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The Effects of the Transport Sector on the Achievement of Sustainable Development's Environmental Goals in Algeria

أثر قطاع النقل في تحقيق الأهداف البيئية للتنمية المستدامة في الجزائر

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Abstract :

This study examines the environmental effects of Algeria's transport sector, focusing on road transport as the dominant mode of mobility and energy use. Using a descriptive-analytical approach and official national and international data, it evaluates emissions, energy consumption, fleet composition, and policy effectiveness. The findings show that transport remains a major source of carbon emissions and air pollution because of fleet growth, ageing vehicles, road dependence, and fossil-fuel use. Despite limited improvement in emissions per vehicle, total emissions continue to rise. The study recommends fleet renewal, stricter standards, cleaner energy, and stronger monitoring to support Algeria's environmental sustainability goals.

Key words: transport sector, carbon emissions, environmental pollution, sustainable development, Algeria.

JEL classification codes: Q53; Q56; Q58; R41; O18

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1. Introduction.

Air pollution is one of the most pressing environmental challenges of the twenty-first century, particularly in urban areas where high population density and industrial activity intersect intensively (IPCC, Climate Change 2023: Synthesis Report, 2023, p. 46). These emissions, especially carbon dioxide, exacerbate global warming and contribute to increasingly severe climate disturbances, including heat waves, droughts, and extreme weather events (IPCC, Climate Change 2023: Synthesis Report, 2023, p. 50). thereby producing grave consequences for humanity and the planet as a whole. Climate change has also generated adverse effects on human health and livelihoods. In this context, the transport sector, which relies heavily on fossil fuels, is considered one of the major sources of such pollution.

Following the temporary decline in transport emissions during the COVID-19 pandemic in 2020, these emissions resumed a marked upward trend between 2020 and 2024. The International Energy Agency reported that transport-sector emissions increased from approximately 5.6 Gt in 2020 to around 6.6 Gt in 2021 (IEA, CO_2 Emissions in 2022 International Energy Agency, 2023, p. 09). This upward trend continued, as noted by Yang and Takase (Yang & Takase Tatsuo, 2024, p. 02)with emissions rising by 2.1% in 2022, equivalent to 137 Mt of CO_2, reaching nearly 6.8 Gt (IEA, 2024, p. 19) In 2023, emissions continued to grow, recording an increase of more than 240 Mt of CO_2, corresponding to a growth rate of 3.53% compared with 2022, to reach approximately 7.09 Gt of CO_2. In 2024, carbon dioxide emissions from fuel combustion increased by about 1%, equivalent to 357 Mt of CO_2 (IEA, 2025, p. 31) Although land absorbs around 23% and oceans 29% of these emissions (Pierre Friedlingstein & Other, 2024, p. 132) the remainder continues to accumulate in the atmosphere.

In light of the worsening of these environmental challenges, whose early signs began to emerge decades ago, international efforts were launched to confront climate change and environmental degradation within the framework of a growing awareness, since the 1980s, of the need to establish a development model capable of balancing economic growth with environmental preservation for the prosperity of both people and the planet. This orientation was embodied in the concept of "sustainable development," which was first consolidated in the Brundtland Report, where it was defined as "development that meets the needs of the present without compromising the ability of future

generations to meet their own needs" (Our Common Future, 1978, p. 41).

Within this framework, the United Nations adopted a comprehensive global vision that culminated in the 2030 Agenda for Sustainable Development (UNITED NATIONS, 2015, p. 01), which set out "17 global goals and 169 targets" interconnected across the economic, social, and environmental dimensions. Among these goals, several targets relate directly or indirectly to climate and environmental issues (UNITED NATIONS, 2015, pp. 23, 26, 27), notably SDG 7 on clean and sustainable energy, SDG 11 on sustainable transport and improved urban air quality, and SDG 13 on climate action. These goals reflect a growing global awareness of the importance of integrating the environmental dimension into sustainable development policies. Despite the global framework established by the 2030 Agenda for Sustainable Development, which reflects an increasing international commitment to climate issues, air quality, and sustainable transport, the implementation of these orientations remains uneven across countries, especially in many developing nations that face structural and technical difficulties in keeping pace with the transition toward low-carbon development pathways.

Although numerous studies have examined the relationship between transport and carbon emissions, most have addressed the African or international context in general terms, without exploring the specific characteristics of the Algerian case in sufficient depth. Based on the foregoing, there is an urgent need to understand the extent to which the transport sector contributes to the intensification of climate change and environmental degradation in Algeria. Accordingly, this study raises the following central research question:

- **To what extent does the transport sector contribute to carbon emissions and climate change in Algeria, and how does this affect the achievement of the environmental goals of sustainable development?**

The transport sector in Algeria contributes substantially to carbon emissions and to the intensification of climate change, thereby constraining the achievement of the environmental goals of sustainable development, particularly in the context of the rapid expansion of the vehicle fleet and the limited effectiveness of existing government policies.

This study adopts a descriptive-analytical design supported by quantitative techniques to assess the environmental effects of Algeria's transport sector on sustainable development goals. It relies on secondary data drawn from official national statistics and international institutional sources, covering key variables such as carbon emissions, air pollutants, energy consumption, fleet growth, and vehicle age structure. The analysis uses indicator-based evaluation, trend comparison, and policy review to examine environmental performance. The study assumes the reliability of official data and focuses primarily on road transport, given its dominant role in national mobility and energy use.

in a study analyzing carbon efficiency in the transport sector, its determinants, and its mitigation potential across 40 African countries using a cross-boundary sustainable development framework to account for regional disparities, revealed low levels of carbon-emission efficiency and significant differences across regions of the continent. Although the study pointed to tangible possibilities for reducing CO_2 emissions, it did not provide a detailed vision at the national level. This leaves a clear research gap that the present study seeks to address by conducting an in-depth environmental assessment of the transport sector in Algeria during a period of major political and environmental transformations (Sai & others, 2024).

