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Systematic Review

Sustainability Indicators of Surface Public Transportation

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Abstract: Historically, roads and transportation have been critical and essential factors in the development and prosperity of cities and societies. The well-being of cities and their expansion were measured by the road networks that linked them to the rest of the world, especially the land roads, which were the biggest challenges for communities. With time, the transportation sector has become an integral part of human life. However, this contribution to the development of cities has come to collide with the challenges arising from the means of transportation, which include large-scale environmental, economic, and social impacts on the communities benefiting from them. Therefore, it has become necessary to make transportation, especially public transportation, sustainable to address environmental challenges such as climate change. To achieve this, more than two thousand research papers published between 2002 and 2022 and retrieved from scientific databases using specific and connected keywords were preliminarily investigated based on the year and number of citations. It was necessary to identify the important sustainability indicators for each sector and study them closely in a detailed manner. We concluded that the sustainability of public transportation is directly affected by environmental, economic, technical, and social factors which can be expressed as follows: 1—emissions, pollution, and the consumption of energy resources as environmental indicators related to sustainability; 2—travel time, cost, travel distance, and operation cost as economic indicators; 3—social demographics, accessibility, and travel behaviours and time as social indicators; and 4—traffic flow, speed, and availability of infrastructures as technical indicators that affect transport sustainability.

Keywords: sustainability indicators; public transport; sustainable development; systematic review

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1. Introduction

Researching and improving the definition of sustainability in order to facilitate the sustainable development of transport systems requires the consideration of a huge number of factors. Maintaining sustainability requires developing transport system control procedures and strong measuring and decision-making tools [1]. Numerous definitions of sustainability can be found across different sources, leading to a lack of consistency. Similarly, the principles for achieving sustainable development in public transportation systems are not thoroughly defined in the existing literature [2]. Careful planning is essential for expanding transportation infrastructure and services cost-effectively and environmentally sustainably while maintaining financial stability. The effect of transportation on various aspects of society, like economy, mobility, development, quality, government financing, the environment, and quality of life, is significant. Understanding the factors that affect the choices people make concerning their mode of transportation in different areas is also crucial for comprehending travel behaviour [3]. Sustainable development and transport are linked; for example, cities worldwide experience congested roads due to a reliance on automobiles, leading to environmental, noise, and accident costs [4,5]. As a result,

transportation networks take on a paradoxical role: they drive urban development, but, at the same time, they lead to a series of challenges. These challenges include economic, social, and environmental impacts [6,7]. Challenges across these three spheres can be considered 'sustainability challenges'.

CO_2 emissions from the transportation sector have increased, with over 50% of these emissions coming from passenger vehicles [8]. Since 1990, greenhouse gas (GHG) emissions from the transport sector in the EU have grown considerably, and they are projected to continue increasing [9,10]. The transportation sector is one of the EU's largest sources of greenhouse gas emissions. In 2011, transportation represented approximately 25 percent of the EU's total greenhouse gas emissions. Urban mobility accounts for 40% of all CO_2 emissions from road transport and up to 70% of other pollutants from transport [11].

These emissions should be reduced by 55%, and zero emissions should be achieved by 2050 [12]. Burning fossil fuels, such as gasoline, produces emissions that contribute to global climate change [13]. Public transportation, along with walking and cycling, are encouraged because they produce fewer negative externalities than private motorised modes of transportation and are therefore crucial factors in urban sustainability design and GHG emission reductions [14]. These emissions can also be reduced by improving propulsion sources and traffic flow (avoiding traffic jams due to accidents) [15]. The transport industry must adopt the idea of sustainable development, which involves people satisfying their own needs by calculating opportunities for subsequent generations [16]. Insufficient understanding exists regarding the factors that inhibit individuals from utilising sustainable modes of transport, such as walking, biking, or public transportation, and the underlying causes behind their transportation mode decisions, particularly in specific areas.

An investigation highlighted the significance of encouraging commuting by developing a personalised route planner that employs non-coercive tactics to influence travel behaviour. A utility function that accounts for four transportation modes (walking, biking, public transit, and driving) and four features (travel time, transportation expenses, environmental impacts, and health impacts) was devised to reflect user preferences precisely. This method can aid in creating tailored travel plans that meet individual requirements and desires [17].

More than two thousand research papers published between 2002 and 2022 and retrieved from scientific databases using specific and connected keywords were preliminarily investigated based on the year and number of citations. The purpose of this study is to conduct a comprehensive literature review covering the period from 2002 to 2022 to identify popular research topics, address knowledge gaps, suggest future directions for sustainable transportation, and summarise the most important indicators that can be used to evaluate transport sustainability.

In Section 2, we present a brief literature review in two parts. The first is a general review of the literature concerning sustainable transportation, and the second defines sustainability dimensions based on past studies. Section 3 explains the methodology used for this research. Section 4 shows and discusses the results obtained from the research outlined in Section 3. We then illustrate the conclusions of this research in Section 5. Finally, in Section 6, our recommendations for future work are outlined.

2. Review of Previous Work

2.1. Sustainable Transportation

This analysis of transportation systems encompasses various components, such as human behaviour, network configuration, system geography, external influences (such as politics and economics), and available modes of travel. On the other hand, sustainability encompasses multiple elements, including human welfare (the social aspects), economic expansion, and environmental impacts of human growth and development. Combining these complex fields into a common domain poses a challenge. Therefore, this review aims to elucidate current perspectives on the intersection of transportation and sustainability [1,18–20].

