Towards a Global Standard for Estimating Life Cycle Greenhouse Gas Emissions from Public Transport Services

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Short abstract (max 250 characters)

This paper presents a systematic review of existing standards and methods for transport-related GHG emissions calculation and reporting. A methodological framework for the assessment of life cycle emissions from public transport services is provided.

Abstract (max 750 words)

Public transport systems offer significant potential for mitigation of transport sector's greenhouse gas (GHG) emissions - the second largest contributor in the European Union (EU) accounting for 23.2% of the total GHG emissions in 2020. The Sustainable and Smart Mobility Strategy, part of the European Green Deal, stipulates higher utilization of public transport systems together with the diffusion of zero-emission vehicles, renewable and low-carbon fuels, and related infrastructures as prerequisites in reaching the overall decarbonization targets.

As major fleet operators, and in some cases builders of extensive infrastructure systems, public transport operators (PTOs) will require effective management of GHG emissions and established procedures for their transparent reporting. Current practices include mainly voluntary carbon footprint reporting often limited to the well-to-wheel (WTW) scope, i.e., direct emissions from fuel combustion (tank-to-wheel, TTW) and upstream emissions linked to the fuel production (well-to-tank, WTT). Due to the implementation of the Corporate Sustainability Reporting Directive (CSRD) which stems from the European Green Deal, further new reporting obligations and standards will follow for many PTOs from the reporting year 2025 onwards. Reporting under the CSRD will follow the European Sustainability Reporting Standards (ESRS) which define new mandatory disclosures for climate reporting. In particular, in addition to Scope 1 and 2 emissions, the reporting of Scope 3 emissions will become mandatory in accordance with the GHG Protocol. This imposes significant challenges for PTOs in accounting the full life cycle emissions which were traditionally omitted and considered as out of influence, with these emissions assumed a responsibility of vehicle suppliers.

Another reason for neglecting emissions associated with upstream (e.g., vehicles and equipment production) and downstream (end-of-life) processes in the past is the absence of a globally-recognised and accepted standard for the calculation of the carbon footprint that adopts a life cycle perspective and covers the entire transport supply chain. As the only international and transport-specific standard, ISO 14083 (previously EN 16258) provides general principles and guidelines, while limiting the scope to WTW emissions. PTOs and transport sector in general are faced by the existence of a diverse mix of state-supported standards, standards self-developed by associations, recommendations by research bodies, regional approaches, methods and tools for individual modes of transport, mainly focussing on the freight transport and logistics sector.

This paper aims to provide a thorough systematic review of the existing standards, guidelines, methods and tools developed for transport-related GHG emissions calculation and reporting, and to synthesize a methodological framework for the assessment of life cycle emissions from public transport services.

The review begins with a juxtaposition of outputs provided by each standard or method with PTO's reporting needs. The paper then discusses the analysis scopes of existing standards/methods in regard to the types of GHG emissions reported, life cycle analysis boundaries, modal coverage, and fuel/energy coverage. Further, an explanation of the calculation processes used by the standards/methods, including a discussion of data needs and limitations is provided. Based on the results presented, a methodological framework for the calculation of life cycle GHG emissions is presented and showcased for the railway and bus transport services of Arriva in Limburg region in the Netherlands. The case study considers heterogenous train and bus fleet, including both electrical and diesel powertrains, allowing for the comparative assessment of various propulsion systems. It also provides deeper understanding of the environmental impacts of emerging technology such as Lithium-ion batteries, often regarded as a critical component in novel powertrain solutions in the transport sector associated with a high degree of uncertainty in their overall carbon footprint. Finally, a discussion of the need for a consistent accounting and calculation standard for PTO's life cycle GHG emissions management concludes the paper.

The outcomes of this study can be leveraged by PTOs in determining their overall emissions and identifying the main contributors to their overall carbon footprint. In addition to the corporate responsibility and the compliance with the new regulation, applying appropriate measures and good reporting practices can help PTOs to improve their market share, company image, and value. For instance, the Dutch "CO2 Performance Ladder" management tool provides a concrete award advantage during the tendering process for certified companies in the Netherlands and Belgium. This system managed by the Foundation for Climate Friendly Procurement and Business (in Dutch: SKAO) is being adopted in Ireland, France, the United Kingdom (UK), and Germany. Furthermore, consistent calculation and declaration procedures can help PTOs in their preparation for different trading schemes, such as the European Trading System (ETS), the world's first carbon market established within the EU in 2005.