

# Comparative Analysis of Sustainable Development Indicators in the World and in Mexico since the Last 20 Years

Diocelina Toledo-Vazquez<sup>a</sup>, Gabriela Hernández-Luna<sup>b</sup>, Rosenberg J. Romero<sup>b,\*</sup>

<sup>a</sup>Posgrado en Ingeniería y Ciencias Aplicadas – UAEM, Av. Universidad 1001, (62209) Mor., México

<sup>b</sup>Centro de Investigación en Ingeniería y Ciencias Aplicadas – UAEM, Av. Universidad 1001, (62209) Mor., México  
 rosenberg@uaem.mx

In recent years, Mexico has developed and implemented a range of policies and targets to address climate change, reduce greenhouse gas (GHG) emissions, and transition toward a low-carbon and climate-resilient society. These policies contribute to global efforts to limit climate change and Mexico's own need to maintain energy security, diminish air pollution, and improve the health and well-being of its people. Derived from the twenty-first Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), the country assumes the aspirational goal of reducing emissions by 30 % of the baseline by 2020 and a 50 % reduction in emissions by 2050 about those emitted in the year 2000. The transport sector is the second source of GHG emissions, it is a key sector for cities to mitigate their emissions and for countries to comply with their international commitments.

## 1. Introduction

Climate change is unequivocal, the human influence on the system is clear, anthropogenic emissions of GHG are the highest in history driven largely by economic and population growth. The average temperature of the land surface and oceans has increased, the volumes of ice and snow have diminished, and the sea level has risen (IPCC, 2014). The 21st annual session of the Conference of the Parties (COP21) was held in 2015 in Paris, bringing together 195 countries to establish actions and investments toward a future with low carbon emissions, resilient and sustainable (UNFCCC, 2021). This agreement is the most ambitious document on climate change in history, it commits countries to decarbonize their economies, and assume commitments against climate change, in favor of the environment and sustainable development. This agreement consists of an action plan to limit global warming to below 2 °C concerning pre-industrial levels and continuing efforts to limit it to 1.5 °C (UNFCCC, 2015).

In 2015, the 2030 Agenda for Sustainable Development was approved, an action plan in favour of people, the planet, and prosperity. Made up of 17 Sustainable Development Goals (SDGs) of an integrated and indivisible nature, combining the three dimensions of sustainable development: economic, social, and environmental, it is proposed that it will guide decisions during the next 15 years considering the different realities, capacities, and levels of development of the countries, respecting their national policies and priorities (UN, 2015).

As part of its sixth assessment report (AR6), in 2018 the Intergovernmental Panel on Climate Change (IPCC) published a special report on global warming of 1.5 °C, presenting updated information on the time available to achieve the goals of the Paris Agreement. Specifically, it establishes that global emissions in 2030 must be 45 % lower than in 2010, to reach zero net CO<sub>2</sub> emissions in 2050, so an unprecedented transformational change must begin immediately (IPCC, 2018). Transport has the highest reliance on fossil fuels of any sector and accounts for 37 % of CO<sub>2</sub> emissions from end-use sectors (IEA, 2021), so efforts to reduce emissions and mitigate climate change must include this sector.

### 1.1 Mexico's transport sector (case study)

Mexico is, like many other countries, a country highly sensitive to the effects of climate change due to its geographical conditions and the wide gaps in socioeconomic inequality of the population. In response to the challenges posed by climate change, Mexico created a legal, regulatory, and long-term planning framework,

becoming one of the first countries to pass comprehensive climate change legislation to direct national policy. This legislation consists of general law, a national climate change strategy, and a special climate change program, and it also covers a wide range of concerns including mitigation, adaptation, and institutional arrangements (Altamirano, et al., 2016). Its function is to regulate, promote and incorporate adaptation and mitigation actions; it also defines the obligations of the authorities and establishes institutional mechanisms to face the challenge. Derived from the twenty-first Conference of the Parties to the UNFCCC, the country assumes the aspirational goal of reducing emissions by 30% by 2020 concerning the baseline which is about those emitted in the year 2000; as well as a 50% reduction in emissions by 2050 about those emitted in the year 2000 (DOF, 2020).

