ability to accurately track and transfer sustainability attributes depends heavily on the fuel supplier's IT systems and documentation processes. Ensuring full traceability throughout the supply chain therefore introduces additional complexity.

Bio-CNG introduces a distinct documentation challenge: if biomethane is injected into the grid, it becomes indistinguishable from fossil gas and physical tracking is not possible. The Guarantee of Origin (GO), issued by national energy market operators, is therefore the only available mechanism to prove renewable origin.

In the absence of consistent and verifiable documentation, transparency is reduced and comparability across market participants becomes more difficult. Over time, this may undermine trust in the integrity and robustness of market-based measure systems.

Solutions

- **Define and communicate clear documentation requirements.** Organizations should specify expectations for fuel documentation, including:
 - sustainability certification according to recognized scheme
 - Guarantee of Origin – Bio-CNG/BEV; required data points: feedstock type, origin, CI scores, and volume
 - contractual provisions that prevent double counting and clearly establish emission attribution
 - mass-balance or market-based measure certification, if relevant
- **Provide documentation through transparent channels.** All required documentation should be shared either directly (e.g. own internal ledger) or via a verified EAC/TIEC (preferably within a registry), ensuring traceability and clarity of emission claims.
- **Support fuel providers in meeting requirements.** Actively share documentation standards with fuel suppliers and provide guidance or assistance to ensure accurate and timely delivery of necessary records.

Market practices

- 123Carbon defines documentation requirements per intervention model, establishing clarity on the data and documentation needed. In addition, it supports fuel providers in issuing their first EAC/TIEC within the registry, helping align documentation practices with broader market expectations.
- As a vertically integrated biofuel producer and supplier, Love's Travel Stops is able to track environmental attributes throughout each step of its value chain. The company provides customers with a simplified, verified certificate that references underlying documentation, such as contracts, bills of lading (BOLs), product transfer documents (PTDs), certificates of analysis (COAs), and relevant records under the producer provided CI data tied to CARB-certified pathways. Where

pathways are not certified (as not required by legislation), Love's uses conservative CARB substitute pathway CI values and is transparent about doing so. Where appropriate, customers and auditors are permitted to conduct spot checks to validate the underlying data.

- As a non-asset-owning logistics service provider, sennder has established a broad network of fuel providers that can be connected to its European carrier base in accordance with defined sustainability criteria. Where carriers maintain existing relationships with fuel suppliers, sennder conducts an assessment to determine whether those suppliers meet its documentation and sustainability requirements. To ensure timely EAC/TIEC creation, carriers are required to upload all relevant documentation to sennder's systems for processing on a monthly basis.
- Sovereign Speed has conducted joint workshops that bring together fuel providers, importers, auditors, and their registry operator to align on required data fields and ensure a complete and robust audit trail.
- Gruber Logistics has gone further to integrate documentation standards with operational practices. They have implemented a supplier accreditation and ranking system to evaluate fuel providers based on, among others, their certification capabilities. This is complemented by fleet management tools that guide drivers to approved fueling stations and fuel cards that restrict access to validated networks, effectively bridging the gap between documentation standards and on-the-ground fueling behavior.
- GL events bypasses much of the fuel provider documentation challenge by owning fuel tanks at their depots. Both their own fleet and subcontracted carriers fuel directly from these tanks using individual carrier identification at fuel tank, giving GL events full visibility over who fueled, how much was drawn, and which routes the trucks serve. This depot-based model eliminates dependency on third-party fuel station documentation and keeps the entire chain of custody under one roof.

Challenge 1C. Complex data collection process from multiple (public) charging touchpoints (BEV)

Challenge description

When carriers use public charging networks, they interact with multiple Charge Point Operators (CPOs), each with different data systems, reporting formats, and levels of data granularity. Most CPOs are not yet set up to provide the level of detail that market-based measures require: emission factor per station and proof of renewable energy procurement. However, a growing number of CPOs are beginning to make this data available. This inconsistency in data quality and availability across CPOs makes it difficult to build a reliable and auditable documentation chain for BEV-based emission reductions.

Data collection from depot charging infrastructure is generally under the direct control of the carrier. Both electricity consumption data and the applicable emission factor (e.g., the share of grid electricity versus renewable electricity) are typically known, eliminating dependency on third-party CPOs. However, depot charging infrastructure also introduces additional data collection points, which can require additional administrative effort when carriers operate across multiple locations.

Solutions

- **Carrier engagement with CPOs.** Where public charging infrastructure is used, carriers should proactively engage with CPOs to communicate documentation requirements and reporting timelines. Like liquid fuel supply chains, CPOs may require guidance on the level of data transparency and verification expected in market-based measure frameworks.
- **Implement automated data interfaces.** The use of automated data connections, such as APIs [*iLEAP¹¹ open source API, could be expanded to fit the purpose of this use case*] or fuel and charging card integrations, can capture charging events in near real time. This reduces the need for manual data reconciliation and supports more frequent and reliable reporting to customers.
- **Strive for end-to-end reporting throughout the value chain**, where primary data is reported from the carrier to the LSP to the shipper, enabling all parties to base their reporting on a single source of truth. Where possible, employ partly or fully automated reporting mechanisms such as iLEAP to reduce manual effort and improve data consistency and comply to the GLEC Framework and ISO 14083 as much as possible.

Market practices

- Sovereign Speed combines internal OEM-reported monthly kWh data with external charging data, producing manual annual reports through ShipZero. They acknowledge that the process involves time-delayed information from multiple systems and manual reconciliation.
- A shipper notes that the process relies on a well-positioned CPO, as they represent the starting point of the chain and are most likely to have access to the required data. The CPO should determine the appropriate emission factor and then pass it along the chain (carrier – LSP – shipper).

