

SUSTAINABLE MOBILITY INDICATORS FOR CITIES

Grațîela BRÂNZĂ

Constanta Maritime University, Romania
gratielabranza@gmail.com

Abstract

The development of every nation is measured through its grade of industrialization and especially its transportation system development. But this development can only be achieved by respecting and fulfilling the goals of sustainable mobility. This paper presents the concept of sustainable mobility and the specific set of sustainable mobility indicators for cities, that are used to analyze, evaluate and improve urban policies in the sphere of sustainable mobility. The paper also includes a brief comparison between the country with the highest score and the one with the lowest score in the global ranking, depending on the value of the GSMI score. Since Sweden is the leader of the European countries in sustainable mobility, the paper also highlights some examples of good practices in the field of sustainable mobility promoted by Swedish companies.

Key words: *sustainable mobility, Europe, Sweden, indicators, sustainable development, transport, transport system, cities*

JEL Classification: *Q56, Q01, R41*

I. INTRODUCTION

In a global world, where the living standards' evolution depends on economic, social and environmental challenges, it is essential to think and to act in a sustainable manner. The development of every nation is measured through its grade of industrialization. Scientific research, innovations and high technology can boost the development of sustainable industry, especially of sustainable transport systems. At the level of each country, the promotion of right policies can cut transport CO₂ emissions in cities, 70% of the reduction coming from new technologies (more efficient engines, electric mobility, other alternative fuels) and 30% coming from human behavior changes (incentives for car sharing, pricing of fuel and parking and so forth).

In order to modernize the European mobility and transportation, European Economic and Social Committee proposed a package of measures that will help the sector to remain competitive in a socially fair transition towards clean energy and digitalization. "Europe on the Move" is a wide-ranging set of initiatives that will make traffic safer, encourage fairer road charging, reduce CO₂ emissions, air pollution and congestion, generating long-term benefits for transport sector by promoting jobs, growth and investments and putting European cities on the path towards sustainable mobility. (EESC, 2017)

II. LITERATURE REVIEW

According to the World Business Council for Sustainable Development, sustainable mobility represents "the ability to meet society's need to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values, today or in the future". (WBCSD, 2004)

Sustainable mobility means clean, efficient, safe and accessible transportation for people and goods, being environmentally-friendly and considering its regeneration capacity. Battery and fuel cell-powered electric vehicles, renewable fuels, fuel-efficient and hybrid engines generate net-zero transportation for almost every mode, meaning no air pollutants in road transport, maritime transport and air transport. Worldwide, the global goal for 2050 is that all vehicles have zero carbon electric drivetrains. Zero-emission autonomous passenger vehicles will increase efficiency, road safety and resilience. (WBCSD, 2021)

The definition of the European Union Council of Ministers of Transport for sustainable transportation system is that it "allows the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations." (https://ec.europa.eu/commission/presscorner/detail/en/PRES_01_131) The United Nations has defined sustainable transport as "the provision of services and infrastructure for the mobility of people and goods—advancing economic and social development to benefit today's and future generations—in a manner that is safe, affordable, accessible, efficient, and resilient, while minimizing carbon and other emissions and environmental impact." (<https://www.neste.com/media/sustainable-mobility/what-is-sustainable-mobility>)

Sustainable transport systems respect people and the whole society, protecting the health and security of them and increasing the communities’ life quality. Innovations in infrastructure and traffic management systems promote road safety, reducing road traffic injuries and deaths at almost zero. Also, innovations in information and communications technology can contribute to a safer, cleaner, efficient and accessible mobility and to promote performance-based taxation and subsidy programs.

Sustainable mobility must take care also about social equity and justice, shared transport services being accessible for all and increasing the life quality of the whole community. An important role is taken by the community’s companies, that have to help the diversification of mobility options, in order to use on a large scale electric fleets, vehicle sharing and incentives for walking, biking and public transportation.(WBCSD, 2021)

III. THE SET OF SUSTAINABLE MOBILITY INDICATORS FOR CITIES

Sustainable mobility indicators are described with SMART methodologies (specific, measurable, attainable, relevant, time-based), permitting the standardized evaluation and improvement measures after new mobility policies implementation. The indicators set was built, considering the essential dimensions of sustainable development applied on sustainable mobility, such as: global environment, quality of city’s life, economic success, mobility system performance.

