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Systematic Review

Road Freight Transport Literature and the Achievements of the Sustainable Development Goals—A Systematic Review

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Abstract: Considering the importance of the road freight transport sector on the sustainability debate, the purpose of this paper is to present a comprehensive review of the road freight transport literature to provide key information on the role that this field of knowledge must play in contributing to the achievement of the Sustainable Development Goals (SDGs). To accomplish this, we performed a state-of-the-art review via systematic literature on 86 documents published during 2015–2020, with an emphasis on environmental, economic, and technical studies. Ultimately, this paper seeks to uncover research gaps and to suggest means in which the freight transport literature and the 17 SDGs may be faced by this field in future studies. the results showed that the SDGs were not target by the analyzed papers, and the sustainable development goals were not quoted at all. The only SDG fully contemplated was number 7—affordable and clean energy. The findings of this study suggest that this field should add research of SDGs 2, 3, 7, 9, 11, 12, 13, and 17 as priority areas to be further developed by the RFT literature to achieve SDGs goals.

Keywords: SDG; literature review; transport sector; road freight; sustainability; interdisciplinary

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1. Introduction

In 2015, during the United Nations Sustainable Development Summit, the SDGs—a set of goals created to follow-up and review the Millennium Development Goals (MDGs) initiated in 2013—were negotiated. The SDGs are composed of 17 goals to be met by 2030. They have 169 associated targets, integrated and indivisible, which are supposed to guide national policies and international cooperation activities for more than 190 countries. In general, the SDGs aims to ensure sustainable global social and economic development and to strengthen universal peace by focusing on people and their human rights. The 17 SDGs requires multilateral effort and integrated policies development.

With such complexity, it is expected that the economic, social, and environmental concerns considered in the definition of these 17 objectives will no longer be dealt with separately and independently. The SDG agenda calls for a global partnership—at all—between countries and stakeholders, including a broad spectrum of actors such as multinational and multisectoral businesses, local governments, regional and international bodies, academia, and civil society organizations.

In this regard, the road freight transport (RFT) sector has a key role in the achievement of a sustainable future, as it is wrapped in serious environmental concerns due to the use of petroleum-based fuels to power vehicles, which, according to Sharma and Strezov (2017) [1], are the main cause of greenhouse gases (GHG) and the criteria pollutant emissions worldwide. The search for alternative fuels is often associated with sustainable development, energy savings, efficiency, and environmental conservation [1].

In addition, RFT is an important sector in the global economy and directly affects the efficiency of national economies [2]. According to IEA (2019) [3], energy consumption and CO_2 emissions generated by trucks and buses have increased by 2.2% yearly. In general, the sector is driven by fossil fuel demand, and diesel oil is still the most used energy carrier in road heavy-duty vehicles (HDV) [4]. Because the freight transport profile is associated with travelling long distances and powered by fossil sources, the sector is a major source of air pollution and GHG emissions, directly impacting human health and the environment [5].

However, the RFT is going through changes and has been evolving over the years to improve its efficiency and cost–benefit patterns and meet the emissions standards [4,6]. To attain the SDG and the Nationally Determined Contributions (NDC), countries have been creating different policies to support strategies in the transport sector [7–9].

In the same way, the scientific community has been studying and evaluating the use of different types of fuel technologies to be used in RFT to reach better performance and to reduce costs and emissions. Renewable fuels have been studied in several countries such as the case of biodiesel from different feedstock such as sunflower oil, canola oil, waste cooking oil, cottonseed, pomegranate seed, and others [10–13]. More alternative energy carriers such as hydrogen [14,15], renewable diesel [16], biogas [17], and natural gas [18–21] have also been studied to evaluate pollutant emissions and impacts on heavy-duty engines characteristics.

Considering the importance of this sector, the purpose of this paper is to present a comprehensive review of the RFT literature to provide key information on the role that this field of knowledge must play in contributing to the achievement of the SDGs. To accomplish this, we performed a state-of-the-art systematic literature review on 86 documents, published during 2015–2020, with an emphasis on environmental, economic, and technical RFT literature. Ultimately, this paper seeks to uncover gaps and to suggest means in which the freight transport sector and the 17 SDGs may be faced by these fields of research in future studies.

The paper is organized as follows; in addition to this introduction, Section 2 presents the materials and methods used in achieving the paper's goals by presenting the systematic review's methodology. Section 3 presents the paper's results in terms of the RFT literature performance in addressing the SDGs, and Section 4 gives insights on the field of research that need to be further developed. Finally, Section 5 concludes the paper, highlighting the study's main discoveries.

2. Materials and Methods

The systematic review methodology is presented according to its scope, search strategy, eligibility criteria used to select papers, and the methodology used to extract data and analyze the results.

The study scope is the environmental, economic, and technical RFT literature (from the period of 2015–2020), which means that papers from the fields of social, regulation, and public policy knowledge areas were excluded from the analysis. In order to achieve the paper's goal—assessing the RFT literature performance on addressing existing SDGs—the following research questions were proposed:

(1) Has the environmental, economic, and technical literature on RFT addressed the SDGs in the last 5 years?
(2) How is the RFT literature addressing the SGDs? What are the most and least addressed SDGs?
(3) What are the main knowledge gaps that will need to be faced by this field considering future studies?

To answers those questions, this systematic review looked for relevant studies inside two databases: Scopus and Web of Science. Thus, a keyword search was developed by using different combinations: alternative fuel, HDV truck, commercial vehicle, freight, air pollution, and GHG emission. Searches were held on 15 May 2019. Only papers published in English and published during the period from 2015 to 2020 were considered. Duplicate papers were removed. Figure 1 summarizes the literature review steps.