¹¹ The [iLEAP](https://ileap.global/) project is a joint initiative from SFC and SINE foundation. This project has developed an open source protocol (data model and API) to establish the standard for seamless data exchange of activity and logistics emissions data. The aim is to increase interoperability in the tech ecosystem of logistics and lower the barrier to automated B2B exchanges. Further reading: **WHITEPAPER : [Demystifying the iLEAP Project and Technical Specifications V1](https://specs.ileap.global/) TECHNICAL SPECIFICATIONS:** <https://specs.ileap.global/> Our webpage: <https://ileap.global/>

Challenge 1D. Delay in Booking TIECs/EACs due to delayed certificate provision

Challenge description

Fuel providers each operate on different timelines for issuing sustainability documentation. While certificates are generally provided on a quarterly basis, actual delivery can range from two weeks after the quarter's end to up to three months. For BEVs, the delay can be even more pronounced: charging data and emission factors from CPOs are often only available on an annual basis, as CPOs are not yet accustomed to providing this information at the frequency that market-based measure systems demand. These delays slow down the booking and claiming of environmental attributes, which can interfere with client agreements, audit cycles, reporting deadlines, vintage constraint¹² and overall operational processes.

Solutions

- **Set clear expectations on reporting timelines.** Communicate transparently with customers about expected reporting timelines and align these with the reporting cycles of fuel providers and CPOs.
- **Use provisional reporting where appropriate.** For biofuel-based interventions and location-based BEV reporting, provisional reporting can be used to bridge reporting gaps when final documentation is not yet available. Such figures should be clearly labeled as provisional, explicitly noted as subject to change, and excluded from year-end reporting. Where applied, this approach should be coordinated with the verification party to ensure methodological consistency.

Market practices

- LKW Walter issues provisional CO₂ reports (for biofuels only) using default values, which are finalized once actual certificates are received.

Vintage refers to the specific year or period in which a carbon credit was generated, an emission reduction occurred, or an investment was made. It is a critical metric for ensuring integrity, additionality, and temporal relevance of market instruments.

¹² For details on the vintage requirements associated with each type of book and claim scenario read sections 8 and 9 of the [MBM framework](#)

Challenge 1E. Lack of (standardized) documentation at carrier level (Biofuel and BEV)

Challenge description

Beyond the documentation provided by fuel suppliers, carriers are often required to include additional operational information when booking an EAC/TIEC.

The scope and format of this broader documentation set were not previously standardized across the sector, prior to the publication of ISO 22095-3:2026. As a result, carriers and other market participants face varying data requirements depending on the framework or transaction partner involved. This lack of alignment increases administrative complexity and can make it more challenging to implement market-based measures consistently across the sector.

Solutions

- **Define a minimum documentation set for booking an EAC/TIEC in line with ISO 22095-3:2026.** At a minimum, booking an EAC/TIEC should include:
 - The fuel provider documentation described under challenge 2 (Biofuel). For BEV, this would include proof of sustainability such as RECs or grid mix emission factor
 - Proof of fueling (commonly through fuel card data) and/or proof of fuel delivery at a carrier home depot (biofuel). For BEV, this would be proof of charging or vehicle consumption in kWh
 - Evidence of the transport activity performed using the fuel or energy, typically expressed in tonne-kilometers and, where relevant, linked to a specific shipment
 - Additional accountability documentation appropriate to the role of the participating parties in the value chain, such as declarations preventing double registration or Scope 3 waivers
- **Engage and support carriers in implementation.** Provide guidance and, where necessary, operational support to help carriers understand and fulfill the administrative requirements associated with EAC/TIEC booking.
- **Standardize data collection processes.** Utilize an internal ledger and/or an external registry that supports the booking process and ensures that all required data fields are completed and supporting documentation is available.

Market practices

- As a carbon calculation and registry platform, [pacemaker.ai](#) guides carriers step-by-step through the booking process. This structured workflow helps ensure that all required data fields are completed, and that supporting documentation is uploaded. Once the booking is completed, the intervention can be linked to a specific customer shipment, enabling the associated transport activity to be recorded and integrated into customer emissions reporting.
- Loves engages directly with carriers when shipper or LSP customers request alternative fuel solutions. The company organizes joint discussions with the involved parties to align on documentation requirements, allocation mechanisms, and operational expectations.
- sennder, a freight forwarder, developed a system that automatically calculates the fuel consumption from every single transport operated. HVO volumes are determined according to GLEC and ISO standards. They are externally audited by a third party quarterly, to ensure that the system is fulfilling all decarbonization contractual obligations. Contractual obligations explicitly prohibit carriers from selling or declaring the same fueling event to multiple parties, supported by mandatory invoice-level declarations confirming exclusive allocation.

2. Definition and Calculation

Once documentation is in place, the next layer of complexity is how emission reductions are defined and calculated - specifically whether an additionality assessment is required, which depends on the delivery model and applicable regulatory framework. Beyond this, transfer units for trading EACs/TIECs, baseline selection, and the gap between modelled and primary data directly affect the volume and credibility of reductions that can be claimed. The following challenges capture the key areas where greater alignment is needed.

Challenge 2A. Uncertainty in determining additionality across regions and intervention types (Biofuel and BEV)

Challenge description

Determining additionality in road freight is complex, as interpretations vary by region and intervention type. According to the MBM Framework and following the BCC'S Principles and Best Practices, indirect generation interventions must always demonstrate additionality¹³ – meaning the emission reduction must go beyond what is already required by regulation, such as fuel blending mandates. Direct interventions (mass balance), where the party generating the reduction is also the one claiming it, do not require a separate additionality assessment. It is critical that all value chain actors adhere to the same standards; inconsistent application risks undermining the credibility of market-based measures.

Solutions

What you can do today

- **Adopt a conservative approach to additionality by default.** When in doubt, act on the side of caution.
- If it is an indirect generation scenario, conduct a thorough additionality assessment before entering a new region or launching a new intervention model (e.g. BEV), taking into account local regulations, blending mandates, and subsidy schemes. The SFC “Integrity Measures and Constraints” worksheet¹⁴ is a publicly available tool that can be used to do so.
- Within Europe, no fuel available at public fueling stations can with certainty be said to be additional to regulatory requirements. Organizations should therefore prefer **a direct generation scenario** – where the fuel is physically introduced into carrier operations – to avoid additionality concerns. The additionality implications of any indirect generation scenario should be discussed in detail with the solution provider.