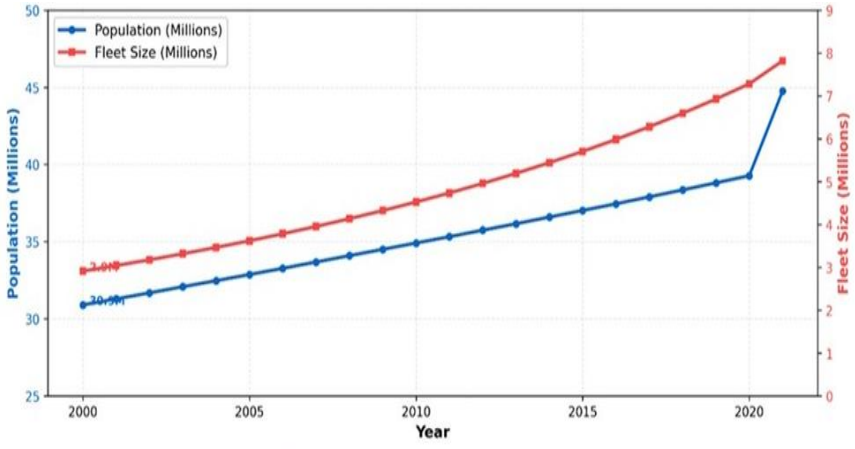
Accordingly, there is a clear need for a study focusing on the impact of the transport sector on the environment in Algeria within the conceptual framework of sustainable development, while drawing on data and empirical analysis that take into account the specificities of both the period under investigation and the national context. In this regard, the study (Amal Mamdouh Mohammed Abdallatif, 2023), which examined the environmental impact of different intercity transport modes in Egypt, focused primarily on carbon dioxide emissions. The study revealed that road transport was the principal contributor to emissions, accounting for 92.3% of the total, whereas inland water transport and railways had relatively limited effects. Although this study made a significant contribution to understanding the relationship between transport modes and carbon dioxide emissions, it remained constrained by its limited treatment of broader environmental dimensions. Likewise, (Saif Eddine CHETTAH & Nadra NAIT AMAR, 2021, p. 34)pointed out the growing reliance on motorized transport, particularly in developing countries, where there is a substantial lack of environmentally friendly alternatives.

2. Results:

2.1 Overview of Algeria's Transport Fleet:

Algeria's transport system includes road, maritime, and air modes. This subsection outlines the fleet's main components and recent trends, with a focus on road transport. According to vehicle fleet statistics published by the (ONS), together with population estimates reported by the United Nations and the **(World Bank)**, Algeria exhibited a pronounced divergence between demographic growth and fleet expansion over 2000–2021 (see Figure 1). Over this period, the population increased by 44.85%, from approximately 30.9 million to 44.76 million, whereas the vehicle fleet grew by 168.24%, from 2,914,272 to 7,817,256 vehicles. Consequently, motorization rose from 94.3 to 174.6 vehicles per 1,000 inhabitants (+85.18%), indicating that fleet growth outpaced population growth by a factor of 3.75.

Fig 1. Growth of the Algerian Vehicle Fleet Compared to Population Growth.



Metric	2000	2021	Change	Growth Rate
Population (Millions)	30.90	44.76	**+13.86**	**+44.85%**
Fleet Size (Millions)	2.914	7.817	**+4.903**	**+168.24%**
Motorization Rate (Vehicles/1000 Inhabitants)	94.3	174.6	**+80.3**	**+85.18%**

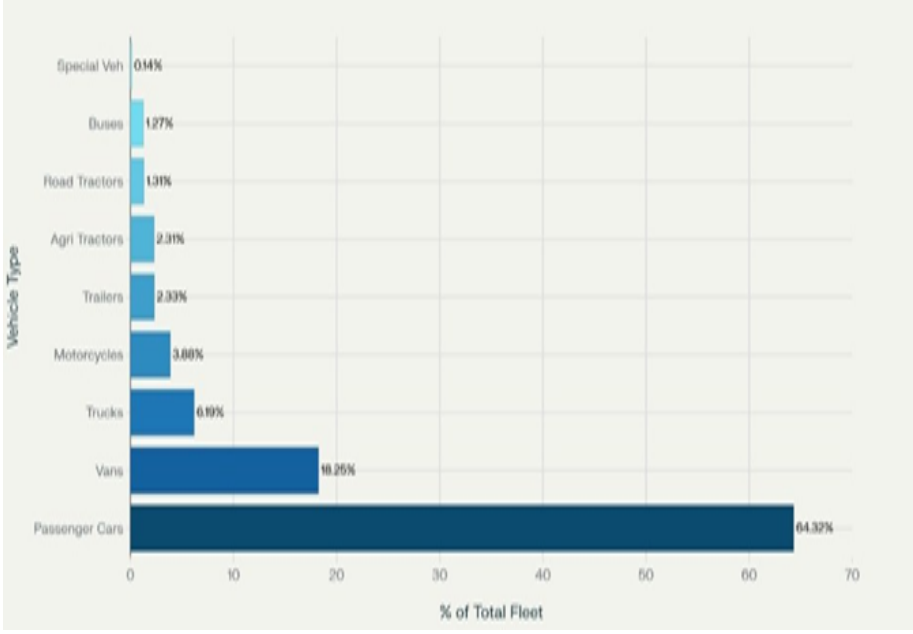
Source: Chart prepared by the authors based on data from the National Office of Statistics.

Understanding the environmental implications of transport in Algeria requires first examining the structure and evolution of the national

vehicle fleet. (ONS) indicate that the fleet is heavily dominated by private passenger cars (64.32%), followed by commercial vehicles (18.25%) and freight trucks (6.19%) (Figure 2). In addition, private cars recorded a cumulative growth rate of 193.88% over the study period, indicating a strong acceleration of individual motorization relative to other vehicle categories.

