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Alternative fuels in road freight transport: Objectives and scope of a literature review

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Abstract

This literature review investigates alternative solutions to fossil fuels in the context of road freight transport, focusing on both ecological and economic perspectives. A rigorous bibliographic methodology was employed to ensure the relevance and quality of the selected studies. The research process was structured through a systematic, multi-step decision-making approach, which included selecting the most appropriate research plat-form, identifying a relevant keyword combination, and deciding whether to search for keywords in abstracts only or across the entire text. Through this process, 157 scientific publications were identified as relevant for further analysis. The present document focuses on the methodology used to collect, select, and classify the relevant literature.

Keywords

Literature review, Alternative fuels, Road freight transport

1. Introduction

The use of fossil fuels as an energy source for transport has long been predominant due to their performance and energy efficiency characteristics. However, the combustion of these fuels is associated with high levels of pollutant emissions such as nitrogen oxides, carbon oxides, and fine particles (NOx, CO, CO2, PM10, PM2.5), which significantly con-tribute to air pollution, global warming, and public health issues (Pietrzak and Pietrzak, 2020; Zhang et al., 2022). Faced with growing environmental and health concerns, it becomes imperative to seek and adopt alternative solutions that can offer comparable performance while minimizing negative environmental impacts. Among the explored alternatives are electric vehicles, biofuels, hydrogen, and hybrid technologies. Each of these alternatives offers specific advantages and unique challenges in terms of performance, cost, and long-term viability. The main objective of this literature review is to highlight the research that has been conducted in this field.

1.1. Purpose of the literature review — research question

This literature review on alternative solutions to fossil fuels focuses on the analysis of drivetrain technologies in road freight transport. The analysis addresses both the eco-nomic and ecological aspects of alternative solutions. It is thus essential to evaluate not only the economic viability of these technologies — in terms of total cost of ownership (TCO) and life cycle profitability — but also their environmental impact, notably through life cycle assessments (LCA). These two dimensions enable a comprehensive understanding and comparison of the benefits and challenges associated with each alternative compared to conventional diesel.

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Modes of transport such as pipeline, air, rail, maritime, or river transport are excluded from this study. Indeed, the focus is limited to technologies applicable to road vehicles, which are currently the most impacted by debates and policies on energy transition. It should also be noted that road transport will be limited to the carriage of goods (road haulage).

1.2. State of the art

In the field of alternative solutions to fossil fuels, several literature reviews have already been conducted, each offering valuable but limited perspectives due to certain methodological and thematic aspects.

For instance, the review by Contestabile et al. (2011) focuses primarily on light vehicles in Europe and the United States, using techno-economic models like LBST and ANL GREET to compare technologies such as hybrid electric vehicles, plug-in hybrid vehicles, battery electric vehicles, and fuel cell vehicles. Although this review provides a detailed analysis of existing technologies, it is limited to a few reference studies and does not account for all vehicle types. Indeed, medium-duty vehicles and heavy-duty vehicles are entirely absent. This limitation reduces the scope of conclusions regarding the applicability of these alternative solutions in freight transport.

Sen, Ercan and Tatari (2017) adopt an LCA-approach to evaluate emissions and energy consumption of light, medium, and heavy vehicles in developed areas, mainly in the United States. Their work, which encompasses a set of 31 studies, stands out for its in-depth environmental analysis but fails to address economic aspects and lacks a comprehensive examination of the specific challenges faced by developing regions. Thus, caution must be exercised in generalizing conclusions.

Zhang et al.'s (2022) literature review focuses exclusively on the electrification of heavy-duty trucks in various regions of the world, analyzing costs and emissions. Although this review provides critical insights into technologies used for some heavy-duty vehicles, it neglects other market segments, such as light- and medium-duty freight vehicles, which may prevent a comprehensive overview of fossil fuel alternatives or lead to a biased one.

Faced with these limitations, this literature review stands out by its breadth and depth. Covering 157 scientific publications, it encompasses a wide and diverse range of fuel technologies, transport types, and vehicles in various geographic contexts, including both developed and emerging regions. Moreover, this review includes not only ecological analyses but also economic analyses, relying on various methods such as TCO (Pihlatie et al. 2023), LCA (Haugen et al. 2021, Zhao/Tatari 2015), simulation (Pihlatie et al. 2023, Teichert et al. 2023, Zhao/Tatari 2015), WTW-Analysis (Liu et al. 2020), and mathematical optimization (Castillo/Álvarez 2023, De La Peña et al. 2020, Romejko/Nakano 2017, Sen et al. 2019, Wang et al. 2023). This analysis integrates both retrospective and prospective studies to understand the evolution of technologies and policies related to alternative solutions while identifying emerging trends that could sustainably transform the sector. This literature review also encompasses studies modeling scenarios related to charging conditions, energy prices, and vehicle mileage. This more comprehensive and diversified approach provides more robust guidance for policymakers, researchers, and practitioners in their search for sustainable and efficient solutions to replace fossil fuels in freight transport.