2.2. Defining Sustainable Transportation

Sustainable transportation has become a topic of great interest among scholars, policymakers, and industry professionals, partly because of its link to sustainable development, which encompasses environmental, social, and economic aspects. Additionally, the transition toward future mobility is fuelled by the need for economic, environmental, and social sustainability. Numerous studies indicate that autonomous and shared autonomous vehicles are expected to greatly improve transportation network efficiency [21,22], which should lead to increases in the consumer surplus and social welfare for the public [23]. As a result, the implementation of this technology is being promoted, and it is anticipated to have a high adoption rate over the next two decades [24]. The idea of sustainable transport emerged from sustainable development [25]. Sustainable transport can be defined narrowly as addressing environmental issues and resource depletion or, broadly, to include social and economic welfare. The broad definition is preferable as it enables a comprehensive consideration of all transport sector impacts, including environmental, social, and economic aspects [19]. There has been a continuous increase in people's interactions with and interest in aspects of sustainable transport [26]. In the past two decades, research activities spanning various topics concerning sustainable transport have significantly increased. It is now widely acknowledged that the topic of sustainable transport is not limited to transportation alone; it also involves institutional reforms, governance, policy making, and inter-sectoral interactions [19]. A broad spectrum of research topics has emerged around sustainable transportation. As such, it is important to comprehend the present status of this domain, as well as popular research topics, knowledge gaps, and possible future directions. This study aims to conduct a comprehensive literature review covering 2002 to 2022 to identify popular research topics, address knowledge gaps, and suggest future directions for sustainable transportation.

The act of reviewing existing literature aids in comprehensively grasping a research area. Scientists have conducted literature reviews in the realm of sustainable transportation. Transportation system analysis encompasses a wide-ranging subject matter that includes human behaviour, network design, system geography, external influences like politics and economics, and the various modes of travel available [27]. Sustainability is a complex concept involving multiple dimensions, including the social, economic, and environmental aspects of human development. The intricate nature of sustainability combined with the complexity of transportation systems makes examining the intersection of these two domains a challenging task [28]. According to studies, the indicators of sustainable transportation can be divided into four dimensions [29–33]. Researchers have evaluated the sustainability of transportation through social dimensions and dealt with social matters that affect sustainability, such as social factors related to equality, accessibility, behaviour, and social demographics. In the sector of economics, researchers have investigated the sustainability of transportation by focusing on the cost of travel, time, distance, GDP, operation cost, and income factors affecting the economic matters of the beneficiaries and operators and in terms of the development of cities and communities [34–36]. Also, a high percentage of researchers have studied and evaluated the sustainability of transportation by investigating the environmental aspects which have a direct effect on people, like the toxic gases resulting from climate change or the economic side of dealing with this toxic material and which emissions come from which modes of transportation [37–40]. The Technical and operational aspects can also be used to assess sustainability, and researchers have studies the infrastructure, LOS, speed, traffic flow conditions, and land use as main indicators to evaluate these aspects [41–44]. Also, according to a WoS analysis, the impact of sustainability and transportation research greatly depends on the country. Figure 1 illustrates that the USA has the highest number of researchers in sustainable transport, with 608 publications, and that China has the second highest, with 458 publications, then Italy, with 127 publications. India, which has the highest population density, comes in the 8th, with 101 publications, while Canada has produced 125 publications, Spain has produced

114 publications, Germany has produced 110 publications, and England has produced 99 publications [45].

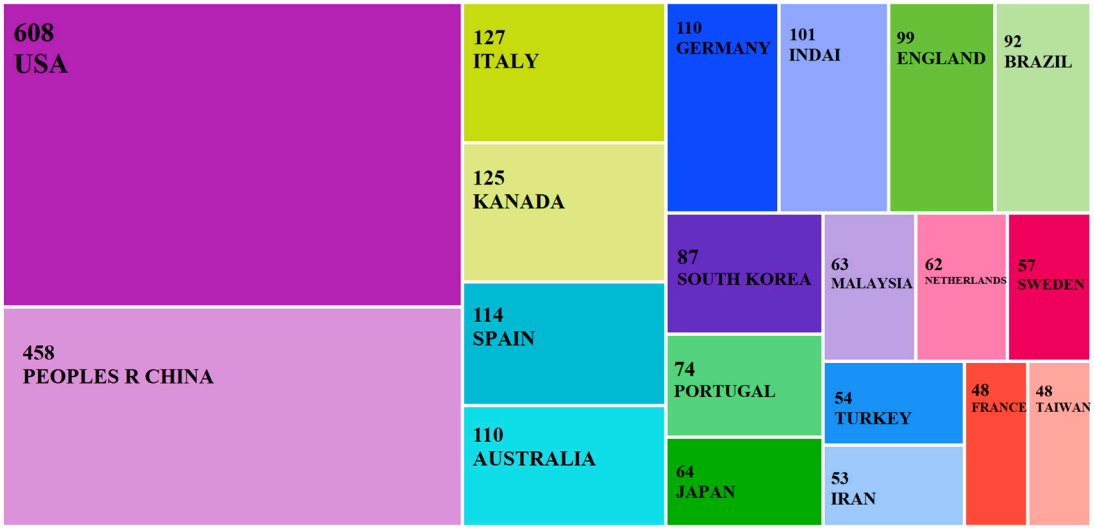

Figure 1. Distributions of publications by country according to WoS.

In our investigation-related articles, most of the researchers in the field of sustainable transportation mentioned in a general form the dimensions of sustainability. Without delving into these dimensions and the relevant environmental aspects, 45% of the publications studied emissions and climate change as a means to evaluate sustainability in transportation, while 39% focused on the economic side because most articles study the economy and environment simultaneously as side effects of emissions, taxes, or travel costs. A further 13% of the publications we looked at studied the social demographic variables to evaluate the sustainability of transportation according to the direct effects on users. The technical and operational aspects of sustainable transport have received the lowest amount of attention by those investigating sustainability, who connect them with economic issues concerning public transportation infrastructure.

3. Methodology

3.1. Overview

This study utilises a science mapping technique to analyse scholarly articles on sustainable transport published between 2002 and 2022.

Scientific mapping is a strategy used for analysing and visualising the intellectual structure of a particular scientific field by examining a significant amount of literature and bibliographic information. It can identify patterns and trends within a domain, and it is an efficient tool that can enable researchers to understand and explore scientific areas [13,46].