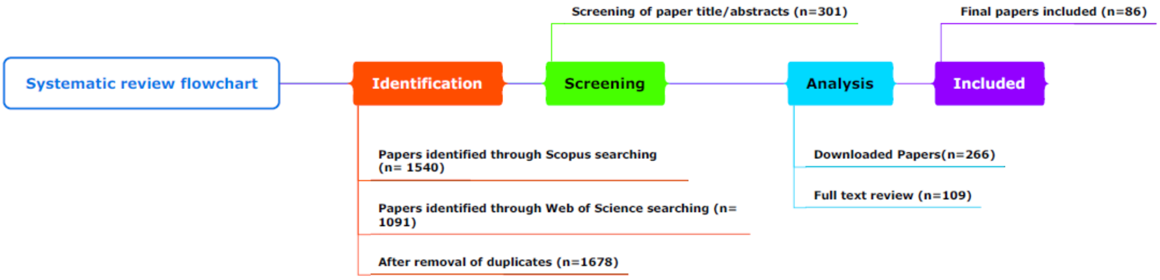

Figure 1. Systematic review flowchart.

After developing the search inside the databases previously mentioned, a total of 2631 papers were identified. By applying the inclusion criteria (only scientific and peer-reviewed journals, as well as papers with full available content), and by removing review studies, the new total was 1678. At this stage, the studies were screened by titles and abstracts. Just environmental, economic, and technical RFT literature was selected, and after full-text review, 86 papers were used in this study. To proceed with the *corpus* analysis on the achievement of the SDG, we divided the 17 SDG and respective targets (144 targets) into 2 categories called "ideals" and "instruments" (see Table 1). The SDG "ideals" category included the keywords associated with the qualitative goals of each SDG target. For instance, if we took SDG7 as an example, its first target is: "By 2030, ensure universal access to affordable, reliable and modern energy"; the selected keywords were: "energy", "modern energy", "affordable modern energy", and "reliable modern energy". The category allocation was as an "ideal" of "Access to Modern Energy" (see Table 1).

Table 1. Corpus achievements and allocation of SDG ideals and instruments.

SDGs		SDG Ideal and Instrument Achievement	Results per Reference and Its Performance (%)
1 NO POVERTY	ideal	ID1. End poverty; ID2. Increase rights; ID3. Reduce vulnerability.	ID3: [22]; IN2: [22–25]; Performance: 5% of the *corpus*
	instrument	IN1. Implement social protection systems; IN2. Ensure resources for National Policies and Programs.	
2 ZERO HUNGER	ideal	ID1. End hunger and malnutrition; ID2. Increase agricultural productivity;	ID1: [26–28]; IN1: [12,13,29–32]; IN2: [13]; Performance: 10% of the *corpus*
	instrument	IN1. Increase investment, research, and gene banks; IN2. Implement Measures to food reserves, access to land, and limit food price.	

Table 1. *Cont.*

SDGs		SDG Ideal and Instrument Achievement	Results per Reference and Its Performance (%)
3 GOOD HEALTH AND WELL-BEING	ideal	ID1. Ensure health and well-being; ID2 End preventable deaths, reduce disease; ID3. Reduce deaths from hazardous.	ID1: [25,33–35]; ID2: [22,24,34]; ID3: [22,33–46]; IN2: [10,13,22,24,25,33–35,42–44,47,48]; IN3: [49]; Performance: 27% of the *corpus*
	instrument	IN1. Ensure universal access to sexual and reproductive services; IN2. Ensure access to universal health coverage and financing; IN3. Support research and development.	
4 QUALITY EDUCATION	ideal	ID1. Inclusive and quality education; ID2 Lifelong learning opportunities; ID3. Decent Job; ID4. End gender education disparities.	ID2: [50]; ID3: [9,40]; Performance: 3% of the *corpus*
	instrument	IN1. Build and upgrade education facilities	
5 GENDER EQUALITY	ideal	ID1. Gender equality; ID2. End discrimination; ID3. End gender violence	N/A Performance: 0% of the *corpus*
	instrument	IN1. Gender focused Public Policies; IN2. Empower women	
6 CLEAN WATER AND SANITATION	ideal	ID1. Water Sustainable management; ID2. Water for all/Reduce water scarcity; ID3. Water quality	ID2: [27,37,40]; ID3: [23,46]; Performance: 6% of the *corpus*
	instrument	IN1. Implement measures for Protect, Restore, and Management; IN2. Implement Policies and Programs	
7 AFFORDABLE AND CLEAN ENERGY	ideal	ID1. Access to modern energy; ID2. Increase renewable energy	ID1: [8,15–17,26,29,30,36–39,41,51–64]; ID2: [7–9,12,17,22,23,26,28,29,31,35–37,40,41,44–47,51,52,55,56,59,61,63,65–76]; IN1: [7,12,13,24,26,33,39,41,52,54,57,66–69,74,77]; Performance: 65% of the *corpus*
	instrument	IN1. Enhance international cooperation to clean energy research and technology	
8 DECENT WORK AND ECONOMIC GROWTH	ideal	ID1. Promote economic growth; ID2. Productive and decent work; ID3. Eradicate forced labor.	ID1: [8,10,32,41,51,53,72,78]; IN1: [23,26,44,56,57]; IN2: [12,27,69]; Performance: 19% of the *corpus*
	instrument	IN1. Promote development-oriented policies; IN2. Implement resource efficiency programs; IN3. Strengthen the capacity of domestic financial institutions	