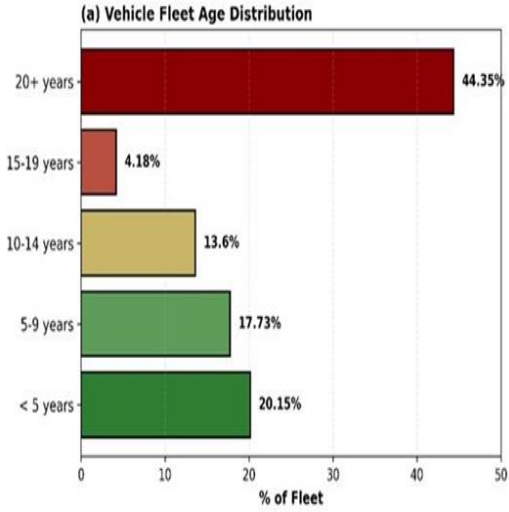
Beyond composition, the fleet's age profile indicates marked obsolescence (Figure 3). Vehicles older than 20 years account for 44.35% of the total, while those aged 10–19 years represent 17.78%; in aggregate, 62.12% of vehicles are more than 10 years old, compared with 37.88% that are less than 10 years old, and only 20.15% that are under five years. This ageing structure is environmentally significant because older vehicles are generally associated with higher fuel consumption and higher emission factors for key pollutants—particularly carbon monoxide, nitrogen oxides, and fine particulate matter—thereby increasing the sector's emissions footprint and intensifying urban air-quality pressures. Accordingly, the high average age of the fleet constitutes a material constraint on environmental sustainability and public health, underscoring the policy relevance of targeted fleet-renewal initiatives complemented by strengthened inspection and maintenance regimes.

Fig 2. Categorization of Algeria's vehicle fleet by type of vehicles.



Source: Chart prepared by the authors based on data from the National Office of Statistics.

Figure 3. Age structure of the Algerian automobile fleet



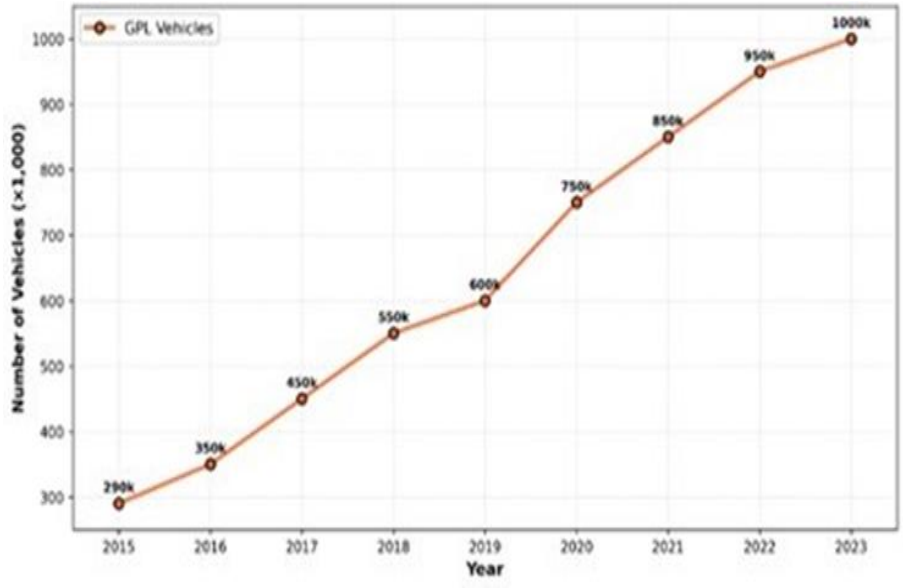
(b) Summary Statistics

Age Category	% of Fleet
< 5 years	20.15%
5-9 years	17.73%
10-14 years	13.60%
15-19 years	4.18%
20+ years	44.35%
Modern Fleet (<10 years)	**37.88%**
Aged Fleet (≥10 years)	**62.13%**

Source: Chart prepared by the authors based on data from the National Office of Statistics.

Algeria's LPG-powered vehicle fleet expanded sharply between 2015 and end-2023, increasing from about 290,000 vehicles to approximately one million (Figure 4), which reflects the rapid diffusion of LPG as an alternative transport fuel and suggests relative progress in the country's alternative-fuel strategy (WLGA, 2024). This uptake is consistent with a combination of strong economic incentives and enabling public support: LPG is priced substantially below conventional fuels (around five times cheaper than gasoline and three times cheaper than diesel), and conversion costs have been reduced through subsidies covering 50% of retrofit expenses alongside favourable tax measures (WLGA, 2024). In parallel, supply-side capacity expanded markedly, with refuelling stations rising from a few hundred in 2015 to more than 1,200 by 2020 and exceeding 1,600 by 2023, reducing access constraints. Demand indicators corroborate this shift, as LPG consumption increased from 290 to over 1,800 thousand tonnes of oil equivalent between 2015 and 2022, reinforced by fuel-price adjustments that widened the price differential between LPG and conventional fuels (reaching DZD 36.62 per litre by 2020) (Abdenadir MOUSLI, 2025). Collectively, these dynamics imply a measurable substitution away from gasoline and potential improvements in Algeria's energy balance, with relevance for sustainable development objectives.

Figure 4. GPL Vehicle Fleet Expansion (2015-2023)

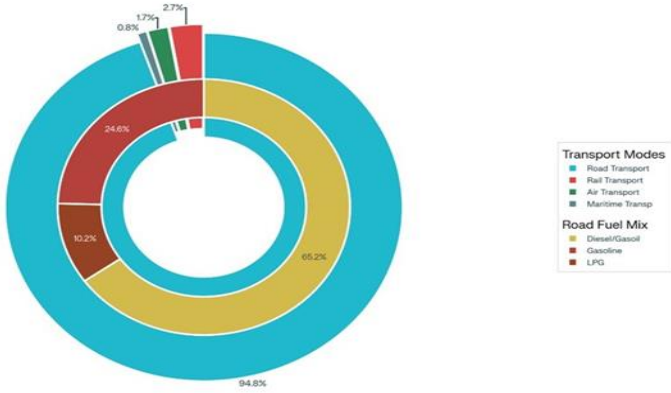


Source: Chart prepared by the authors based on data from (WLGA, 2024)

