

## **ANALYSIS OF THE INFLUENCE OF ECONOMIC AND EXPLOITATION FACTORS ON THE PUBLIC TRANSPORT SYSTEM IN THE PETROȘANI BASIN**

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**Abstract:** The main objective of public passenger transport is to serve them at the most demanding level of requirements. Through public passenger transport, it is ensured that the time lost for travel to the workplace, school, shop, doctor, visits to relatives, business trips, etc. is reduced, in favour of time for rest, relaxation, self-education, children's education, political concerns or business. An efficient urban transport system has the following goals: ensuring a sufficient transport capacity; achieving accessibility; achieving a minimum time on the origin-destination route; the security of performance in any weather; an acceptable comfort for the passenger; minimal negative effects on the tranquillity of the inhabitants and the environment. In this context, the analysis of the road infrastructure and superstructure, of the factors of technical operation of the transport system and economic factors (in general and of the transport system) in the Petroșani Basin helps to understand the current situation of the public transport system and how it should be developed and modernized.

**Keywords:** public transport, sustainable mobility, transport demand

### **1. INTRODUCTION**

The public transport of people constitutes one of the most important functions of the community, through it ensuring the unity and coherence of the activities carried out in the community. It can be considered an indicator of the level of development of the community, being an intrinsic part of civilization. The basic characteristic of the public transport of people through regular services is that it takes place in an organized framework, on fixed routes, with timetables and predetermined routes. It must be carried out at the time of the request and be organized in such a way as to ensure the taking over of the transport task, with an appropriate degree of comfort and safety, the purpose of an urban public transport system being that of meeting the requirements of the inhabitants to travel within the territory, both in residential, industrial and

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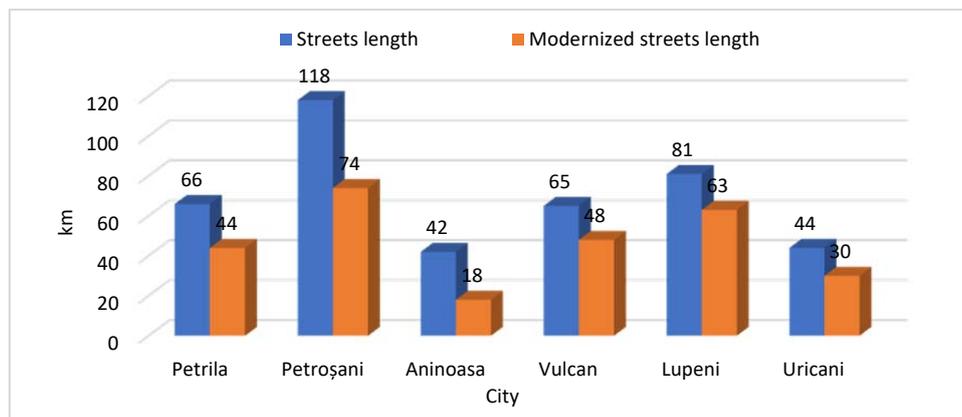
recreational areas. The quality of a trip - which is the actual product of this transport activity - includes a multitude of factors, essential being the safety, comfort and rhythm of the trip [1], [2], [3], [4].

## 2. THE INFRASTRUCTURE AND SUPERSTRUCTURE OF THE ROAD TRANSPORT SYSTEM

The physical condition, the type of ownership of the infrastructure and superstructure of the transport system, induce, among other things, a competitive side, beneficial for the transport system [5].