Table 1. *Cont.*

SDGs		SDG Ideal and Instrument Achievement	Results per Reference and Its Performance (%)
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	ideal	ID1. Resilient infrastructure and Sustainable industrialization; ID2. Reliable infrastructure; ID3. Raise industry share employment and gross	ID1: [7,8,15,17,23–26,39–41,43,50–53,55,59,64,72,75,76,79,80]; ID2: [43,52]; IN2: [10,12,15–17,22,23,26,33,34,36–39,41,43,47,50,52–61,63,64,67–69,76,78,80]; Performance: 52% of the corpus
	instrument	IN1. Promote financial services; IN2. Retrofit and enhance research and innovation	
10 REDUCED INEQUALITIES	ideal	ID1. Reduce inequality;	N/A Performance: 0% of the *corpus*
	instrument	IN1. Adopt Social protection policies; IN2. Strengthen the implementation of regulations and institutions; IN3. Implement migration policies	
11 SUSTAINABLE CITIES AND COMMUNITIES	ideal	ID1. Inclusive, safe, resilient and sustainable cities; ID2. Adequate and safe basic services/Upgrade slums; ID3. Reduce impacts on deaths and economic losses.	ID1: [9,17,24,26,35,37,38,40,45,50,52]; ID3: [10,15,22–24,33,36–44,47,52,57,58,60,62,64,72,79,81,82]; IN1: [9,10,16,17,22,24,26,27,30,33,37,40,42,52–55,59,61,64,72–74,78,79,82,83]; Performance: 51% of the *corpus*
	instrument	IN1. Implement integrated policies development	
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	ideal	ID1. Sustainable consumption and production; ID2. Achieve the environmentally sound management	ID1: [23,41]; ID2: [10,13,15–17,22,24,26,29–31,33–36,39–43,46–49,51,52,55–57,59–64,66,68,72–74,78,79,81–86]; IN1: [10,23,24,34,35,40,43,47–49,52,70,72–74,79,82,86,87]; Performance: 63% of the corpus
	instrument	IN1. Implement programs on sustainable consumption and production patterns; IN2. Policies to rationalize inefficient fossil-fuel subsidies	
13 CLIMATE ACTION	ideal	ID1. Combat climate change; ID2. Strengthen resilience	ID1: [9,10,14–17,22–24,26–28,30,34,36–40,42,43,45,46,48,50,52–64,68,73,77,78,87–89]; ID2: [40,78]; Performance: 56% of the *corpus*
	instrument	IN1. Implement national disaster risk reduction strategies	
14 LIFE BELOW WATER	ideal	ID1. Conserve oceans, seas, and marine resources.	ID1: [30,37,39]; Performance: 3% of the *corpus*
	instrument	IN1. Regulate harvesting and combat illegal fishing; IN2. Develop science and technology; IN3. Recognizes rights for small-scale fisheries	

Table 1. *Cont.*

SDGs		SDG Ideal and Instrument Achievement	Results per Reference and Its Performance (%)
15 LIFE ON LAND	ideal	ID1. Protect, restore and promote sustainable use of terrestrial ecosystems	N/A Performance: 0% of the *corpus*
	instrument	IN1. Promote the implementation of sustainable management; IN2. Restore and conserve degraded land and soil; IN3. Finance and resource mobilization	
16 PEACE, JUSTICE AND STRONG INSTITUTIONS	ideal	ID1. Peaceful societies; ID2. Reduce violence; ID3. End abuse and exploitation; ID4. Reduce corruption and bribery	N/A Performance: 0% of the *corpus*
	instrument	IN1. Promote Public Policies to ensure justice, participation, and accountability	
17 PARTNERSHIPS FOR THE GOALS	ideal	ID1. Sustainable development; ID2. Share knowledge	IN1: [8,17,23,29,43]; IN2: [25,52,72]; IN3: [7,8,23,28,47,74,76,88,90]; **Performance: 16% of the *corpus***
	instrument	IN1. Strengthen domestic resource mobilization; IN2. Implement development assistance commitments; IN3. Promote access to science, technology, and innovation; IN4. Global partnership for Sustainable Development	
Total	**42**	**36**	**N/A**

The "instruments" category, in its turn, used keywords found in the SDG targets that were associated with measures/actions developed to achieve the SDG goals. For example, the target 7.a SDG—"By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology"—was summarized into the following keywords: "clean energy", "research and technology", "cleaner fossil-fuel technology", "energy infrastructure", "clean energy technology", "international cooperation", and "clean energy research", which, in turn, was allocated as an "instrument" of "Enhance international cooperation to clean energy research and technology". Figure 2 summarizes the categorization methodology's development.

As a result of this categorization, i.e., the selection of keywords into SDG ideals and SDG instruments, a scoring analysis was performed through a Python script. The script was designed combining a PDF miner and a keyword processor. The script goes through each article and compares the keywords related to the SDG ideals and instruments with the words in the PDF. It then counts the number of times each keyword appears in the text.

