

TOWARD A SUSTAINABLE MOBILITY SYSTEM IN MIDDLE EAST CITIES: THE CASE OF ERBIL CITY, IRAQ

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Abstract

In the Middle East, a sustainable mobility system is crucial for sustainable development. However, there is a scarcity of quantitative investigations on sustainable transport indicators in the region, despite their significance to scholars. The central focus of this paper is to execute two objectives: firstly, to construct a comprehensive set of sustainable transport indicators by reviewing 71 studies that highlight sustainable transportation. Following that, these indicators will undergo quantitative evaluation through normalization and scoring on a scale of 0 to 10. These scores will then be utilized to compare Middle East cities with the Kurdistan Region, the European Union, and the world. The study database was developed using two distinct sources. The primary source consists of original articles published in reputable scientific journals, while the secondary source consists of open-source government datasets and data from international organizations. According to the proposed indicators, Erbil City has a sustainability score that exceeds the average for cities in the Middle East. However, at the country level, the Kurdistan Region's sustainability score is lower than the Middle East average, while the European Union excels at both city and country levels. Ultimately, potential policies were suggested to reinforce sustainable development in the region.

Keywords:

Sustainable development;
Sustainable indicators;
The Middle East;
Erbil city;

1. Introduction

In general, the mobility system in most Middle Eastern cities has been overlooked in the policies of their respective countries because of political and economic crises. The financial allocation of a mobility system is adversely affected by the negative effects of poverty. This explains the monotype transport in these cities. An increase in travel demand can affect health and the environment by inducing road congestion, traffic accidents, and air and noise pollution. Travel demand contributes to sedentary lifestyles (particularly in urban areas) and greenhouse gas (GHG) emissions [1]. Many of these risk factors are associated with respiratory diseases, high blood pressure, obesity, cardiovascular diseases, cancer, and mental health problems [2].

The transportation sector may become unhealthy in the long term unless sustainable mobility is achieved. Sustainable transportation prioritizes humans and aims to make a city a better place to live, work, and conduct business, as well as improving its accessibility and quality of life [3]. When considering sustainability, it is crucial to assess the current state of mobility systems in order to determine their level of sustainability. The primary objective of this research is to develop a set of SMART indicators focused on sustainability.

The central question addressed by the research was: "How can we evaluate the efficiency of transportation systems at city and country levels to conform with sustainability requisites?"

The suggested indicators underwent evaluation using a smart methodology, which established a scale for each and displayed their values on a scale of 0 to 10 (with 10 representing the optimal outcome).

Indicators are used to evaluate progress toward objectives. Indicators can play essential roles such as help identify trends, predict problems, and evaluate options. Using indicators, cities can identify the strengths and weaknesses of their mobility systems and the most appropriate solutions [4].

A set of indicators enables monitoring of progress. By calculating the indicators at regular times (e.g., every year), cities can measure the progress towards being more sustainable and having an urban mobility system with higher performance.

The main emphasis of this study was on the Middle East and North Africa (MENA) region, stressing the crucial need for a sustainable mobility system. The case study focused on Erbil city, the capital of the autonomous region of Iraqi Kurdistan, which has a metropolitan population of 861,000 people as of 2021. The car ownership rate stands at 476 cars per thousand inhabitants [5]. Official transport statistics in the region show that development cannot be achieved in cities without a transportation system that has a specific culture, climate, and mobility patterns distinct from those of other cities such as European and American cities. In terms of Middle Eastern cities, quantitative techniques for evaluating sustainability are not widely used. As a result, the present study measured and explored the sustainability level in the region and its relationship with European Union cities and the rest of the world.

The text provides an overview of the transportation system in the Middle East, reviews previous research, and identifies key indicators to inform the formulation of transportation policies in the region. The details of selected indicators and their measurement are presented. Ultimately, the study utilizes a spider chart to present indicators at the city and country levels, providing an in-depth look at the sustainable mobility performance of Erbil city, MENA, the EU, and the world.

2. The Middle East's transportation system

Currently, the Middle East has developed a complex network of roads, air travel, and sea routes due to its increasing urbanization and economic growth. However, significant challenges continue to exist. In cities like Cairo, Amman, Riyadh, and Baghdad, transportation systems struggle with congested roads and inefficient public transport [6]. These challenges not only hinder the daily travel of residents but also present significant environmental issues, as the region heavily relies on private vehicles (Appendix A). These issues have far-reaching consequences that extend beyond daily setbacks, affecting the economy and contributing to social issues. An official report released from the Middle East has revealed that the region experiences one of the highest rates of road traffic fatalities on a global scale, with around 22.6 deaths per 100,000 residents. This alarming rate is indicative of poor road safety measures and insufficient infrastructure. Furthermore, the significant environmental impact, such as increased levels of air pollution, is a result of heavy dependence on private cars. This has negative implications for health and overall quality of life in the region.

A major factor contributing to the overuse of private cars is the inadequate public transport system. Current public transportation services offered in many Middle Eastern cities are not comprehensive or user-oriented, often omitting key areas of the cities or lacking in punctuality [7]. Ultimately, this case study is intended to illuminate the transportation challenges in the Middle East, emphasizing the critical need to thoroughly understand them in order to formulate effective and sustainable solutions.

3. Literature review

The analysis of sustainable indicators proposed various benchmarks for evaluating the performance of mobility systems. The majority of these measures prioritize crucial elements such as social, environmental, and economic aspects, all necessary for achieving sustainability. All studies are part of the general policy of their respective countries and have addressed specific social and economic circumstances.

According to the urban transport indicator review, the study's model is based on three key pillars of sustainability (social, economic, and environmental) in conjunction with transportation performance and planning characteristics. Through analysis of urban transport literature as shown in Table 1, some indicators were identified that were recurring. The selection of indicators was greatly influenced by data availability and reliability.

Table 1. A detailed inventory of selected indicators and their corresponding themes.

Dimensions	Indicators	Related Studies/Reports	Related Themes
1. Urban Form & Planning Characteristics	Urban Density	[8] Newman & Kenworthy (1989), [9] Newman & Kenworthy (2015), [10] Jan Gehl (2010), [11] Ewing, R. et al. (2017), [12] Yosef Jabareen (2006), [13] UN-Habitat (2020)	- Density & Gasoline Consumption per capita. - Density & Car dependency. - Density & Sustainable city. - Density & VKT. - Density and sustainable urban form. - Compact urban form & energy consumption.
	Share of urban area allocated to streets.	[14] UN-Habitat (indicator 11.7.1) [15] Guzman, Luis A. et al. (2021) [16] Samuel Nello-Deakin (2019) [17] Petzer, Brett J. M (2021) [18] Lefebvre-Ropars, Gabriel (2021) [19] Gössling, Stefan (2020)	- Land allocated to streets (LAS). - Relationships between mode share, street space distribution, and construction costs of spaces. - Fair distribution of road space. - Legal streets method for comparing space allocation processes. - Three fundamental dimensions of the street: the link, the place, and the environment. - Redistribution of road space is crucial for achieving modal split variation. The extraction of road space from cars is valid from the social, health, environmental, and economic perspectives.
2. Performance of the Mobility System	Commuting Travel Time	[20] Liao, Yuan; Gil (2020) [21] Bauer, Dietmar (2019) [22] Bauer, Marek et al. (2021) [23] Salonen, Maria et al. (2013) [24] Chatterjee, Kiron et al. (2019) [25] Ha, Jaehyun et al. (2020)	- Travel time, the built environment and mode choice. - Route travel time predictions using the floating taxi dataset. 3. Duration of Journey stages and transport mode choice. - Evaluation of comparability of different methods of calculating travel time by different travel modes. - Individual's satisfaction with the mobility system decreases with commuting time. - The impact of travel time, cost, and transit burdens on commute mode choice.
	Modal Split	[26] J. Reck, Daniel (2022) [27] Abdullah, Muhammad (2021) [28] Drlicak, Marek et al. (2020) [29] Miriam Müller (2021) [30] Sun, Xiaoqian et al. (2021) [31] Memon, I. Ahmed et al. (2021)	- Mode choice and Micro-mobility in planning process. - Mode choice before and during the COVID-19 pandemic. - Traffic volumes as a modal split parameter. - The role of modal shift as a strategy with respect to land-use and efficiency measures. - Predicting passenger mode choice behavior. - Mode choice and factors that influence single occupant vehicle.
3. Global Environment and Quality of Life	GHG Emissions	[32] UN-Habitat (2021) [33] Albuquerque et al. (2020) [34] Solaymani, Saeed (2022) [35] Aroke, O.M. et al (2021) [36] Liimatainen, H. et al. (2018) [37] Çakar, N. D. et al. (2021)	- Cities and GHG. - GHG emissions in the Gulf Cooperation countries. - "The relationship between transport CO₂ emissions and its key drivers using the Autoregressive Distributed Lag (ARDL) technique". - Differences in perception regarding climate change among transportation professionals. - Produce alternative scenarios to reduce CO₂ emissions by 80% by 2050. - "The impact of innovation on carbon emissions originating from the transportation sector in Mediterranean countries".