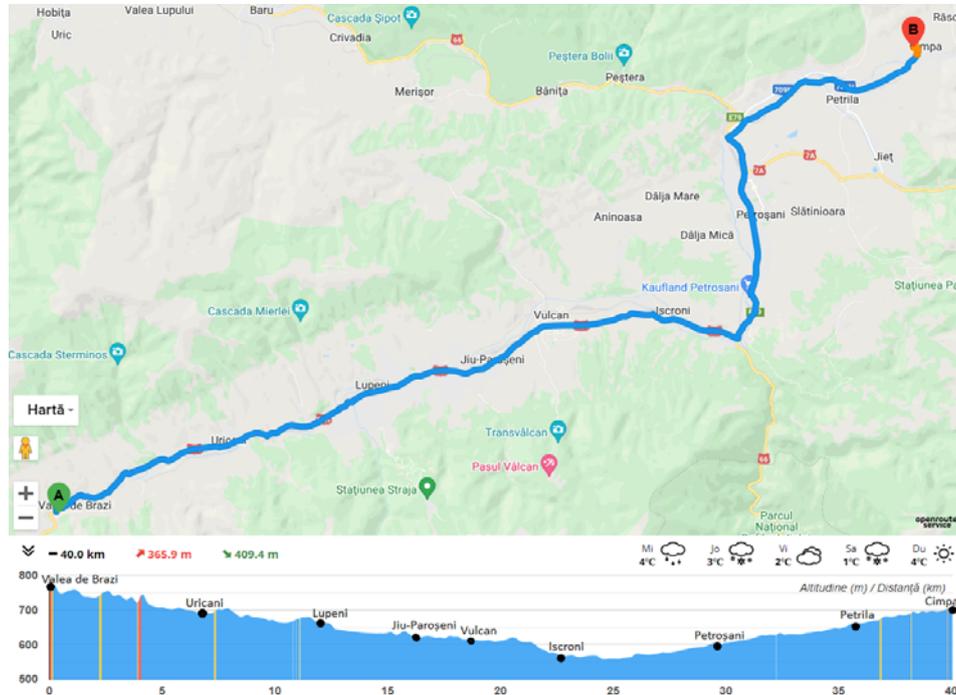
The road infrastructure in the Petroșani Basin is represented by the national roads DN 66, DN 7A and DN 66A and the road network of the component localities. The road infrastructure is public property, belonging to the Romanian National Road Infrastructure Administration Company and the Territorial Administrative Units of the Petroșani Basin.

As for the street network, it totals 416 km, distributed relatively uniformly among the localities that make up the microregion, considering their surface area [7]. The constraints given by the relief imposed the development of the street network with a longitudinal structure, along the East Jiu and West Jiu rivers. The modernization of the street network (Fig. 1) in the localities of Petroșani Basin was carried out through the implementation of some projects financed from the European Regional Development Fund through the Regional Operational Program 2007-2013 and 2014-2020, through the National Construction Program Public or Social Interest and from funds from local budgets [6], [7], [8], [9], [10], [11], [12].



**Fig. 1.** The total length of streets and modernized streets in the localities of the Petroșani Basin

The area of interest is located between the town of Petrila (Cimpa neighborhood), located on DJ 709K, and the village of Valea de Brazi, a component locality of the city of Uricani, located on DN 66A (Fig. 2).