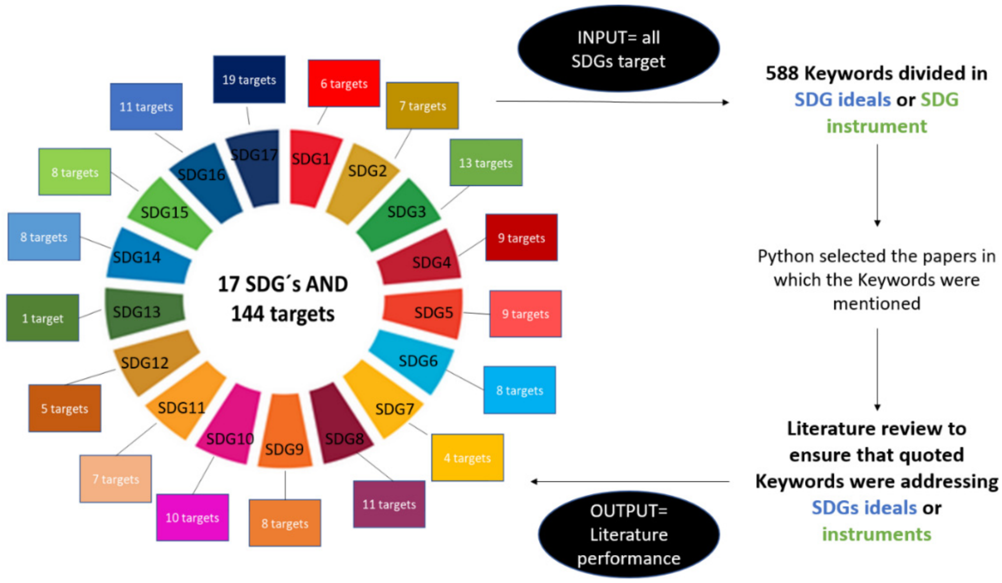

Figure 2. Categorization methodology developed for addressing RFT literature SDG achievements.

Finally, since Python is unable to judge if each keyword is directly related to the SDG or just, for example, a coincidence, the coherence of the keywords was analyzed by reading each paper and judging if the keywords found in each paper were related with the SDG's ideals and instrument goals. A matrix was developed with all 86 papers listed in a column and their keywords. By doing this, all papers were scored considering the keywords found and if they addressed the SDG's general ideals or instruments.

3. Systematic Review Results

As it is possible to see in Figure 3, from the total of 42 ideals that could be targeted by the RFT literature, 22 SDG ideals were addressed, which represent 52% of the SDG coverage by the analyzed *corpus*. It is important to know that this result does not imply a high level of comprehensive literature engagement, since a single mention in one article to any of the keywords related to the SDG was sufficient to be scored and considered as an achievement of the *corpus*. This was the case for the following ideals: SDG1—reduce vulnerability; SDG4—lifelong learning opportunities; SDG6—water quality; and SDG16—peaceful societies.

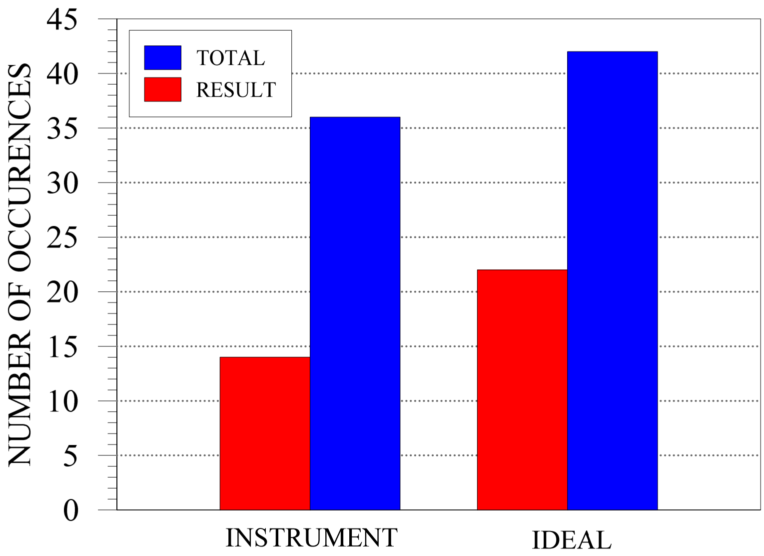

Figure 3. Road freight transport literature performance in achieving SDGs ideals and goals.

Regarding the instrument's achievement, from a total of 36 SDG instruments, the literature addressed 14 SDGs instruments (39%). So, less than half of the intended SDG instruments where target by the *corpus*. The same situation discussed for the SDG ideals happened for some of the SDG instruments, where just one paper scored the instrument and it was counted as the *corpus* achievement: SDG2—implement measures to food reserves, access to land, and limit food price—and SDG3—support research and development.

From the total of 20 non-targeted SDG ideals and 22 non-targeted SDG instruments, the following are directly associated with the sector and, thereby, should be further focused by the RFT literature: SDG8 ideal—productive and decent work; SDG15 ideal—protect, restore, and promote sustainable use of terrestrial ecosystems; and SDG17 ideal—sustainable development.

Mainly, the SDG12 instrument—policies to rationalize inefficient fossil-fuel subsidies—is particularly important for the sector, and curiously, none of the 86 papers had addressed or discussed this kind of policy implication since most of the papers were developing fuel technology replacements, which implicates them in policy analysis, i.e., calculating the impact of NOx emissions from changing from diesel fuel to other fuels.

Nevertheless, it is worth mentioning that four SDGs were not targeted at all: SDG5—gender equality; SDG10—reduce inequalities; SDG15—life on land; and SDG16—peace, justice, and strong institutions. These SDGs did not have any of their ideals or instruments addressed by any of the 86 papers. Although this is an important gap concerning the RFT literature's performance in addressing the SDGs, it was expected that the technical literature would not bring such themes to the discussion. Figure 4 presents the overall performance of the *corpus* in achieving each SDG regarding the ideals and instrument categories.