Numerous software tools have been created for science mapping, and these aid in examining and presenting patterns and trends about a particular domain in scientific literature. VOS Viewer (1.6.19), was used to analyse and visualise the intellectual structure of the sustainable transport domain. This study employed VOS Viewer, a tool for visual analytic tasks in science mapping. VOS Viewer can process bibliographic data and identify clusters and emerging trends through network graphs. After VOS Viewer was used, we investigated the top 53 papers related to certain sustainability topics to identify the highest indicators that affected the sustainability of public transportation (Supplementary Materials).

3.2. Data Analysis Method

This study employed a scientific metric analysis to map the science fields and keyword co-occurrences for this specific investigation. This offered a wider variety of related research topics than a traditional manual revision. Figure 2 illustrates the framework of

this research, starting from data visualisation to the analysis of the related dimensions and indicators of public transportation sustainability. As the figure shows, the article selection process involved three main steps: (1) a first round, in which articles were refined based on the keywords related to this research, e.g., sustainability and public transportation; (2) a second round, in which the most cited articles were selected and considered for a deeper investigation by reading the abstract of each one; (3) based on the analyses of the abstracts, if the article was found to be relevant, it was considered for a full investigation. Otherwise, it was discarded. This three-step selection process yielded a final selection of 53 articles.

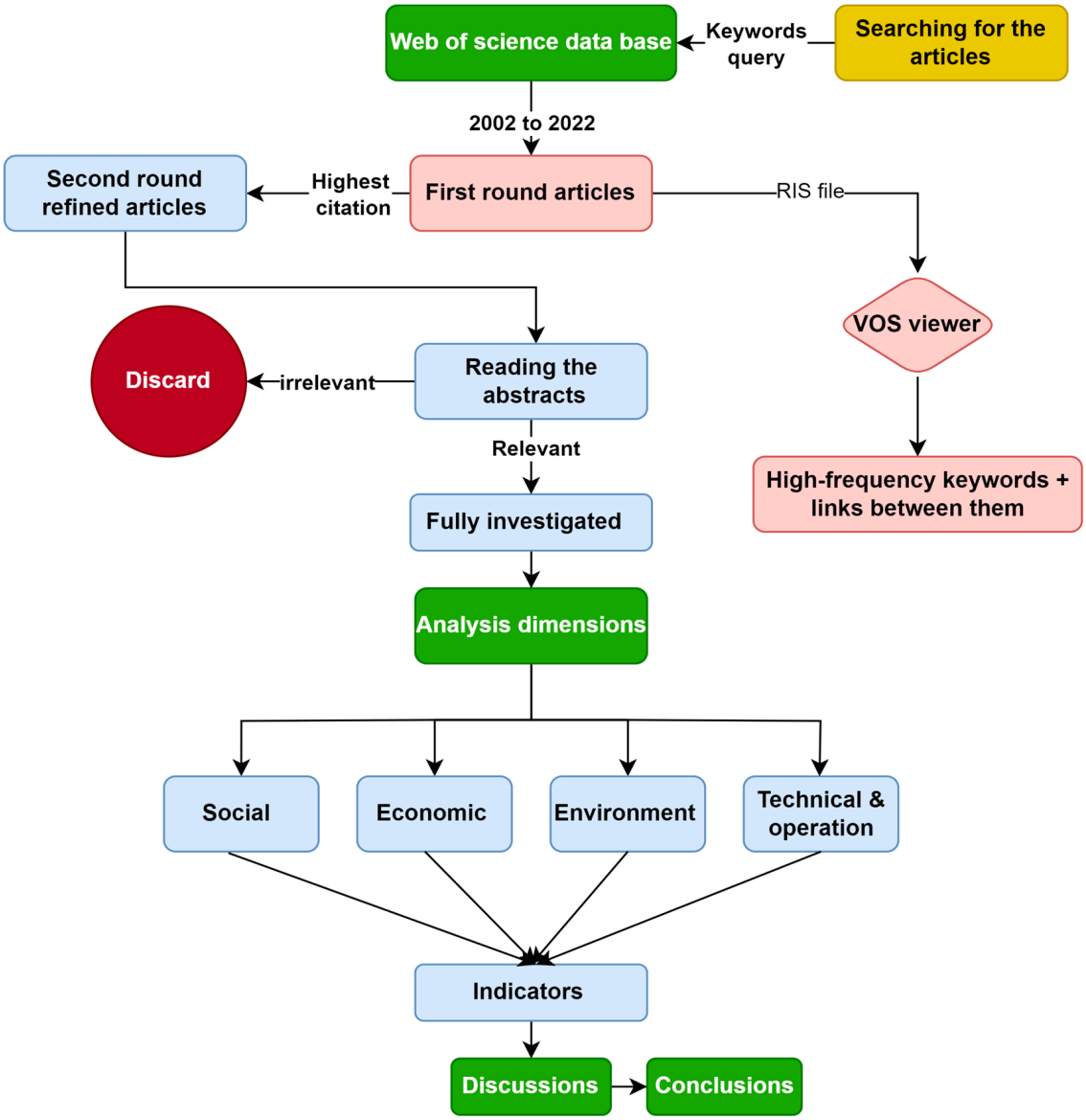

Figure 2. The methodological framework of the review process.

Keyword co-occurrence analysis entails identifying keywords that appear together in two or more publications within a specific time frame, thereby revealing significant research topics and trends based on the frequency and centrality of these keywords. Conversely, document co-citation analysis aims to understand the intellectual structure of the scientific field by creating a network of links between documents cited in subsequent publications. The most frequently co-cited documents tend to hold greater influence and be of greater impact within a field [47].

Figure 3 illustrates the number of articles on sustainable transport published in the past two decades, and it shows a general upward trend. In the first ten years of this period, only a few articles were published annually, ranging from 10 to 38 between 2005 and 2011. However, from 2016 to 2022, the number of articles dramatically increased from 144 to 401. This suggests that sustainable transport research has gained more attention and grown significantly over time due to the increase in the need for public transport and population increase, which have been accompanied by a large increase in the problems that the world is facing, such as pollution, climate change, and economic inflation, to which public transport contributes its share. Therefore, there is a continuous and urgent need to study these issues and find solutions to problems regarding the role of transport in general.