2.2 Share of the Transport Sector in Energy Consumption in Algeria:

The transport sector is among Algeria's largest energy consumers. In 2021, it consumed 14.5 million tonnes of oil equivalent (Mtoe), representing 29% of total final energy consumption (50.2 Mtoe), and recorded a 7.6% increase relative to 2020 (Ministry of Energy and Mines, 2022, pp. 3-29) as activity recovered following the easing of COVID-19 restrictions (Figure 5). Sectoral energy use is overwhelmingly petroleum-based, with road transport accounting for 94.8% (13.8 Mtoe); diesel (gasoil) is the dominant fuel at 9.7 Mtoe (66.9%, +5.1%), followed by gasoline at 3.7 Mtoe (25.2%, +1.8%) (Ministry of Energy and Mines, 2022, p. 27). LPG constitutes the fastest-growing component, rising by 35.8% to 1.5 Mtoe (10.5%), reflecting widening price incentives and policy support (Ministry of Energy and Mines, 2022, p. 28). while Jet A1 recovered to 0.246 Mtoe (1.7%) (+15.0%) with the gradual reopening of air travel. By contrast, rail and maritime transport remain marginal (0.5 Mtoe; 3.5%), consistent with limited alternative-mode infrastructure and continued reliance on private vehicles and road freight (Ministry of Energy and Mines, 2022, p. 29).

Figure 5. Distribution of Energy Consumption in Algeria's Transport Sector by Transport Modes and Road Fuel Mix – 2021.



Source: Prepared by the authors based on data from (Ministry of Energy and Mines, 2022)

2.3 The Impact of the Transport Sector on the Environment and Quality of Life in Algeria:

This section assesses the environmental and quality-of-life impacts of transport in Algeria, with a focus on CO_2, CH_4, and N_2O emissions.

2.3.1 Measuring Greenhouse Gas Emissions (CO_2, CH_4, and N_2O) in Algeria:

Energy consumption translates into substantial emissions of air pollutants that adversely affect air quality and public health in Algeria. In 2021, Algeria's total greenhouse gas emissions reached approximately 284 million tonnes of CO_2 equivalent (CEIC Data, 2023), including 180.2 million tonnes of direct CO_2 emissions, with an annual per capita average of 4.08 tonnes. This placed Algeria as the third-largest emitter of CO_2 in Africa, after South Africa and Egypt (Enerdata, 2025). The transport sector alone accounted for

The transport sector alone contributed about 42.3 million tonnes of CO_2—around 24% of national emissions—despite an 8.9% decline compared with 2015 linked to the COVID-19 shock on mobility; transport-related per-capita CO_2 emissions were 0.96 tonnes, exceeding both the African average (0.25) and the upper-middle-income benchmark (0.53) (TCC-GSR, 2023, p. 03).

In terms of composition, transport-related emissions are overwhelmingly dominated by CO_2 (97.76%), followed by N_2O (2.22%) and CH_4 (0.02%) (BUR1, 2023, p. 165) .

CO_2 emissions arise proportionally from fuel combustion in internal-combustion engines ($C + O_2 \rightarrow CO_2$), and their magnitude is shaped

by fuel type, carbon content, engine efficiency, and activity levels; typical emission factors are approximately 2.31 kg CO_2/litre for gasoline and 2.68 kg CO_2/litre for diesel (U.S. EPA., 2025).

CO_2 is the principal contributor to the greenhouse effect because it absorbs infrared radiation emitted from the Earth's surface and traps heat in the atmosphere, thereby increasing global temperatures (IPCC, 2023, p. 50). As CO_2 accumulates, it strengthens radiative forcing by creating an imbalance between incoming solar energy and outgoing terrestrial radiation, which contributes to interconnected climate impacts, including warming, shifts in precipitation regimes, more frequent and intense extremes (e.g., heatwaves and droughts), increasing stress on surface and groundwater resources, and potential declines in agricultural productivity due to heat stress and altered growing seasons (IPCC, 2021, pp. 5–11). (IPCC, 2021, pp. 5-11). that have become increasingly observable in Algeria: the annual average temperature has risen at a rate of 2.7°C per century since the early twentieth century (UNDP, 2022, p. 02), and in June 2024 temperatures exceeded 50°C for the first time, reaching 51°C in several regions (Katherine Hearst, 2025), Over the long run, rainfall declined by 40% in western Algeria, 30% in central regions, and 20% in eastern regions relative to the 1900–2000 reference period (Leila Bensmaine, 2022), while dam storage fell to 29% of total capacity in 2024, with an estimated 25% loss in reserves (Eromo Egbejule, 2024), As for nitrous oxide (N_2O), which accounted for 2.22% of transport-related emissions in Algeria, this share may appear limited; however, N_2O has a global warming potential 273 times greater than that of CO_2 over a one-hundred-year period, remains in the atmosphere for more than a century, and also contributes to the depletion of the stratospheric ozone layer (IPCC, 2021, p. 30), Consequently, even relatively small quantities of nitrous oxide exert a tangible climatic impact. And Methane (CH_4), which represents only 0.02% of emissions, also has a significant climatic effect despite its very small share. Its global warming potential is 28 times greater than that of CO_2 over a one-hundred-year period, and it remains in the atmosphere for approximately 12 years, which makes it a short-lived climate pollutant with an immediate effect on global temperatures (IPCC, 2021). In the transport sector, methane emissions are primarily associated with the incomplete combustion of liquid fuels occurring in the engine and exhaust system, as well as with evaporation from the fuel system. This phenomenon is particularly concentrated under suboptimal operating conditions, as incomplete combustion generally occurs at low speeds, during idling, and during cold starts in spark-ignition gasoline engines (IPCC, 2021, pp. 14-16).