From all SDGs, just "SDG7—ensure access to affordable, reliable, sustainable and modern energy for all" had all ideals and instruments addressed by the reviewed papers, which means that this SDG was fully contemplated by the *corpus*. Nevertheless, it is important to understand how this literature is addressing the SDG ideals and instruments. Table 1 presents the allocation of SDG into ideals and instrument categories, and as mentioned in the methods sections, the keywords were selected from the 17 SDGs and their respective targets into keywords that represent the SGDs' "ideals" or the SDGs' "instruments", resulting in a total of 42 SDG ideals and 36 SDG instruments. In red, Table 1 presents the SDGs' ideals and instruments that were not tackled, and the last column presents the contemplated ideals and instruments per reference.

Analysis of the SDGs' achievement by the *corpus* will be developed from the least achieved SDG to the most, with examples of how papers addressed the topics of each SDG.

SDG4 was addressed by 3% of the analyzed papers. ZHANG et al. (2019) [9] addresses the SDG4 ideal "decent job" when considering it as a factor of influence for truck fleets′ willingness to purchase alternative fuel vehicles (AFVs) in China, the need to consider as a cost for the transition, and the employment of new maintenance workers for AFVs. TAEFI et al. (2016) [50] addressed SDG4's ideal "lifelong learning opportunities" when the authors specify that there will be a need for large investments in research, development, and pilot projects for training new workers for the delivery of supplies or the maintenance of technical equipment related to emissions-free vehicles.

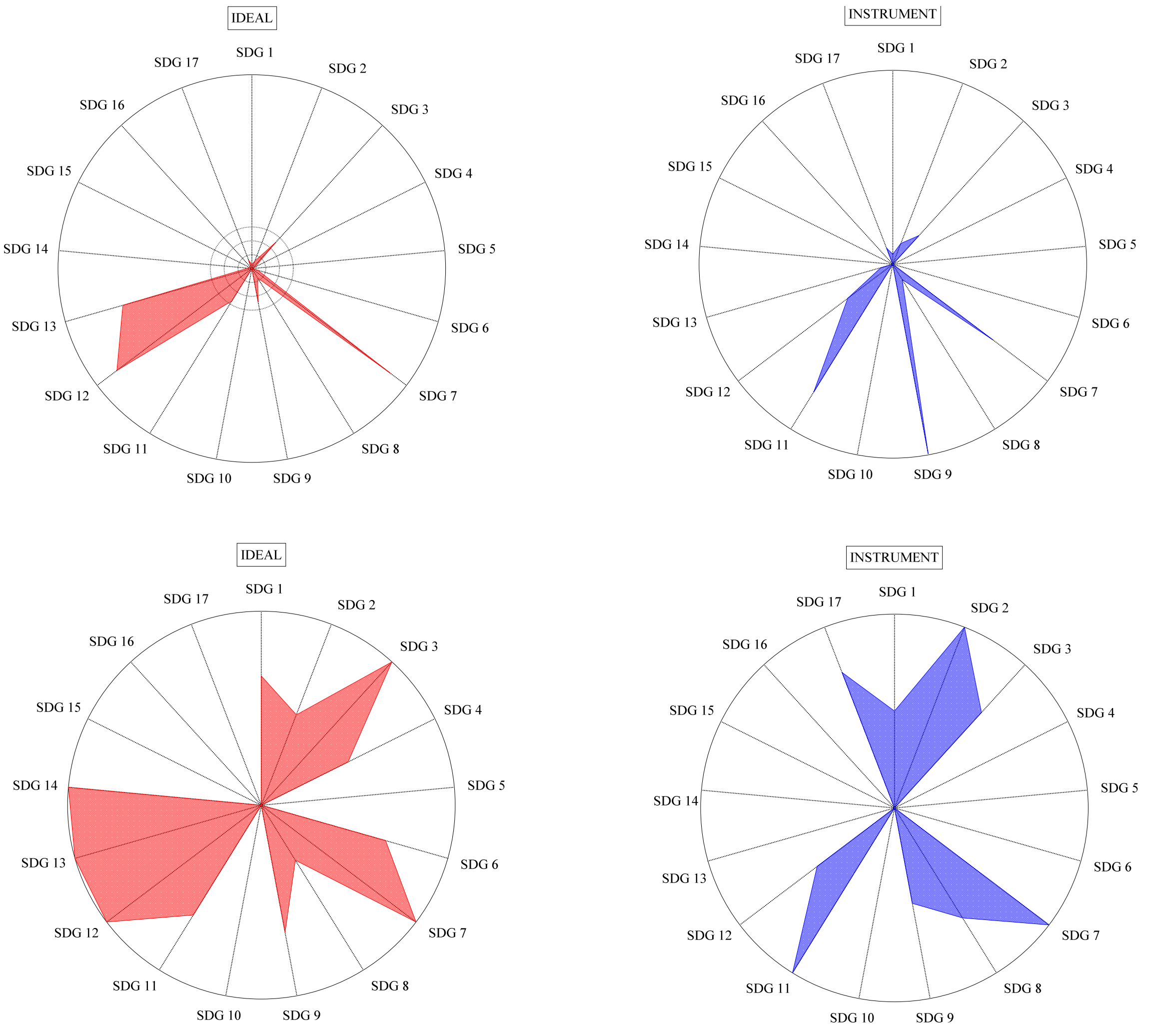

Figure 4. Road freight transport literature performance in achieving SDGs ideals and goals.

Regarding SDG14 (also with 3% of the analyzed papers), Osorio-Tejada; Llera-Sastresa; Scarpellini, (2017a) address SDG14's ideal "conserve oceans, seas, and marine resources" when they refer to the environmental risks of the construction of regasification terminals near settlements or in protected natural areas. Specifically, authors mention the "fracking and methane hydrates extraction from beneath the ocean floor, still generate controversy for their environmental risks" [39], p. 791.