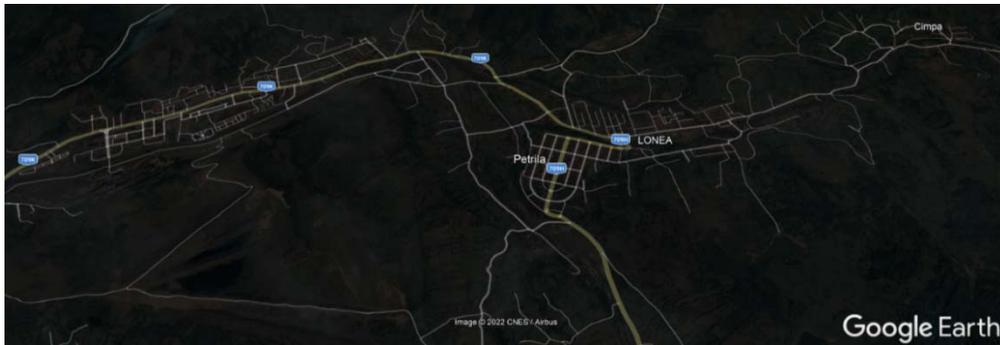


**Fig. 2.** Area of interest regarding transport infrastructure and route elevation

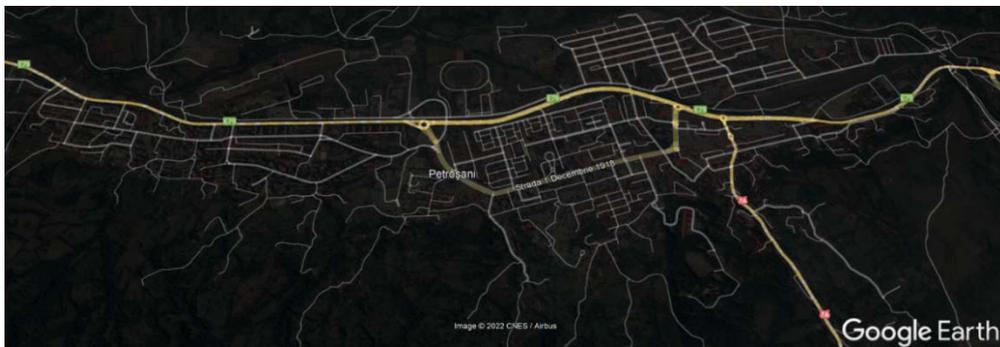
Access to the town of Petrila (Fig. 3) is provided in the western part by DN 66 Simeria-Petroșani which intersects with DJ 709K which runs through the town. Major road traffic in the city of Petrila takes place on Republicii street, a category II street, which crosses the town from west to east, ensuring the connection with the towns of Cîmpa and Jieț and further on the route DJ 709H with exit to DN 7A towards Vâlcea county. Strada Republicii, which crosses the city along its entire length, is strongly affected both by the crossings generated by the branches to the utility networks, and by the heavy traffic, resulting from the activities of mining, forestry, and supply of economic agents.

The municipality of Petroșani is located on two important communication routes, the national road DN 66, having the route Filiași-Jiului-Simeria gorge, including the main railway 202 with the same route and the national road DN 7A connecting the municipality with Valea Oltului (Petroșani-Voineasa-Brezoi). The municipality of Petroșani has a relatively orthogonal arrangement of streets (Fig. 4). Their total length is 118 km, of which only 4 km fall into the 2nd technical category (2 lanes per direction).

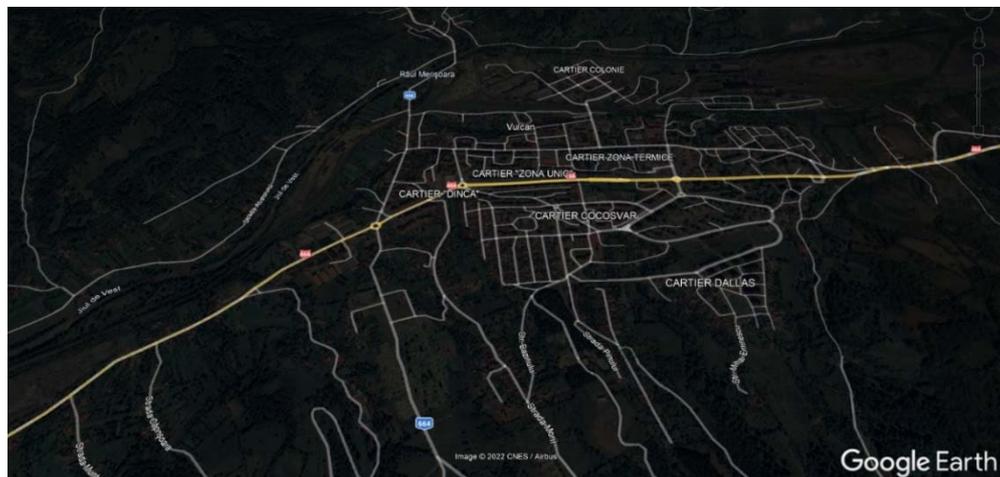
The municipality of Vulcan can be crossed on two main roads, namely on DN 66A from DN 66 (the intersection of the road from Petroșani to Vulcan) and on Mihai Viteazu boulevard. The total length of the streets (Fig. 5) of Vulcan municipality is 65 km, and of the modernized streets is 48 km, most of them being streets with asphalt surface.