2.3.2 Air Pollutants (NO_x, PM_{10}, $PM_{2.5}$, CO):

Air-quality pressures are further amplified by conventional pollutants from the transport sector, particularly in urban areas. Nitrogen oxides (NO_x), formed mainly during high-temperature combustion, promote the formation of ground-level ozone (O_3) through photochemical reactions involving VOCs and sunlight; ozone is a short-lived climate pollutant and a key component of smog with documented respiratory impacts (IPCC, 2001, pp. 256-260). In addition, transport contributes to particulate matter ($PM_{2.5}$ and PM_{10}) through both exhaust emissions linked to incomplete combustion and non-exhaust sources (brake/tyre wear and road abrasion), whose relative contribution has increased with heavier vehicle fleets (EEA, 2025), Black carbon, a harmful $PM_{2.5}$ component, is of particular concern due to its high warming potency despite a short atmospheric lifetime, with diesel engines identified as a major source within the transport sector (ICCT, Kate Blumberg, & Sarah Chambliss, 2014).

2.4 Analysis of Environmental Transport Sector Indicators Related to Sustainable Development in Algeria (2000-2021):

This section analyzes the main environmental indicators of Algeria's transport sector in relation to sustainable development over t

2.4.1 Indicator 1: Emissions per Vehicle (Per Vehicle Emissions Indicator).

This indicator measures the average annual CO_2 emissions per vehicle within the national fleet. It reflects the environmental efficiency of vehicles and the extent to which fleet ageing influences individual emission levels (IPCC, 2006, p. 28).

- $\boldsymbol{Emissions\ per\ Vehicle} = \left(\frac{\boldsymbol{Total\ CO2 \times 1000}}{\boldsymbol{Fleet\ Size}}\right)$

- **Total CO_2**: total carbon dioxide emissions (kilotonnes).
- **Fleet Size**: size of the national fleet (number of vehicles).
- **1000**: conversion factor from kilotonnes to kilograms.

Table 1. Annual CO_2 Emissions per Vehicle in Algeria (2000, 2021)

Year	CO_2 (kt)	Fleet Size	Calculation	Result (kg/vehicle/year)
2000	15.600	2.914.272	(15,600 × 1000) ÷ 2,914,272	5.353
2010	23.400	4.314.607	(23,400 × 1000) ÷ 4,314,607	5.423
2021	29.100	7.817.256	(29,100 × 1000) ÷ 7,817,256	3.723

Source: Prepared by the authors (ONS), (World Bank)

The emissions-per-vehicle indicator declined by 30.5% between 2000 and 2021, falling from 5,353 to 3,723 kg/vehicle/year. This apparent improvement is misleading, as it does not reflect genuine gains in vehicle efficiency or the enforcement of stringent emission standards;

instead, it is a mechanical (mathematical) outcome of fleet growth outpacing emissions growth. Over the period, the fleet expanded by 2.7× (from 2.9 to 7.8 million vehicles), whereas total CO_2 emissions increased by only 1.9× (from 15.6 to 29.1 Mt CO_2), which necessarily reduced the per-vehicle coefficient.

Despite the decline in emissions per vehicle, total fleet emissions—the most meaningful indicator of climate impact—increased by 86.5%, implying a near doubling of atmospheric pressure over two decades, with a CAGR of 3.01%. This confirms that relative efficiency gains did not reduce the transport sector's carbon footprint and highlights the need to prioritize absolute emissions alongside relative indicators when assessing environmental sustainability.

2.4.2 Indicator 2: Compound Annual Growth Rate of CO_2 Emissions

The Compound Annual Growth Rate (CAGR) measures the average annual rate of growth in CO_2 emissions from the road transport sector in Algeria over the period 2000-2021, while accounting for the cumulative effect of growth over time (IPCC, 2022, p. 1827). (IPCC, 2022, p. 1827)

Data:

- **2000:** 15.6 million tonnes of CO_2
- **2021:** 29.1 million tonnes of CO_2

$$\mathbf{CAGR} = \left[\left(\frac{\mathbf{2021}\boldsymbol{Emissions}}{\mathbf{2000}\boldsymbol{Emissions}}\right)^{\frac{1}{21}} - \mathbf{1}\right] \times \mathbf{100\%}$$

$$\mathbf{CAGR} = \left[\left(\frac{29.1}{15.6}\right)^{\frac{1}{21}} - \mathbf{1}\right] \times \mathbf{10\%} = \mathbf{3.01\%}$$

CO_2 emissions from Algeria's road transport sector grew at a CAGR of 3.01% over 2000–2021, rising from 15.6 to 29.1 Mt CO_2 (+86.5%), which indicates a sustained intensification of the sector's environmental impact and implies an approximate doubling every 23 years if the trend persists. The continued positive growth rate suggests that existing environmental measures have been insufficient to curb emissions, adding roughly 0.47 Mt CO_2 per year on average; if maintained, emissions are projected to reach about 38 Mt by 2030 and 49.4 Mt by 2040 (over three times the 2000 level). These dynamics underscore the need for a structural policy shift toward cleaner vehicle technologies, expanded public transport, and stricter emission standards to prevent further escalation in transport-related carbon pollution.

2.4.3 Indicator 3: Old Vehicles and Their Environmental and Health Impacts:

The Old Vehicles Percentage measures the relative share of vehicles older than 15 years within the total national fleet (World Bank Group, 2021)

- $\mathbf{Old\ Vehicles\ \%} = \frac{\mathbf{+15}\boldsymbol{N}}{\boldsymbol{Total\ N}} \times \mathbf{100\%.}$

- **+15 N:** number of vehicles older than 15 years

- Total N\text{Total }NTotal N: total size of the national vehicle fleet.

Table 2. Age Structure of Algeria's National Vehicle Fleet

Year	Total Fleet	Vehicles Aged 15-19 Years	Vehicles Aged 20+ Years	Total Old Vehicles (15+)	Percentage
2000	2,914,272	735,484	1,134,205	1,869,689	64.16%
2005	3,211,052	477,599	2,002,458	2,480,057	77.24%
2010	4,313,607	238,470	2,487,959	2,726,429	63.21%
2015	5,683,156	187,067	2,726,529	2,913,596	51.27%
2020	7,731,664	747,185	4,089,723	4,836,908	62.56%

Source: Prepared by the author based on data from the Office National des Statistiques (ONS) on the age distribution of Algeria's national vehicle fleet.