In addition to national efforts, Mexico has actively participated in international meetings on climate change and sustainable development. Mexico signed the Paris Agreement to boost its economy, reduce the vulnerability of the population, preserve ecosystems, and reduce GHG emissions and short-lived climate pollutants (SCVC), taking care of priority the sectors with the highest incidence (DOF, 2016). The Agreement asks each country to prepare, communicate and maintain successive Nationally Determined Contributions (INDC) that they plan to make as part of the efforts to reduce emissions and adapt to the effects of climate change, in this context, the content of an INDC depends on national processes, priorities, circumstances, and capacities of each country within the global framework towards low GHG emissions (UNFCCC, 2015). With the update of the National Inventory of Emissions of Greenhouse Gases and Compounds (INEGYCEI), Mexico was the first country in Latin America to present it (INECC & SEMARNAT, 2018). According to INEGYCEI 2015 data, Mexico was responsible for the emission of 699.56 megatons of carbon dioxide equivalent (Mt of CO<sub>2</sub>e). Of the total emissions, the energy sector contributed 71.11 % derived from its high dependence on fossil fuels, in particular, the transport sector contributed 34.4 % of the emissions of this sector.

Mexico's contribution contains two components, one for adaptation and the other for mitigation. The adaptation component includes two types of measures: unconditional measures, which refer to those that the country can pay for with its own resources, and conditional measures, those which require the establishment of a new international climate change regime in which Mexico could obtain additional resources and achieve effective technology transfer mechanisms. Mexico has assumed the international commitment to reduce 22 % of its GHG emissions by 2030, a figure that could be raised to 36% conditionally in case of receiving international support (Government of the Republic, 2014).

## **2. Methodology and Results**

Transport is vital for promoting connectivity, trade, economic growth, and employment. Yet it is also implicated as a significant source of GHG emissions. Resolving these trade-offs are essential to achieving sustainable transport and, through that, sustainable development. Within the framework of the fight against climate change, the transition towards sustainable development, and given the growing importance of sustainability aspects in national energy plans, an analysis of the sustainable development indicators in the transport sector was carried out. Some SDGs are directly connected to sustainable transport through targets and indicators. This document presents a summary description of these targets, what the current situation in Mexico is, how it has evolved, and where it stands globally.

### **2.1 SDG target 9.1**

SDG 9.1 calls for developing quality, reliable, sustainable, and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. Infrastructure investment covers spending on new transport construction and the improvement of the existing network. Infrastructure investment is a key determinant of performance in the transport sector. Efficient transport infrastructure provides economic and social benefits to both advanced and emerging economies by improving market accessibility and productivity, ensuring balanced regional economic development, creating employment, promoting labor mobility, and connecting communities.

Transport infrastructure investment remains one of the key decisions taken by policymakers and accounts for a large fraction of Organization for Economic Cooperation and Development (OECD) countries' budgets. In 2016, the average total inland transport infrastructure investment amounted to roughly 1 % of GDP across member countries of the OECD International Transport Forum (ITF) (OCDE, 2020). This indicator is measured as a share of GDP for total inland investment. In 2020, Mexico invested only 0.2% of its GDP in infrastructure development (OECD, 2022) being the country of the G20 that allocated less capital to the fulfillment of this goal as can be seen in Figure 1.