What the sector needs

- **Develop industry-wide guidance on additionality across geographies.** Given the complexity and regional variability of additionality assessments, a coordinated industry effort, bringing together carriers, shippers, standard-setting bodies, and regulators, is needed to establish consistent, geography-specific guidance on how additionality should be determined and documented across different intervention types.
- **Stay informed and leverage additionality assessments and guidance published by credible third parties.** Drawing on established, peer-reviewed resources reduces the risk of inconsistent interpretation and strengthens the defensibility of your additionality claims.

¹³ Further reading: The [BCC Principles and Best Practices](#) “Principle 5: Ensure Additionality”

¹⁴ Download Smart Freight Centre’s [Integrity Measures & Constraint—Emission Reporter/VVB Worksheet](#)

Market practices

- DHL limits the implementation of biofuels for road freight strictly to direct and mass balance arrangements. For third-party carrier networks, DHL is exploring trilateral agreements with fuel suppliers to confirm the physical introduction of biofuel into carrier operations. Focus for these agreements is to involve carriers and pursue direct LETS generation, but keep it low-effort and not overburden carriers, often SMEs, with extensive accounting and reporting requirements.
- ShipZero clarifies, after an internal additionality investigation, that carriers operating BEV in Germany can participate in both the national THG quota system and the market-based measures system, given it is a direct generation scenario, simultaneously as the two operate under separate accounting frameworks. The THG quota is a regulatory compliance mechanism under German law, generating approximately €1,400 per vehicle per year for the carrier through sales to fuel suppliers. Market-based measures is a voluntary carbon accounting tool. Because they serve different purposes and different audiences, the same vehicle activity can support both without constituting double counting.
- Sovereign Speed, as a carrier operating a direct model (mass balance) with own vehicles, deliberately chose not to purchase standalone certificates (even when offered), because their customers expect physical fueling. They positioned starting with a direct (mass balance) carrier model as a practical way to sidestep additionality complexity entirely.
- TERC excludes all LCFS markets (California, Oregon, Washington) from their program, as fuels generating carbon intensity-based credits are not eligible for voluntary claims.

Challenge 2B. Lack of standardized transfer units (Biofuel and BEV)

Challenge description

The SFC MBM framework recommends that EAC/TIECs be traded on a tonne-kilometre (TKM) basis, with a linked carbon intensity, to reflect the replacement of actual fossil fuel transport activity. In practice, however, various transfer units are seen in the market: tonnes of CO₂e reduced, fuel volume (energy density adapted), or even CO₂e reduced per shipment. This fragmentation complicates comparability and undermines standardization efforts and is not currently endorsed by the MBM.

While there is market pressure to re-evaluate the TKM-based approach due to practical implementation challenges, any alternative must be applied with the necessary guardrails in place to prevent overallocation of emission reductions.

Solutions

- **Maintain activity data as a crucial data point:** Regardless of how results are expressed, EAC/TIEC must have activity data as a mandatory data point attached to the certificate.
- **Ensure transparency in swapping methodologies.** Organizations should clearly disclose the methodology used for attribute swapping, including the underlying documentation and calculation approach. Regardless of the transfer unit applied, the calculation logic should be transparent, auditable, and communicated to the customer.
- **Respect the maximum achievable emissions reduction.** EAC/TIEC allocation should never exceed the emissions reduction that is technically achievable based on the intervention. For example, if the intervention fuel achieves an 85% well-to-wheel emissions reduction compared with the baseline, the maximum reduction allocated through the system must not exceed that level. 100% reduction is never possible with biofuels because there are always residual emissions.

Market practices

- DHL recognizes that different transfer units may be appropriate depending on the context of the transaction - for example, in post and parcel operations, where tonne-kilometre is not an established reference base, a CO₂e reduction per parcel might be a more suitable transfer unit. The company therefore adapts the transfer unit used based on the specific business unit and/or the requirements of the customer.
- Kuehne + Nagel allocates BEV reductions on a TKM basis but keeps biofuels on a liter basis, noting that TKM allocation for biofuels adds complexity without clear benefit.
- 123Carbon is revising its platform to support multiple transfer units, liters, CO₂e, and TKM, recognizing that different clients and intervention types require different approaches. They maintain a clear distinction between the transfer unit used for commercial purposes and the reporting unit for emission disclosures.
- GMA, together with Pegasus Logistics, Nevoja and other participants in GMA trucking program, have adhered to TKM per the SFC MBM Framework for their BEV program, but acknowledge that this may be revisited as the MBM Framework enters its next revision cycle.
- FincoEnergies facilitates the transfer to customers over its Decarb Desk on both liters, as well as tonnes of CO₂e. They find that LSPs prefer the transfer of reductions in liters of biofuels, while cargo owners predominantly express preference on the transfer of reductions in CO₂e.

Challenge 2C. Baseline selection unclarity (Biofuel and BEV)

Challenge description

When tonnes of CO₂e reduced is used as the transfer unit rather than TKM - an approach not endorsed by the MBM framework - the choice of baseline¹⁵ fuel becomes critical. Calculating emission reductions from biofuel use or BEVs requires a reference against which reductions are measured - and the higher the assumed carbon intensity of that baseline fuel, the larger the resulting reduction.

In practice, market participants may apply different baseline assumptions. For biofuels, this can range from a B0 baseline (pure fossil diesel) to a B7 (7% biodiesel blend) - depending on the geography.

The SFC MBM Framework and MBM Specification¹⁶ adopt a case-by-case approach to baseline (reference fuel) determination because it employs inventory accounting rather than project accounting¹⁷. Under both documents, the baseline is established for each individual LETS or reporting scenario by reference to a standard commercially recognized fossil fuel appropriate to the relevant transportation mode, with the Specification further requiring that the same data sources and quantification methods be applied to both the baseline and the LETS to ensure comparability and transparency.

Solutions

- **Apply consistent and transparent baseline emission factors:** baseline values must be used consistently across calculations and disclosed within the EAC/TIEC.
- **Mandatory blends define the baseline:** where a solution is delivered in a region with a mandatory biodiesel blend, that blend must serve as the reference point. Using a higher-CI baseline in such cases overstates the reduction and violates the principle of conservativity.