4. Economic Success (Economics of Urban Mobility)	Renewable energy consumption	[38] Olivares, Antonio et al. (2018). [39] Li, Linna (2014). [40] Mikołaj Bartłomiejczyk (2018). [41] J. Redgate et. al. (2006). [42] Buonocore, Jonathan J. (2019) [43] Franzitta, Vincenzo et al. (2017)	- New renewable transportation sector. - Alternative and transitional energy sources in the transportation system. - The development of zero-emission public transportation system. - The use of zero-emission electric vehicles. - Renewable energy and CO₂ reduction/health advantages. - Economic analysis of the use of renewable energy in the bus system.
	Equivalent Noise Level "LAeq"	[44] Ibili, Fidelma et al. (2021) [45] Gilani, T.A. et al. (2021) [46] Cole-Hunter, Tom et al. (2021) [47] S. Lindgren (2021) [48] Gozalo, G. Rey et al. (2020) [49] Wrótny, M. et al. (2021)	- Review certain traffic noise modeling strategies and parameters used by different agencies worldwide. - Assessment of risk factors for nuisance caused by traffic noise as well as of levels of awareness among exposed populations. - "Examining the association between long-term exposure to road traffic noise and its incidence Total and secondary stroke (ischemic or hemorrhagic) after air pollution adjustment". - "Estimating the advantages of noise mitigation by its capitalizing into property values". - The study shows that street location, urban land use, street geometry, road traffic control, and public and private transportation are correlated with the noise levels. - Comparison of the effect of road noise on human health, with that of railroad noise.
	Traffic Safety	[50] Morimoto, A. (2021) [51] Alhajyaseen, Wael et al. (2021) [52] Topolšek, D. et al. (2019) [53] Bucsuházy, K. et al. (2020) [54] Gifty, Gyan et al. (2021) [55] Al-Wathinani, Ahmed M. (2021)	- Provide a conceptual framework for road traffic safety by comparing traffic safety objectives and strategies worldwide. - Investigate the status of traffic safety and public perception of traffic safety during the COVID-19 pandemic. - Training and education are two pillars of traffic safety. - Analyze human behavior that can cause accidents or affect the causes of accidents. - Conduct a comprehensive review to provide evidence of effective interventions to prevent road traffic accident among young adults. - The behavior of drivers in Saudi Arabia is generally identical to that of their counterparts in other cultures and countries, with men and young individuals being exposed to the highest risks while driving.
	Percentage of the labor force in the transport sector	[56] Bastiaanssen, J. et al. (2020) [57] Hine, John (2019) [58] Wachs, Martin (2011) [59] Acker (2020) [60] Barak, A. (2019)	- "The relationship between transportation and employment outcomes". - "Provide information and guidance on issues and trends relating to employment within the transportation sector and on the effect of transportation investment on employment." - "Spending on transportation programs generates jobs. Infrastructure investments are prescribed to stimulate the economy in the short term by generating construction employment, and to foster longer-term economic growth by making the transportation system more efficient and reliable. President George H. W. Bush stated that the value of the bill is summarized by three words: jobs, jobs, jobs."

			- The gender dimension of the transportation workforce. - The study examines public transportation reform affecting employment in Arab localities in Israel.
	Travel Expenditures	[61] Eliasson, Jonas (2021) [62] Zhang, Q.; Tong, Q. (2021) [63] Anowar, S. et al. (2018) [64] Venter, C. et al. (2011) [65] Kim, W.G. et al. (2011) [66] Li, T. et al. (2015)	- Efficient transportation pricing. - "Examining the economic impacts of traffic consumption during the COVID-19 pandemic in China." - "The study indicated that a household socio-economic attribute in conjunction with the residential location characteristics affect the apportioning of income to various expenditure categories and savings." - "The study reviewed evidence on transportation expenditure and affordability in South Africa. It focused particularly on low-income and mobility constrained individuals." - "The study examined factors affecting the travel expenditure of visitors to Macau." - "This study investigated transportation disadvantages by examining spatial patterns of household transportation expenditures on public transportation fares and private vehicle fuel use in the Brisbane metropolitan area".
	Economic value added by transport	[67] Stehel, V. et al. (2016) [68] Gutiérrez, J. et al. (2011) [69] Meersman, H et al. (2017) [70] Jankalová, M. et al. (2020) [71] Sahara, Lia Ira. (2018) [72] Jurgelane-Kaldava, I et al. (2019)	- "The study focused on an analysis of economic value added by transportation companies in the Czech Republic." - "The study attempted to develop a methodology for calculating the European value added (EVA) generated by transport infrastructure projects." - "The study quantified the impact of transportation infrastructure investment on the Belgian economy." - "The study aimed to apply the economic value-added methodology to real-life corporate data and present the company's value through a case study." - "The study attempted to examine the effects of economic-value-added and market-value-added, including and their effects on the stock return of five transportation companies." - "The study aimed to evaluate the feasibility of modeling the impact of the transportation and storage industry on the economic development of Latvia."
	Fuel consumption	[73] Loman, M. et al. (2021) [74] Chikishev, E. et al. (2022) [75] Hien, N. L. Huy et al. (2022) [76] L. Sheldon, T. et al. (2021) [77] Alarenan, S. et al. (2019) [78] Zhang, X. et al. (2021)	- "The aim of the research was to determine the effect of driving technology on fuel consumption." - "Investigation of factors causing increased fuel consumption of a diesel bus operating in an urban environment." - "Analytical and predictive studies of fuel consumption for different vehicle models in Canada." - "The study investigated the drivers of recent improvements in Saudi Arabia's fleet fuel economy for new vehicles including passenger cars and light-duty trucks." - Energy efficiency and fuel consumption in Gulf Cooperation Council (GCC) countries. - "The study attempted to estimate and analyze the energy consumption and carbon dioxide emissions of fuel vehicles and battery electric vehicles in China during the COVID-19 pandemic."

Related literature demonstrates the importance of the selected indicators drawn from the three pillars of sustainability. Figure 1 shows key dimensions of sustainable mobility system in the Middle East. Banister (2005) suggested seven principles for the mobility system to be sustainable. These are (i) air pollution, (ii) global warming, (iii) traffic noise, (iv) traffic safety, (v) degradation of the urban landscape, (vi) share of urban area allocated to streets and (vii) traffic congestion. Additionally urban form characteristics [79].