2. Procedure for bibliographic research

The effectiveness of literature research relies on a rigorous and well-defined methodology. This section details the strategies and criteria used in this study to collect and select relevant publications in the field of alternative fuels.

2.1. Search criteria

The search criteria refer to the pre-established principles and conditions that guide data collection during a literature review. Defining these criteria is essential to structure the research systematically and ensure the relevance and reliability of the information gathered. The criteria to be defined for this literature review include the selection of information sources, the choice of keywords, and exclusion criteria.

2.1.1. Selection of information sources

The selection of information sources involves determining where and how data will be collected. This is a crucial step that directly influences the quality and relevance of the literature review's results.

To ensure comprehensive coverage of available academic work, three research platforms were considered, each offering unique characteristics that could influence the coverage and depth of the research: EBSCO Discovery Service (EDS), EBSCOhost, and Web of Science (WoS). These platforms are widely used in academic circles, libraries, schools, and by professionals to access quality resources in various disciplines.

The next sections provide an overview of the advantages and limitations of each research platform. It should be noted that keyword searches and the application of various filters, such as restricting by date or type of text to refine results, are not discussed here, as these features are available in all three research platforms.

- EBSCO Discovery Service

EDS is ideal for preliminary or exhaustive searches because it provides a broad and diversified overview of available resources on a given topic. A single search interface allows access to a wide range of resources, simplifying the search for users who do not need to navigate between different databases. However, the large volume of results generated by EDS can sometimes be overwhelming and may require more meticulous evaluation to isolate the most relevant documents.

- EBSCOhost

EBSCOhost's specialized databases are particularly useful for in-depth searches in specific fields. However, unlike EDS, the search in EBSCOhost does not automatically extend to non-EBSCO databases, which may require additional searches in other resources for a comprehensive view. While the platform is designed to be intuitive and easy to use, users must pre-select specific databases to query, requiring some knowledge or familiarity with available resources.

- Web of Science

WoS is known for its regularly updated information from verified sources, ensuring high data reliability. It is recognized for its precision and the quality of its content, often serving as a reference for academic evaluations and measuring the impact of research. Key indicators, such as the journal's impact factor and other metrics, help assess the quality and influence of published research. While highly

functional, the interface can be perceived as complex by new users, requiring some time to fully exploit the platform's capabilities.

	Advantages	Limitations
WoS[3]	- Data integrity - Authority and precision	- Interface complexity
EBSCOhost[4]	- Specialization	- Limited access to non-EBSCO databases - Pre-selection required
EDS[5]	- Completeness - Simplicity	- Information overload

Table 1: Advantages and limitations of the research platforms

Table 1 provides a summary of the advantages and limitations of each research platform. Given the specific characteristics of each research platform, it is clear that the results obtained for a study can vary significantly depending on the chosen research platform. This is due to several fundamental factors, such as source coverage, search algorithms, and the frequency of updates. Indeed, each research platform has a unique set of indexed journals, books, conferences, and other resources, determined by licensing agreements and editorial choices. Additionally, databases that are frequently updated can provide more current information.

Thus, the choice of search platform is a decisive first criterion that must be carefully considered to align research tools with the study's needs. This will directly influence the quality, coverage, and efficiency of the bibliographic search.

2.1.2. Choice of keywords

Keywords are used to target searches within databases. Identifying keyword combinations is essential for filtering results relevant to the subject under study.

For this literature review, which aims to explore alternative solutions to fossil fuels in transport, a systematic method of combining keyword sets was implemented. This method allows for a focused examination of the ecological and economic impacts of alternative propulsion technologies while covering the two main transport domains: freight and passenger transport. Notably, including keywords related to passenger transport helps ensure that no potentially useful studies are excluded due to overly strict categorization. For example, this approach can capture studies that primarily focus on passenger transport but also include relevant sections or analyses related to freight transport. Similarly, the inclusion of both ecological and economic aspects will be evaluated to ensure they contribute meaningfully to the research objective. Adjustments to keyword combinations may be made depending on the relevance and quality of the results retrieved.

Thus, six different combinations of five keyword sets were prepared to optimize the search. The following shows how the combinations were formulated:

[3] https://www.webofscience.com/wos/alldb/advanced-search
[4] https://research.ebsco.com/c/jpkfed/search/advanced/filters?autocorrect=n
[5] https://research.ebsco.com/c/6az4lk/search/advanced/filters?autocorrect=n

Keyword sets used:

- Set E_1 : "Alternative Drives" — Includes terms related to various alternative propulsion technologies.
- Set E_2 : "Economic aspect" — Focuses the analysis on the economic impacts of propulsion technologies.
- Set E_3 : "Ecological aspect" — Focuses the analysis on the ecological impacts of propulsion technologies.
- Set E_4 : "Freight Transport" — Specifies freight transport as the application domain.
- Set E_5 : "Passenger Transport" — Specifies passenger transport as the application domain.