**Fig. 3.** The street network of the city of Petrița



**Fig. 4.** The street network of Petroșani municipality



**Fig. 5.** Street network of Vulcan municipality

The geographical position and the industrial specifics make the municipality of Lupeni benefit from a street network (Fig. 6) made up of roads, which favours access to the main tourist attractions. Road access is via DN 66A (Livezeni-Câmpul lui Neag) which crosses the municipality of Lupeni and connects with DN 66 and via DJ 664A connects DN 66A and the "Straja" Lupeni Tourist Resort.



**Fig. 6.** The street network of Lupeni municipality

The main access road is DN 66A, which connects the city of Uricani with the municipality of Lupeni. Within the radius of the locality there is also the county road DJ 672C with a length of 15 km, which connects with the town of Runcu in Gorj county. Inside the city there are 13 main streets and 5 connecting streets (Fig. 7).



**Fig. 7.** The street network of the city of Uricani

The main road serving the town of Aninoasa is DN 66A, which starts from the intersection with DN 66, crosses the town belonging to Iscroni, a part of Aninoasa, heading towards Vulcan (Fig. 8).



**Fig. 8.** The street network of the city of Aninoasa

From DN 66A starts the county road DJ 666B (6.2 km) which goes along the Aninoasa stream. The two main roads of the town are part of third category streets, having the role of collector streets. These major traffic arteries are modernized, having asphalt (DN 66A) and concrete (DJ 666B) surface, but in a deteriorated state.

At the moment, no public transport terminals are set up, so that appropriate conditions are ensured from the point of view of the safety and comfort of travellers (Fig. 9).



**Fig. 9.** Piața Victoriei Station, Petroșani

Authorized public stations related to the public transport of people through regular routes are located on the main traffic arteries. During the routes, the means of transport cross the central areas of the towns in the Petroșani Basin, the external effects produced by the circulation of these vehicles (which are in considerable number) being borne by the inhabitants of the urban areas. Regarding the state of the passenger stations, at the level of each locality there are certain arrangements made both at the level of alveoli and shelters, most of which are in an advanced state of degradation (Fig. 10):

- Vulcan: there are temporary constructions of light metal structure, vandalized. The stations are not marked and there is no transport schedule or other information useful and intended to encourage public transport;
- Lupeni: the passenger stations, old buildings, were concessioned to private operators, with commercial spaces set up within them, with the exception of the Hospital station. Platforms for private passenger transport are waiting on the sidewalk. The stations are partially marked and there is no transport schedule or other information useful and intended to encourage public transport;
- Aninoasa: there is no arrangement for people who use minibus transport, they wait for the means of transport on the side of the street. The stations are not marked and there is no transport schedule or other information useful and intended to encourage public transport;
- Petroșani: there are shelters for travelers in several locations, mostly vandalized. The stations are not marked and there is no transport schedule or other information useful and intended to encourage public transport;

- Petrița: there are traveler shelters in a few locations, some vandalized others were upgraded during 2017 by the local authority. The modernized stations are marked, otherwise, the minibuses waiting areas can be guessed. There is no transport schedule or other useful information displayed to encourage public transport.



**Fig. 10.** Route station in Petroșani

### **3. OPERATING FACTORS**

Capacity, speed, flexibility, etc., represent the operating factors of the public transport system.