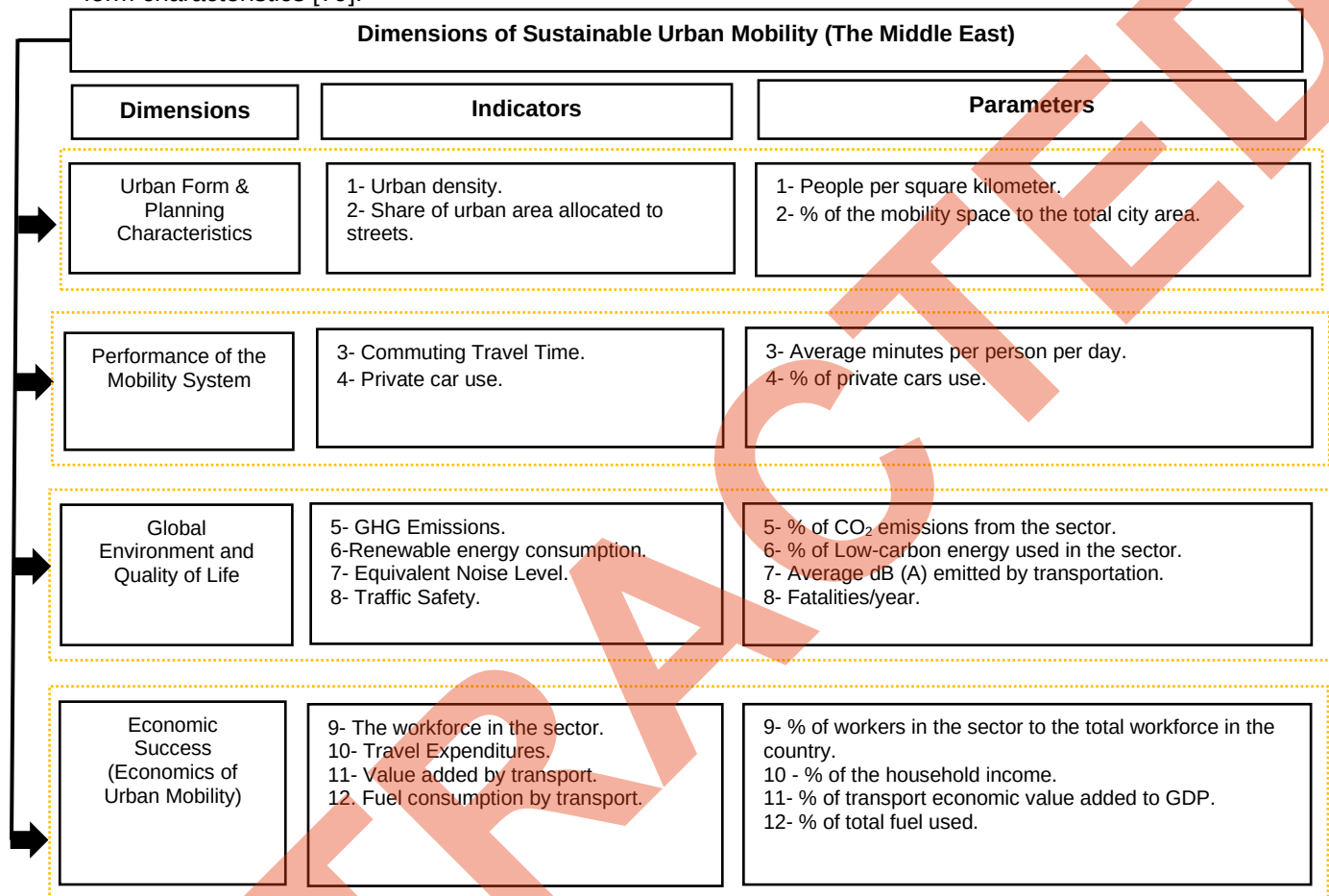


Fig. 1: Dimensions of sustainable urban mobility (Middle East Cities)
Drawn by the author

Urban density refers to the level of compactness and sprawl of an urban form, which has a direct influence on mode choice and travel behavior. Commuting travel time and private car use are reliable measures of a city's mobility performance and traffic management tactics.

In the context of environmental factors, carbon dioxide emissions and noise levels refer to the planning paradigm in terms of traditional and intelligent systems. The incorporation of renewable energy in the transportation industry is indicative of a sustainable system.

Traffic fatalities indicate a deficiency in traffic management. The transportation sector's value added at the economic level is a measure of the system's overall macroeconomic success, while the strength of its workforce reflects its microeconomic performance. The transportation sector's high fuel consumption is a clear indication of an inefficient mobility system. Ultimately, the affordability of transportation can be measured by travel expenditures.

The mentioned indicators were chosen based on sustainability, but they should not be viewed as a definitive measure of sustainability. Different themes may be introduced in the future, while the selection of indicators will remain grounded in the reliability and availability of data.

Despite the continuous expansion of knowledge on mobility indicators in recent decades, previous research has demonstrated some shortcomings, highlighting the potential for further contributions to the literature. Firstly, the majority of studies have been conducted in cities across Europe and America, while there is a scarcity of research on sustainable indicators in the Middle East.

Secondly, previous studies primarily focused on the methodology, with little consideration for the benchmarking process.

This paper's contribution is its ability to be extended to other areas in the Middle East, like Beirut, Tehran, Baghdad, and Riyadh, which possess comparable social, environmental, and economic qualities. From a worldwide standpoint, this study carries significance for the following rationales:

- Through the study, a diverse set of sustainable indicators was identified, which can effectively predict sustainability levels and can be generalized to cities worldwide.
- With the suggested indicators, cities worldwide can evaluate their transportation system and identify the best course of action for addressing any deficiencies.
- SMART indicators allow monitoring of progress, by calculating the indicators at regular times (e.g., every year), the level of sustainability and efficiency in urban mobility systems can be measured and monitored by cities to track their progress.

This research introduces a novel method for evaluating the sustainability of transportation in the Middle East, highlighting its performance in comparison to the EU and the world. Consequently, policymakers can make decisions that support sustainability efforts. The significance of sustainability was evident in the planning policies adopted in the region. The final part of the research will focus on the transportation policies that are being enforced in the region.

4. Overview of proposed indicators

This section provides an overview of the chosen indicators and their respective measurement methods. (Refer to the appendix for indicator values and corresponding links.)

4.1. Urban density (inhabitants/ sq km: as an indicator of the urban form)

Density is a good indicator of urban form in terms of compactness and sprawl. Urban density can affect the manner in which humans travel and thereby, the energy consumption and carbon emissions of such travel. The objective of sustainability is to induce a modal shift in travel behavior from high-carbon forms of transportation (principally individual car use on routes) to lower-carbon forms such as public transportation, cycling, and walking [80]. A compact urban form has economic, social, and environmental advantages (See: UN-Habitat 2014)

According to UN-Habitat, low density is 5000 p/km², middle density is 10000 p/km², and high density is 15000 p/km² (UN- Habitat: urban planning discussion note 3). Figure 2 illustrates the urban density values of Erbil, EU, MENA, and the global average.

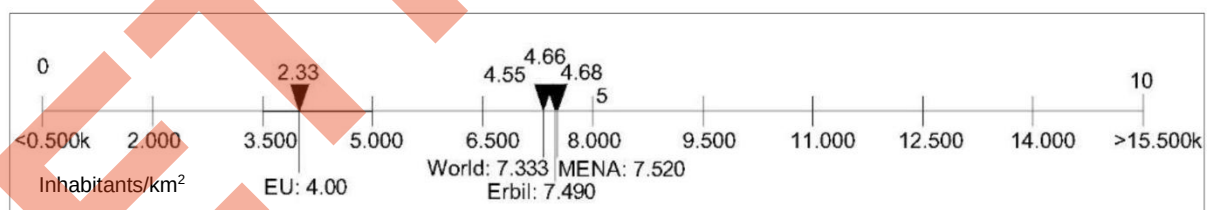


Fig. 2: Urban density rating

4.2. Share of urban area allocated to streets (street area in km²/ total area in km²: as an indicator of road density)

It refers to the total urban area occupied by all forms of streets and green areas that are identified as part of the street space within the city. In accordance with UN-Habitat recommendations, the network should occupy at least 30% of the urban land or at least 18 km of street length per km² as shown in Figure 3. (See UN-Habitat, Module 6, indicator 11.7.1).

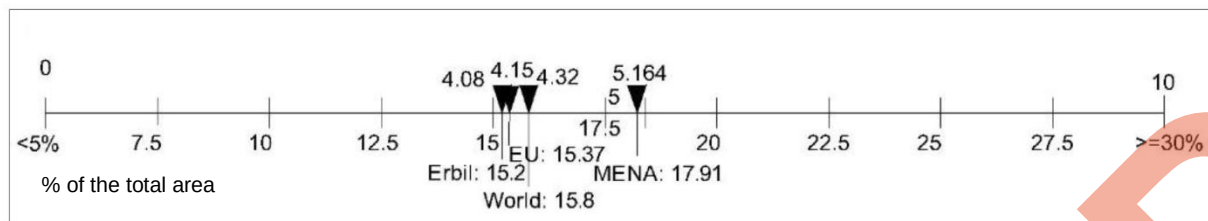


Fig. 3: The score of the urban area allocated to transport facilities

4.3. Share of private car use (% of private car users: as an indicator of travel behavior)

This addresses the unsustainable modes that people utilize for travel, particularly through the use of private cars. The value is converted into a scale of 0 to 10 (with the highest value representing the most unsustainable) as illustrated in Figure 4.