Despite rapid fleet expansion from 2.9 million vehicles in 2000 to 7.7 million in 2020 (+165%), the age structure remained characterized by persistently high obsolescence: vehicles aged 15 years and older represented 64.16% of the fleet in 2000, peaked at 77.24% in 2005, declined to 51.27% in 2015, and rose again to 62.56% by 2020 (Table 2). More critically, vehicles aged 20+ years accounted for 52.90% of the fleet in 2020, meaning that more than half of the national vehicle stock consisted of very old vehicles. This composition constitutes a significant environmental concern because older vehicles typically emit pollutants at substantially higher rates than newer vehicles and often fall outside effective emissions-control regimes; in Algeria, this implies that a large share of the fleet operates without meaningful environmental regulation, thereby aggravating urban air pollution (Saif Eddine CHETTAH & Nadra NAIT AMAR, 2021) .In quantitative terms, if each vehicle older than 20 years emits an additional 1.5–2 tonnes of CO_2 annually relative to newer vehicles, the 4.1 million vehicles in the 20+ category would add approximately 6–8 million tonnes of CO_2 per year, a magnitude close to one-third of transport-sector emissions. Overall, the limited net improvement in the share of old vehicles over two decades indicates that fleet growth has not been accompanied by sufficient renewal, underscoring the need for policy measures that accelerate fleet replacement through stricter standards and structured retirement of obsolete vehicles.

2.4.4 Urban Noise Pollution:

Noise pollution generated by road transport constitutes one of the most significant environmental challenges in Algeria, particularly in light of the increase in the urban population share from 58% in 2000 to 75.75% in 2024 (worldometer, 2025). This rapid urban growth has led to a rising demand for transport and traffic mobility, resulting in the continuous intensification of noise pollution in urban areas currently

inhabited by approximately 35 million people. In this context, excessive traffic noise gives rise to serious health and social consequences, including sleep disturbances, stress, cardiovascular diseases, and adverse psychological effects, particularly in densely populated urban environments.

The study by (Karim Bouzir & Other, 2017, p. 1052) shows that equivalent noise levels (Leq) in Algerian urban areas range from 55 to 76 decibels. More than 70% of the recorded measurements exceeded the Algerian legal limit of 70 decibels, whereas the World Health Organization guideline for residential areas is only 55 decibels. From a causal perspective, traffic-related noise pollution can be attributed to several structural factors, including fleet ageing, given that 49% of vehicles are more than 20 years old, non-compliance with modern emission and technical standards, the poor condition of road infrastructure, and the absence of effective protective measures such as noise barriers and buffer zones.

2.4.5 Land Footprint Indicator of Transport Infrastructure

Algeria's road network reached approximately 141,500 km by 2025, ranking ninth in Africa and third in the Arab world, and includes major corridors such as the East–West Motorway (1,216 km) and the Trans-Saharan Highway (over 4,800 km), reflecting sustained investment in connectivity and territorial integration (رادية مراكشي، 2025). However, this expansion entails non-negligible environmental trade-offs, notably through the direct appropriation of ecological and agricultural land for road construction. The ecological land-loss indicator captures the area (in hectares) converted from green or productive land to transport infrastructure; higher land take implies greater pressure on natural resources and potential risks to ecosystem services and food security, thereby sharpening the policy challenge of balancing development needs with environmental protection and sustainability objectives.

3 Discussion:

The results show that Algeria's transport sector is a persistent source of environmental pressure: road dominance, rapid fleet growth, and an ageing stock have kept total emissions rising despite minor gains in relative indicators. Consistent with prior work, this reflects not only fleet expansion but also fossil-fuel dependence and weak policy implementation, revealing a gap between stated commitments and effective regulation.

3.1 Algerian Efforts Undertaken in Support of Sustainable Transport:

This section reviews Algeria's main policy initiatives and investments undertaken to promote sustainable transport and improve the environmental performance of the transport sector.

3.1.1 International Commitments and National Policy Orientation:

From independence to the late 1990s, Algeria largely prioritized economic growth and urban expansion, with limited attention to transport's environmental dimension; this orientation shifted in the early 2000s toward developing legal and policy frameworks in response to fleet expansion and deteriorating urban air quality. In the international climate context, Algeria ratified the **Kyoto Protocol on 16 February 2005**, thereby committing to global mitigation efforts and assuming three core obligations: **procedural** (periodic national emissions/mitigation reporting), **strategic** (integrating emission-reduction objectives into national environmental plans and public policies), and **participatory** (active engagement in international climate negotiations, notably COPs) (UNFCCC, 1997, pp. 6-7-10).

3.1.2 The Gap between Policy Commitments and Environmental Outcomes:

Algeria's initiatives signal a growing official commitment to sustainable transport; however, outcomes remain misaligned with stated objectives. While the country has achieved visible progress in metro, tramway, and railway infrastructure, these investments have not delivered commensurate environmental gains—particularly in reducing fossil-fuel dependence and advancing a credible transition toward clean energy. Overall, the evidence points to a persistent implementation gap in translating international commitments into effective, operational policies and measurable environmental results on the ground.

3.1.3 Policy and Investment Measures Supporting Sustainable Transport in Algeria :

Algeria's efforts to support sustainable transport evolved through successive planning, energy, and infrastructure initiatives. The **PDAU (2005–2025)** constituted an early institutional attempt to integrate sustainable transport into national urban planning and environmental governance (Baba Slimane , Nour El Houda, & Other, 2023, p. 159). This orientation was reinforced by the **National Programme for Energy Management (2007–2010)** backed by **DZD 832.7 billion (≈ EUR 6 billion)** which targeted a 20% reduction in energy consumption by 2030 and emphasized alternative fuels (CNG and LPG) in transport (Amin, LARIDJI Mohammed, & MALIKI Samir Baha Eddine, 2021, pp. 125-128), alongside the adoption of the **SNAT** framework in 2010 under Law No. 10-02 to align territorial development with sustainability objectives through planning instruments (هاجر شنيخر، 2020، الصفحات 07-10) . From 2011, Algeria also implemented concrete mass-transit investments, including the Algiers tramway (23 km) and metro (9.2 km), followed by expansions