The World Business Council for Sustainable Development (WBCSD) developed and proposed a set of 19 indicators to assess the sustainable mobility in urban areas and to base the best decisions after their analysis and interpretation. So, sustainable mobility can be measured and characterized by various indicators, such as:

Table 1. Dimensions of sustainable development and sustainable mobility indicators

Global Environment	Economic Success	Quality of life	Performance of the mobility system
Mobility space usage, Emissions of greenhouse gases, Congestion and delays, Energy efficiency, Opportunity for active mobility.	Urban functional diversity, Commuting travel time, Economic opportunity, Net public finance, Mobility space usage.	Affordability of public transport for the poorest group, Accessibility for mobility-impaired groups, Air polluting emissions, Noise hindrance, Fatalities, Access to mobility services, Quality of public area, Urban functional diversity, Commuting travel time, Economic opportunity, Comfort and pleasure, Security.	Affordability of public transport for the poorest group, Accessibility for mobility-impaired groups, Congestion and delays, Energy efficiency, Opportunity for active mobility, Intermodal integration, Comfort and pleasure, Security.

Source: WBCSD, 2015

Later, the set of 19 indicators was enriched with new indicators: Occupancy rate, Motorization rate (4 wheels, 2 wheels), Modal Split, Vehicle miles travelled per capita, Smartphone penetration, Availability of public transport cards, Car friendliness, Speed in the transport network. (WBCSD, 2015)

The set of indicators is valid for cities at any stage of economic development. Data are collected through a questionnaire, that comprises recommended surveys questions. By calculating the indicators periodically, cities can measure in which areas they made progress towards sustainability, obtaining a better urban mobility system.

SuM4All constructed a composite index score for sustainable mobility, whose values ranges between 0 and 100. The Global Sustainable Mobility Index score (GSMI) was developed in 2019 by the Sum4All partners to permit comparisons and rankings of transport systems across countries. (Sum4All, 2022) The score is calculated as the average score of the four goals defining sustainable mobility (universal access, efficiency, safety, green mobility), giving each goal an equal importance. The score for each goal ”is computed by taking the country’s value for the principal indicator expressed as a percentage relative to the best and least performing countries in the world on that goal”.(Sum4All, 2022) There are seven “principal” indicators and all are used to calculate the GSMI.

The GSMI countries’ scores are used to rank 183 countries on a global scale. For example, Romania

ranks 23rd on sustainable mobility, with a GSMI score of 67,97 in a global ranking of 183 countries. In 2022, according to SuM4All partners, the best scores of GSMI were recorded by Sweden (86,22), Singapore (86,11), Germany (85,91), Switzerland (84,64), Netherlands (84,15), United Kingdom (82,21), France (81,41), Japan (79,45), Spain (79,21), Denmark (79,07), Austria (79,04). The lowest scores were obtained by Libya (22,41), Liberia (22,37), Venezuela (22,37), Central African Republic (21,76), Chad (20,65), Eritrea (19,14), South Sudan (17,10), Saudi Arabia (14,51), that ranks 183rd place.

In the table below, we can see a comparison between the “principal” indicators for the country who’s leading the global ranking and the country with the lowest score.