Each set is defined by a group of keywords, as listed in Table 7 (see Appendix).

Keyword set combinations defined for the search:

- Combination C_1 : E_1 AND E_2 AND E_4 — Focused on the economic analysis of freight transport
- Combination C_2 : E_1 AND E_3 AND E_4 — Focused on the ecological analysis of freight transport
- Combination C_3 : E_1 AND E_2 AND E_3 AND E_4 — Targeting studies that address both economic and ecological aspects of freight transport
- Combination C_4 : E_1 AND E_2 AND (E_4 OR E_5) — Focused on the economic analysis of freight and/or passenger transport
- Combination C_5 : E_1 AND E_3 AND (E_4 OR E_5) — Focused on the ecological analysis of freight and/or passenger transport
- Combination C_6 : E_1 AND E_2 AND E_3 AND (E_4 OR E_5) — Targeting studies that address both economic and ecological aspects of freight and/or passenger transport.

The systematic inclusion of Set E_1 in all combinations reflects the central importance of alternative propulsion technologies in the study, emphasizing the primary goal of understanding and evaluating their viability and impact in the transport sector.

While several combinations are applied to explore the use of alternative propulsion technologies from different angles, only one combination will subsequently be selected to ensure the study's relevance and research results.

2.1.3. Exclusion criteria

The exclusion criteria are based on concrete aspects to determine, as the name suggests, which studies or data will be excluded from the research and, by extension, which studies or data will be included. Thus, several limits have been set to refine the search.

- Language: Publications in English were prioritized to ensure a uniform understanding and access to a broad scientific database. However, publications in German were not excluded.
- Year of publication: Only studies published after 2000 were considered to ensure the currency of the technologies and data.
- Peer review: Only peer-reviewed articles were included to ensure the credibility of the information.

Thus, the results utilized in the subsequent sections of this document are restricted by the above criteria. In addition to these three exclusion criteria, one criterion remains to be determined. The decision on whether to include studies based solely on keyword representation in the abstract or in the full text is still to be made.

In summary, three major choices, which will directly influence the quality and scope of the literature review, must be made to effectively structure the bibliographic research. These include selecting the research platform, choosing the keyword set combination, and deciding whether to search for keywords in abstracts only or in the full text.

2.2. A multi-step decision-making approach

In this literature review, a methodical, multi-step decision-making approach is adopted to refine the different research criteria. Through a series of four queries, each with different combinations of criteria, the process of selecting sources is gradually optimized.

2.2.1. The first query

This first query aims to provide an initial overview of the results from the different databases and can serve to narrow the selection. Initially, all three research platforms (EDS, EBSCOhost, and WoS) are exploited, and all keyword set combinations are tested. In the first instance, full texts are targeted. Then, in the second instance, only abstracts of the documents are analyzed. Table 2 provides the number of search results for each search platform from this query.

	WoS		EBSCOhost		EDS	
Combination	Full text	Abstract	Full text	Abstract	Full text	Abstract
C_1	718	263	237	14	8805	20
C_2	1933	727	884	41	6771	71
C_3	442	132	87	2	787	4
C_4	2311	821	4702	245	374140	482
C_5	5845	1693	12506	524	5910	1060
C_6	1304	363	1054	47	1971	62

Table 2: Number of results retrieved from the first query

For each keyword set combination, the smallest and the highest number of search results among the three research platforms are highlighted in Table 3. The green cells indicate values obtained from WoS, the yellow cells correspond to EBSCOhost, and the blue cells represent EDS. The predominance of EBSCOhost in the smallest results reflects the specialization of its databases, as stated in section 2.1.1.

	Smallest number		Highest number	
Combination	Full text	Abstract	Full text	Abstract
C_1	237	14	8805	263
C_2	884	41	6771	727
C_3	87	2	787	132
C_4	2311	245	374140	821
C_5	5845	524	12506	1693
C_6	1054	47	1971	363

Table 3: Lowest and highest number of search results across the three platforms

Except for combination C_5, EDS provides the highest number of results when full texts are analyzed. However, this changes when only document abstracts are considered (WoS dominates in this case). Therefore, it is reasonable to question the relevance of results from this research platform. Indeed, a specific search term can sometimes be located in the bibliography or footnotes and still be indexed by the platform's search engine. However, this does not necessarily mean the subject is thoroughly discussed in the text itself. As a result, articles may appear in search results despite not offering substantive discussion on the topic in question. This phenomenon is reflected here by a very low ratio – apart from combination C_5 - between the number of results based on abstracts and those based on full texts (see Table 4). Due to the risk of irrelevant results, EDS was excluded from the platforms used for future searches. From now on, queries will be performed only on the other two research platforms.