to Oran (32 km) and Constantine (20.3 km) in 2013 (Baba Slimane , Nour El Houda, & Other, 2023, pp. 162-164). Internationally, the **Paris Agreement (2015)** further anchored emissions-reduction commitments (7% unconditional, up to 22% by 2030 conditional on support) (Abdelillah Bendaoudi, 2025), while public transport infrastructure continued to expand—such as the Saïda tramway (8 km) in 2017 and subsequent extensions in Algiers (Amin, LARIDJI Mohammed, & MALIKI Samir Baha Eddine, 2021, pp. 11-14). Investment intensity peaked between 2018 and 2021, marked by extending the Algiers tramway to 31 km and inaugurating a second metro line (10.5 km) in 2021, within a broader investment cycle estimated at **EUR 72.6 billion** during 2011–2017. More recently, Algeria launched a bus-fleet modernization programme (2023–2024) to replace **10,000** old buses with Euro 5/Euro 6-compliant vehicles, although delivery reached **3,000** units by November 2025 (30% of the target), and it advanced high-speed rail development, including completion of the Oran–Tlemcen line (130 km) in 2024 (Baba Slimane , Nour El Houda, & Other, 2023, pp. 159-162).

4. Conclusion:

In conclusion, Algeria's road-transport policies reveal a persistent gap between declared green-economy objectives and actual environmental outcomes. The study shows that improvements in relative metrics (e.g., lower emissions per vehicle) have not translated into aggregate progress, as total CO_2 emissions continue to rise. This reflects the limits of an approach dominated by voluntary incentives and investment programmes that has not tackled core structural drivers—especially fleet ageing, continued reliance on conventional fuels, and fuel subsidies that sustain high consumption—thereby constraining an effective transition toward clean and renewable energy. Consequently, achieving measurable emissions reductions requires moving from partial, optional measures to a comprehensive and integrated strategy built around:

- Binding fleet renewal and universal enforcement of emission standards for all vehicles;
- Effective fiscal measures that price pollution and incentivize cleaner alternatives;
- Scaling up clean/alternative fuels through policies that move beyond voluntary incentives toward binding measures;
- Mandatory periodic technical inspections to ensure compliance with approved emission standards; and
- Transparency and accountability in implementation, with regular monitoring of verified emission reductions.

This study confirms that road transport in Algeria poses an increasing challenge to the environmental goals of sustainable development. While infrastructure progress is notable, it cannot deliver measurable environmental improvement without structural reforms in fleet composition, fuel consumption patterns, and regulatory enforcement. Delaying such reforms is costly, as current emissions trends imply a potential doubling by 2040, with escalating climatic, health, and economic risks.

5. Bibliography List:

Journal Article:

Abdenadir MOUSLI. (2025, 06 04). LPG/C in Algeria: A Strategic Lever for Sustainable Mobility? *El-Manhel Economy, 08*(01), 1-20.

Amal Mamdouh Mohammed Abdallatif. (2023). The impact of using Different Modes of Transportation ON the Volume of Emissions (A Case Study of Egypt). *International Journal of Commercial Research*, 1-31.

Amin, LARIDJI Mohammed, & MALIKI Samir Baha Eddine. (2021, 03 22). Transport infrastructure spending in Algeria: State of the Art. *Mediterranean Journal of Economics, Administration and Law, 17*(01), 125-137.

Karim Bouzir, & Other. (2017). Assessment of noise pollution in the city of Biskra, Algeria. *World Academy of Science, Engineering, 01*(12), 1052-1055.

Pierre Friedlingstein, & Other. (2024). *Global Carbon Budget 2024. Earth System Science Data Discussions.* doi:https://doi.org/10.5194/essd-2024-519

Sai, & others. (2024, 11 24). Evaluation of transport carbon efficiency, reduction potential and influencing factors in Africa. *Sustainable Production and Consumption*, 01-67. doi:https://doi.org/10.1016/j.spc.2024.03.020

Saif Eddine CHETTAH, & Nadra NAIT AMAR. (2021). Towards a sustainable transport in Algeria: The requisite of energy transition in the road transport sector. *Scientific Journal of Silesian University of Technology, 112*, 33-49. doi:https://doi.org/10.20858/sjsutst.2021.112.3

Yang, & Takase Tatsuo. (2024, 10 15). Spatial characteristics of carbon dioxide emission intensity of urban road traffic and driving factors: Road network and land use. *Sustainable Cities and Society, 113*(00). Retrieved from https://doi.org/10.1016/j.scs.2024.105700

هاجر شنيخر. (12, 2020). استراتيجية التهيئة الإقليمية لتحقيق التنمية المستدامة والفاعلية الإقتصادية. *مجلة العلوم الإنسانية لجامعة أم البواقي، 07*(03)، 200-218.

Seminar article:

Baba Slimane , Nour El Houda, & Other. (2023). Indicators for the evaluation of sustainable mobility in Algiers metropolis by 2035. *2nd International Conference on Engineering, Natural and Social Sciences* (pp.

156-165). All Sciences Proceedings. Retrieved from https://as-proceeding.com/index.php/icensos/article/download/431/383

Reports:

BUR1. (2023). *Soumis à la Convention-Cadre des Nations Unies sur les Changements Climatiques.* Algérie: Ministère de l'Environnement et des Energies Renouvelables. Retrieved from https://data.undp.org/sites/g/files/zskgke476/files/2025-01/bur1_algerie_revise_vf_22102023.pdf

IEA. (2023). *CO_2 Emissions in 2022 International Energy Agency.* Retrieved from https://www.iea.org/reports/co2-emissions-in-2022

IEA. (2024). *CO_2 Emissions in 2023: A new record high, but is there light at the end of the tunnel?* France, Paris: International Energy Agency. Retrieved from https://www.iea.org/reports/co2-emissions-in-2023

IEA. (2025). *Global Energy Review 2025.* International Energy Agency. Retrieved from https://www.iea.org/reports/global-energy-review-2025

IPCC. (2001). *Atmospheric Chemistry and Greenhouse Gases Section 4.2.4.* Cambridge: Cambridge University Press.

