eurobitume

The Executive Summary of the Eurobitume Life Cycle Assessment for Polymer Modified Bitumen

The information provided herein, including any values or summaries, is derived from the latest Life Cycle Inventory report. This information should be considered only in the context of the complete reports from which it is extracted and not as standalone sources of information. This information and the reports have been prepared by Sphera Solutions, Inc. ("Sphera") with reasonable skill and diligence within the terms and conditions of the contract between Sphera and the client. Sphera is not accountable to the client or any others with respect to any matters outside the scope agreed upon for this project. Sphera disclaims all responsibility of any nature to any third parties to whom this information, report, or any part thereof is made known. Any such party relies on the information or report at its own risk. Interpretations, analyses, or statements of any kind made by a third party based on this report are beyond Sphera's responsibility. If you have any suggestions, complaints, or other feedback, please contact servicequality@sphera.com.

ISBN: 978-2-39068-114-4
D/2026/7512/250

© Eurobitume 2026

Published by the European Bitumen Association
Avenue des Nerviens 85
1040 Brussels, Belgium
www.eurobitume.eu

By consulting and/or using this publication, the user acknowledges and agrees to be bound by the following stipulations. Eurobitume has made considerable efforts to compile this publication on the basis of reliable sources. However, Eurobitume cannot and does not guarantee the completeness, accuracy, reliability and effectiveness of the information contained in this publication for whatever purpose. Furthermore, the content of this publication may be changed, suspended, revised and/or removed by Eurobitume, at its sole discretion, at any time for whatever reason and without notice. Finally, except for cases of fraud, neither Eurobitume nor its members are liable for any loss, damages or injury whatsoever relating to the consultation or use of this publication, or the inability to do so.

Eurobitume, May 2026, info@eurobitume.eu

List of Acronyms

AR	Assessment Report
CH_4	Methane
CHP	Combined Heat and Power
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2 eq.	Carbon Dioxide Equivalent
EF	Environmental Footprint
EPD	Environmental Product Declarations
EU	European Union
GaBi	Ganzheitliche Bilanzierung (German for holistic balancing)
GLO	Region Global
GWP	Global Warming Potential
H+	Hydrogen Ion
HFO	Heavy Fuel Oil
ILCD	International Life Cycle Data System
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
kg	Kilogram
LCA	Life Cycle Assessment
LCA FE	Life Cycle Assessment for Experts
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
MLC	Managed LCA Content
NMVOC	Non-Methane Volatile Organic Compound
NO_x	Nitrogen Oxides
PMB	Polymer Modified Bitumen
RER	Region Europe
RNA	Region North America
SBS	Styrene-Butadiene-Styrene Block Copolymer
SO_2	Sulfur Dioxide
t	Metric Tonne
UK	United Kingdom
% wt/wt	Weight Percentage

Glossary

Life Cycle
A view of a product system as "consecutive and interlinked stages, from raw material acquisition or generation from natural resources to final disposal" (ISO 14040:2006/Amd.1:2020, section 3.1) [1]. This includes all material and energy inputs as well as emissions to air, land and water.

Life Cycle Assessment (LCA)
"Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle" (ISO 14040:2006, section 3.2) [1].

Life Cycle Inventory (LCI)
"Phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle" (ISO 14040:2006, section 3.3) [1].

Life Cycle Impact Assessment (LCIA)
"Phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product" (ISO 14040:2006, section 3.4) [1].

Life Cycle Interpretation
"Phase of life cycle assessment in which the findings of either the inventory analysis or the impact assessment, or both, are evaluated in relation to the defined goal and scope in order to reach conclusions and recommendations" (ISO 14040:2006, section 3.5) [1].

Functional Unit
"Quantified performance of a product system for use as a reference unit" (ISO 14040:2006, section 3.20) [1].

Declared Unit
"Quantity of a product for use as a reference unit in the quantification of a partial carbon footprint of a product" (ISO 14067:2018) [2].

Allocation
"Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems" (ISO 14040:2006, section 3.17) [1].

Foreground System
"Those processes of the system that are specific to it … and/or directly affected by decisions analysed in the study" [3, p. 97]. This typically includes first-tier suppliers, the manufacturer itself and any downstream life cycle stages where the manufacturer can exert significant influence. As a general rule, specific (primary) data should be used for the foreground system.