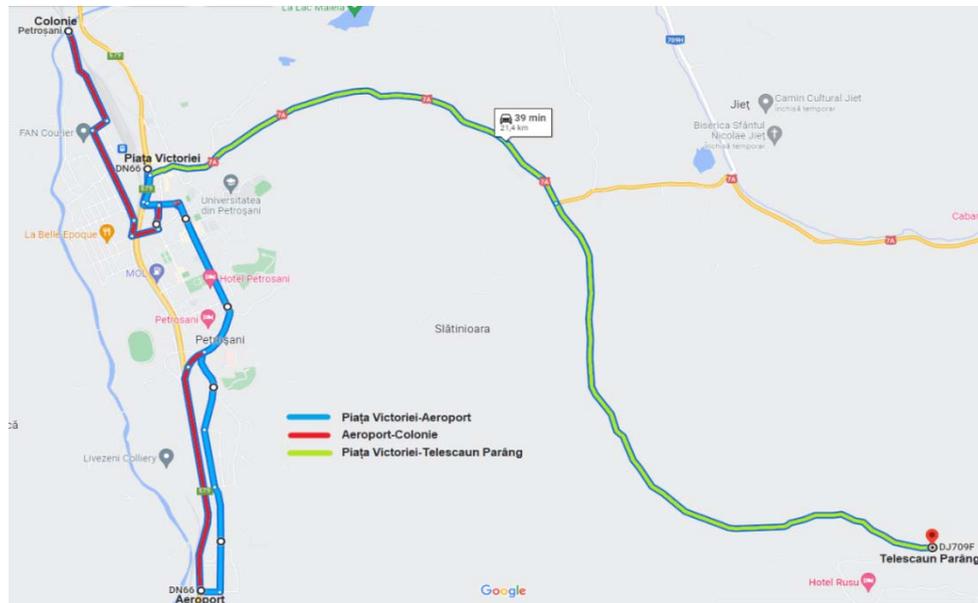
The main mode of public transport found in the Petroșani Basin is road transport with minibuses and buses. It operates at local, regional, county and inter-county level. Public road transport through regular services at the county level is administered by the Hunedoara County Council, and inter-county transport is administered by the Romanian Road Authority.

Local transport in the municipality of Petroșani is carried out by the private operator S.C. ZMK S.R.L. through regular routes, based on the contract for delegating the management of the local public transport service concluded with the Petroșani Local Council. The operation of the local public transport service is carried out with a fleet of 20 vehicles with a capacity of 19 seats, which were put into operation in 2015. The frequency with which the minibuses run is between 5 and 15 minutes.

The local public transport network consists of 3 lines (1 main line and 2 secondary lines) (Fig. 11), with a total route length of 18.8 km:

- main line: Piața Victoriei-Aeroport;
- secondary line 1: Micropiață Aviatorilor-Colonie);
- secondary line 2: ENEL-Telescaun).

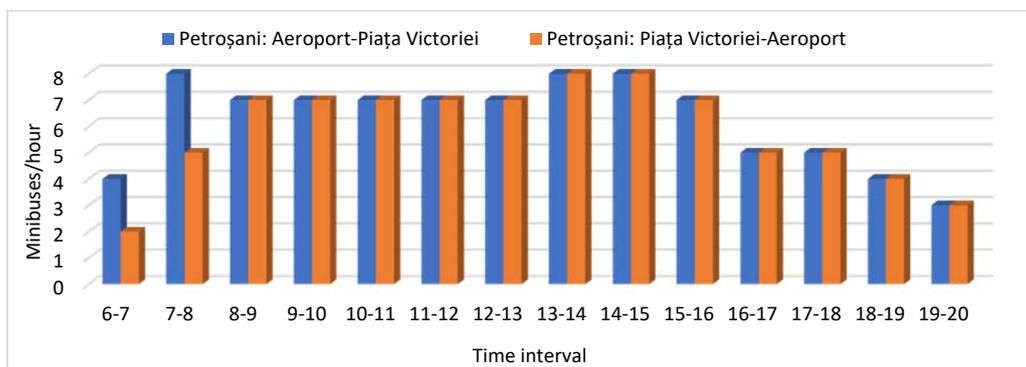
The main line and the secondary Line 1 overlap for a significant length of the routes. This situation presents an advantage for the users of the network segments characterized by the concentration of the public transport offer, at the expense of potential travellers located in areas not served by the public transport network.



**Fig. 11.** Local public transport routes in Petroșani Municipality

On weekdays, the minibuses run between 5:30 and 23:00. The line on which the vehicles show the highest frequency is the Main Line. During peak traffic periods (06:00-09:00 and 13:00-19:00) vehicles run at 5-minute intervals, during the rest of the operating period the succession interval between vehicles is 10 minutes, except for the last hours, when the frequency is reduced to 2 vehicles per hour. On Secondary line 1, the succession interval between vehicles is fixed, at 60 minutes, during the entire operating period. Secondary line 2 has the lowest frequency of vehicles, on weekdays they have a succession interval of 120 minutes. On non-working days, the interval between vehicles is reduced to 60 minutes, this line being used for tourist purposes.