Market practices

- DHL always uses country-specific standard diesel blends as baseline per operating location; documented in certificates for audit transparency.
- pacemaker.ai enforces a standardized approach by locking the B7 diesel (in EU) baseline in line with the GLEC Framework. The system automatically rejects unsupported or invalid emission factors.
- For BEV, a global shipper uses diesel emission factors as the baseline (rather than complex grid mix calculations) which simplifies comparison and quantifies BEV benefits clearly.

¹⁵ Further reading on project accounting baseline approach: [GHG Protocol FAQ's](#): "19. How can I account for scope 3 emissions and reductions over time?"

¹⁶ Read together, clauses 3.2, 6.2.1 and 6.4 of the [MBM Specification](#) on how to establish a case-by-case approach

¹⁷ Further reading: GHG Protocol: [Inventory and Project Accounting: A Comparative Review](#)

Challenge 2D. Emission inventory differences between carrier and LSP or Shipper (Biofuel and BEV)

Challenge description

The quantity of EACs/TIECs that can be claimed through direct generation market-based measures depends on how much emissions a carrier produced on behalf of the LSP or shipper: you cannot allocate more sustainable fuels / energy to a transport than what is physically needed to conduct the corresponding transport activity. For example, you cannot allocate more HVO to a road transport than the amount that is combusted for such transport, to compensate for residual HVO emissions to bring the shipment's emissions to zero.

In practice, however, most emission calculations on the LSP or shipper side are modeled rather than based on primary data. This creates a potential mismatch between the emissions a carrier measures and what a freight forwarder or shipper calculates and the EACs/TIECs to be allocated.

Solutions

- From a carrier perspective, the clearest step is to always **provide primary data for both baseline references and low-emission transport services** to freight forwarders and/or shippers. This gives the receiving party a grounded reference point rather than forcing reliance on modeled estimates alone.
- From a freight forwarder or shipper perspective, one approach involves building an own consumption model designed to approximate primary data using fleet-level information. Due to the complexity involved, carrier-provided primary data is not yet incorporated into these models, but the ambition is to do so in the coming years as data quality and availability across the industry matures.

Market practices

- LKW Walter applies its own baseline consumption model (with built-in margins for variance) instead of individual carrier baselines; continuously refined with primary data from carriers via automated interfaces. The company recognizes that industry-wide primary data quality and coverage will require 5–6 years to reach majority status.
- Gruber Logistics uses the most conservative GLEC default factor for owned and third-party trucks to prevent overclaiming emission reductions.
- Sovereign Speed anchors claims in primary B7 baseline data (European transports) via ShipZero. It provides customers with detailed before-and-after CO₂ reports based on primary data for inventory reconciliation.

3. Reporting

Reporting translates calculated emission reductions into claims that customers can use in their own sustainability disclosures. For BEVs, there remains unclarity around aspects of location- versus market-based accounting – a methodological choice with direct impact on the reported reduction. More broadly, verification of market-based measures programs for road freight lacks standardized audit guidance, leading to inconsistent verifier interpretations and undermining confidence in reported outcomes. The challenges below address the gap between generating a reduction and being able to credibly report it.

Challenge 3A: Unclear (market-/location-based) reporting practices (BEV)

Challenge description

There is limited established consensus on how to account for electricity EACs within a BEV market-based measures context. The question is not whether to apply market-based or location-based accounting, but rather: when market-based instruments are used for only part of the electricity mix, how should the remainder be reported?

Additionally, consumption data from BEVs typically does not account for electricity losses in the transmission and distribution network (from point of generation, into the grid and to the charger) as well as the actual charging (inverter to battery). Charging losses are estimated at 5 to 10% as well as additional losses between the charging meter and the inverter. Under location-based accounting, excluding losses understates BEV emissions and thereby overstates the claimed reduction. Under market-based accounting, it leads to under-procurement of renewable energy instruments.

Lastly, the treatment of upstream emissions of purchased electricity is equally inconsistent, with some organizations excluding them entirely and others applying partial adjustments. These divergent practices undermine comparability, especially given that BEV market-based measure system is still in its early stages.

Solutions

- Ensure that **renewable energy certificates or equivalent market-based instruments are purchased by the CPO or carrier directly** – not by the freight forwarder or shipper – to maintain a credible chain of custody aligned with the MBM framework.
- **Include charging losses in consumption calculations.** Either apply an estimated loss rate of 5 to 10%, or prioritize charge point operator (CPO) data over vehicle-reported consumption, as CPO-measured kWh inherently accounts for losses at the point of delivery.
- **Account for transmission and distribution (T&D) losses:** electricity lost between the grid and the charge point is not captured in CPO consumption data and should be accounted for using grid- or region-specific T&D loss factors where available, or a default loss percentage were not, to ensure full emissions coverage.
- If the electricity or EAC provider does not disclose upstream emissions, **conservative estimates should be applied based on the underlying generation technology (e.g., solar, wind, hydro)** to maintain full lifecycle coverage of energy provision emissions. Where reliable upstream emission factors for renewable energy infrastructure are not yet available on a comparable basis to fossil fuel upstream factors, document the exclusion clearly and revisit as data quality improves.
- **Clearly differentiate between location-based and market-based accounting** and align the chosen methodology with existing Scope 2 reporting practices. Where market-based instruments cover only part of the electricity mix, residual mix factors must be applied to the remainder.

Best Practices

- DHL reports exclusively on a market-based basis across all customer carbon reporting, backed by close to 100% green electricity procurement (through a mix of own production, strategic PPAs, and certificates). For own electricity consumption, T&D losses are included in the factors used. So far, DHL mostly implements BEV in its owned fleet. In the few cases where subcontractors implemented electric trucks, DHL relies on the information provided by the carrier.