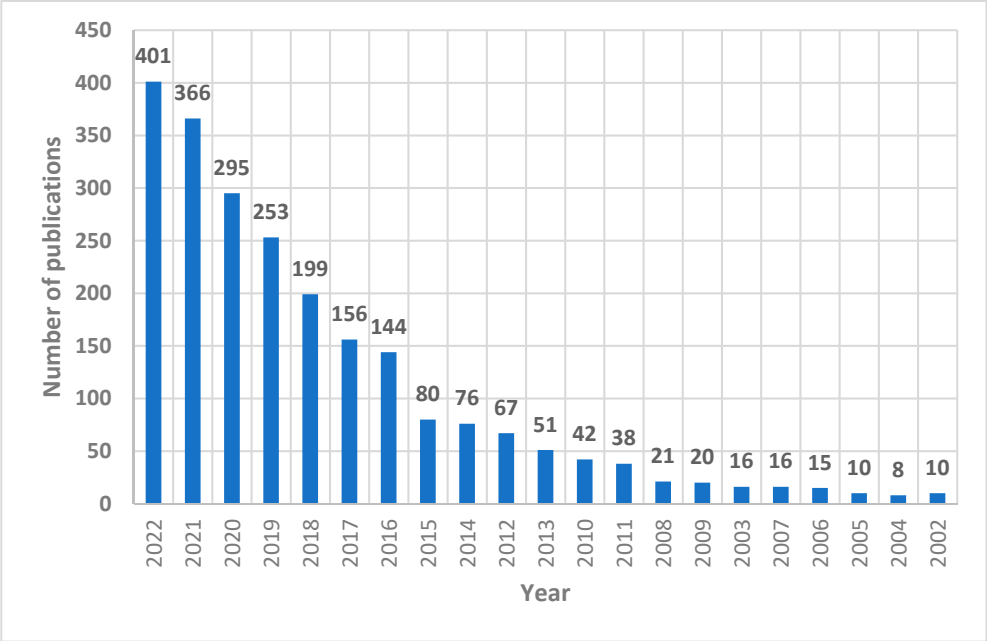

Figure 3. Historical distribution of relevant articles from WoS.

Keywords indicate the core content of articles and describe the topics of focus covered in a scientific domain [13]. Figure 3 shows a graphical keyword map, created using VOS Viewer software (1.6.1) [45], illustrating the associations between public transportation and sustainability in the Web of Science (WoS) database. A co-occurrence network was constructed, and a general query was employed to examine all instances of sustainable transportation in the literature: ALL FIELDS = (public transportation AND sustainability) in the range from 2002 to 2022. However, this query was applied with specific constraints to remain within the scope of this research. The search results were refined depending on the "Web of Science Categories". Four main categories were considered: economics, environmental, social, and technical. Using these conditions, 2555 publications were selected. The map shows the relations among 311 keywords from the chosen studies, which are depicted in clusters. These clusters display the connections between the keywords. The bubble size represents the number of keyword occurrences, and the links between the bubbles show the relatedness strength. There are a total of 21 clusters and 2246 links.

The keyword "sustainability" is quite prevalent in the research, appearing in several occurrences and forming 18 clusters with 118 links. Alternative fuels and energy consumption have also garnered significant interest, generating 13 clusters, 51 links, and 4 occurrences. Furthermore, researchers are paying substantial attention to decision-making processes when evaluating sustainability, as evidenced by the 10 clusters, 56 links, and 5 occurrences. We focused on the 200 publications with the highest number of citations in the WoS. They were downloaded and investigated by summarising each abstract and conclusion. After this process, the 53 articles most related to sustainability and transportation were selected

based on many factors, like the mode of transportation, the models used to analyse the data, the year of publication, the citations, the region, and the number of keywords related to the targeted field. We undertook a thorough investigation to illustrate the goals and objectives of the authors, the dimensions of sustainability according to the researchers, and the connections between these dimensions. Finally, we summarised the indicators used to evaluate each sustainability dimension related to the transportation mode.

Figure 4 shows the Keyword co-occurrence network produced using our search and the links between them: 'mode choice', 'sustainability', 'behaviour', 'choice', 'transportation mode choice', 'public transport', 'travel mode choice', 'alternative fuel', 'travel', 'bike-sharing', 'emissions', 'carbon', 'decision-making', 'economics growth', 'smart cities', and 'climate change'. Moreover, it shows strong links between sustainability, public transport, and emissions.