Combination	WoS	EBSCOhost	EDS
C_1	36,6%	5,9%	0,2%
C_2	37,6%	4,6%	1,0%
C_3	29,9%	2,3%	0,5%
C_4	35,5%	5,2%	0,1%
C_5	29,0%	4,2%	17,9%
C_6	27,8%	4,5%	3,1%

Table 4: Ratio of results retrieved from abstract searches versus full-text searches

2.2.2. The second query

This step aims to define the appropriate research platform for further research. For this second query, only EBSCOhost and WoS were used. Combination C_3 is the subject of the search extended to full texts. This keyword combination was selected because it yielded a relatively low and manageable number of results across platforms, making it suitable for manual evaluation. Additionally, it includes

a balanced representation of ecological and economic terms, aligned with the objectives of this review.

The evaluation conducted here is based solely on document titles, in accordance with the relevance criteria defined earlier (see section 1.1). While this method provides only a preliminary estimate of relevance, it is justified by practical constraints — including the high volume of results, limited access to abstracts or full texts in some cases, and the exploratory nature of this step. This approach facilitates an initial comparison of platform performance and keyword relevance, with the expectation that more in-depth analysis involving abstracts or full texts will follow.

Query results:

- EBSCOhost: 87 documents retrieved, of which 16 were deemed relevant (18.4%)
- WoS: 442 documents retrieved, of which 139 were deemed relevant (31.4%)

WoS stands out not only for its larger number of documents but also for a significantly higher proportion of relevant documents compared to EBSCOhost.

Opting for EBSCOhost over WoS dramatically reduces the number of relevant documents, from 139 to 16. This significant reduction highlights the clear loss of relevant documents. However, among these 16 relevant documents, only six are found in WoS results, raising the question of whether to maintain searches on both research platforms.

A higher number of results does not necessarily imply more relevant documents but inevitably lengthens the analysis time. To quickly assess whether this extra effort is justified, a specific formula was developed:

- A document not found in the results of the other search platform and deemed irrelevant receives a value of -1.
- A document also found in the results of the other search platform receives a value of 0.
- A document not found in the results of the other search platform and deemed relevant receives a value of +1.
- These values are then added to obtain a total score, which is ultimately divided by the total number of examined results.
- Thus, the final score can vary between -1 and 1. A score close to -1 suggests that the extra effort is not worthwhile, while a score close to 1 indicates the opposite, justifying the additional effort.

After applying this formula to EBSCOhost results, the score obtained is -0.70. The extra effort is thus perceived as largely unnecessary. For this reason, WoS was chosen as the sole research platform for the remainder of the study.

2.2.3. The third query

This query aims to determine the keyword set combination that will provide the most appropriate results for this study.

The results from WoS seem at first sight to reveal a predominance of studies focusing on the ecological aspect compared with the economic aspect. Indeed, depending on the part of the text studied and whether passenger transport is included or not, articles resulting from a combination of keywords with an ecological perspective account for between 67.3% and 73.4% of the articles considered in each case, while those based on an economic perspective represent only 26.6% to 32.7% (see Table 5).

	Including passenger transport		Not including passenger transport	
	Ecological perspective	Economic perspective	Ecological perspective	Economic perspective
Full text	71.7%	28.3%	72.9%	27.1%
Abstract	67.3%	32.7%	73.4%	26.6%

Table 5: Breakdown of the number of search results by perspective (whether or not including passenger transport)

Including passenger transport in the search significantly increases the number of results, revealing a stronger scientific focus on passenger transport compared to freight transport alone. Depending on whether the keywords are searched within the full text or just the abstract, the number of results increases by a factor ranging from 2.3 to 3.2 when passenger transport is included (see Table 6).

	Ecological perspective	Economic perspective	Both
Full text	3.0	3.2	3.0
Abstract	2.3	3.1	2.8

Table 6: Increase in the number of search results by including passenger transport

However, including such a large number of articles may hinder the ability to maintain a literature review focused specifically on freight transport. To preserve the overall coherence of the analysis and facilitate the synthesis of results, it is therefore necessary to exclude all keyword combinations that include Set E_5, which relates to passenger transport. At the same time, neither the economic nor the ecological dimension should be neglected in this study. As a result, a new keyword combination is proposed:

- Combination C_7 : E_1 AND (E_2 OR E_3) AND E_4 — Targeting studies related to the economic and/or ecological analysis of freight transport.

Compared to Combination C_3, which requires both economic and ecological terms to be present, C_7 adopts a broader logic by allowing for the inclusion of studies focusing on either economic or ecological aspects (or both). This adjustment increases sensitivity by capturing studies that focus exclusively on one dimension (economic or ecological), while still remaining within the thematic scope of freight transport analysis.

This query returned a total of 2,209 documents, illustrating the broader reach of this combination while maintaining relevance to the research focus.

2.2.4. The fourth query

A final query was conducted using WoS, this time analyzing abstracts only. The same keyword combination as in the second query – namely C_3 - was used to ensure a consistent basis for comparison between full-text and abstract-level searches. Using a different combination, such as C_7, would have introduced bias, making it difficult to isolate the effect of the section analyzed.