- Kuehne + Nagel started with location-based accounting using average grid factors for depot charging in France and is now investigating the transition to market-based. For losses, K+N uses its own charging infrastructure data (metered at the charger) rather than vehicle consumption, capturing the 5–10% loss observed between charger input and battery output.
- GMA developed a data hierarchy, which has been used in a BEV pilot with Pegasus Logistics and Nevoja (and other participants in GMA trucking program) : CPO-reported kWh is the preferred source (as it inherently accounts for losses), with vehicle-reported consumption accepted as a fallback with a 10% adjustment factor applied. On upstream emissions, GMA excluded capital equipment embodied carbon due to a lack of comparable data for fossil fuels, but does include a transmission and distribution loss adjustment of 4.2% on dispensed kWh.
- ShipZero deliberately works with charging station data rather than vehicle consumption data, as this inherently captures losses at the point of delivery. They are building API connections to CPOs (public provider or company-owned depot) and charging card providers so that every charging event is automatically funneled into their system. However, they note that CPO data maturity varies significantly - larger operators have not yet standardized the provision of charging data to third parties.

Challenge 3B. Immature verification process/landscape (Biofuel and BEV)

Challenge description

Robust verification is important to maintain trust and credibility in the market-based system. Yet the verification landscape has not fully matured alongside the market it serves. There are three different verification lenses or steps in a market-based system

1. Verification of overall book and claim process
2. Intervention / certificate verification (of specific interventions / certificates to be transferred)
3. (Sustainability) Reporting verification of company selling EACs / TIECs
4. (Sustainability) Reporting verification of company buying EACs / TIECs

Different frameworks are in place, verification frequencies vary across participants, and there is no standardized guidance on what constitutes a minimum audit scope for road freight interventions.

“Every time a company changes auditor, we could be back to square one – more explanation, more delays. The guidance exists, but it’s interpreted differently depending on which auditor is sitting across the table. That inconsistency is one of the biggest practical barriers we face in getting programs across the finish line.”

— René Groot Bruinderink, FincoEnergies

Solutions

- **Define a clear verification scope and frequency.** At a minimum, this should cover three layers: verification of the registry used by an accredited third party, verification of the overall process (methodology, data flows, and controls from fuel intake through to customer allocation), and verification of individual certificates in sample sizes at least once per year. Consult the October 2024 release of the MBM Specification or further details.
- **Build a robust audit trail that links every step in the chain** – from fuel purchase and sustainability proof, through booking and allocation, to customer-facing claim documentation. This reduces audit friction and makes the process reproducible regardless of which verifier is involved.

Market practices

- FincoEnergies operates a multi-layered audit structure: an annual process audit covering the overall methodology and the digital platform (Decarb Desk), an audit on the blending volumes entering the network, and an audit on the allocation of reductions to individual customers (verification of book and claim process and intervention & certificate verification).
- GMA developed its own verification document to address insufficient guidance in existing frameworks. The document establishes clear requirements for primary data use, which GMA considers critical to ensuring market integrity. GMA’s approach prioritizes primary data to ensure that the flexibility and reliance on assumptions permitted by ISO standards does not undermine the integrity of EAC/TIEC issuance and LETS generation (Intervention & certificate verification).
- DHL conducts a third-party verification of systems, tools and methods as well as a validation of data communicated to customers on certificates at least annually, for selected customers even on a quarterly basis (verification of book and claim process and intervention & certificate verification)

4. Scaling

The challenges above are largely solvable at an individual program level. Scaling introduces systemic barriers: multiple registries operate without interoperability, and the market lacks institutional trust infrastructure, e.g. formal SBTi acceptance. The following challenges address what is needed to take road freight market-based measures from early movers to market scale.

Challenge 4A. Double counting risk from EAC/TIECs being registered on multiple registries (Biofuel and BEV)

Challenge description

Maintaining chain of custody transparency is one of the most critical factors in preserving trust in market-based measure systems. Many organizations achieve this by registering their EAC/TIECs alongside the relevant supporting documentation in registries – whether externally operated or developed in-house – to enable transparency, streamline allocation, and simplify customer reporting.

However, these registries do not currently interact with one another, creating a risk that EAC/TIECs are registered in multiple systems and sold more than once. Market feedback from interview participants indicates that registries are more mature for maritime and aviation than for road freight, where full market maturity has not yet been reached. Adding to the complexity, logistics companies often cannot dictate which registry to use: fuel suppliers each bring their own preferred system, while customers may demand a different one - leaving the party in the middle forced to work across multiple registries simultaneously. Several participants voiced a clear need for a public or interoperable database where all fueling certificates are centrally tracked, eliminating the risk of double counting.

Solutions

- **Establish a contractual framework across the value chain** – from fuel provider to carrier to freight forwarder – that safeguards Scope 3 claims and governs communication and reporting in line with the MBM Framework. This ensures that EACs/TIECs are not accidentally reported twice through miscommunication between parties.
- **Map out internal requirements clearly and assess whether an external registry can satisfy them.** Where external solutions fall short, an internal ledger may need to be built to maintain the required level of control and traceability.
- **Engage with existing industry initiatives on registry interoperability** to avoid building in isolation and to contribute to a longer-term solution for the market as a whole.

Market practices

- pacemaker.ai flags duplicate proof-of-sustainability IDs across users at system level and exposes certificate references in shipper claim reports, enabling downstream due diligence.
- ShipZero addresses double issuance risk contractually: clients warrant uniqueness and non-duplication, while indirect interventions require proof of contractual rights to specific volumes. Automated data feeds via API and fuel card integrations further reduce manual error.
- LKW Walter built an internal ledger with direct interfaces to own databases, eliminating manual reconciliation. They require any external registry to communicate via ILEAP or equivalent, maintaining full traceability from allocated fuel back to the underlying sustainability statement.
- Gruber Logistics has in place a digital registry for fuel accounting and reporting and is further involved in the development of a digital blockchain-based allocation registry as part of the EU Horizon IKIGAI project, a consortium involving Smart Freight Centre and others, with expected completion in the coming years.
- FincoEnergies built its own registry and digital platform, the Decarb Desk, on which the company manages the inventory generation and allocation flows. Auditors as well as resellers/forwarders and final customers have direct access to the platform to review the sustainability documentation, bunker and blending details and inventory positions. API connections allow customers and partners to interact with the platform.

