REDUCING GREENHOUSE GAS EMISSIONS BY IMPLEMENTING SUSTAINABLE INFRASTRUCTURE PROJECTS

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ABSTRACT

Climate change is an inevitable and urgent global challenge with long-term implications for the sustainable development of all countries. In order to respond to climate change, it is very important to identify new ways of reducing greenhouse gas emissions. The present paper emphasizes that the use of a greener and more efficient means of transport, such as a highway (in this case Buzău-Focșani) is more beneficial in terms of reducing greenhouse gas emissions than using old infrastructure. Through specific traffic data processing and dispersion modelling, it was shown that the polluting emissions will increase in the next years, in case of using the already existing road, while the use of a sustainable highway provides a downward trend for these emissions. The construction of the highway will have positive effects on air quality, will ensure a good traffic flow, but the benefits will be even greater when the replacing of the existing car fleet (Diesel vehicles) with hybrid and electric vehicles will take place.

Keywords: *GHG, emissions, highway, environment, mitigation*

INTRODUCTION

Global warming currently involves the main need of reducing greenhouse gas emissions in order to mitigate the anthropogenic influence on the climate system and allow ecosystems the opportunity to increase their resilience and adaptability capacity. Despite global efforts to reduce greenhouse gas emissions, the average temperature will continue to rise in the coming period, requiring urgent measures.

According to national estimates [1], GHG emissions increased in the transportation field by approx. 155%, compared to the emissions from 1989. This phenomenon can be attributed to the increase of mobility between 1990 and 2008, the urban expansion, the use of roads for passenger and freight transport and the intensification of air traffic.

In Romania, the effects of climate change are felt especially through changes of temperature, rainfall amounts and winds' frequency and intensity. According to Climate Change Scenarios [2], we are dealing with significant warming of about 2°C, since 1961, in almost the whole country, during the summer, with increasing rainfall and significant downward trend of the winds.

The present paper aims, through specific traffic data processing and dispersion modelling, to demonstrate the beneficial effect, in terms of greenhouse gas

emissions, of the development of a greater and greener type of infrastructure network, instead of the existing one.

In order to better highlight this aspect, the Buzău – Focșani highway was used as an example in this article. This highway is part of the TEN-T Core (Central) network, and it connects the south of the country with the NE region, the historical regions of Moldova and Bucovina, and also with Ukraine and the Republic of Moldova. As a strategic objective, it is intended to build a highway along the entire corridor.

METHODOLOGY

The route of Buzău - Focşani highway is located on the administrative territory of two counties, namely: Buzău (from km 0+000 to km 45+455) and Vrancea (from km 45+455 to km 82+440).

In order to determine the estimative quantities of pollutants emitted during the operation of the Buzau - Focşani highway compared to those emitted by the existing infrastructure (DN2 Urziceni - Buzău – Focșani), the Tier 1 methodology from the EMEP/EEA/2019 guidebook [3] was used.

For modelling the dispersion of air pollutants during the operation period, the BREEZE AERMOD/ISCTM program was used, a program based on the AERMOD mathematical dispersion model, developed and used by the United States Environmental Protection Agency.

Dispersion modelling involves several intermediate steps, such as preparing meteorological data, land surface data and information related to topography. The modellling takes into account the topographic and climatic characteristics for each location (sources of pollution) and can predict concentrations of pollutants from fixed sources, surface or volumes.

In order to calculate the emission quantities of vehicles during the operation phase, the following data were taken into account:

- average vehicle flow/year/ vehicle categories;

- average and total number of traveled km/year/vehicle categories;

The data obtained from the calculations were introduced in COPERT 5 and processed in the AERMOD program, in order to determine the concentrations and dispersion of pollutants from mobile emission sources. Pollutant dispersion calculus by vehicle type during operation is presented in Table 1, for the year 2050 [4].

The specific source of pollution during the operation period is represented by the road traffic on the new road artery. Using the specified calculation method, the concentrations of greenhouse gases (evaluated through CO_{2e}) were estimated.

To assess the impact on the environment from the perspective of pollutant emissions and climate change during operation, the methodology included in the Update of the Handbook on External Transport Costs - Final Report from 2014 [5]

was applied. In order to assess the impact on the environment, the following steps were taken:

- quantification of pollutant emissions (by using vehicle emission factors, vehicle types and traffic flow data);
- modelling the dispersion of pollutants around the source using complex atmospheric dispersion models.