Finally, a last query was conducted using WoS for the same keyword combination as in the second query, that is C_3, but this time only the abstracts were analyzed. The objective was to determine the part of the text to analyze for this literature review.

Reminder of the second query result (C_3 with full text):

- WoS: 442 documents retrieved, of which 139 were deemed relevant (31.4%)

Result of this fourth query (C_3 with abstracts only):

- WoS: 132 documents retrieved, of which 45 were deemed relevant (34.1%)

Although the relevance rate of documents is slightly higher for this latest query, the results clearly indicate that analyses based solely on abstracts omit important documents. Indeed, 67.6% of the relevant documents identified in the query using full texts were absent from the results obtained with abstracts only. For this reason, although more time-consuming (due to the larger number of documents to analyze), the decision was made to proceed with a full-text review for the literature study.

In summary, this multi-step decision-making approach allowed for the determination of three major choices to structure the bibliographic research effectively. Thus, the WoS search platform was selected, as well as the keyword set combination C_7 : E_1 AND (E_2 OR E_3) AND E_4. Finally, the decision was made to conduct keyword searches within the full text of the documents.

3. Literature assessment

Following the definition of all research criteria, the next step consists in conducting the literature assessment to build a solid knowledge base and guide future research. This phase begins with an evaluation of the results to identify the most relevant documents according to the research objectives. The selected documents are then classified according to precise criteria, enabling clear organization and effective comparison of the information.

3.1. Evaluation of result

When conducting a search in a vast research platform like WoS, it is common to end up with a large volume of results. To better manage this abundance of information and reduce "noise" — i.e., the presence of irrelevant documents — the exclusion of categories not essential to the research objectives is crucial. This allows for the extraction of the most relevant documents before moving on to the next step, which is their classification.

It is worth noting that WoS offers a detailed classification system that categorizes scientific publications into specific fields, allowing for further refinement of results through targeted filters. For this study on alternative solutions to fossil fuels, it is essential to retain categories such as “Environmental Sciences & Ecology”, “Energy & Fuels”, “Science & Technology - Other Topics”, “Transportation”, and “Business & Economics”. However, since the study specifically focuses on the ecological and economic aspects of the transition, documents classified under "Engineering" can be excluded, reducing the initial number of 2,209 documents (result for C_7 and full text) to 1,814 documents.

After a careful evaluation based on the titles and abstracts of the articles, 297 documents were considered potentially relevant. A more in-depth reading of key paragraphs from these documents allowed the focus to be narrowed further to road freight transport. As a result, 140 documents were excluded because they focused exclusively on passenger transport, despite the use of a keyword combination targeting only freight transport. An overview of this stepwise filtering process is illustrated in Figure 1. In total, 157 documents were selected for the second phase of the literature assessment, which involves classification. The complete list of these documents is available in Table 8 (see Appendix).

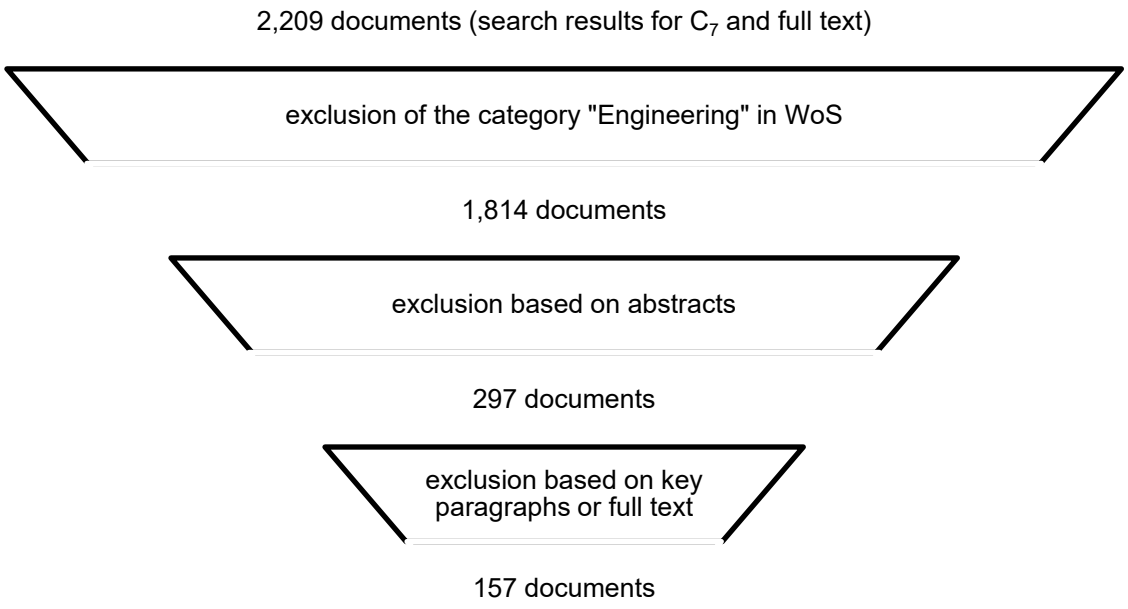

Figure 1: Stepwise filtering of retrieved documents

3.2. Classification

Each of the 157 documents was categorized according to the following criteria:

- Title, Authors, Journal or review, Year of publication: These fundamental data provide a quick overview of the source and the time period of the study.
- Geography: Documents are classified by geographic regions, including Africa, Oceania, Asia, America, and the European Union + United Kingdom.