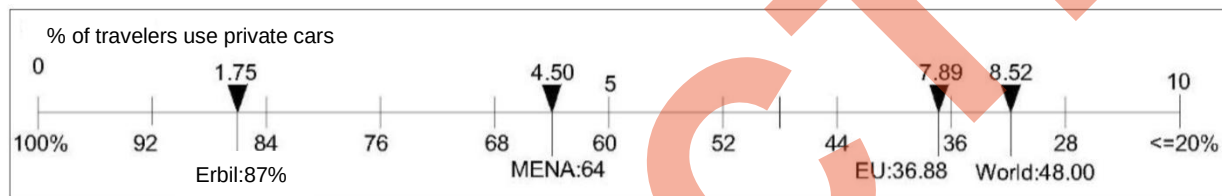


Fig. 4: Measuring the rate of private car use

4.4. Commute travel time (minutes: as an indicator of delay level)

This describes the average time spent traveling to work or education on a normal day. The average one-way travel time is 10 to 25 minutes, with a maximum of 45 minutes. (It is assumed that dissatisfaction with commute time increases exponentially with each minute when a one-way commute time is longer than 25 min). Figure 5.

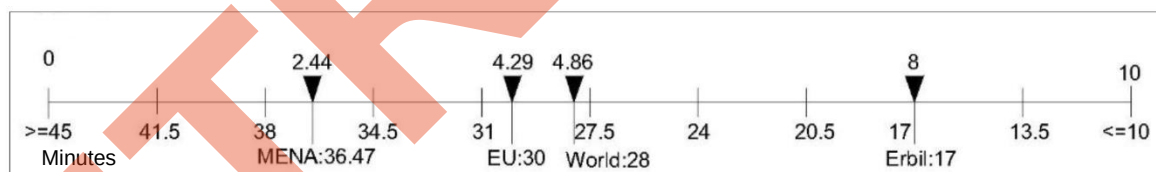


Fig. 5: Commute travel time scale

4.5. Equivalent noise level (LA_{eq} Decibel: an indicator of quality of life)

Noise pollution is mainly generated by traffic among various human activities [81]. In the European Union, about 125 million people are exposed to noise levels higher than 55 decibels [82]. LA_{eq} is the average sound level over a specified time at a specified location. According to the guidelines of the World Health Organization, the acceptable levels for continuous sound pressure in an urban residential area are 55 dB(A) during daytime and 45 dB(A) at night [83]. For commercial zones, it is 65 dB(A) during the day and 55 dB(A) at night. Sounds above 85 dB(A) are hazardous as portrayed in Figure 6.

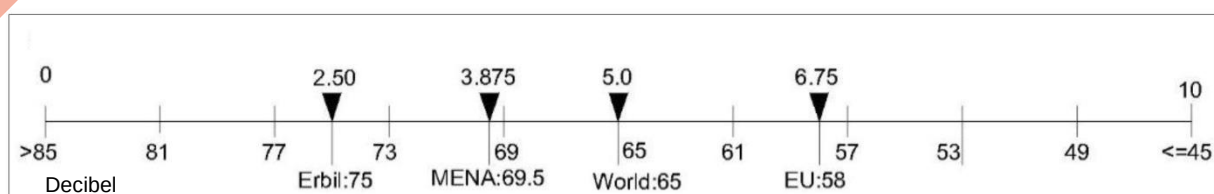


Figure 6. Noise level scale

4.6. CO₂ emissions from the transport sector: (% of total GHG emissions from the transportation sector: as an indicator of the global environment)

Air pollution is now identified as the primary environmental health hazard, with a yearly death toll of 7 million [84], and carbon dioxide is the most important anthropogenic GHG. The main source of atmospheric CO₂ is the burning of fossil fuels, and the transportation sector is responsible for 20.4% of the total emissions¹. A numerical scale of 0 to 10 is utilized to convert the CO₂ value, where a lower figure is considered more advantageous. The transportation sector contributes 30% of total GHG emissions in high-income economies, compared to less than 3% in the least developed nations² as depicted in Figure 7.

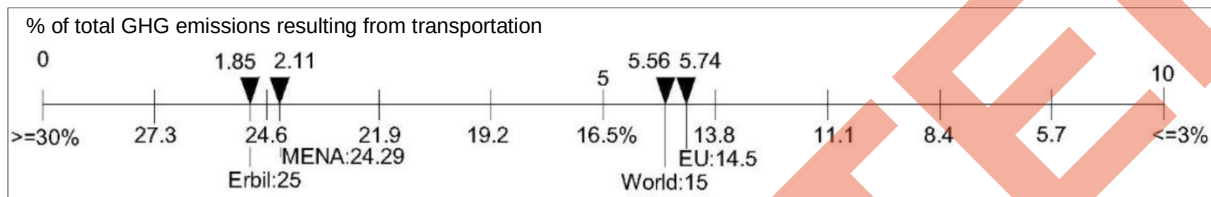


Fig. 7: GHG scale

4.7. Traffic fatalities (deaths/ 100 000 people: as an indicator of traffic management)

Road fatalities refer to deaths that occur immediately or within 30 days of a road accident injury, with the exception of suicides committed using road motor vehicles³. The World Bank (2019) reports that Monaco boasts the lowest rate (0), while Zimbabwe holds the highest rate (41.2) as evidenced in Figure 8.

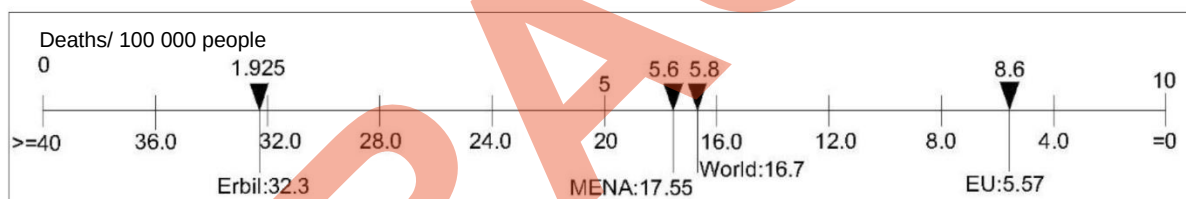


Fig. 8: Traffic safety scale

4.8. Share of total final energy consumption by the transportation sector (% of energy consumed by transportation: as an indicator of system efficiency)

The transportation industry is a major consumer of energy, with a focus on oil products. The final amount of fuel used for city transportation, including gasoline 90, diesel, and LPG, is the measuring unit for fuel consumption. The transportation of humans and goods accounts for approximately 25% of the total worldwide delivered energy consumption⁴. Some studies have proven that by utilizing construction-technical solutions during the design phase of the track structure or during the reconstruction or modernization of the lines, the energy demand of a railway line can be decreased [85]. The total fuel consumption is greatly impacted by an inefficient mobility system, accounting for around 50%. Sustainable transport is defined as the area in the lower right quadrant where the maximum and minimum requirements are satisfied, per capita energy consumption is below 5.6 KWh/day, and per capita travel distances are above 9.2 km/day as illustrated in Figure 9.

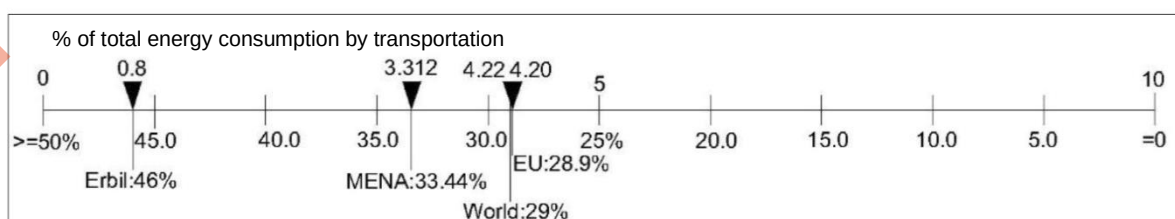


Fig. 9: Fuel consumption scale

4.9. Travel expenditures (as a percentage of household income)

Travel expenditures include the costs of traveling to the workplace or educational institute⁵. The recommended budget for transportation should not exceed 15% of net monthly income⁶. The Victoria Transport Policy Institute's research reveals that households generally devote less than 20% of their budget to transportation, and less than 45% to both transportation and housing expenses combined. The 2018 statistical model of Erbil indicates that transportation expenditures account for approximately 13% of the total household income⁷ as shown in Figure 10.