Challenge 4B. Lack of formal recognition and consistent language (Biofuel and BEV)

Challenge description

Despite growing adoption of market-based measures as a credible means to reduce transport emissions, SBTi and GHG Protocol have not formally recognized reporting of not physically-linked EAC/TIECs within physical inventory reporting. As a result, companies are reluctant to commit budgets to interventions that may ultimately not count toward their science-based targets or be recognized in their GHG reporting.

This uncertainty is compounded by lack of consensus around terminology: terms like “book and claim”, “mass balance”, “insetting”, “direct/indirect” variants are used interchangeably, confusing value chain actors. Furthermore, insetting is oftentimes mistakenly conflated with offsetting, which wrongly erodes market-based measures credibility.

“Historically the events space has lent heavily on offsetting, but clients believe that if we offset one ton of emissions, they automatically get that reduction in their supply chain. To shift to market-based measures, we re-educate them: offsets don’t work that way – this is how you can allocate real carbon reductions to your own supply chain via insetting.” — Jamie Connolly, GL events

The dual challenge of regulatory ambiguity and definitional complexity negatively impacts the entire value chain. Carriers and logistics service providers struggle to build a commercial case for scaling up sustainable fuel programs when their customers cannot guarantee that the purchased reductions will be accepted by auditors or reporting frameworks. At the same time, the absence of clear rules and boundaries leaves room for inconsistent practices, which risks undermining the credibility of programs that are already operational.

Solutions

- **Embrace a first-mover mindset by piloting market-based measure programs now, even in the absence of full regulatory clarity.** Early adoption generates real-world evidence that demonstrates the value and integrity of market-based measures to standard setters such as SBTi and the GHG Protocol.
- **Maintain consistent use of terminology across internal and external communications,** aligning with the definitions established in the MBM Framework to reduce confusion across the value chain.
- **Communicate transparently with customers that market-based measures for Scope 1 and 3 are not yet formally recognized by SBTi or the GHG Protocol** and ensure that contractual agreements clearly reflect the associated reporting risk borne by the buyer.
- **Actively monitor regulatory developments and emerging guidance from SBTi, the GHG Protocol, and other standard-setting bodies.** Invest in internal education and share updates with value chain partners to ensure a consistent and informed understanding of the landscape.
- **A formal stance from SBTi and the GHG Protocol** – with clear guidance on eligibility, boundaries, terminology and quality criteria – would not only legitimize existing initiatives but also unlock market confidence needed to accelerate adoption at scale.

Market practices

- In the interim, leading organizations such as TERC/EcoEnergy are proactively assuming an educational role across the value chain:

“Market-based measures requires a significant education uplift. Complex concepts like chain-of-custody, mass balance, and compliance methodologies overwhelm stakeholders. Normalized language and simplified explanations are essential to drive broader adoption in road freight decarbonization – Sarah Filus, EcoEnergy “

Section 4: Conclusion and Pathway Forward

Market based measures have matured significantly as a mechanism for allocating emission reductions in road freight. However, challenges in documentation standards, calculation methodologies, reporting practices, and market adoption remain. For battery electric vehicles, market-based measures are at an earlier stage of development than for liquid and gaseous biofuels, and several foundational questions remain unresolved.

The market practices documented in this white paper demonstrate that progress is possible at company level, even in the absence of full regulatory clarity. However, company-level best practice can only go so far. Several challenges identified in this paper require coordinated action across the industry to scale market-based measures.

- **Additionality guidance by geography.** Value chain actors need to collaborate to develop consistent, region-specific guidance on how additionality should be assessed and documented across different intervention types.
- **BEV reporting conventions.** The industry needs clear guidance on how to report BEV EAC/TIECs, specifically, how to handle the remainder of the electricity mix when market-based instruments cover only part of it, and whether dual reporting must always be maintained. Without this, claims risk being inconsistent and incomparable across the market.
- **Registry interoperability.** The industry needs to move toward a centralized registry solution or interoperable solutions that track all road freight EAC/TIECs across systems, eliminating double counting risk. This is not a simple fix and will require sustained, large-scale collective action from registries, carriers, fuel suppliers, and customers over time.
- **Formal recognition by SBTi and the GHG Protocol.** Guidance on eligibility, boundaries, terminology, and quality criteria would legitimize existing initiatives and unlock the market confidence needed to accelerate adoption at scale.

The **Book and Claim Community** Road working group are working to actively address several of these gaps. In 2026, forthcoming publications will include a position paper on EV emissions accounting, an end-to-end guidance document on EV emission reporting for both direct and book and claim interventions, a deep dive on the point-of-sale verification gap (so called “gas station problem”), and a dedicated paper on additionality.

The road freight sector stands at an inflection point. The building blocks are in place: the frameworks exist, the market actors have demonstrated feasibility, and the commercial logic is becoming clearer. What is needed now is collective action to close the remaining gaps, standardize further where it is possible to do so, and drive the industry forward together.

Glossary of Key Terms

Term	Definition
Additionality	A metric for evaluating whether the emissions reductions or profile associated with an intervention (e.g. certificate purchase) would have occurred absent the intervention. In particular, regulatory additionality assesses whether the activity is already required by and used toward a regulatory obligation.
Baseline	The reference emission level, typically based on the fossil fuel counterfactual against which the emission reduction from a Low Emission Solution is measured.
Book	The act of recording a Low Emission Solution or Low Emission Transportation Service, together with its environmental attributes, into a tracking system (typically a registry) so that those attributes can later be transferred and claimed by another party.
Book and Claim	A chain of custody model in which the administrative record of environmental attributes is decoupled from the physical flow of the product or energy carrier. A producer books the attributes into a registry; a buyer claims them by purchasing and retiring the corresponding certificate (ISO 22095:2020/Amd.1:2026).
Carbon Intensity (CI)	The lifecycle greenhouse gas emissions per unit of energy, typically expressed in grams of CO ₂ equivalent per megajoule (gCO ₂ e/MJ).
Claim	The act of taking ownership of the environmental attributes of a Low Emission Solution or Low Emission Transportation Service from a tracking system (typically a registry) and retiring them, thereby converting the right to claim into a finalized emission reduction reported in the holder's GHG inventory.
Chain of Custody (CoC)	The set of rules and procedures that govern how the environmental or sustainability attributes of a product are tracked and transferred through a supply chain — from origin to final claim.
Double Counting	Double counting in book and claim systems refers to the erroneous, duplicate or improper accounting of emission reductions, encompassing three main scenarios: double issuance (duplicate creation of certificates for the same solution), double claiming (multiple parties claiming the same certificates), double use (repeated utilization of a single certificate by the same party for multiple purposes).
Environmental Attribute Certificate (EAC)	An administrative record that captures, tracks, and transfers the environmental characteristics of a Low Emission Solution or Low Emission Transportation Service through the value chain. Also referred to as a TIEC under ISO 22095-3:2026.
Insetting	An emission reduction achieved within a company's own value chain (Scope 1 or 3), as distinct from offsetting, which funds reductions outside the value chain.
Low Emission Solution (LES)	Any fuel, energy source, or technology that demonstrably reduces the lifecycle GHG emissions intensity of a road freight transport activity relative to a defined fossil fuel baseline.