- Perspective: Each study is analyzed to determine whether it addressed ecological, economic, or both issues.
- Scenario focus: Table 9 (see Appendix) groups the various scenarios identified during the analysis of the studies. Note that simply considering different fuels is not retained as a scenario since it is the core subject of the study.
- Transport type: A distinction is made between studies dedicated exclusively to freight transport and those that also cover passenger transport (see section 2.1.2).
- Vehicle type: Table 10 (see Appendix) lists the groups of vehicle types.
- Drivetrain technology and Fuel: Table 11 (see Appendix) summarizes the different vehicle propulsion technologies. In addition, Table 12 (see Appendix) shows the types of fuels studied.
- Study type: A distinction is made between retrospective and prospective studies.

This classification can serve as a foundation for subsequent statistical analysis aimed at identifying current trends and research gaps in alternative fuels for road freight transport. However, such an analysis falls outside the scope of this document.

4. Conclusion

This paper provides a detailed presentation of the methodology used to conduct a systematic bibliographic search and select relevant studies on alternative solutions to fossil fuels for road freight transport. The selection process was conducted in several stages, including the choice of the WoS research platform, the definition of a keyword combination covering both economic and ecological aspects with an exclusive focus on freight transport, and the decision to perform the search within the full text of the documents. The final corpus consists of 157 scientific publications, carefully selected for their relevance to the research objectives.

Additionally, a detailed classification framework was developed to categorize the selected articles based on geography, perspective (ecological, economic, or both), scenario focus, transport and vehicle type, drivetrain technology, and study type. These classification criteria provide the foundation for future statistical analysis.

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Appendix

Alternative drives (Set E_1)	“Autogas*” OR “LPG” OR “CNG” OR “natural gas*” OR “fuel cell” OR “diesel” OR “electr*” OR “battery” OR “internal combustion engine*” OR “hydrogen*” OR “alternative drives” OR “alternative propulsion” OR “biofuel” OR “biogas*” OR “Elektr*” OR “Wasserstoff*” OR “Hybrid*” OR “Autogaz” OR “Erdgas*” OR “Bioethanol” OR “Biodiesel” OR “Kraftstoff*” OR “Brennstoffzelle*” OR “Batterie*” OR “alternative Antriebe”
Economic aspect (Set E_2)	“total cost of ownership” OR “TCO” OR “life cycle cost*” OR “operational lifetime costs” OR “LCC” OR “Gesamtbetriebskosten” OR “gesamte Betriebskosten” OR “Gesamtkosten des Betriebs” OR “Lebenszykluskosten*”
Ecological aspect (Set E_3)	“life cycle assessment” OR “life cycle analysis” OR “sustainability assessment” OR “carbon footprint” OR “cradle-to-grave analysis” OR “LCA” OR “Ökobilanz” OR “Umweltbilanz” OR “Lebenszyklusanalyse” OR “CO2-Fußabdruck”
Goods transport (Set E_4)	“ground transport*” OR “land transport*” OR “transport by road” OR “road traffic” OR “heavy goods vehicles” OR “HGV” OR “road freight” OR “road carriage” OR “road haulage” OR “trucking” OR “truck transport” OR “Straßenfracht” OR “Straßengüterverkehr*” OR “Lkw-Transport”
Passenger transport (Set E_5)	“passenger transport*” OR “public transport*” OR “mass transit” OR “passenger car*” OR “Bus*” OR “Personentransport*” OR “öffentlicher Verkehr” OR “Massenverkehrsmittel” OR “ÖPNV”