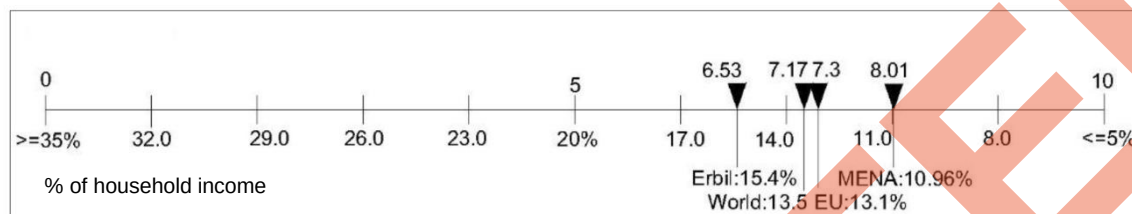


Fig. 10. Travel expenditure scale

4.10. Economic value added by transportation (% of economic value added: as an indicator of macroeconomic success)

The transportation, storage, and communication sectors greatly contribute to the GDP, as shown by economic value added. This metric is a strong reflection of the transportation sector's performance. The Transportation sector typically adds up to 10% to the total GDP in the Middle East⁸. Globally, the economic analysis of transportation demonstrated that Lithuania had the highest economic value (15.9%)⁹, while Libya had the lowest (3.4%)¹⁰ as evidenced in Figure 11.

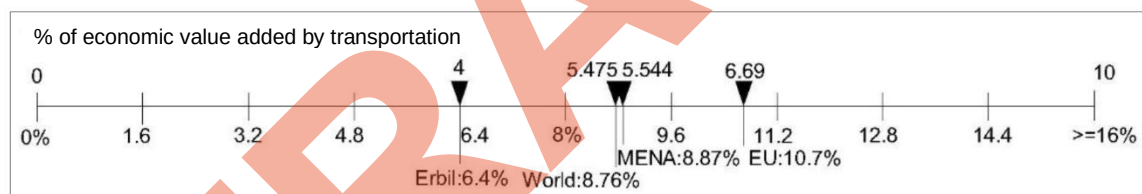


Fig. 11: Economic values scale

4.11. The workforce in the transportation sector (% of workers employed in the transportation industry: as an indicator of microeconomic success)

The transportation workforce consists of employees aged 15 years or older who work in the transportation sector¹¹. The Transport and Logistics industry plays a vital role in facilitating economic and social activity. It is responsible for employing approximately 6.7% of the total workforce in the Middle East¹². Figure 12 displays the rating of employees within the transportation sector.

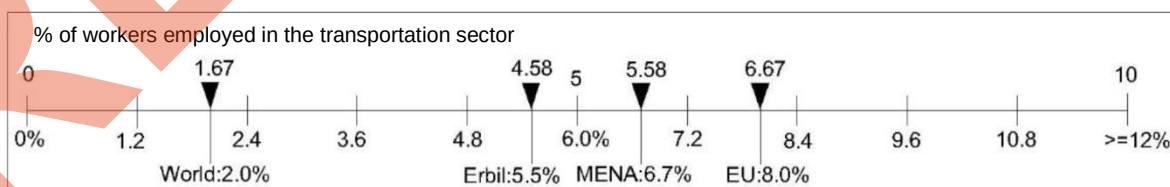


Fig. 12: The score of the workforce in the transportation sector

4.12. Renewable energy consumption for urban transportation (% of renewable energy consumption in the transportation sector: as an indicator of system smartness)

Low-carbon energy encompasses all renewable sources used in transportation, but does not include conventional biofuels. The EU has set a target of 14% for 2030¹³. Figure 13 demonstrates the rating of renewable energy consumption in transportation.

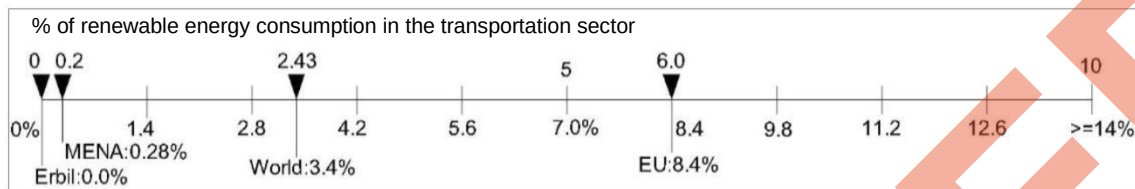


Fig. 13: Renewable energy consumption scale

5. Data collection

The data collection process was guided by specific criteria, including reliability and comparability. Two sources of data were incorporated: 1) primary sources being original articles published in scientific journals and 2) secondary sources include open-source government data and international organizations like UN-Habitat, IEA, and IRENA.

5.1. Data availability & reliability

The construction of a sustainability model is hindered by the challenges of data availability and consistency, which are crucial aspects of data collection. This is particularly true in conflict-ridden regions, such as Lebanon, Libya, Syria, and Yemen. The data-collection process is hindered by inconsistencies, presenting a major obstacle.

The prerequisite for data sources is for these to be comparable. This implies that data for different regions are collected using an identical method and under identical conditions. Data robustness is an essential consideration for constructing indicators that determine whether the data are sufficiently robust for its intended usage. Only indicators that can be collected with meaningful quality should be included. The research encompassed indicators from both the country and city levels, which were then differentiated for comparison. The quality of data is a key factor in determining its relevance to a specific objective. This research sought to tackle quality obstacles, such as duplication, inconsistency, incorrectness, and lack of clarity, by analyzing data from diverse sources.

The reliability of the data source plays a vital role in data analysis, impacting the accuracy and trustworthiness of the findings. However, assessing the dependability of various data sources can pose difficulties, particularly with extensive, intricate, or varied datasets. The initial step in assessing data source reliability involves checking the data's origin, authorship, and purpose. The information presented in this article was collected from primary sources such as original articles and data from international organizations. The following measure in determining the reliability of the data source involves checking the accuracy and consistency of the data. It's important to assess data quality through factors such as completeness, correctness, timeliness, and standardization. The procedure involves cross-referencing the information with various sources like official data, scholarly articles, or reliable databases to check for consistency or discrepancies.

It is vital to provide an instance that illustrates the evaluation of data reliability from specific sources. The data from a 2024 study demonstrated that 87.18% of passenger travels in Erbil city were carried out using private cars, a statistic that was further supported by NUMBEO's report showing that 84.62% of journeys were made in private cars.¹⁴ Thus, the comment accurately reflects the data from the two sources, with the study depending on the more credible data source, and in this specific case, utilizing the data from the original paper.

6. Descriptive statistics of input data source

The standard deviations (SDs) reveal a considerable range in both travel time and private car use. The city of Erbil had the shortest travel time at 17 minutes, while Baghdad recorded the longest at 59 minutes. In terms of private car use, Riyadh city had the highest percentage at 92%, while Casablanca city had the lowest at 33%. The SDs for fuel consumption and traffic fatalities demonstrate significant fluctuation. Beirut city had the greatest fuel consumption rate (54.2%), while Muscat city had the least (17.2%). The standard deviation of traffic fatalities varies

significantly among Middle Eastern countries, with Turkey having the lowest rate (6.7 per 100,000 inhabitants) and Saudi Arabia having the highest rate (35.9/100 000 inhabitants). Consequently, the high SDs signify more data spread and distribution in the Middle East. Figure 14 shows that the world, the European Union, the Kurdistan Region, and MENA have scores of 4.62, 6.46, 2.81, and 4.35 respectively. At the city level, these have scores of 5.45, 5.08, 4.20, and 4.13, respectively.



Fig. 14: Sustainability Model (Final Rating 0-10)
Drawn by the author

Identifying the factors contributing to these results in Table 2 is essential. For instance, in Erbil City, the scores were 2.81 at the country level and 4.20 at the city level. The findings indicate how the traditional transportation system in the region is influenced by the mobility paradigm. Erbil city's official traffic authority adopted engineering solutions with a focus on improving traffic flow, which included the construction of new roads, closure of U-turns, and regulation of traffic lights, all of which underscore the engineering dimension of the mobility system. Improving sustainable transportation planning can enhance the quality of life and help manage urban travel demands. The transportation system in Erbil City is predominantly centered around private cars, with a notable absence of sustainable modes such as advanced bus systems, Tram, walking, and cycling.

At the country level, the European Union has achieved a sustainability rate of 6.46. The findings indicated that sustainable strategies focusing on the supply side of the system can successfully decrease the need for city trips and promote the use of more sustainable modes of transportation.