Table 1. *Estimated amounts of CO emissions by vehicle type during operation*

Vehicle categories	**Years**					
	2025	**2030**	**2035**	**2040**	**2045**	**2050**
Buses - Highway	0.472	0.323	0.219	0.241	0.255	0.270
Buses - DN2 Urziceni - Buzău - Focşani	1.258	1.306	1.381	1.573	1.764	1.896
Heavy trucks - Highway	33.520	15.817	11.508	13.057	14.298	15.460
Heavy trucks - DN2 Urziceni - Buzău - Focşani	63.115	67.820	75.645	106.157	122.516	138.457
Light commercial vehicles - Highway	8.713	5.794	3.943	4.683	5.145	5.696
Light commercial vehicles - DN2 Urziceni - Buzău - Focşani	18.354	22.430	24.833	27.630	29.872	39.898
Light-duty vehicles - Highway	23.515	18.220	12.109	12.992	13.499	14.044
Light-duty vehicles - DN2 Urziceni - Buzău - Focşani	352.103	333.117	339.375	366.315	426.008	884.407
Total - Highway	**66.220**	**40.153**	**27.779**	**30.972**	**33.196**	**35.470**
Total - DN2 Urziceni - Buzău - Focşani	**434.831**	**424.673**	**441.234**	**501.675**	**580.160**	**1064.658**

RESULTS AND DISCUSSIONS

According to the presented data, the quantities of traffic emissions for the CO indicator, during the operation period, have an increasing trend for DN2 Urziceni - Buzău - Focşani (Baseline scenario) and a decreasing trend for the Buzău - Focşani Highway (Projection scenario).

Following the mathematical modelling of the pollutant dispersion based on the values of local background concentrations, the total quantities of emissions from mobile sources were obtained during the operating period for the baseline and projection scenario, presented in **Table 2**.

Table 2. *CO concentrations (mg/m^3) values obtained for a mediation period of 8 hours - for the years 2025, 2035 and 2050*

	DN2 Urziceni – Buzău - Focşani (Baseline scenario)			**Highway Buzău – Focşani (Projection scenario)**			**The limit values provided by Law no. 104/2011 (mg/ m^3)**
	Traffic on DN2 Urziceni-Buzău-Focşani	Local background	**Total**	Traffic on Buzău – Focşani Highway	Local background	**Total**	
2025							
Route from Buzău county	0.00233	0.558	0.560	0.00024	0.558	0.558	10
Route from Vrancea county	0.00219	0.559752	0.562	0.00043	0.559752	0.560	10
2035							
Route from Buzău county	0.0023	0.558	0.560	0.0001	0.558	0.558	10
Route from Vrancea county	0.00216	0.559752	0.562	0.00018	0.559752	0.560	10
2050							
Route from Buzău county	0.00596	0.558	0.564	0.00013	0.558	0.558	10
Route from Vrancea county	0.00559	0.559752	0.565	0.00023	0.559752	0.560	10

The table above highlights the differences between the basic scenario, which involves maintaining the current situation of pollutant emissions by using the alternative route DN2 Urziceni - Buzău – Focşani, and the projection scenario, which involves reducing pollutant emissions by using the Buzău - Focşani highway. Thus, in the projection scenario, the concentration values are lower than the baseline scenario. The projection scenario has a higher efficiency, due to the maintenance of the concentrations during the operation period below the limit values and the target air quality values provided by Law no. 104/2011 (**Error! Reference source not found.**).