SDG1 was the target of 5% of the papers in this *corpus*. SEN et al. (2019) [25] found that the costs incurred by the health impacts of tailpipe emissions are the major cost component for each HDT, so this was considered as one angle of the discussion of SDG1's instrument "ensure resources for National Policies and Programs".

Regarding SDG6, it was found in 6% of the papers, in which [27,37,40] relate SDG6's ideal "water for all/reduce water scarcity" when presented that oil and gas operations extraction methods, such as fracking, could affect the availability and quality of water and soil [40] or when analyzing the water final uses in the RFT feedstock fuel production [27,37]. Regarding SDG6's ideal "water quality", papers [23,46] argue that freshwater eutrophication, human toxicity, eco-toxicity, soil/water contamination, and natural land transformation are the most relevant impact when comparing RFT fuels options.

SDG2 was target by 10% of the analyzed *corpus*. Papers that addressed SDG2's ideal "end Hunger and malnutrition" discuss the challenges associated with biofuels in the indirect land-use change, which can result in additional GHG emissions and raise concerns around food security and biodiversity maintenance [26–28]. So, the discussion relates to the production of energy with food security and access to food.

SDG17 was scored by 16% of the *corpus*. SDG17's instruments were observed as a general policy recommendation in papers that were exploring possibilities of the RFT energy transition. So, SDG17's instrument "strengthen domestic resource mobilization" was targeted as a way to improve the domestic capacity for taxes and other revenue collection to fund sustainable transport in a renewable-based energy system and to mobilize additional financial resources [8,17,23,29,43].

SDG8 was targeted by 16 papers—19% of the total. The ideal "promote economic growth" was mentioned in eight papers as a possible outcome from the investment in the transport sector [8,10,32,41,51,53,72,78]. Its instrument "promote development-oriented policies" was target by five papers whose main concerns were about the technological upgrading and innovation of the transport sector [23,26,44,56,57]. Lastly, the instrument "implement resource efficiency programs" was only targeted by three papers in reference to the need for investment in resource efficiency [12,27,69].

SDG3 was scored by 23 references. SDG3's ideals "ensure health and well-being", "end preventable deaths, reduce disease", and "reduce deaths from hazardous" were discussed by 17 papers that mentioned the relation between road freight fuel options and its pollutants emissions and the public health and well-being nexus [22,24,25,33–41,43–46]. Half of these papers also scored for the instrument "ensure access to universal health coverage and financing", but from a perspective of the social costs of the choice of fuel and its implication on public health [10,13,22,24,25,33–35,42–44,47,48].

SDG11 was target by 51% of the *corpus*. SDG11's ideal "inclusive, safe, resilient and sustainable cities" was scored by 11 papers that mentioned the influence of RFT on the possible pathways for making cities sustainable [17,24,35,37,38,52]; for instance, [38,40] suggest that LNG use in HDT has the potential to reduce environmental impacts and noise in cities.

SDG9 was addressed by 52% of the *corpus*. The ideals "resilient infrastructure and sustainable industrialization" and "reliable infrastructure" were found in 24 papers (see Table 1). CONNOLLY (2017) found that there will be a need for large-scale investments in road infrastructure mainly for electric vehicles. OSORIO-TEJADA, LLERA-SASTRESA, and SCARPELLINI (2017a and 2017b) [39,40] highlight the decision-making relevance of defining a methodology to integrate the three pillars of sustainability to propose adequate road freight fuels policies, which will require legislative and infrastructural adaptations. SDG12 was addressed by 63% of the *corpus*; nevertheless, the ideal "sustainable consumption and production" was mentioned in just two papers [23,41]. On the other hand, the ideal "achieve the environmentally sound management" was target by 48 papers, in which the main arguments were built on the need to minimize pollution adverse impacts on the environment and on the need to reduce air pollution from diesel-powered trucks [73,82]

Finally, SDG13 was targeted by 56% of the *corpus*. SDG13's ideal "combat climate change" was scored by 45 papers (see Table 1), addressing this issue by studying and discussing the technologies (fuel substitution and other related transport sector technologies, i.e., road infrastructure for electrical vehicles, batteries technologies, and combination of biofuels to replace diesel fuel) in experimental, life cycle analysis, or cost–benefit studies that aim to point to the best options to reduce the transport sector's impact on GHG emissions and other pollutants.

Nevertheless, just two papers were found on the ideal "strengthen resilience": Osorio-Tejada, Llera-Sastresa and Scarpellini, (2017b) touch on the SDG ideal context by presenting some literature review on adaptability implementation barriers for road freight alternatives fuel and rail infrastructure. Yangka and Newman (2018) [78], in turn, discuss how to strengthen Bhutan's resilience to climate change by analyzing both transport and industries energy policies.

Lastly, SDG7 was target by 65% of the analyzed papers. The ideal "access to modern energy" was mainly targeted because all papers consider biofuels and electric mobility as types of modern energies, but no paper addressed the universal access to modern, affordable, reliable, and sustainable energy in the transport sector. From the total of the 56 papers that had scored on the SDG7, 22 also scored for the ideal "increase renewable energy" by arguing for the need to increase the share of renewable energy in the RFT sector [12,52,55] by improving the sector's energy efficiency [8,46,56] and by developing renewable energy production, including in hybrid systems [17,36,41].