Table 7: Keyword set

Author(s), Year of publication, Title
• Ahluwalia, R.K. et al. (2022) "Performance and total cost of ownership of a fuel cell hybrid mining truck" • Allwright, J. et al. (2022) "Heavy Multi-Articulated Vehicles with Electric and Hybrid Power Trains for Road Freight Activity: An Australian Context" • Alonso-Villar, A. et al. (2022) "Technical, economic, and environmental feasibility of alternative fuel heavy-duty vehicles in Iceland" • Anselma, P.G. and Belingardi, G. (2022) "Fuel cell electrified propulsion systems for long-haul heavy-duty trucks: present and future cost-oriented sizing" • Antonini, C. et al. (2021) "Hydrogen from wood gasification with CCS – a techno-environmental analysis of production and use as transport fuel" • Arteconi, A. et al. (2010) "Life-cycle greenhouse gas analysis of LNG as a heavy vehicle fuel in Europe" • Arvidsson, R. et al. (2011) "Life cycle assessment of hydrotreated vegetable oil from rape, oil palm and Jatropha" • Atkins, P. et al. (2021) "A Local Ecosystem Assessment of the Potential for Net Negative Heavy-Duty Truck Greenhouse Gas Emissions through Biomethane Upcycling" • Bachmann, C. et al. (2015) "Life-Cycle Assessment of Diesel-Electric hybrid and conventional diesel trucks for deliveries" • Balboa-Espinoza, V. et al. (2023) "Comparative life cycle assessment of battery-electric and diesel underground mining trucks" • Baral, N.R. et al. (2021) "Biomass feedstock transport using fuel cell and battery electric trucks improves lifecycle metrics of biofuel sustainability and economy" • Bidart, C. et al. (2022) "Biogas catalytic methanation for biomethane production as fuel in freight transport - A carbon footprint assessment" • Booto, G.K., Espegren, K.A. and Hancke, R. (2021) "Comparative life cycle assessment of heavy-duty drivetrains: A Norwegian study case" • Brand, C., Tran, M. and Anable, J. (2012) "The UK transport carbon model: An integrated life cycle approach to explore low carbon futures" • Brynolf, S. et al. (2022) "Review of electrofuel feasibility—prospects for road, ocean, and air transport" • Burke, A.F. et al. (2023) "Projections of the costs of medium- and heavy-duty battery-electric and fuel cell vehicles (2020-2040) and related economic issues" • Cabrera-Jiménez, R. et al. (2023) "Microalgae Biofuel for a Heavy-Duty Transport Sector within Planetary Boundaries" • Carlsson, F. and Johansson-Stenman, O. (2003) "Costs and benefits of electric Vehicles A 2010 perspective" • Casolari, B.L. et al. (2014) "Model study of a fuel cell range extender for a neighborhood electric vehicle (NEV)" • Castillo, O. and Álvarez, R. (2023) "Electrification of Last-Mile Delivery: A Fleet Management Approach with a Sustainability Perspective" • Charalambous, M.A. et al. (2023) "Absolute environmental sustainability assessment of renewable dimethyl ether fuelled heavy-duty trucks" • Cooper, J., Hawkes, A. and Balcombe, P. (2019) "Life cycle environmental impacts of natural gas drivetrains used in UK road freighting and impacts to UK emission targets" • De La Peña, A.G. et al. (2020) "Projecting adoption of truck powertrain technologies and CO2 emissions in line-haul networks"

- Drawer, C., Rödl, A. and Kaltschmitt, M. (2024) "Life cycle assessment of construction and driving operation of a hydrogen-powered truck built from a used diesel truck"
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Table 8: Selected documents for classification

Annual mileage	The total distance covered by a vehicle over a year influences energy demand, operating costs, as well as wear and tear and vehicle depreciation (particularly for electric vehicles, whose range depends on usage).
Battery degradation / vehicle age	Battery performance declines over time due to charging and discharging cycles, affecting maintenance costs, vehicle durability, and energy efficiency.
Driving conditions	Driving conditions affect energy consumption and vehicle wear (load factor, weather, road, and traffic conditions).
Energy price (including carbon price)	Fluctuations in energy prices, including the cost of carbon, which varies according to government policies, directly impact the profitability of fossil fuel alternatives.
Energy production method / energy mix	The source of the energy used to power vehicles (renewable energy, nuclear, fossil fuels) affects the overall life cycle emissions of alternative fuels.
Equipment costs (including subsidies)	The cost of purchasing and installing necessary equipment (vehicles, charging infrastructure, etc.) impacts the financial analysis, as do state subsidies and financial incentives.
Penetration rate / fleet size	The adoption rate of alternative technologies in the vehicle fleet or the size of the fleet of alternative fuel vehicles influences economies of scale for vehicle and infrastructure acquisition and maintenance.
Refueling / recharging method	Different recharging technologies (slow, standard, fast charging, overnight recharging, etc.) influence the operational efficiency of alternative vehicles.
Technological advancements	Future technological advancements can influence the performance, costs, and efficiency of alternative vehicles and infrastructure (e.g., improved batteries).
Vehicle configuration	The specifications of the vehicle (dimensions, weight, type of transmission, tire size, battery type, etc.) affect energy consumption and carbon emissions.
Vehicle lifetime	The operational lifespan of vehicles impacts the TCO and the amortization of investments.
Vehicle range / battery capacity	The maximum range, depending on battery or fuel tank capacity, affects the operational performance of vehicles and the feasibility of transitioning to alternative solutions.