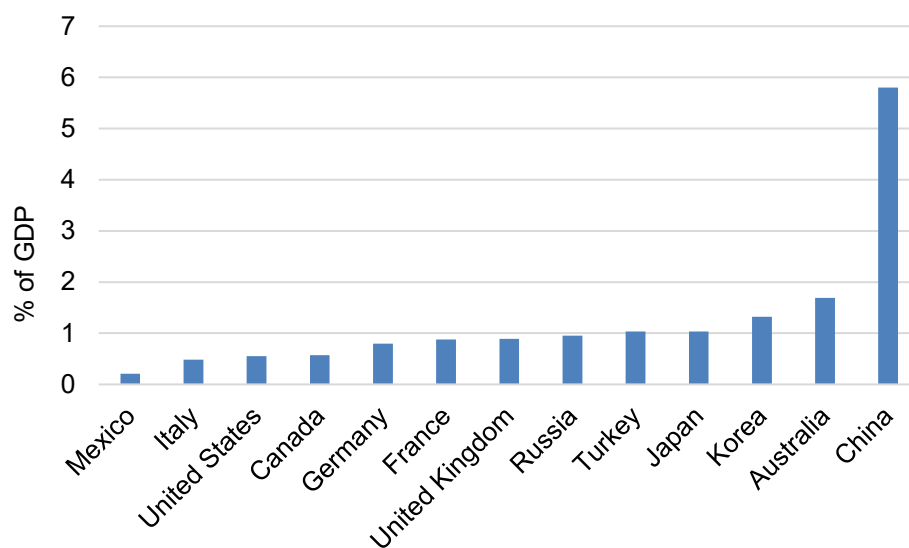


Figure 1: Infrastructure investment, % of GDP, 2020 or latest available (OECD, 2022).

Electric car deployment has been growing rapidly over the past ten years, with 16 million on the World's roads at the end of 2021. In 2021, electric car sales more than doubled to reach 6.7 million, representing close to 9% of global car sales (IEA, 2021). Although the units of hybrid and electric vehicles (H&E-Vs) sold in Mexico have been increasing in recent years, but the percentage that these vehicles represent among all light vehicles sold is very small as can be seen in Figure 2. According to data from the National Statistics Institute of Mexico, the amount of H&E-Vs sold represented 2.16% of the total of new light vehicles sold in 2021 for private use (INEGI, 2022)

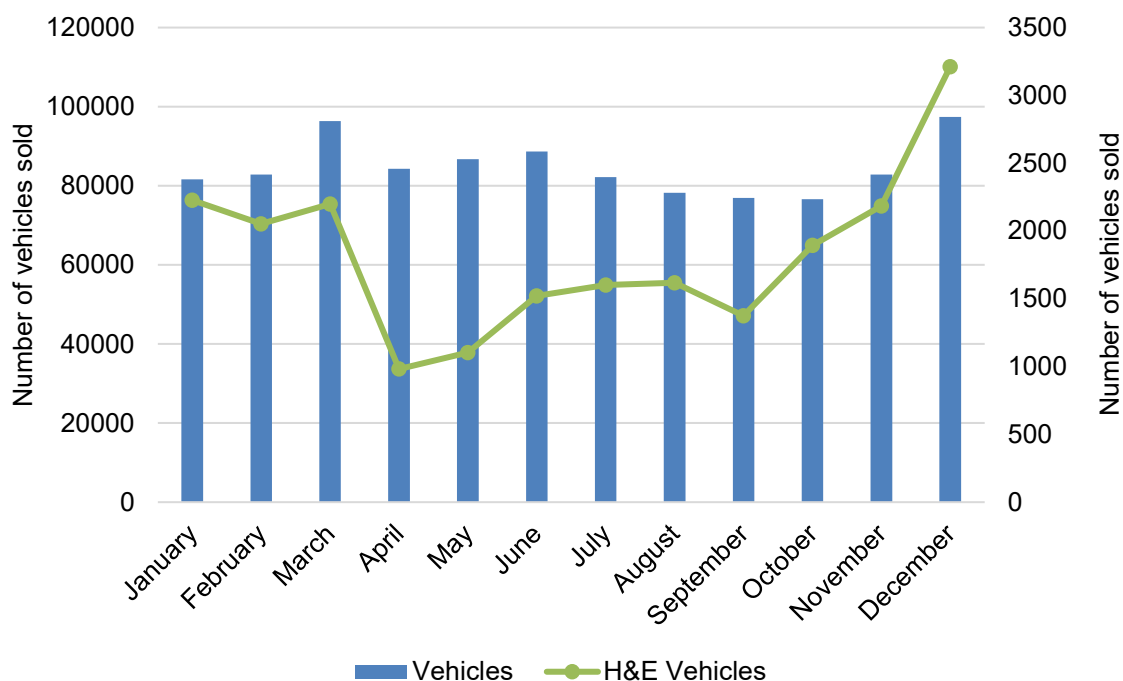


Figure 2: Sales of vehicles vs hybrid and electric vehicles in México, 2021. Source: (INEGI,2020)