Table 2. Sustainability values for selected areas (World, EU, Kurdistan, and MENA)

Case Studies	Country_ Level	City_ Level
World (Avr.)	4.62	5.45
EU-28 (Avr.)	6.46	5.08
Kurdistan Region (Erbil City)	2.81	4.20
MENA (Avr.)	4.35	4.13

In this article, a spider chart is used to analyze the sustainable mobility performance in Erbil city, MENA, the EU, and worldwide, showcasing data at city and country levels in Figures 15 and 16. The value of this chart lies in its ability to facilitate a comparison between regions. Through this, it becomes possible to pinpoint the strengths and weaknesses of each indicator, and devise suitable mobility measures. This spider chart also shows how these indicators are interconnected and help researchers examine how their solutions can affect several indicators simultaneously [86]. For example, a reduction in the demand for daily trips is likely to positively affect GHG emissions and fuel consumption.

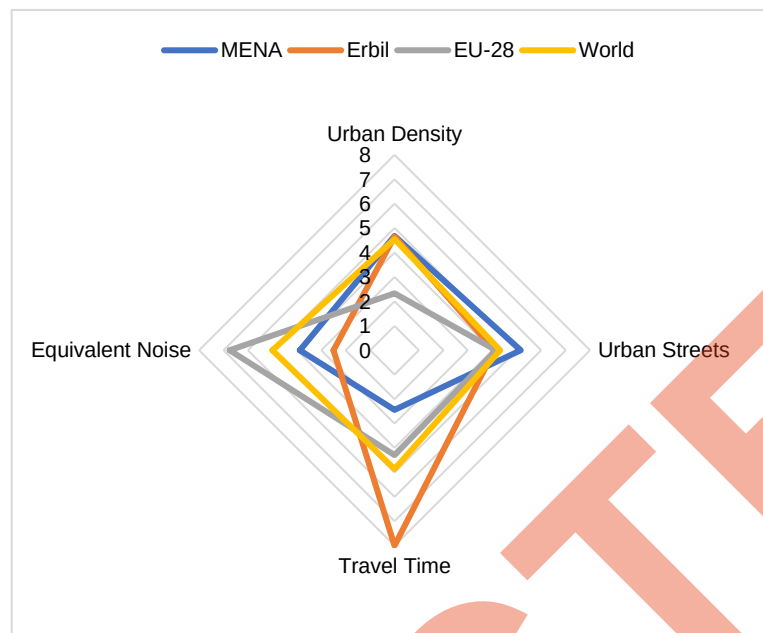


Fig. 15: City-level: Spider chart 4 Sustainable Urban Mobility Indicators for Erbil city, EU, MENA, and the World

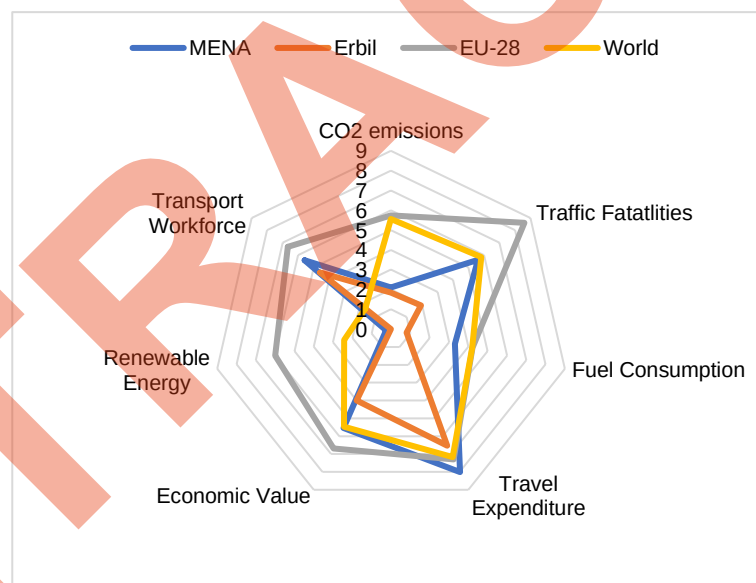


Fig. 16: Country-level: Spider chart 7 Sustainable Urban Mobility Indicators for Kurdistan Region, EU, MENA, and the World. Drawn by the author

7. Conclusion

This study aims to tackle the challenges posed by climate change in the Middle East, specifically the surge in dust storms, droughts, and the temperature has climbed twice as quickly as the global average, causing a decrease in rainfall and increased unpredictability. Some policies will be presented to help combat these increasingly prevalent issues. The purpose of this investigation was to quantify mobility performance by creating a set of sustainable mobility indicators, these indicators were established based on four core dimensions of sustainable urban development: social, economic, environmental, and mobility system performance.

The proposed methodology would help cities perform standardized evaluations of their mobility systems, identify their strengths and weaknesses, and implement targeted actions.

According to the proposed indicators rating, the sustainability score of Erbil City is 4.20 out of 10. This is higher than the average for Middle Eastern cities. However, at the country level, the Kurdistan region scored 2.81 out of 10, this indicates a low level of sustainability resulting from a significant weakness in its global environment driven by its strong dependency on cars, low use of renewable energy, and the traditional planning system implemented in the city. The European Union has a higher value for sustainability resulting from successful strategies and sustainable planning that have been implemented to reduce the impact of the mobility system on the global environment. These include the increase in the share of renewable energy in the final energy consumption, and the use of more sustainable modes (walking and biking), which have positively affected the final score.

Ultimately, according to the proposed indicators rating, the world has scored 5.45 out of 10 at the country level, indicating a moderate degree of sustainability.

8. The Middle East's progress towards sustainability (potential policies)

In the past few decades, the population of the Middle East and North Africa has experienced a significant increase, growing from 256,203,998 million in 1990 to 493,279,469 million in 2022. Urbanization in the region also saw significant growth during this time. In 1990, only 55% of the population resided in urban areas, but by 2022 it has reached 66%. The global population living in urban areas was 43% in 1990 and reached 57% in 2022, highlighting the Middle East's accelerated urbanization compared to the rest of the world¹⁵.

The increasing use of cars in congested cities is a major concern, as it has a detrimental effect on the built environment and the physical health of people [2]. It is crucial for local governing bodies to implement initiatives that promote the use of sustainable transportation options, particularly in the Middle East. The region's efforts towards promoting sustainable transportation will be highlighted through an examination of key policies in this section.

8.1. Kurdistan Region (Erbil City)

The objective of this study is to assess the sustainability of Erbil city and propose a series of measures to enhance its mobility system. The recommended policies include:

- The first priority is to develop alternative modes of transportation in the city. Policies must also consider the potential for public transit. The results of a study conducted in 2024 demonstrated that 22.4% of the surveyed population in Erbil showed a positive attitude towards utilizing the tram service if it was made available. The need for adequate sidewalks and bike lanes, especially for young adults, was also emphasized.
- In countries where oil is a major industry, transportation demand management is considered an essential policy that involves utilizing a range of actions, including pricing, to manage demand. A comprehensive pricing strategy should encompass various measures, including taxes, fuel costs, traffic fines, and parking prices. At this stage, it is important to monitor car ownership and usage. Additionally, encouraging a shift towards alternative modes of transportation, such as walking, biking, and public transit, should be a top priority.
- Human development is an essential element of urban development, and has a significant impact on progress. The first step towards changing behavior is acknowledging the detrimental effects of private cars on both people and the environment. Social media, TV, and radio can play a crucial role in increasing awareness about personal choices, behavior patterns, and the outcomes of these actions.
- The urban transportation department should adopt sustainable planning methods that prioritize pedestrian and cyclist needs over car-centric traditional planning, such as expanding and enhancing pedestrian and bike lanes while reducing car lanes.
- Creating a designated car-free zone in the heart of the city (Erbil Citadel) to reduce traffic and encourage the utilization of public transit.
- Supporting the idea of ride sharing, specifically for individuals who travel to the same location, like students and workers, to optimize the occupancy of private cars.

Ultimately, the application of research findings can contribute to enhancing the transportation system in cities. A few possible uses for these findings are:

- Exploring new scientific avenues: The realm of transportation can be explored through the application of research findings, both in theory and practice.
- Promoting social change: By incorporating research findings into the formulation of social policies and interventions, we can drive positive social change and enhance the well-being of individuals and communities.

- Optimizing transportation policy: The outcomes of this study can offer valuable recommendations for transportation policies and optimize decision-making at the local, state, and regional levels.
- Streamlining approaches: Utilizing research-based evidence can optimize planning approaches and streamline the city's transportation system.