Background System
"Those processes, where due to the averaging effect across the suppliers, a homogenous market with average (or equivalent, generic data) can be assumed to appropriately represent the respective process" and/or "Background system comprises those processes that are operated as part of the system but that are not under direct control or decisive influence of the producer of the good" [3, pp. 97-98]. As a general rule, secondary data are appropriate for the background system, particularly where primary data are difficult to collect.

Critical Review
"Process intended to ensure consistency between a life cycle assessment and the principles and requirements of the International Standards on life cycle assessment" (ISO 14044:2006, section 3.45) [4].

Executive Summary

Polymer Modified Bitumen (PMB) is bitumen modified with polymers to enhance performance properties. This report focuses on the most widely used polymer: SBS Styrenic Block Copolymers and possibly other additives to facilitate its use in paving applications. The investment in polymer modification seeks to extend the service life of the pavement to reduce lifecycle cost and environmental impact. SBS modified bitumen is widely used to enhance the performance of asphalt pavements subjected to heavy traffic or exposure to a wide range of temperatures. This report addresses two average products representative of current practices in paving application: a standard PMB (based on 3,5 % SBS) and a high-performance PMB (based on 6,0 % SBS).

Eurobitume, the European industry association for the producers of refined bituminous products in Europe, has commissioned Sphera Solutions, Inc. (Sphera) to perform a life cycle assessment (LCA) of PMB products that are representative of those produced by Eurobitume's members within the European Union (EU) and the United Kingdom (UK). The present study supplements Eurobitume's 2025 Life Cycle Assessment 4.0 for Bitumen study [3], expanding the breadth of bituminous products assessed under the lens of LCA to produce life cycle inventory (LCI) data and life cycle environmental impact results that can be used in the development of broader LCA studies which take into account the effect of polymer modification on the service life.

The goal of the present LCA study is to provide LCI data and life cycle environmental impact results on the production of PMB with SBS concentration of 3,5 % wt/wt (i.e., standard SBS concentration) and PMB with SBS concentration of 6,0 % wt/wt (i.e., high-performance PMB) within a refinery representative of Eurobitume members in the EU/UK region. The PMB products should be compliant with EN14023:2010 [4]. Its intended application is to serve as a building block in broader life cycle studies taking PMB into account. Its boundary is cradle-to-gate, i.e., it accounts for the environmental impacts of crude oil extraction, transportation of crude oil to the refinery, the production of paving grade bitumen (EN 12591), the production of the raw materials for SBS polymer, as well as the SBS polymer production and the polymer modification process. The environmental impacts are referenced to one metric tonne of PMB produced by Eurobitume member refineries at refinery gate.

The baseline environmental impacts of the PMB products were assessed using primary data collected from Eurobitume member refineries (4 member refineries in the EU and UK) during the data collection stage of the previous Life Cycle Assessment 4.0 for Bitumen study [3]. Collected data used in the present study includes feedstock supply mix (3-year average of feedstock supply, 2021-2023, comprising crude oil and heavy fuel oil, HFO), relevant refining processes, and the entire refinery utilities and emissions profile, and allocated to PMB products based on energy content.

Results for the environmental impact indicator Global Warming Potential over 100 years (GWP_{100}, IPCC's Six Assessment Report (AR6) [5]) are presented and discussed. In addition, the complete set of environmental impact indicators required by the EN 15804+A2:2019 standard of construction products [6] for the development of Environmental Product Declarations (EPD) is incorporated into the analysis.

Sensitivity analyses were carried out to assess [1] the impact that variations in the concentration of SBS and [2] the impact that transportation of bitumen to an offsite PMB production plant have on the GWP_{100} of PMB products. The sensitivity analysis shows that the standard PMB result applies to PMBs with 2,5-4,5 % SBS content, and the high-performance PMB result applies to PMBs with 4,6-7,0 % SBS content, both with less than 5 % deviation. Background life cycle inventory data from Sphera's Managed

LCA Content (MLC) 2024.1 databases (formerly known as GaBi databases) were used throughout the assessment to complement primary data. The intended audience of the present study is bitumen and PMB users and organisations studying environmental aspects, such as the European Commission, national official bodies, asphalt producers, road authorities, and other industry associations as well as consultants and universities.

The present non-ISO conform report does not contain any comparison of products that could be interpreted as a comparative assertions or superiority claim. Paving-grade bitumen according to EN 12591 and PMB have different properties and are used for different applications, hence a direct comparison of impacts is not meaningful. The results are intended to be used for external communication to the public, a critical review by an independent LCA expert is not foreseen.