Table 2. The Principal Indicators from the composition of GSMI in Sweden and Saudi Arabia

Sustainable mobility goals	Principal indicators	Sweden	Saudi Arabia
1. Universal Access	1.1.Rural Access Index (%)	91	39
	1.2.Rapid Transit to Resident Ratio (km per millions)	70,7	0
	1.3.Workers in transport who are female (%)	23	3
2.Safety	2.1.Mortality caused by road traffic injury (per 100000 people)	3,1	35,9
3.Efficiency	3.1.Logistics performance index: Overall (1=low to 5=high)	4,1	3
4.Green Mobility	4.1.PM 2.5 air pollution, mean annual exposure (micrograms per cubic meter)	5,7	64,1
	4.2.Transport – related GHG emissions per capita (tons of CO ₂ per capita)	1,7	4,1

Source: SuM4All, 2022

IV.SWEDEN – EXAMPLE OF GOOD PRACTICES IN SUSTAINABLE MOBILITY

Sweden is one of the most developed countries in the European Union in the direction of sustainable mobility and the fulfillment of the targets set at the level of the Union in this regard. Most of the active companies in the field of transport or in the economic branches with direct implications in this sector, contribute significantly to the development of sustainable mobility in Swedish cities.

"2MA Technology" AB is a prime example of a company that offers a data system for vehicles – ISA (intelligent speed adaptation), which gives the driver the possibility of maintain the right speed, reducing very much the risk of major accidents.(<https://swedishcleantech.com/companies/1041/2ma-technology/>)

Another good practice example is that of “Alelion Energy Systems” AB, a pioneer company which promotes lithium-ion battery technology. The company works with electric forklift trucks and other vehicles for storage and transport, where this technology is advantageous for clients’ businesses and for the environment.(<https://swedishcleantech.com/companies/1567/alelion-energy-systems-ab/>)

“Candela Speed Boat” AB is also among companies that promote sustainable mobility through the first electric boat with speed and range equivalent to fossil fuel vessels. The foils of boat minimize energy consumption by 80 percent and the cost for the trip is 95% cheaper compared to traditional boats of the same size. After five years of research and development activities, serial production of this kind of boats started in 2019. The company’s long-term mission is to scale the foiling technology to coastal ferries. In urban environment, in cities like Hamburg, Stockholm or on rivers like the Rhine, “a foiling electric ferry could reduce pollution and traffic congestion on highways and provide a cheap, zero-emission mass transport”, according to the boat “Candela” engineer Hasselskog. His goal was to change the marine transport industry by removing the dependence on fossil fuels in boating.(<https://swedishcleantech.com/companies/2003/candela-speed-boat-ab/>)

A successful Swedish company in the field of sustainable mobility, “Elonroad”, develops a high-tech electric road system. It auto charges all types of electric vehicles when parked as well as when driving. “Elonroad” is a pioneer in road digitization. The company’s electric road system is equipped with IoT sensors and software which collects and analyses transportation data to generate intelligent feedback that interacts in real-time with moving and stationary vehicles. By 2026, “Elonroad” forecast that they will have the capacity to charge 20.700 electric vehicles trucks, with a CO₂ emissions reduction of 1,53 Mt CO₂. By 2050, the company wants to reduce CO₂ emissions by 7.66 Mt CO₂.(<https://swedishcleantech.com/companies/2012/elonroad/>)

And the examples of Swedish companies that support and promote the development of sustainable mobility can continue. Any city, from any country can take these examples of good practices, adapting them to their national context. Sweden is a forerunner on issues related to sustainable mobility, the city of Stockholm being the first “European Green Capital” since 2010. (Fenton, 2020)

V. CONCLUSION

In a modern society, economically, socially and environmentally sustainable, the orientation of cities towards sustainable mobility and multimodal integration between the different modes of public transport represent the solution to safer and healthier urban areas. The development of cities in the spirit of sustainable mobility has many values, but they all converge towards clean energy and digitization.

Sustainable mobility means clean, efficient, safe and accessible transportation for people and goods, being environmentally-friendly and considering its regeneration capacity. Sustainable mobility must take care also about social equity and justice, increasing the life quality of the entire community. The National authorities have a set of indicators to evaluate the sustainable mobility in cities and to take the best decisions after their analysis and interpretation. Every country has a rank after the calculation of a composite index score for sustainable mobility, depending on the sustainable transport goals accomplishment. Sweden has the highest score of Global Sustainable Mobility Index score (GSMI) and it is an example of best practices nation, that can be taken over and adapted to the specifics of each individual country.

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