8.2. Iraq (Baghdad)

The Iraqi government recently took action to alleviate traffic congestion and establish working hour regulations for state departments. The recommendations of the consultative meeting held on March 16, 2024, regarding the transportation system were officially approved by the Council of Ministers and as follows¹⁶:

- The fourth mass transit route in Baghdad has been launched, connecting Bismayah city to Bab Al-Muadam with round trips available.
- The Baghdad Metro project was initiated in 2023 and is expected to be completed in 2027. It is expected to transport 3,250,000 commuters every day and significantly alleviate the city's traffic congestion (Supply management).
- Enforcing the use of ministry-provided buses for at least 30% of their employees in order to activate the mass transportation system for all affiliated and non-affiliated entities (Supply management).
- Vehicle registration fees are set to increase, with ongoing considerations for raising customs duties on imported cars (Demand management).
- Increasing the cost of improved gasoline from (500 IQD) to (850 IQD) per liter, and super gasoline from (1000 IQD) to (1250 IQD) per liter (Demand management).
- Eliminating trespassers and street vendors from sidewalks and streets (Transportation system management).
- Establishing pedestrian bridges near colleges and hospitals (Transportation system management).
- Approving the start and end times of official working hours at the ministries' headquarters (Demand management).
- Raising awareness through media about the environmental, economic, and social advantages of utilizing public transportation, and encouraging individuals to change their behavior (Voluntary Travel Behavior change).

The proposed policies aim to reduce car dependence, alleviate congestion, and manage demand, particularly during peak hours. It is crucial to implement various measures to effectively manage transportation in the city. However, for these measures to be successful, it is imperative to also offer alternative modes of transportation to users and a fair distribution of these options. Baghdad's transportation system is primarily based on inefficient buses, minibuses, and unaffordable taxis, which do not adequately serve the needs of the majority of its inhabitants. Moreover, cultural norms discourage walking and cycling¹⁷. In conclusion, effective urban transportation policies must be accompanied by the development of a sophisticated and sustainable transportation system.

8.3. The UAE (Abu Dhabi)

The United Arab Emirates is making great strides in promoting smart and sustainable mobility as part of their Net Zero by 2050 strategic initiative, which aims to eliminate carbon emissions by 2050. The UAE government is actively promoting the use of electric vehicles (EVs) as a solution to reduce carbon footprint. By 2030, the country plans to have at least 10% of all cars on the road powered by electricity. To promote the use of EVs, the UAE government has implemented measures such as free registration, parking, and reduced charging and toll fees. In addition to EVs, the UAE has also invested in other eco-friendly modes such as buses and the Dubai Metro system¹⁸.

8.4. Qatar (Doha)

As for Qatar, the transportation system has made great progress. Qatar has been recognized as one of the leading markets for electric vehicles, ranking 9th in the 'Global Electric Mobility Readiness Index (GEMRIX) 2023'. In line with its commitment to sustainability, the Ministry of Transport has a vision to fully convert the public bus system to electricity by 2030. Currently, nearly 70% of the buses are already operating on electric power, and are supported by an integrated infrastructure for electric charging.

8.5. Iran (Tehran)

In Tehran, the distribution of daily trips among different modes of transportation is as follows: 15% use the metro, 18% take buses and minibuses, 21% opt for taxis, and 46% use private cars and motorcycles. The government has set a goal for Tehran to create a unified transportation system by 2025, focusing on enhancing citizens' well-being and advancing human-centered growth within the city. The following policies will be taken into account¹⁹:

- Changing attitudes towards walking and cycling.
- Modifications in perspectives towards parking space supply and demand, with a focus on effectively managing travel demands.
- Restrictions in urban roads network development.
- ITS based mobility.

The share of public transportation is projected to reach 55% in 2025, including 30% for rail, 22% for buses, and 3% for minibuses. The remaining 45% will be divided among taxis, vans, private cars, and motorcycles. In the near future, the city's public transportation will expand to cover 98% of the city, with the rail network and BRT system reaching 13.2% and 56.7%, respectively.

8.6. Turkey (Istanbul)

A total of 30.3 million daily trips are made in Istanbul, with 37.5% being on foot, 19.5% by private cars, 15% by company/school buses, and 28% by public transport during peak hours²⁰. The key objective of the Istanbul sustainable urban mobility plan (SUMP) is to concentrate on reducing car dependency and addressing the negative effects of carbon emissions, air and noise pollution, and traffic accidents. Additionally, the Istanbul SUMP adheres to the UN Sustainable Development Goals (SDGs) in every aspect, including scope, context, vision, and project implementation.

The SUMP for Istanbul outlines various policies to improve the city's mobility system (Ince et al. 2020):

- Green and smart mobility (From fossil fuels towards renewable energy- electromobility).
- Shifting from the "ownership" model to the "user" model.
- Developing a car-sharing system, ride-sharing, and bike-sharing in the city.
- Integrating mobility considerations into urban planning, including car-free zones, walkable areas, and cycling options.
- Innovation approaches, road pricing, and digital mobility management.
- A mobility system that facilitates compact and polycentric development.

8.7. Saudi Arabia (Riyadh)

Saudi Arabia is focused on developing a comprehensive and interlinked transportation infrastructure that can effectively serve the needs of its citizens and visitors. Technological progress is a top priority for Saudi Arabia, with a focus on future mobility and electric buses. The most important policies towards transportation are electric buses and intelligent transportation system. The integration of ITS into its infrastructure is a testament to Saudi Arabia's commitment to a smart mobility plan that places importance on connection, dependability, and user convenience²¹.

8.8. Israel (Tel Aviv)

Israel has signed and is bound by numerous international agreements addressing air pollution and climate change, such as the Kyoto Protocol, Paris Agreement, and UN Framework Convention on Climate Change²². By 2030, Israel's primary goal in mitigating climate change is to decrease per capita greenhouse gas emissions. The country aims to generate 17% of its electricity from renewable sources and transition 20% of its transportation from private cars to public transport. With a focus on sustainability, Israel's Ministry of Transport plans to electrify all public transportation (trains, light rail, and buses) by 2030 according to their Strategic Plan. The appeal of electric and fuel cell vehicles lies in their potential to lower emissions and more efficient traffic. The fundamental pillars of Israel's transportation policy are:

- National preference for mass transit.
- Demand management and regulations.
- Technological advancement.
- Reducing the need for mobility.

8.9. Jordan (Amman)

Jordan's capital city of Amman is leading the way in urban transformation. As a metropolis that is growing at a rapid pace, Amman has its own set of challenges in its urban transportation system, which is shaped by its exceptional topography, cultural dynamics, and infrastructural limitations. Amman has a daily total of seven million trips, with 34% being made by private cars, 9% by taxis, 17% by public transportation, 14% by bicycles, and 26% by other non-motorized vehicles [87]. The Ministry of Transport²³ has declared their plans for sustainable mobility, including the launch of the 20 km Amman- Zarqa bus rapid transit (BRT) line in 2024.

8.10. Morocco (Casablanca)

Casablanca is the largest city in Morocco with a population of 3.89 million residents (2023)²⁴, with an area²⁵ of 220 km², and 7.8 million daily journeys with 13% being made by formal public transportation, 6% by informal public transportation, 60% by walking, 13% by private cars, private motorbikes or 2-wheelers:4%, and taxi 4%.

The municipality's strategic development plan is aligned with sustainability goals and emphasizes the expansion and improvement of the existing tram and bus networks to facilitate integration among various neighborhoods, and planning to develop a modernized public transport network, incorporating four tram lines and two rapid bus routes, spanning approximately 100 km by 2025 (Casa Transports SA, 2020). Through enhancements to multiple aspects of the public transportation system, the city is dedicated to decreasing car dependence and reducing GHG emissions in alignment with Morocco's Nationally Determined Contributions (NDCs.).

8.11. Egypt (Cairo)

The capital of Egypt, known as the Greater Cairo Metropolitan Area, is a megacity that has a population of over 22.2 million inhabitants²⁶ in 2023, making it the most populous city in the country. As the primary transport hub of Egypt, Cairo facilitates over 20 million motorized and 7 million non-motorized trips daily. The distribution of transportation modes was dominated by private cars at 63%, with public transportation, car ride-hailing, private buses, and walking or biking accounting for 14%, 11%, 6%, and 3%, respectively. Taxis made up the remaining 3% [88]. The primary aim of the Egyptian government was to carry out the latest comprehensive transportation policies. The main priority was on the following targeted areas²⁷:

- Enhancing infrastructure development.
- Transit-oriented development.
- Digitization in transport.
- Public vs. private: The trend towards greater private sector involvement in the sector is enhancing the reach of these system modernization efforts.