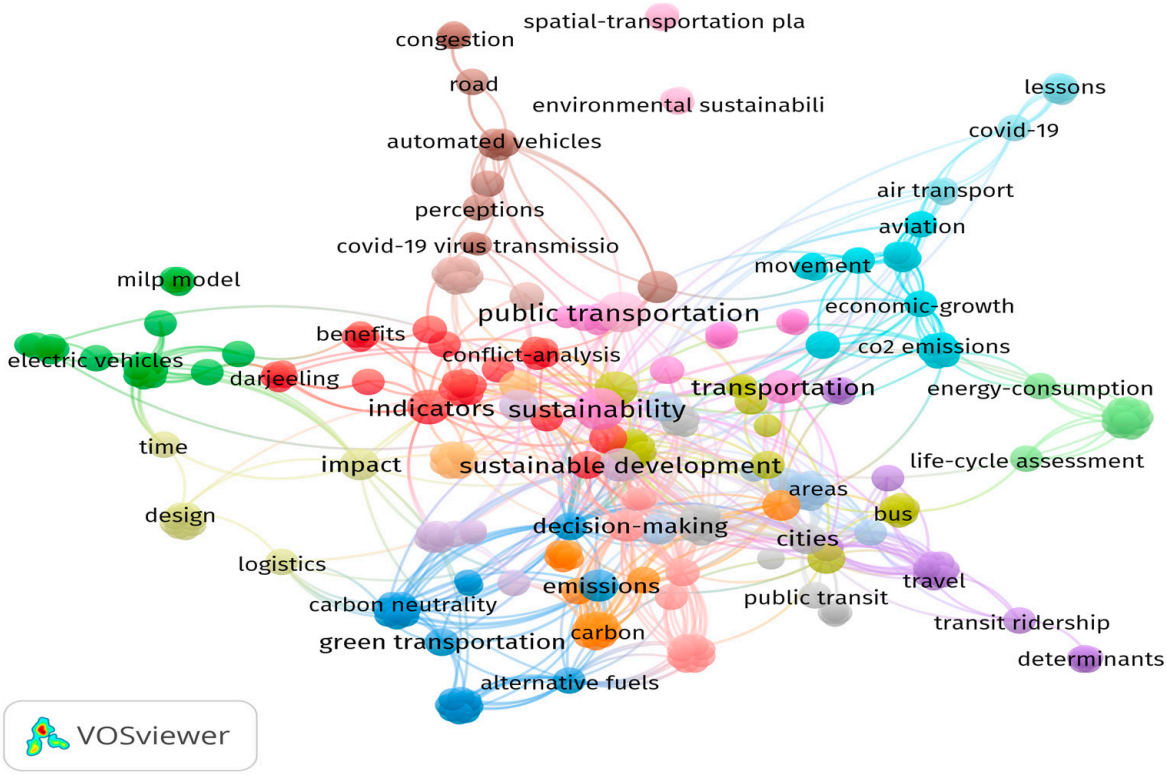

Figure 4. Co-occurrence map of keywords associated with public transportation and sustainability (WoS).

4. Results and Discussion

In this part of our research, we investigated the 53 articles and their indicators (shown in Figures 5 and 6) to determine which had the highest number of connections to sustainability topics. We identified the sectors that engaged with transportation and the components for each sector over the years. The selected articles were published between 2002 and 2022, and the number of articles increased over the years. We found a positive correlation of 0.71 between the years and the number of articles. This is evidence of the increased interest shown by researchers in the issue of public transport sustainability. Many criteria were used to classify the 53 articles, starting with several citations and focusing on the dimensions of sustainability related to public transportation. All the publications referred to surface public transportation and its effect on society. Most of them covered the socioeconomic and environmental sides of sustainability. Approximately 25 studies delved into the societal impact of these transportation modes on the environment, examining dimensions such as health, income levels, equity, and accessibility [39,42,48]. From the 17 publications that explored user behaviour, it was evident that user comfort and satisfaction play a pivotal role in influencing the demand for public transportation. Furthermore, characteristics

such as gender and age were employed to assess the sustainability of transportation by encouraging the adoption of more sustainable travel modes [29,32,49,50]. The availability of land and facilities for public transport impacted sustainability on two sides. The first was sustainability and land usage and its effect on society. Also, technology solutions can support the sustainability of public transport [14,51–53].

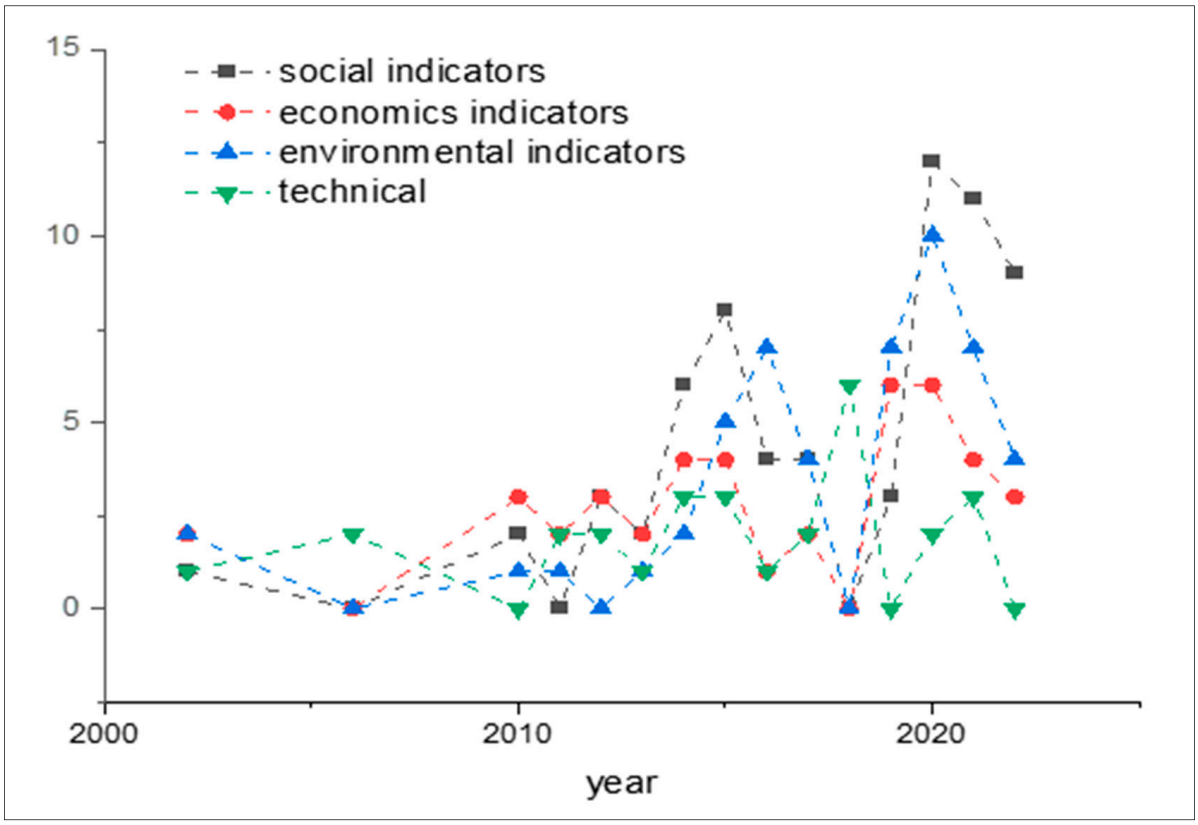

Figure 5. Number of investigated articles arranged according to year of publication.