## 2.2 SDG target 11.2

SDG 11.2 seeks to by 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons. Due to their high concentration of people, infrastructures, housing, and economic activities, cities are particularly vulnerable to climate change and natural disasters impacts. Estimates suggest that cities are responsible for 75 % of global CO<sub>2</sub> emissions, with transport being among the largest contributors (UNEP, 2022). As can be seen in Figure 3, the metropolitan areas of the world and Mexico have high rates of pollution.

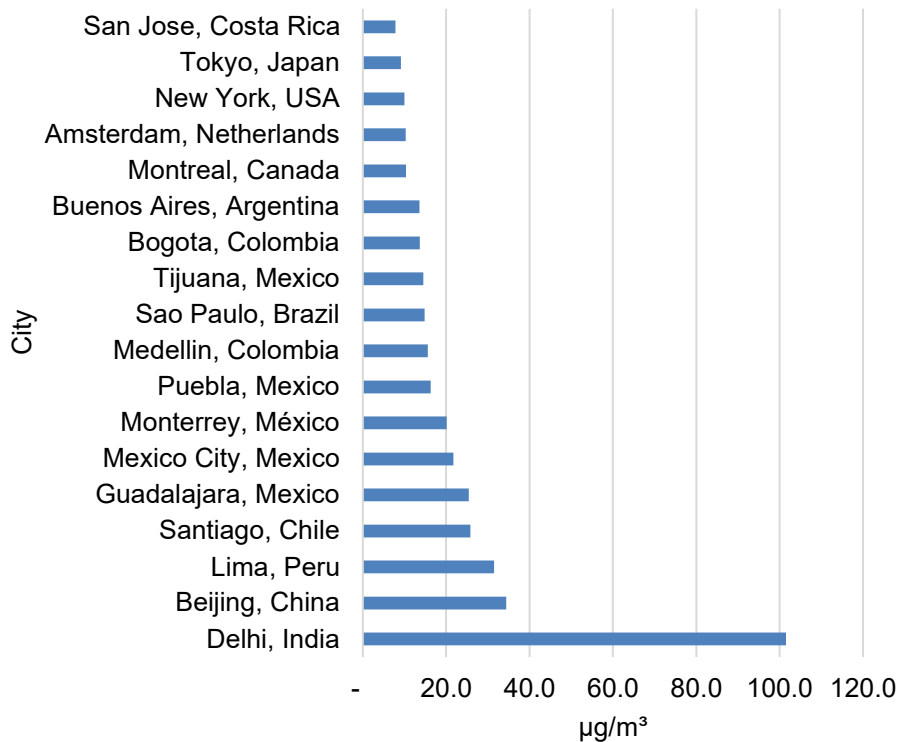


Figure 3: Polluted city ranking based on annual average PM<sub>2.5</sub> concentration (µg/m<sup>3</sup>). Source: (IQAir, 2022)

## 2.3 SDG target 13

Flows of people have increased dramatically over recent decades and will continue to rise alongside associated increases in demand for sustainable transport. At the same time, the dire impacts of climate change are already apparent and expected to worsen, at least in the short term. Emissions from the transport sector have a high impact on climate change, so it is important to incorporate urgent measures. Transport has the highest reliance on fossil fuels of any sector and accounts for 37 % of CO<sub>2</sub> emissions from end-use sectors at the world level (IEA, 2021). Figure 4 shows the per capita emissions of the transport sector worldwide in 2018. Mexico is ranked 14th due to the high demand for fossil fuels in the sector.