8.12. Beirut, Sana'a, and Khartoum

The economic and political situation of a country has a significant impact on urban development. The stability of finances and politics are crucial factors in driving development and attracting investment. Some countries in the region have faced financial and political turmoil, which has led to a decline in urban development and quality of life. They face major challenges such as environmental pollution, water scarcity, and insufficient infrastructure to support population growth. In the realm of urban transportation, countries undergoing economic downturns have become increasingly dependent on traditional forms of transportation, namely informal buses, minibuses, and taxis. As a result, there has been a notable uptick in private car ownership due to the subpar quality of public transportation services.

9. RECOMMENDATION

This article presents a set of sustainable indicators used to evaluate the sustainability of urban transportation in cities across the Middle East, and assess their progress towards achieving sustainability. In addition, this assessment offered insights into the system and policies implemented in each city, shedding light on their strengths and weaknesses.

In future research, other indicators may be suggested and evaluated in comparison to this study. However, the availability and reliability of data pose a challenge for conducting such studies.

Ultimately, this study sheds light on potential policies and sustainability levels for cities in the Middle East; this article emphasizes the importance of continuous research and analysis to improve our understanding of the sustainable urban mobility system in the Middle East.

Competing interests

The author declares that there is no conflict of interest associated with this work.

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Notes

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Appendix A (City-Level Indicators and their Associated Hyperlinks)

MENA, EU, the world	Urban Density capita/sq.km "in thousands"	Share of urban area allocated to streets (%)	% Private Car Use	Commute Travel Time	Noise Level "dB (A)"
Kurdistan (Erbil City)	7.49	15.2	87.00	17.00	75.00
Iraq (Baghdad)	10.12	13.37	79.00	59.00	68.00
Turkey (Istanbul)	9.87	.....	19.5	50.00	73.00
Iran (Tehran)	11.80	15.5	46.00	45.00	75.00
Saudi Arabia (Riyadh)	4.30	13.91	92.00	38.00	69.00
Egypt (Cairo)	19.38	10.15	63.00	45.00	76.00
Israel (Tel Aviv- Yafo)	8.90	12.61	74.00	39.00	77.00

Kuwait (Kuwait City)	<u>3.46</u>	<u>22.52</u>	<u>85.40</u>	<u>26.00</u>	<u>65.00</u>
Lebanon (Beirut)	<u>7.43</u>	<u>14.72</u>	<u>81.00</u>	.....	<u>71.00</u>
Jordan (Amman)	<u>6.48</u>	<u>17.96</u>	<u>34.00</u>	<u>31.00</u>	<u>64.00</u>
Bahrain (Manama)	<u>8.67</u>	<u>22.08</u>	.....	<u>30.00</u>	<u>66.00</u>
Oman (Muscat)	<u>0.34</u>	.....	<u>71.50</u>	<u>30.00</u>	<u>58.00</u>
Qatar (Doha)	<u>5.34</u>	<u>21.24</u>	<u>82.40</u>	<u>23.00</u>	.....
Syria (Damascus)	<u>7.10</u>	<u>18.6</u>	<u>52.70</u>	<u>35.00</u>	<u>75.00</u>
Emirates (Abu Dhabi)	<u>7.20</u>	.....	<u>48.00</u>	<u>44.00</u>	<u>52.00</u>
Yemen (Sanaa)	<u>5.54</u>	<u>22.94</u>	.....	<u>21.00</u>	.....
Tunisia (Tunis)	<u>5.38</u>	<u>22.20</u>	<u>80.00</u>	.....	<u>72.00</u>
Libya (Tripoli)	<u>2.91</u>	<u>23.10</u>	<u>87.00</u>	.....	.....
Algeria (Algiers)	<u>10.15</u>	<u>12.39</u>	<u>29.00</u>	<u>50.00</u>	<u>78.00</u>
Morocco (Casablanca)	<u>10.20</u>	<u>17.88</u>	<u>13.00</u>	<u>24.00</u>	<u>75.00</u>
Sudan (Khartoum)	<u>5.77</u>	<u>23.23</u>	<u>76.00</u>	<u>30.00</u>	<u>68.00</u>
European Union-28	<u>(4.00)**</u>	<u>15.37</u>	<u>36.88</u> *	<u>30.00</u>	<u>58</u>
World	<u>7.33</u>	<u>15.8</u> *	<u>31.83</u>	<u>28.00</u>	<u>65</u> *

Appendix B (Country-Level Indicators and their Associated Hyperlinks)

CO ₂ emissions from transport	Traffic Fatalities	Fuel Consumption	Travel Expenditures	Economic Value	Renewable Energy	Employees in the transportation
<u>25.00</u>	<u>32.30</u>	<u>46.00</u>	<u>15.40</u>	<u>6.40</u>	<u>0.00</u>	<u>5.55</u>
<u>20.60</u>	<u>27.30</u>	<u>49.70</u>	<u>11.20</u>	<u>10.30</u>	<u>0.00</u>	<u>5.00</u>
<u>17.60</u>	<u>6.70</u>	<u>26.90</u>	<u>15.30</u>	<u>11.50</u>	<u>2.00</u>	<u>8.00</u>
<u>24.90</u>	<u>21.50</u>	<u>23.80</u>	<u>10.60</u>	<u>10.00</u>	<u>0.00</u>	<u>9.00</u>
<u>25.90</u>	<u>35.90</u>	<u>32.60</u>	<u>11.90</u>	<u>6.40</u>	.....	.....
<u>22.50</u>	<u>10.10</u>	<u>29.60</u>	<u>6.10</u>	<u>9.10</u>	<u>0.00</u>	<u>8.70</u>
<u>26.10</u>	.....	<u>38.30</u>	<u>15.20</u>	<u>12.90</u>	<u>0.00</u>	<u>6.80</u>
.....	<u>15.40</u>	<u>29.40</u>	<u>11.00</u>	<u>6.30</u>	<u>0.00</u>	<u>1.60</u>
<u>24.40</u>	<u>16.40</u>	<u>54.20</u>	<u>8.00</u>	<u>6.30</u>	.....	<u>6.60</u>
<u>29.20</u>	<u>17.60</u>	<u>47.40</u>	.....	<u>9.00</u>	<u>0.00</u>	<u>9.10</u>
.....	<u>5.20</u>	<u>18.30</u>	<u>15.20</u>	<u>7.20</u>	<u>0.00</u>	<u>6.50</u>
<u>20.80</u>	<u>13.60</u>	<u>17.20</u>	<u>13.40</u>	<u>5.80</u>	<u>0.00</u>	<u>2.80</u>
<u>18.20</u>	<u>7.30</u>	<u>19.70</u>	<u>13.10</u>	<u>4.50</u>	<u>0.00</u>	<u>6.90</u>
<u>24.00</u>	<u>14.90</u>	<u>33.40</u>	<u>10.20</u>	<u>9.50</u>	<u>0.00</u>	.....
<u>21.00</u>	<u>8.90</u>	<u>21.30</u>	<u>14.70</u>	<u>12.30</u>	<u>1.20</u>	<u>8.90</u>
<u>34.60</u>	<u>29.40</u>	<u>45.00</u>	<u>4.20</u>	<u>13.40</u>	<u>0.00</u>	<u>9.50</u>
<u>25.30</u>	<u>16.50</u>	<u>29.60</u>	<u>9.30</u>	<u>11.70</u>	<u>0.00</u>	<u>8.60</u>
<u>39.30</u>	<u>21.30</u>	<u>52.60</u>	<u>8.10</u>	<u>3.40</u>	<u>0.00</u>	<u>4.60</u>
<u>19.80</u>	<u>20.90</u>	<u>35.30</u>	<u>12.70</u>	<u>11.00</u>	<u>1.40</u>	<u>6.20</u>
<u>18.70</u>	<u>17.70</u>	<u>37.10</u>	<u>7.10</u>	<u>6.60</u>	<u>0.35</u>	<u>5.10</u>
.....	<u>26.80</u>	<u>27.30</u>	.....	<u>10.10</u>	<u>0.00</u>	.....
<u>14.5</u>	<u>5.57</u>	<u>28.90%</u>	<u>13.1%</u>	<u>10.70%</u>	<u>8.40</u>	<u>8%</u>
<u>15</u>	<u>16.70</u>	<u>29.00%</u>	<u>13.5%</u>	<u>8.76%</u>	<u>3.40</u>	<u>2%</u>