4. Gaps and Knowledge Areas to Be Addressed in Future Studies

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

As presented in the previous section, a great *gap* inside road freight literature was identified regarding its performance in discussing the SDG ideals and instruments. The analyzed *corpus* is developed in a very technical approach and does not recognize the need for developing an integrated and holistic research agenda. Nevertheless, of all the 17 SDGs, it is possible to consider that SDGs 1, 4, 5, 10, and 14 are not a priority for the RFT literature's future areas of development. These SDG are essentially cross-sectional themes related to structural problems of our society (i.e., end poverty, quality education, and gender equality), and exploring such issues from the perspective of the RFT research agenda makes little if any sense.

Nevertheless, it is important to address the SDGs holistically, and the review performed here shows that the literature can still advance in key issues that are directly related to this research agenda. In this regard, SDGs 2, 3, 7, 9, 11, 12, 13, and 17 is advised as priority areas to be further developed by the RFT literature. Figure 5 presents a summary of key SDGs that need to be addressed by future studies.

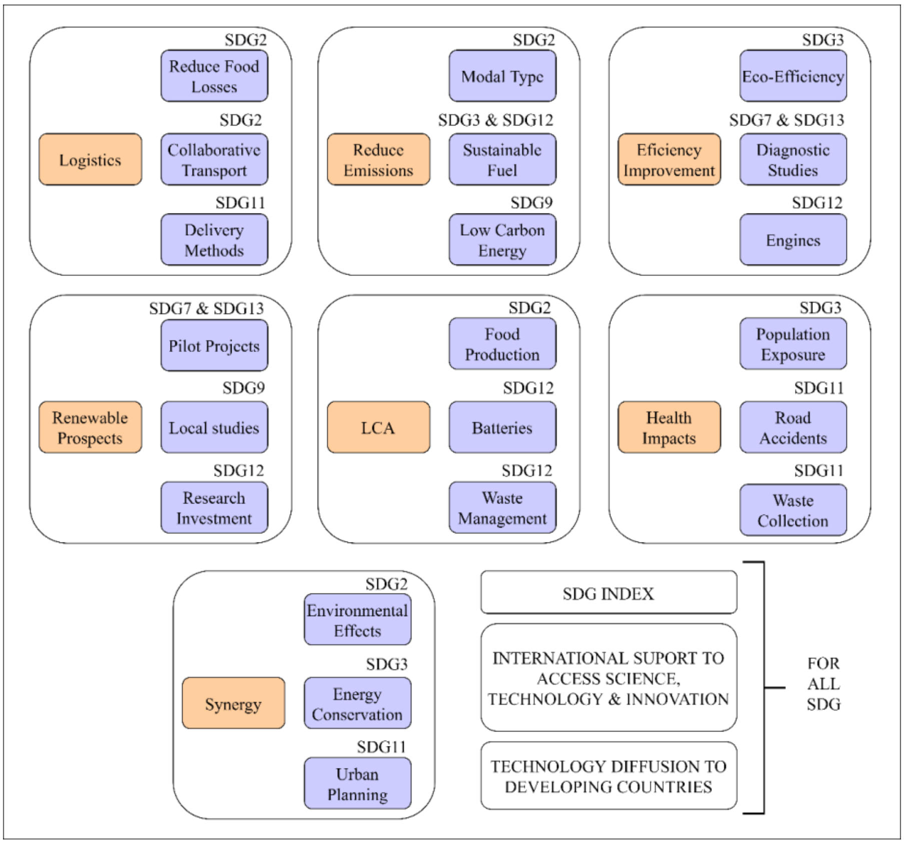

Figure 5. Summary of priority areas to be addressed in the near future.

The previous sections have shown the disparity in the objectives of articles in the road in environmental, economic, and technical RFT literature, which does not necessarily mean that studies from the fields of social, regulation, sectorial, and public policy have not addressed issues in the cross-section of freight transport and SDGs. Therefore, based on the importance of SDGs' integration tradeoffs and synergies [91] and the importance of transdisciplinary research [92], it is possible to draw from other areas of science to build the knowledge of environmental, economic, and technical fields of research. For instance, SDG2 is concerned about ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture. Although this SDG is not directly related to RFT, it does have important connections on some topics.

LIPIŃSKA et al., (2019) [93] demonstrate the social relationship that food loss during cargo transportation can have by redirecting cargo considered inappropriate for commercial quality for people in vulnerable financial conditions, thus limiting food waste. Thus, the RFT system can be analyzed encompassing other SDGs, such as those that discuss sustainable consumption and production patterns (SDG12). To incorporate the proposed goals and indicators of SDG2 in a future RFT literature research agenda in environmental, economic, and technical areas of research, we highlight the following themes:

- Studies designed to promote intelligent food logistics, aiming to reduce the scale of food losses and waste in the cargo transport phase;
- Improve logistics by implementing collaborative transport based on geographic location, reducing travel distance and improving truck utilization;
- Studies on the life cycle assessment of food production, considering the emissions associated with the transport of raw materials.

SDG3 aims to ensure healthy lives and promote well-being for all at all ages. Considering the transport sector and the heavy-duty trucks′ scope of analysis, this SDG can be related to the reduction of deaths and injuries caused by traffic accidents [94]. In addition, it is also necessary to deepen the understanding of the negative impacts on humans health by the RFT sector [95–98].

Thus, the RFT system can be analyzed encompassing other SDGs, such as those that talk about sustainable industrialization and innovation fostering (SDG 9). From this discussion, we present general recommendations for future research to improve the understanding of this SDG for road cargo transportation:

- Studies focused on reducing air pollution from trucks, promoting decarbonization, adopting sustainable fuel;
- Studies that focus on mechanical changes in heavy vehicles, aiming at the ideal configuration for their best eco-efficiency;
- Studies aimed at reducing the population′s exposure to emissions, especially those that live close to highways.