Figure 5 shows the number of articles and the number of indicators that increased with the years, especially in 2020, which included seven articles with 30 indicators (12 social and 10 environmental). Appendix A shows all the details of each article investigated in our research. Also, Figure 6 shows the number of indicators for each dimension of sustainability. There were 56 factors for the social aspect, 21% for social demographics and 19% for accessibility. The economic dimension had 44 factors, of which the travel cost represented 38%. The environmental dimension included 51 indicators, 41% of which were related to GHG emissions. The technical and operational aspects had 17 factors, 35% for the traffic conditions and 23% for the availability of infrastructure.

As the linear regression graphs in Figure 7 show, there have been exponential increases in the number of indicators over the years, especially the social and environmental indicators, then the economic indicators. The technical indicators have received the lowest amount of attention due to the importance of the other dimensions and the fact that they directly involve users and directly affect their lives. Researchers are interested in evaluating and finding solutions for many problems, such as economic factors, pollution, and their relationships with social aspects. According to our results, most research deals with the issue of sustainability primarily from an environmental point of view and focuses on the problems of carbon emissions or GHGs, and socioeconomics are a secondary concern. Many social factors are dealt with because of environmental influences, such as health and diseases resulting from environmental side effects, which lead to joint social and economic damage. From Figure 5, the top (highest frequency) indicators for each dimension are as follows:

- Social dimension: social demographic factors like age, gender, education, and type of journey occur 12 times, travel time and distance occur 9 times, and accessibility and equity occur 18 times.
- Economic dimension: travel cost and time occur 17 times, cost of operation occurs 4 times, and income level occurs 3 times.
- Environmental dimension: emissions occurs 21 times, pollution occurs 7 times, and energy consumption with new fuel type occurs 15 times.
- Technical and operational dimension: traffic flow and speed occur six times and availability of infrastructure occurs four times.

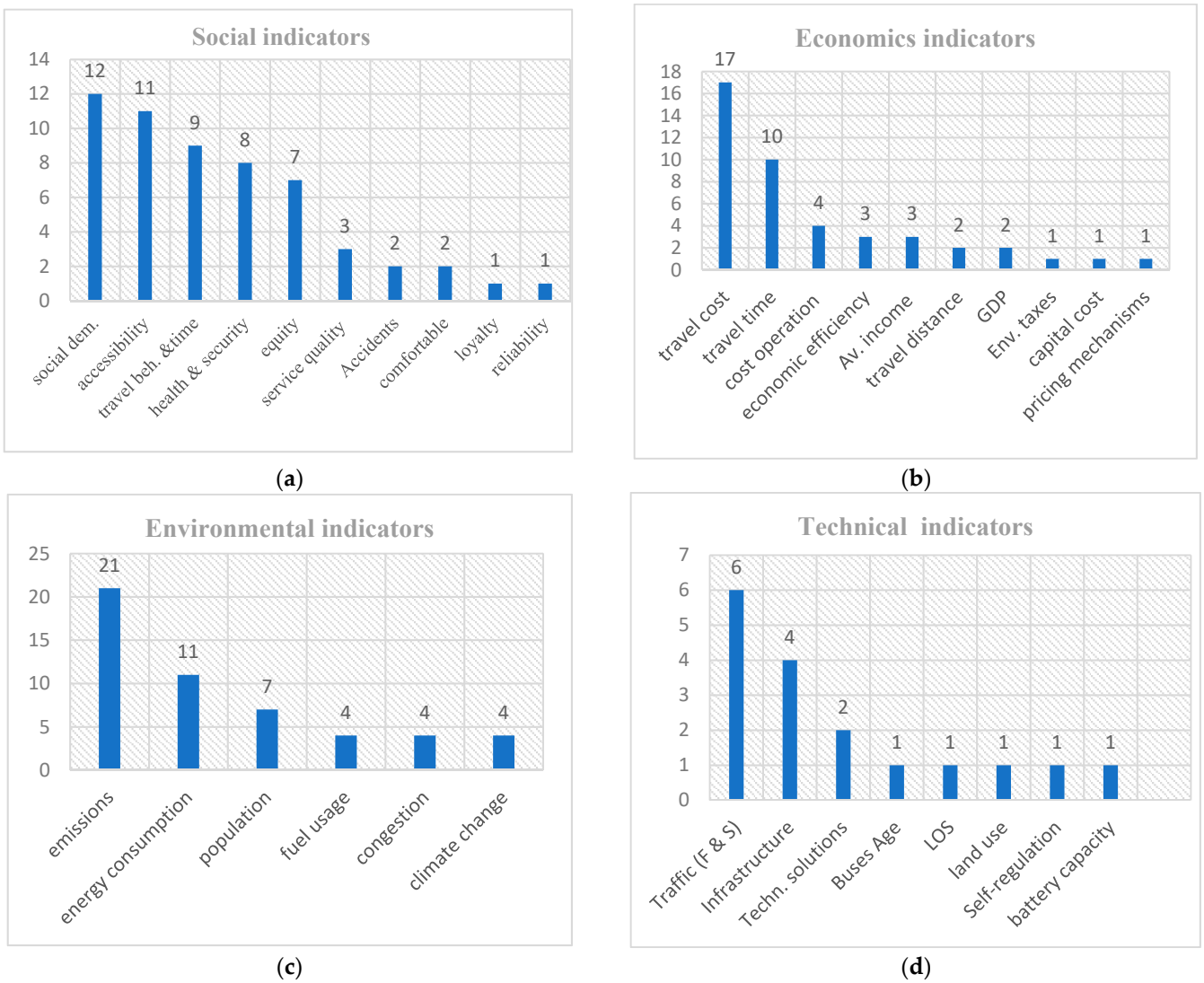

Figure 6. Type and frequency of sustainable indicators.

These selected articles were classified according to the analysis methods they employed. Most of them use statistics models to analyse the data: 18 articles used statistics models, while 6 of them used the multi-criteria decision-making (MCDM) tools like the parsimonious analytic hierarchy process (PAHP) or the analytic hierarchy process (AHP). Also, five articles analysed the data using mathematical equations.