## 2.4 SDG target 17

Fostering and promoting the establishment of effective alliances between multiple stakeholders that exchange knowledge, technology, and financial resources, to achieve development is essential to increasing sustainable transport. In 2020 official development assistance increased by 7 % in real terms from 2019, foreign direct investment flows fell by up to 40 %, and officially recorded remittance flows to low and middle-income countries fell 1.6 % below the 2019 level (UN, 2021). One of the most relevant economic policy decisions that influenced this growth path for Mexico was the entry into force in 1994 of the North American Free Trade Agreement (NAFTA), signed with the United States of America and Canada, which led to economic growth and contributed to raising the standard of living of the population of the member countries. (CEPAL, 2018). The three nations signed a new agreement that replaces NAFTA. The T-MEC entered into force in January 2020 and aims to strengthen the rules and procedures that govern trade and investment, to be a solid foundation for strengthening economic ties between the three nations (FORBES, 2020).

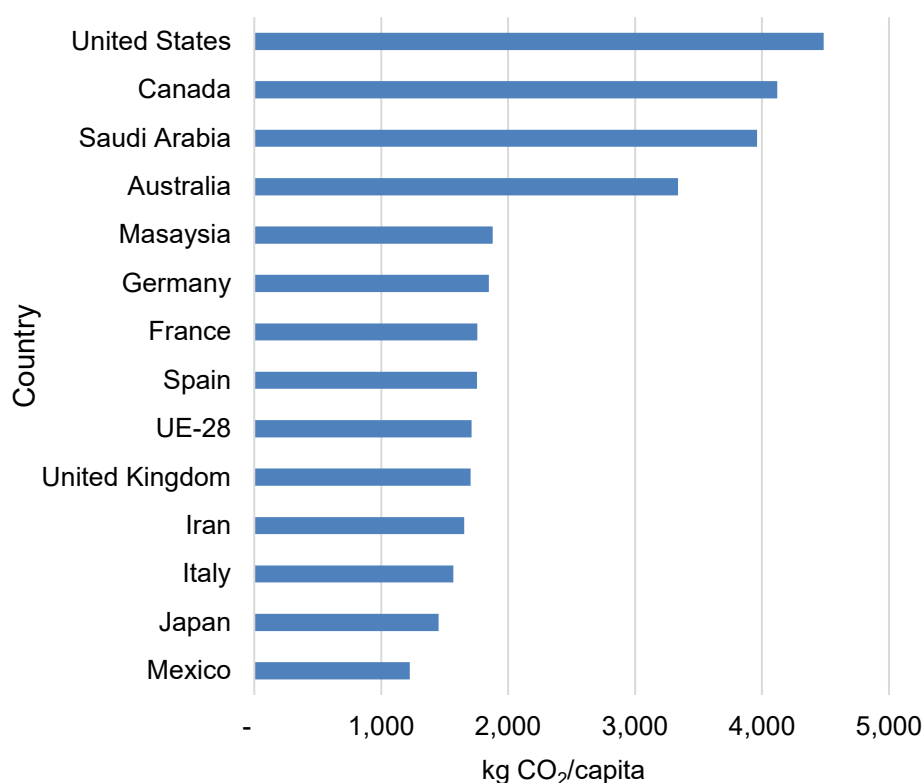


Figure 4: Road transportation emissions worldwide in 2018. Source: (STATISTA, 2020.)

### 3. Conclusions

Sustainable transport, with its objectives of universal access, enhanced safety, improved resilience, greater efficiency, and reduced environmental impact, is vital for achieving the 2030 Agenda for Sustainable Development and the Paris Climate Change Agreement. Even though the need for action is urgent, progress is insufficient. Other actions are needed: increased international cooperation, policies, regulations, standards, and incentives; sustainable planning; increased commitments and efforts to decarbonize passenger and freight transport across all transport modes, including road, rail, aviation, and maritime; and special attention to the needs of countries in development are also required. In particular, Mexico country has great challenges, its efforts have not been sufficient, it lacks adequate infrastructure for the modernization of the sector, it needs to adopt new technologies and less polluting fuels, as well as promote national regulations. Among the specific measures that must be implemented as soon as possible to reduce emissions in the transportation sector are the updating of the efficiency standard for gasoline vehicles, the immediate start of the implementation of the standard on vehicle emissions, the promotion of clean transport and implement the National Electric Mobility Strategy. The Mexican citizens are involved in the CO<sub>2</sub> diminish emission but just 1 of 40 vehicles are electric or hybrid in this year's sales.