Table 9: Scenarios

Forklift + Pushback tractor	Specialized transport for short distances (in warehouses and airports)
Goods and logistics vehicle + Truck	Generic terms that require more specific details and used when neither the class nor the weight is specified
MDT + MDV	Medium-duty truck and medium-duty vehicle
LDT + MiDT + LDV + LCV + van	Light-duty truck, mini truck, light-duty vehicle, light commercial vehicle and van
HDT + HGV + HDV	Heavy-duty truck, heavy goods vehicle and heavy-duty vehicle

Table 10: Vehicle types

BSV	Battery Swap Vehicle
BEV	Battery Electric Vehicle
CV	Catenary Vehicle
EREV	Extended Range Electric Vehicle
FCEREV	Fuel Cell Extended Range Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
FCHEV	Fuel Cell Hybrid Electric Vehicle
HEV	Hybrid Electric Vehicle
HCV	Hybrid Catenary Vehicle
ICEV	Internal Combustion Engine Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
PHFCEV	Plug-in Hybrid Fuel Cell Electric Vehicle
WPT EV	Wireless Power Transfer Electric Vehicle

Table 11: Drivetrain technologies

Biodiesel / oxygenated fuel (ether, ester, alcohol) / FAME	Produced by transesterification of vegetable oils (soybean, rapeseed, sunflower, palm) or animal fats – a reaction between the feedstock and an alcohol (see U.S. Energy Information Administration, 2024)
Biofuel	Generic term for liquid and gaseous transport fuels (such as biodiesel, bioethanol and biogas) made from biomass (see European Union, 2023)
Biogas (gaseous, liquefied)	Mixture of methane, CO_2 and small quantities of other gases produced by anaerobic digestion of organic matter in an oxygen-free environment (see IEA, 2020)
CNG / LNG	Compressed or Liquefied Natural Gas
Diesel	Fossil diesel fuel
Electricity	Generated from fossil fuel, solar energy, biomass, wind, nuclear or hydropower plants (no distinction is made)
Fischer-Tropsch diesel	Synthetic diesel resulting from the FT-synthesis – a reaction between carbon monoxide and hydrogen (see Bezergianni, S. and Dimitriadis, A., 2013)
Fossil fuel	Generic term for non-renewable energy sources, such as coal, natural gas, crude oil and petroleum products
Gasoline	Also called petrol
Hydrogen	Produced from fossil fuels, nuclear or hydropower plant, solar energy, biomass, wind, renewable or grid electricity (no distinction is made)
Hythane	Blend of hydrogen and compressed natural gas
LPG	Liquefied Petroleum Gas
Renewable diesel / HVO	Produced by hydrotreating (Hydrotreated Vegetable Oil), gasification or pyrolysis of biomass feedstock[1]
Renewable NG / biomethane	Near-pure source of methane produced either by "upgrading" biogas (a process that removes any CO_2 and other contaminants present in the biogas) or through the gasification of solid biomass followed by methanation[3]
SVO	Straight Vegetable Oil

Table 12: Fuels

Veröffentlichte Berichte der Fakultät für Wirtschaftswissenschaften

Die PDF-Dateien der folgenden Berichte sind verfügbar unter:

Published reports of the Saarland Business School

The PDF files of the following reports are available under:

http://www.htwsaar.de/wiwi

1 I. Correia, T. Melo, F. Saldanha da Gama

Comparing classical performance measures for a multi-period, two-echelon supply chain network design problem with sizing decisions

Keywords: supply chain network design, facility location, capacity acquisition, profit maximization, cost minimization

(43 pages, 2012)

2 T. Melo

A note on challenges and opportunities for Operations Research in hospital logistics

Keywords: hospital logistics, Operations Research, application areas

(13 pages, 2012)

3 S. Hütter, A. Steinhaus

Forschung an Fachhochschulen – Treiber für Innovation im Mittelstand: Ergebnisse der Qbing-Trendumfrage 2013

Keywords: Innovation, Umfrage, Trendbarometer, Logistik-Konzepte, Logistik-Technologien, Mittelstand, KMU

(5 pages, 2012)

4 A. Steinhaus, S. Hütter

Leitfaden zur Implementierung von RFID in kleinen und mittelständischen Unternehmen

Keywords: RFID, KMU, schlanke Prozesse, Prozessoptimierung, Produktion, Forschungsgruppe Qbing

(49 pages, 2013)

5 S.A. Alumur, B.Y. Kara, M.T. Melo

Location and Logistics

Keywords: forward logistics network design, reverse logistics network design, models, applications

(26 pages, 2013)

6 S. Hütter, A. Steinhaus

Forschung an Fachhochschulen – Treiber für Innovation im Mittelstand: Ergebnisse der Qbing-Trendumfrage 2014

Keywords: Innovation, Umfrage, Trendbarometer, Logistik-Konzepte, Logistik-Technologien, Mittelstand, KMU

(6 pages, 2014)

7 M.J. Cortinhal, M.J. Lopes, M.T. Melo

Redesigning a three-echelon logistics network over multiple time periods with transportation mode selection and outsourcing opportunities

Keywords: logistics network design/re-design, multiple periods, transportation mode selection, product outsourcing, mixed-integer linear programming

(49 pages, 2014)

8 T. Bousonville, C. Ebert, J. Rath

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