Even though SDG7 and SDG13 had presented the highest levels of assimilation by the *corpus*, when compared to the other SDGs, the RFT literature must be better engaged with the ideals and with the goals set by these SDGs.

Energy lies at the heart of both the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change, and according to the United Nations (2019), advancement in SDG7 has the potential to spur progress across the other SDGs (SDG4—quality education; SDG8—inclusive economic growth and jobs; SDG10—reduced inequality; SDG13—climate change; SDG16—peace, justice, and strong institutions; and SDG17—partnership for the goals).

Yet, progress on SDG7 is falling short. There is still much to do to ensure universal access. About 840 million people still lack access to electricity, and around 3 billion people rely on wood, charcoal, animal and crop wastes, or other solid fuels to cook their food and heat their homes, and the rate of progress towards cleaner fuels and technologies slowed down between 2009 and 2017 [99]. In this sense, RFT literature needs to advance in the following topics:

- Energy efficiency: qualitative and quantitative analysis and discussion based more on diagnostic studies rather than scenarios development;
- Renewables prospects, policies, and technologies for transport end use, focused more on pilot projects and empirical measures;
- Synergies between climate change, affordable energy, and strategies for energy conservation on the RFT.

It is well-known that the transport sector depends on different variables to be managed, and infrastructure is one of them. Without the proper infrastructure, any type of modality will struggle to be implemented. So, SDG9 is of high-level importance to the sector. Moreover, SDG9 includes sustainable industrialization and fostering innovation, which have been pushing the development of alternative fuels for HDV to improve engine efficiency and reduce emissions [13,16,17,68,100]. To incorporate the targets and indicators proposed by this SDG, it is suggested that some areas should be deeply studied:

- Energy decarbonization and the improvement of efficiency considering the local level energy potential to provide electricity generation to fuel e-buses or e-trucks;
- Evaluate the actions for sustainable development in different countries through indices and measuring progress, which could facilitate the benchmark, identify mutual trends, and the first step for policy formulation and advocacy;
- Increase research for cleaner technologies in specific places, not in a general way, since each country has particular characteristics regarding energy intensity, subsidies, and infrastructure.

In its turn, SDG11 is concerned about the sustainability of cities and how to develop an urban environment that is accessible, affordable, and inclusive, targeting relevant urban issues such as homes and transport, water and air quality, and urban development and planning [101]. This scope in its majority does not cover RFT, which does not mean that SDG11 has no connection with freight.

Future research in the field of RFT should address the SDG11 from the "inclusive, safe, resilient and sustainable" perspective and find ways to expand the SDG11 targets created for public transport to the freight sector. In general, research should approach ways to deliver goods and services at the local level with better environmental conditions, with improved road safety, and greater accessibility:

- Study the effects of freight on road conditions and how these effects can be avoided;
- Study more inclusive urban delivery methods and reach the more vulnerable;
- Study ways to include RFT into municipal urban planning;
- Study ways to increase waste collection and adapt the traditional truck collection to more sustainable ways.

SDG12 addresses the implementation of sustainable consumption and production. Thus, SDG12 can contribute to pushing the research on the use of waste sources for fuel/energy production for example. Some areas that need to be studied considering the area of the heavy-duty trucks and SDG 12 are as follows:

- Fuel production from liquid and solid waste to reduce oil dependency;
- Improve engines efficiency contributing to reducing fuel consumption and emission;
- Research considering electric trucks instead of trucks powered by internal combustion engines;
- Research about material considering those to build electric vehicles and batteries to reduce impacts and go behind sustainability production.

Finally, SDG17 focuses on global partnership. In the case of globalization, the RFT is seen as having a double role, as a beneficiary of its development, through the sharing of data, services, and information, and as a proactive agent [102]. With globalized knowledge, the overall cost of providing new transport systems would be reduced, which enhances the ability of effective local transport systems [103].

Critical challenges within the transport and infrastructure sectors are more and more subject to technology-based solutions. However, the lag between the innovative technologies cycle in the RFT and the political cycles in many countries still leads to technical fragmentation and interoperability issues across countries [103].

When it comes to strengthening the means of implementation and revitalizing the global partnership for sustainable development (SDG17), the RFT sector could benefit from research in the following areas:

- Analyze the existing international links that enhance the access to science, technology, and innovation of vehicles and how they can help develop a global technology facilitation mechanism for the sector;
- Study the transfer, dissemination, and diffusion of environmentally sound technologies to developing countries.

5. Conclusions

This study found that the RFT literature does not perform well in achieving the SGDs' ideals and instruments. It is worth mentioning that there are some limits in this study since the analyses were performed considering a scientific papers from two database and bounded by language and keywords. Publication data were another filter used in the systematic review, although SDGs were presented only in 2015, which makes the period range ideal in this case.

The highest-scoring SDGs were SDG7 (65%), SDG12 (63%), and SDG13 (56%); the lowest-scoring ones were SDG1 (5%), SDG4 (3%), and SDG14 (3%). In addition, SDGs 5, 10, 15, and 16 were not mentioned at all. Thereby, the RFT literature must advance the literature on key-issues that are directly correlated with this research agenda and are still poorly addressed by the corpus. In this regard, we advise for the development of SDGs 2, 3, 7, 9, 11, 12, 13, and 17 as priority areas to be further developed by the RFT literature.

The analyzed corpus is developed in a very technical approach and does not recognize the necessity of integrated and holistic research development. In addition, there is a lack of a broad-spectrum discussions of relevant SDGs synergies, and these present relevant themes that should be addressed by futures studies in the field, since only SDG7 was fully contemplated by the analyzed corpus.

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