### Acknowledgments

Authors thank to CONACYT for partial support in this research.

### References

- CEPAL, 2018, National monitoring report on energy efficiency in Mexico, 2018, Comisión Económica para América Latina y el Caribe, Mexico <[www.cepal.org/es/publicaciones/43612-informe-nacional-monitoreo-la-eficiencia-energetica-mexico-2018](http://www.cepal.org/es/publicaciones/43612-informe-nacional-monitoreo-la-eficiencia-energetica-mexico-2018)>
- DOF, 2016, Promulgation Decree of the Paris Agreement, Official Journal of the Federation, Mexico.
- DOF, 2020, General Law on Climate Change, Official Journal of the Federation, last reform published 06-11-2020, Mexico.

- FORBES, 2020, ¿Qué es el T-MEC y por qué es importante para México?. < [www.forbes.com.mx/economia-que-es-el-t-mec-y-por-que-es-importante-para-mexico/](http://www.forbes.com.mx/economia-que-es-el-t-mec-y-por-que-es-importante-para-mexico/)>
- Government of the Republic, 2014, Adaptation and mitigation commitments to climate change for the period 2020-2030, New York.
- IEA, 2021, Global Energy Review 2021, International Energy Agency, Paris. <[www.iea.org/reports/global-energy-review-2021](http://www.iea.org/reports/global-energy-review-2021)>
- IPCC, 2014, Climate Change 2014: Synthesis Report. Intergovernmental Panel on Climate Change, Contribution of Working Groups I, II and III to the Fifth Assessment Report, Geneva, Switzerland <[www.ipcc.ch/report/ar5/syr/](http://www.ipcc.ch/report/ar5/syr/)>
- IPCC, 2018, Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change. Intergovernmental Panel on Climate Change, Geneva, Switzerland.
- IQAir, 2022, World's most polluted cities (historical data 2017-2021 <[www.iqair.com/world-most-polluted-cities](http://www.iqair.com/world-most-polluted-cities)>
- OECD, 2022, Infrastructure investment (indicator). doi:10.1787/b06ce3ad-en
- OECD, 2020, Transport Bridging Divides, OECD Urban Studies, OECD Publishing, Paris, doi.org/10.1787/55ae1fd8-en.
- STATISTA, 2020, Road transportation carbon dioxide emissions per capita worldwide in 2018, by select country <[www.statista.com/statistics/1201243/road-transport-sector-per-capita-co2-emissions-worldwide-by-country/](http://www.statista.com/statistics/1201243/road-transport-sector-per-capita-co2-emissions-worldwide-by-country/)>
- UN, 2015, Transforming our world: the 2030 Agenda for Sustainable Development. United Nations, General Assembly. <[www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A\\_RES\\_70\\_1\\_E.pdf](http://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf)>
- UN, 2020, The Sustainable Development Goals Report. United Nations <[unstats.un.org/sdgs/report/2021/#sdg-goals](http://unstats.un.org/sdgs/report/2021/#sdg-goals)>
- UNFCCC, 2015, Paris Agreement. United Nations Framework Convention on Climate Change< [www.unfccc.int/sites/default/files/english\\_paris\\_agreement.pdf](http://www.unfccc.int/sites/default/files/english_paris_agreement.pdf)>
- UNFCCC, 2021, United Nations Framework Convention on Climate Change. <[unfccc.int/timeline/](http://unfccc.int/timeline/)>
- UNEP, 2022, Cities and climate change. United Nations Environment Programme <[www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change](http://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change)>