Low Emission Transportation Service (LETS)	A transportation service in which a Low Emission Solution has been used to perform all or part of the activity. The LETS is the unit of claim in book and claim systems.
Market-Based Measure (MBM)	A mechanism that uses market signals — such as certificate trading, pricing, or attribute transfer — to incentivise emission reductions.
Mass Balance	A chain of custody model in which certified and conventional materials may be mixed, but the volume of sustainability attributes allocated never exceeds the certified input.
Physical Separation	A chain of custody model in which certified low-emission fuel or energy is kept physically separate from conventional products throughout the supply chain.
Retirement	The act of permanently withdrawing an EAC/TIEC from circulation in a registry, thereby converting the holder's right to claim the associated emission reduction into a finalised claim.
Transferable Instrument with Entitlement to Claim (TIEC)	The ISO 22095-3:2026 term for an administrative record issued, tracked, and retired within a book and claim system, the ownership of which confers the unique right to claim consumption or use of specified characteristics upon retirement.
Vintage	Vintage refers to the specific year or period in which a carbon credit was generated, an emission reduction occurred, or an investment was made. It is a critical metric for ensuring integrity, additionality, and temporal relevance of market instruments.

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Appendix A: Interview Contributors

This white paper draws on the insights and practical experience of many experts actively engaged in road freight book and claim initiatives.

Company name	Individual(s)	Company description
123Carbon	Jeroen van Heiningen	Multi-modal book and claim registry, enabling carriers and fuel suppliers to issue, manage and transfer transport-related environmental certificates across road, air, rail and inland waterway
AllChiefs	Inge Tanke Franziska Weber Gabrielle Dumont de Chassart	Consulting firm that supports organizations in accelerating the transition to net-zero logistics by reducing emissions and optimising supply chains
DHL Group	Inka Goethe Christoph Schönwandt Antonia Reinwald Noelle Fröhlich	Global logistics and supply chain company operating across postal, express, freight, e-commerce and supply chain services
FincoEnergies	René Groot Bruinderink	Independent supplier of biofuels and related reduction certificates for transport, operating the BioFuel Swap brand for the road, and the GoodShipping brand for the marine and inland waterway sectors
GL events	Jamie Connolly	French-listed events infrastructure logistics service provider specialised in equipment delivery across event sites
GMA	Clayton Gerber Andre Defontaine Sam Pearl Schwartz	US-based organization focused on developing standards and operationalising market-based mechanisms for Scope 3 decarbonization across hard-to-abate sectors, including heavy-duty trucking, aviation and maritime
Gruber Logistics	Ettore Gualandi Andrea Condotta	Road carrier and freight forwarder operating a fleet of approximately 700 trucks across FTL, XTL, LTL and exceptional cargo transport in Europe, with 40% of the fleet running on biofuel and an active road freight book and claim program in place
Kuehne + Nagel	John de Dryver	Global logistics provider offering sea, air, road and contract logistics services, with an active BEV and biofuel book and claim program
LKW Walter	Justin Lemmens	Asset-light European freight forwarder operating without own tractor units, managing a network of subcontracted carriers across Europe with 15,000 own intermodal trailers. Active biofuel book and claim program in place since 2023, with BEV integration in development
Love's Travel Stops	Derek Klaus	US-based nationwide network of travel stops and fueling stations serving professional truck drivers, with alternative fuel infrastructure across the country
pacemaker.ai	Tim Hoffmann Jacqueline Poeppe	Germany-based software provider offering an integrated transport emissions calculation and

		biofuel book and claim platform for road freight carriers and shippers, built in alignment with ISO 14083, the GLEC framework and the MBM Framework, with SFC verification underway
Pegasus Logistics Group	Phil Clawson Kanishka Pandey	Global Freight Forwarder specialising in shipments of consequence, offering road, air, ocean, and contract logistics solutions through a dedicated partner network, with North America BEV and HVO road book and claim programs in development
sennder	Rémi Despoix	Asset-light European digital road freight forwarder operating across Europe, running one of the world's largest book and claim programs
Shipzero	Nils Riedl	Hamburg-based logistics emissions management platform enabling calculation, monitoring and reporting of transport emissions across modes, with MBM-aligned book and claim functionality
Sovereign Speed	Various	Asset-heavy European Express Groupage and FTL carrier operating its own truck network across Europe. Runs an active HVO 100 program via ShipZero with three product tiers (50% "Boost", 100% intervention (book and claim), FTL direct fueling)
TERC / Eco-Energy	Sarah Filus Jasmine Zhu	US-based energy company that developed and operates the TERC (Transport Emission Reduction Certificate) program, a book and claim mechanism for on-road biofuels in the US market. Acts as a facilitator connecting fuel producers with end buyers

Appendix B: The Book and Claim Community

About the Book and Claim Community

The Book and Claim Community (bookandclaimcommunity.org) is a multi-stakeholder initiative co-chaired by Smart Freight Centre and the Roundtable on Sustainable Biomaterials. It exists to bring together the actors shaping book and claim across heavy transport — cargo owners, carriers, logistics service providers, fuel and energy providers, registry operators, certification bodies, standard setters, and assurance providers — in order to align on shared principles, reduce duplicated effort, and accelerate the development of credible, scalable book and claim systems as the market matures.