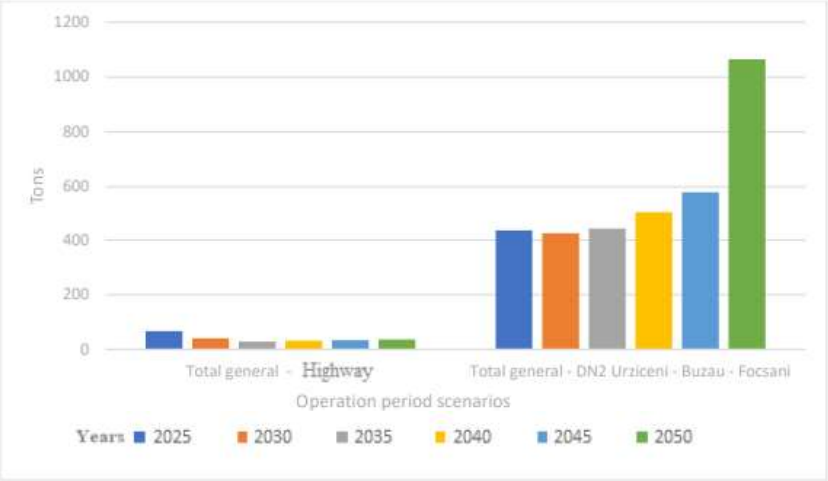

Fig. 1. *The evolution of the carbon monoxide quantities (CO) for the Buzău - Focşani highway and DN2 Urziceni - Buzău - Focşani for 2025 – 2050*

The construction of the highway will have positive effects on air quality, by reducing greenhouse gases, along national and county roads from which the highway will absorb traffic. This will lead to smoother traffic on these roads and to a reduction in greenhouse gas emissions into the atmosphere. In general, traffic on these roads is slow, with frequent braking and stopping. The construction of the highway will contribute to decongesting and improving traffic conditions.

Fig. 2 shows quantities of greenhouse gas (GHG) emissions expressed in tons of CO_{2e}, for mobile emission sources for the Buzău - Focșani highway, compared to the alternative route in the implementation area (DN2 Urziceni - Buzău - Focșani).

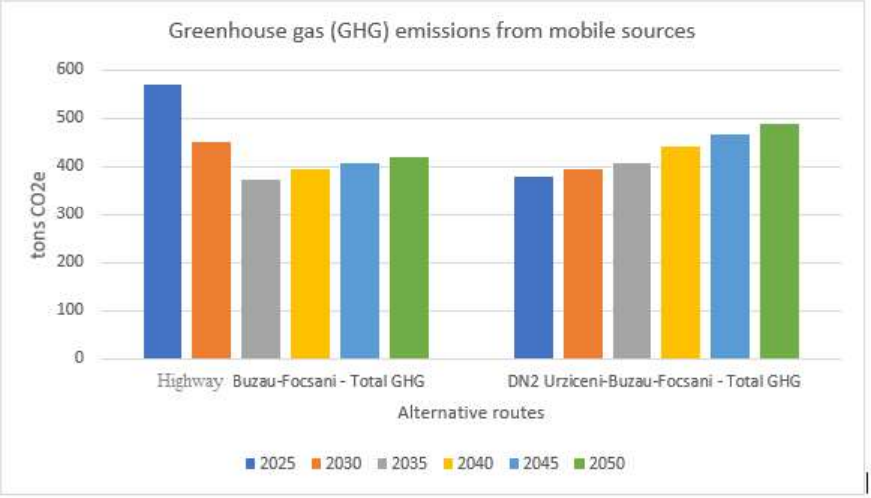

Fig. 2. *Comparative greenhouse gas emissions from mobile sources for the two alternative routes*

CONCLUSION

According to the presented data, the estimated quantities of greenhouse gas emissions from the burning of fossil fuels during the exploitation period, have an increasing trend for DN2 Urziceni - Buzău - Focșani and a stable trend for the Buzău - Focşani highway.

In case the highway project will not be implemented, the following conclusions can be drawn:

- following the regional industrial and touristic development, the route connecting the two municipalities (DN2) will be the subject of an increased number of vehicles transiting it; combined with traffic congestion, this will cause an increase in air pollutant emissions;
- the route connecting the two municipalities (DN2) will maintain its exposure to the risk caused by extreme weather and climatic conditions (accentuated by the absence of forest curtains), which can lead to traffic jams; these are associated with an increase in GHG emissions into the atmosphere.

In conclusion, the existing traffic on DN2 Urziceni - Buzău - Focșani, characterized by congestion and low speeds in the proximity of localities, in the long run, would cause an increase in emissions in the absence of the Buzău - Focşani highway.

The Buzău - Focșani highway will ensure a good traffic flow, the long-term trend being of gradual reduction of emissions. A significant reduction in the amount of emissions from traffic will also occur by replacing the existing car fleet (Diesel vehicles) with hybrid and electric vehicles.

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