GWP_{100} impact calculated according to IPCC's AR6 methodology for PMB produced within the refinery boundaries and with a SBS concentration of 3,5 % wt/wt is 625 kg CO_2 eq./t PMB. Similarly, the GWP_{100} for PMB with SBS concentration of 6,0 % wt/wt and produced within the refinery is 684 kg CO_2 eq./t PMB (Figure E- 1). The polymer modification process undergone by PMB-3,5 % wt/wt SBS (PMB-6,0 % wt/wt SBS) adds 95 (154) kg CO_2 eq./t of product in relation to bitumen (EN 12591)'s GWP_{100}, or ~18 % (~29 %). The major contributors to GWP_{100} are the supply of crude oil (57 % contribution in PMB-3,5 % wt/wt SBS; 51 % in PMB-6,0 % wt/wt SBS) and the supply of SBS (16 % contribution in PMB-3,5 % wt/wt SBS; 25 % in PMB-6,0 % wt/wt SBS).

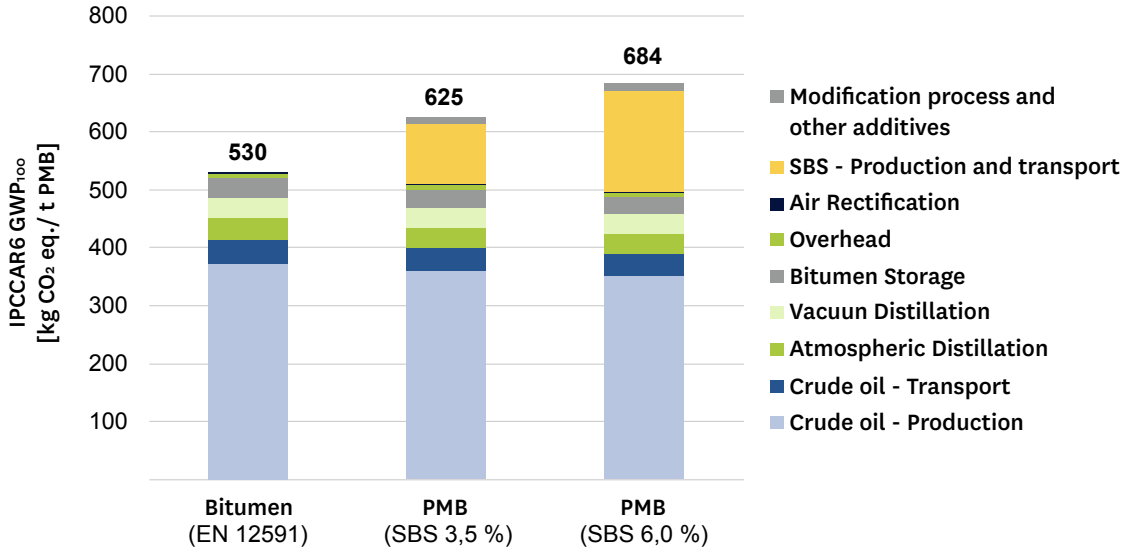

Figure E-1. GWP_{100} (AR6) for paving grade bitumen and PMB products

Find the full report here

References

[1] ISO 14040, ISO 14040: Environmental management – Life cycle assessment – Principles and framework, Geneva: International Organization for Standardization, 2006.

[2] ISO 14067, ISO 14067: Greenhouse Gases - Carbon Footprint for Products - Requirements and Guidlines for Quantification, Geneva, Switzerland: International Organization for Standardizatio, 2018.

[3] Eurobitume, The Eurobitume Life cycle Assessment 4.0 for bitumen, Brussels, Belgium, 2025.

[4] EN 14023:2010, EN 14023:2010 - Bitumen and Bituminous Binders - Specification Framework for Polymer Modified Bitumens, Brussels, Belgium: European Committee for Standardization (CEN), 2010.

[5] IPCC, “Sixth Assessment Report (AR6), Synthesis Report,” Intergovernmental Panel on Climate Change, 2021.

[6] EN 15804+A2, “Sustainability of construction works -Environmental Product Declarations - Core rules for the product category of construction products,” EN 15804, 2019.

Eurobitume
Avenue des Nerviens 85
1040 Brussels
Belgium
info@eurobitume.eu

www.eurobitume.eu
www.linkedin.com/company/eurobitume
www.x.com/eurobitume