The Community's work is organized around four areas, which closely mirror the gaps identified in this paper:

- **Reporting & Targets** — engaging with reporting and target-setting bodies, including the ongoing dialogue with SBTi and the GHG Protocol that will ultimately determine the scale at which this market can grow.
- **Certification** — working toward alignment on how claims are certified and how assurance providers approach verification, addressing the inconsistencies described in Challenge 3C.
- **Registries & Applications** — pushing for interoperability between registries and the software around them, addressing the double-counting risk described in Challenge 4A.
- **Capacity & Communication** — building know-how across the sector and sharing what early adopters are learning, so that organizations entering the market do not have to start from scratch.

Alongside this, the Community publishes FAQs, education materials, the Principles and Best Practices for Book and Claim in Heavy Transport, and a monthly newsletter, all useful starting points for shippers, carriers, LSPs, fuel providers, registry operators, and others looking for a way in.

About the Road Working Group

The Road Working Group (RWG) is the Book and Claim Community's dedicated workstream for heavy-duty road freight, co-chaired by Smart Freight Centre and the Roundtable on Sustainable Biomaterials. It currently brings together more than 70 active participants from over 35 organizations spanning the full road freight value chain such as fuel providers, carriers, logistics service providers, cargo owners, registry operators, certification bodies, amongst others, under 3 workstreams: Liquid and Gaseous Renewable Biofuels, Electric Propulsion and Certification & Registries.

Governance. A group of selected Modal Champions provides strategic direction and validates major deliverables. The Secretariat (SFC and RSB) coordinates the 3 workstreams, manages drafting, and reports to the Book and Claim Community Advisory Board.

2026 Strategic Objectives. The Group's 2026 work plan is organized around five strategic objectives:

(1) bridge the maturity gap between road and other modes by leveraging established systems from maritime and aviation; (2) align road book and claim implementations with the Community's Principles and Best Practices, adapting standard operating procedures to overcome sector fragmentation; (3) disseminate foundational knowledge on both established applications (biofuels) and emerging technologies (BEV trucks); (4) launch technical deep-dives operationalized through the three workstreams; and (5) influence reporting and target-setting standards by advocating for formal integration of market-based measures with the GHG Protocol and SBTi, grounded in real-world evidence.

The Three Workstreams. Technical work is delivered through three topical workstreams, each led by a coalition of volunteer captains:

- **Stream A — Liquid & Gaseous Biofuels** (*led by P&G, DSV, sennder, Shell, and Clean Fuel Alliance America*) addresses the point-of-sale verification gap — the "Gas Station Problem" — alongside mass balance accounting best practices, upstream partner engagement, and regional certification alignment between North America and Europe.

- **Stream B — Electric Propulsion (EV)** (*led by P&G, Gruber Logistics, NGX, GMA, Kuehne + Nagel, and sennder*) focuses on standardization and GHG Protocol / ISO 14083 alignment, covering supplier-specific electricity emission factors, the treatment of RECs, PPAs, and Guarantees of Origin, additionality and temporal matching, and end-to-end guidance for EV emissions accounting.
- **Stream C — Certification & Registries** (*led by 123Carbon, Sovereign Speed, ShipZero, and Shell*) addresses infrastructure and policy fragmentation through policy landscape mapping, additionality frameworks for voluntary markets, registry interoperability requirements, and documentation standards for TIECs.

2026 Deliverables. Beyond this white paper the Group’s 2026 outputs include: a Q1 position paper on the use of supplier-specific electricity emission factors in transport; an internal policy map tool built on an interactive GIS platform; a comprehensive end-to-end technical guidance document on EV emissions accounting for direct and book and claim services (Q2–Q4); an op-ed on solving the Gas Station Problem (Q2–Q3); an op-ed on additionality in road (Q3–Q4); a Modal Champion case study demonstrating a proof-of-usage workflow for EV (Q3–Q4); a public webinar on transitioning from internal ledgers to third-party registries (Q3); and capacity-building media summarizing lessons learned from first movers (Q4).

Call to Action

Road freight book and claim is no longer just an experiment. The market practices documented in Section 3 of this paper speak for themselves: sennder is allocating HVO across a multi-carrier European network; FincoEnergies is running a multi-layered audit on its Decarb Desk platform; DHL has locked in country-specific diesel baselines and is piloting trilateral agreements with fuel suppliers; Gruber Logistics has built a supplier accreditation system that ties documentation standards to driver behavior at the pump; GL events owns its own fuel tanks and keeps the entire chain of custody under one roof; and GMA, Pegasus, Nevoja, Kuehne + Nagel, and ShipZero are working through the harder BEV questions in real-world pilots rather than in theory.

These are not aspirational case studies; they are programs operating today with real customers, verified results, and actual volumes. The methodological questions that once slowed progress now have practical answers grounded in the BCC Principles and Best Practices, the MBM Framework, the MBM Specification, and ISO 22095-3:2026, among others. Most of the remaining challenges involve coordination.

For organizations still hesitant, the takeaway from the early movers is straightforward: start! Choose one trade lane, one carrier, or one shipper relationship. The operational learning, the audit trail, and the supplier conversations that arise from the first program will make the next ones easier. Delaying for perfect regulatory clarity carries its own costs — not only in emissions that go unreduced, but in missing the opportunity to help shape the registries, reporting conventions, and business norms that the rest of the sector will eventually adopt.

For organizations ready to shape the rules of the road, the Road Working Group is the place to do it. Throughout 2026, the Group will be delivering concrete outputs that directly address the challenges set out in this paper.

The Book and Claim Community exists to help the next wave avoid the potholes that the first wave had to learn about the hard way. To get involved — whether as a cargo owner, carrier, LSP, fuel provider, registry operator, or assurance provider — visit bookandclaimcommunity.org. The remaining work is collective, but the path is open, and the people already on the road are happy to have company on the journey toward the net-zero future the sector is working to reach.