IPCC. (2021). *Climate Change 2021: The physical science basis CHAPTER 3 MOBILE COMBUSTION.* Cambridge: Cambridge University Press. Retrieved from https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_07.pdf

IPCC. (2021). *Summary for Policymakers, Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press. Retrieved from file:///C:/Users/mebar/Downloads/summary-for-policymakers.pdf

IPCC. (2022). *Annex II: Definitions, Units and Conventions. In Climate Change Mitigation of Climate Change.* Cambridge: University Press,. doi:https://doi.org/10.1017/9781009157926.021

IPCC. (2023). *Climate Change 2023: Synthesis Report.* doi:doi:10.59327/IPCC/AR6-9789291691647

Ministry of Energy and Mines. (2022). *National Energy Review.* Algeria: Ministry of Energy and Mines. Retrieved from https://www.energy.gov.dz/Media/galerie/bilan_energetique_2021_63df78f2b775e.pdf

Our Common Future. (1978). *Report of the World Commission on Environment and Development Our Common Future.* Stockholm.

TCC-GSR. (2023). *TRANSPORT, CLIMATE AND SUSTAINABILIT Y GLOBAL STATUS REPORT.* SLOCAT Partnership on Sustainable, Low Carbon Transport. Algeria Country Fact Sheet.

UNDP. (2022). *ALGERIA Climate Fact Sheet.* Retrieved from https://prddsgofilestorage.blob.core.windows.net/api/documents/Algeria_-_Climate_Fact_Sheet/Algeria_Climate_Fact_Sheet_EN.pdf

UNFCCC. (1997). *بروتوكول كيوتو الملحق باتفاقية الأمم المتحدة الإطارية بشأن تغير المناخ*. الأمم المتحدة: منظمة الأمم المتحدة المعنية بتغير المناخ. Retrieved from https://unfccc.int/resource/docs/convkp/kparabic.pdf

UNITED NATIONS. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development.* Retrieved from https://sdgs.un.org/2030agenda

CEIC Data. (2023). *Algeria Production Based Emissions of CO2 per Capita*. Retrieved from Our World in Dat: https://www.ceicdata.com/en/algeria/environmental-co2-and-greenhouse-gas-emissions-annual/production-based-emissions-of-co2-per-capita

Enerdata. (2025). *Algeria Energy Information*. Retrieved 10 19, 2025, from Enerdata: https://www.enerdata.net/estore/energy-market/algeria/

ONS. (s.d.). *Parc Automobile.* Récupéré sur Office National des Statistiques: https://www.ons.dz/spip.php?rubrique25

World Bank. (n.d.). *World Bank.* Retrieved from Population, total – Algeria: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=DZ&utm

World Bank Group. (2021). *Global Vehicle Emissions Standards Database - Vehicle Age Distribution Indicator*. Retrieved 11 02, 2025, from https://www.worldbank.org/en/topic/transport

worldometer. (2025). *Algeria population*. Retrieved 11 23, 2025, from worldometer: https://www.worldometers.info/world-population/algeria-population/

WLGA. (2024, 04 10). *Algeria's fleet surpasses one million vehicles fuelled by Autogas.* Retrieved 10 27, 2025, from World Liquid Gas Association: https://www.worldliquidgas.org/news/algerias-fleet-surpasses-one-million-vehicles-fuelled-by-autogas/

WLGA. (2024, 04 10). *Algeria's fleet surpasses one million vehicles fuelled by Autogas.* Retrieved 10 27, 2025, from World Liquid Gas Association: https://www.worldliquidgas.org/news/algerias-fleet-surpasses-one-million-vehicles-fuelled-by-autogas/

Internet websites:

Abdelillah Bendaoudi. (2025). *Algeria's Climate Strategy: Balancing Mitigation and Adaptation*. Retrieved 12 02, 2025, from Arab World Games: https://arabworldgames.com/algerias-climate-strategy-balancing-mitigation-and-adaptation/

Eromo Egbejule. (2024, 06 27). *theguardia*. Retrieved 10 30, 2025, from Whack-a-mole situation': Algerian officials wrestle with water shortage anger: https://www.theguardian.com/world/article/2024/jun/27/algerian-officials-wrestle-water-shortage-anger

Katherine Hearst. (2025, 01 10). *Algeria records highest temperatures in 2024 as global warming breaches 1.5C*. Retrieved 10 30, 2025, from https://www.middleeasteye.net/news/algeria-experiences-highest-levels-heat-stress-2024-global-temperatures-breach-15c

Leila Bensmaine. (2022, 11 05). *assafirarabi*. Retrieved 10 30, 2025, from Climate Change in Algeria and its Impacts:

https://assafirarabi.com/en/48562/2022/11/05/climate-change-in-algeria-and-its-impacts/

EEA. (2025, 10 20). *Emissions of air pollutants from transport in Europe*. Retrieved 10 30, 2025, from European Environment Agency: https://www.eea.europa.eu/en/analysis/indicators/emissions-of-air-pollutants-from

ICCT, Kate Blumberg, & Sarah Chambliss. (2014, 11 06). *Considering Co-benefits: Counting the role of non-CO2 climate pollutants in the near and long term*. Retrieved 11 02, 2025, from Icct20: https://theicct.org/considering-co-benefits-counting-the-role-of-non-co2-climate-pollutants-in-the-near-and-long-term/

U.S. EPA. (2025). *Greenhouse gas emissions from a typical passenger vehicle*. Retrieved 10 30, 2025, from https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle

رادية مراكشي. (26 11, 2025). *بشبكة طرق ضخمة.. الجزائر تتألق في التصنيف الإفريقي لعام 2025*. تم الاسترداد من https://elikaaonline.com/%D8%A8%D8%B4%D8%A8%D9%83%D8%A9-%D8%B7%D8%B1%D9%82-%D8%B6%D8%AE%D9%85%D8%A9-%D8%A7%D9%84%D8%AC%D8%B2%D8%A7%D8%A6%D8%B1-%D8%AA%D8%AA%D8%A3%D9%84%D9%82-%D9%81%D9%8A-%D8%A7%D9%84%D8%AA%D8%B5%D9%86%D9%8A/