Generally, evaluating the sustainability of public transport involves a comprehensive assessment of its environmental impact, economic viability, social inclusiveness, and operational efficiency, as well as user experiences. Such evaluations are essential for making informed decisions regarding investment, policy changes, and improvements in public transport systems, and they ultimately contribute to more sustainable and efficient urban

transportation solutions. Using the new MCDM tools is very useful and leads to more reliable evaluations of the behaviour of users of public transportation. Also, the availability of official data from the organisations that operate public transportation networks will be very helpful to facilitate the researcher's task and obtain real results. Many researchers study this aspect in a general way. To evaluate the sustainability of public transport, one needs to focus on each side deeply, introduce the problems clearly, and suggest solutions. Government policy and decisions play an essential role in accelerating and supporting sustainability efforts in transportation, and this is what most countries lack.

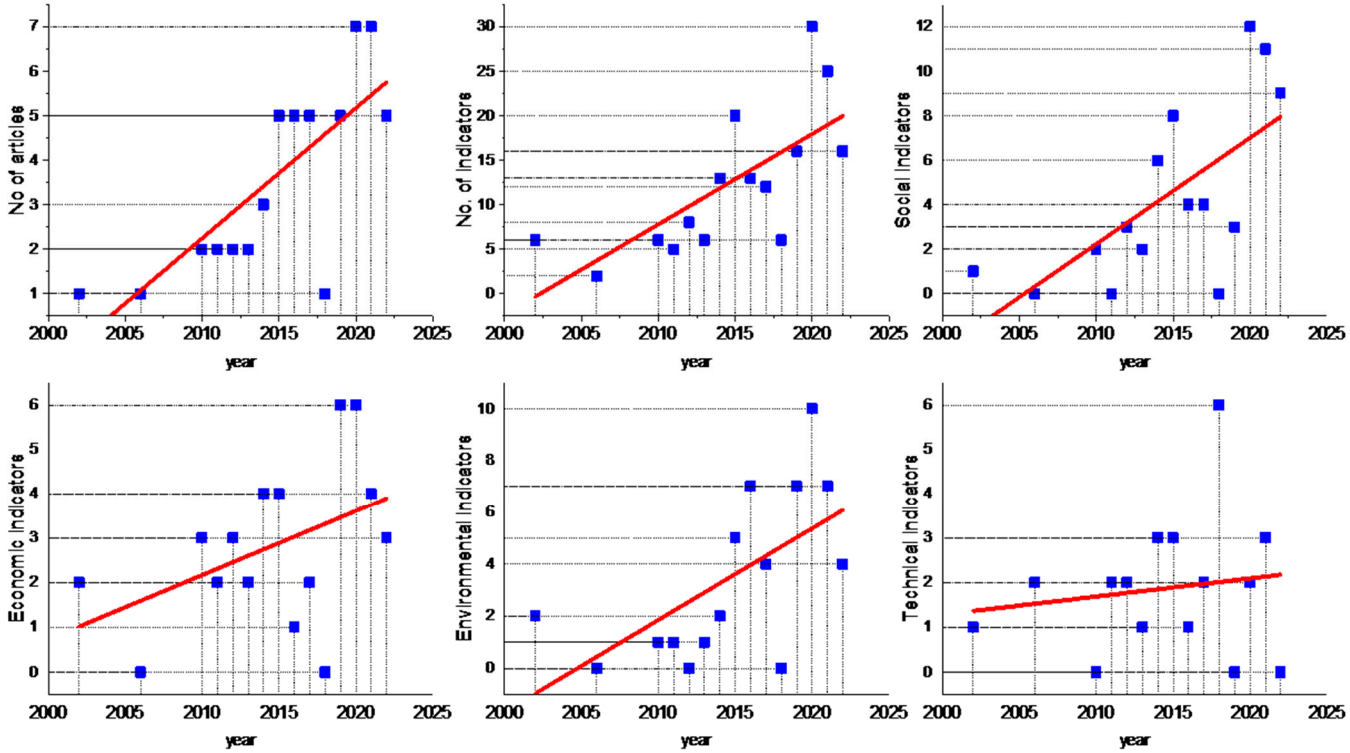

Figure 7. Distributions of indicators.

5. Conclusions

This research aimed to select the indicators most often used to study the sustainability of public transportation. This research can be a starting point to evaluate public transport. From special investigations to related publications, there is an upward path in studying, analysing, and proposing solutions in the field of transportation sustainability. In major cities, public transportation costs per person kilometre are significantly lower, typically from one third to one sixth of the expense incurred using private cars. Furthermore, public transportation methods are more energy efficient, both in terms of direct and indirect energy consumption, and they emit far less CO_2, often by an order of magnitude. However, it is important to note that these advantages can be somewhat compromised by the underutilisation of transit capacity and the energy sources used for electricity generation.

Nevertheless, it is essential to adopt innovative strategies to enhance the performance of public transport or substantially reduce the dependency on automobile services to incentivise public transport usage. Initiatives such as the better integration of bicycles with public transit systems or the construction of light rail systems on wide roadways are worth considering. However, for a transportation system to be sustainable in the broader sense, it must possess flexibility and adaptability, necessitating a blend of various transportation modes [54]. Autonomous vehicles (AVs) can be a solution, and they can be integrated into both private and public transport, but the problems of cost, equity, and employees will be the main challenge. In our investigation, we found that four sustainability dimensions are connected to public transportation in the literature:

1. Social dimensions: the social dimension consists of 56 factors, 21% of which involve social demographics and 19% of which involve accessibility.
2. Economic dimension: This dimension consists of 44 factors. The travel cost represents 38% of the total factors.
3. Environmental dimension: this includes 51 indicators, 41% of which concern GHG emissions.
4. Technical and operational dimension: this includes 17 factors, 35% of which conern the traffic conditions and 23% of which concern the availability of infrastructure.

Moreover, based on the WoS database, we found that researchers in the USA have produced a larger percentage of the total publications on public transport sustainability than China and India, despite the differences in area and population density.

6. Recommendations for Future Work

This research will be a starting point for researchers who wish to focus on evaluating and analysing these indicators and their effects on the sustainability of transportation in each dimension by obtaining real data about the users and the networks and producing real processors linked to the requirements of users and operators.

Based on the analysis carried out for this research, we recommend the following:

- Based on the number of indicators studied, the literature indicates that the social dimension is the most influential in the field of sustainable public transportation. Also, we found that the most studied social indicators are the accessibility of public transportation and travel time. Thus, we recommend mainly focusing on these indicators when designing efficient, sustainable public transportation. Furthermore, for existing public transportation, we recommend that transport specialists investigate the comfort, and reliability of public transportation, as well as the loyalty shown by users, as these are the least investigated in the literature.
- The environmental dimension of public transportation sustainability was found to be the most studied in terms of the amount of research produced in the past two decades: 45% of the articles analysed in this research discussed this factor and the ways in which it relates to sustainability. When designing a new public transportation system, we recommend accounting for CO_2 emissions and energy consumption to make it more sustainable. Certain environmental indicators, including sustainable fuels like electricity, require further in-depth study. It is crucial to note that sustainable engines must be fuelled with eco-friendly alternatives to improve the global emission footprint.
- The technical and operational dimension was the least studied in the literature, although it plays an important role in public transportation sustainability. Technical indicators such as infrastructure improvements and land use considerations are rarely investigated in the field of public transportation sustainability. Thus, it can be a subject for future research.
- We highly recommend analysing each dimension separately to save effort and delve deeper into their impacts on the sustainability of public transportation using a specific case study involving a transportation network that is relevant to the goal of the study.
- Also, statics models and MCDM tools are the most useful methods by which researchers can evaluate the dimensions of sustainability.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su152115289/s1. Reference [55] has been cited in Supplementary Materials.

Author Contributions: Conceptualization, A.A.-l. and A.T.; methodology, A.A.-l. and A.T.; software, A.A.-l. and A.T.; validation, A.A.-l. and A.T.; formal analysis, A.A.-l. and A.T.; investigation, A.A.-l. and A.T.; resources, A.A.-l. and A.T.; data curation, A.A.-l. and A.T.; writing—original draft preparation, A.A.-l. and A.T.; writing—review and editing, A.A.-l. and A.T.; visualization, A.A.-l. and A.T.; supervision, A.A.-l. and A.T.; project administration, A.A.-l. and A.T.;funding acquisition, A.A.-l. and A.T. All authors have read and agreed to the published version of the manuscript.

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Appendix A

Table A1. Details of investigated articles.

Ref. No.	Indicators 1	Indicators 2	Indicators 3	Indicators 4	Indicators 5	Indicators 6
[37]	Emissions	Population	Energy	Consumption		
[38]	Emissions	GHG				
[48]	Travel time	Equity	Economic efficiency	Social inclusion	Safety	Travel distance
[33]	Social	Equity	Accessibility			
[56]		Equity	Accessibility			
[30,49]	User satisfaction	Perceived quality				
[49]	Travel time	Travel cost	Family size	Employment	Gender	Age
[41]			Pedestrians			Traffic flow
[39]	Energy	Emissions				
[29]	User satisfaction	Service quality	Age	Gender		
[42]	Capital costs	Diesel buses	Battery capacity	Speed		
[37]	Emissions	Population	Energy consumption			
[40]	Emissions		Energy consumption			
[57]	Accessibility	Security; satisfaction	Safety	Comfort	Loyalty	Reliability
[58]	Emissions	Consumption	Fuel usage	Revenue–cost analysis		
[35]	Emissions	Travel Cost	Travel time (TT)			
[34]	Congestion	Pollution			Sharing economy	Travelbehaviour
[59]	Availability	Efficiency oftravel time			Quality	Traveltimes
[36]		Average income	Travel times	Efficiency	Accessibility	
[51]	Travel needs	Distance reduction			Technology innovation	Pedestrians andcyclists
[14]	Accessibility	Infrastructure capacity	Economic efficiency	Noise pollution	Cost of transportation	Pollution
[60]	Emissions	Cost				
[61]	Income level	Car ownership Consumption	Land use	CO_2 emissions	Infrastructure	Population growth
[62]	Accessibility	Equity				
[63]	New fuel	Consumption				
[64]	Densify	Congestion	Walking	Compact	Transit	Cycle and connect
[65]		Cost	Behaviour	Comfort		
[1]	Emissions	Time				
[66]	Traffic flow	Pollution				
[53]		Population	Traffic	Accidents		
[67]	Emissions		Traffic safety			
[67]	Equity	Climate change				
[43]	Accessibility	Safety	Infrastructure	Cost of operation	Employment	Emissions
[11]					Emissions	Air pollution
[68]	Emissions	Consumption				
[69]	Emissions	Climate change				
[70]	Emissions	Travel time	Cost			
[71]	Emissions	GDP				
[44]	Infrastructure	Pricing mechanisms			Technological solutions	
[31]		Gender	Age	Deductions	Income	Distance H–W (min.)
[72]	Environment taxes	Transport expenditure	Emissions	Fuel type	Average travel time	Accidents
[73]	Energy usage	Emissions	Economic growth	Security	Health	Social welfare
[74]		Time	Accessibility	Cost		
[70]		GDP		Bus passengers (%)	Health	TD and Supply
[75]	Emissions	Cost				
[76]	Land use	Cost	Emissions		Accessibility	Travel behaviours
[77]	Travel behaviour	Marketing strategy	Competitiveness of transport	Accessibility	Service quality	Traffic management
[78]		Age of buses	Depreciation	Cost		
[79]	Emissions	Equity	Vehicle hours	Cost of travel per capita	Public health	
[80]	Cost of operation	Cost of travel				
[81]	Self-regulation	Infrastructure				
[54]	Emissions	Accidents	LOS	Cost	Expenditure	Consumption

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