The hourly variation of the traffic frequency of vehicles serving the main transport line is represented in figure 12.



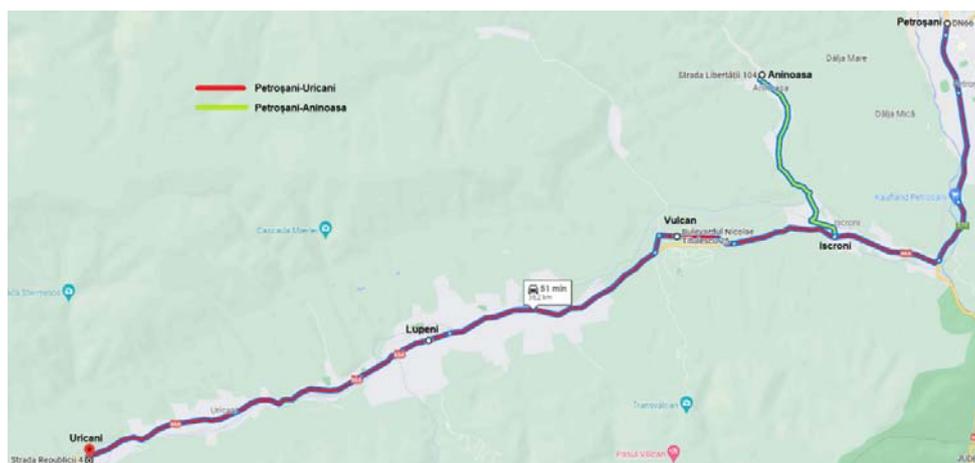
**Fig. 12.** The minibuses hourly frequency on the local route of Petroșani: Piața Victoriei-Aeroport and return

The interurban public transport system through regular services can be found on the territory of the Petroșani Basin, operating routes that have their origin/destination in the 6 localities in the area. This public transport service is managed by the Hunedoara County Council, with private operators. According to the paid road transport program for people through regular services, at the county level valid until 30.06.2023, published by the Hunedoara County Council, during one working day the total number of trips serving the transport demand generated/attracted by the Basin Petroșani is 273, these being distributed on 7 routes (Table 1).

**Table 1.** Interurban public transport routes in the Petroșani Basin

No. crt.	Route code	City of origin	Intermediate town	Destination city	Route length, [km/way]	No. races/day	Minimum carrying capacity, [seats]
1	95	Petroșani	Vulcan, Lupeni	Uricani	29	116	15
2	96	Lupeni	Uricani	Buta	24	14	15
3	97	Petroșani	-	Aninoasa-Vale	17	15	15
4	98	Petroșani	Petrila	Lonea	10	87	15
5	99	Petroșani	Petrila	Cimpa	13	32	15
6	100	Petroșani	Cimpa	Pod Gura Răscoala	14	4	15
7	101	Petroșani	Cimpa	Jieț	14	5	15

The existing fleet addresses the towns of Valea Jiului fragmented in the sense that there is only one route connecting Petroșani-Vulcan-Lupeni and Uricani (Fig. 13), Petrila being connected only to Petroșani (Fig. 14). The same situation is for Aninoasa, but here the geographical positioning means that the only connection possibility is through Petroșani or through the stations located on DN 66A.



**Fig. 13.** Interurban public transport routes Petroșani-Uricani and Petroșani-Aninoasa

Public transport of people is carried out between the cities of Petroșani and Petrila (Route 98: Petroșani-Lonea) and the component localities of Petrila, Cimpa

(Route 99: Petroșani-Cimpa), Răskoala (Route 100: Petroșani-Pod Gura Răskoala) and Jieț ( Route 101: Petroșani-Jieț; Route 102: Jieț-Petroșani).

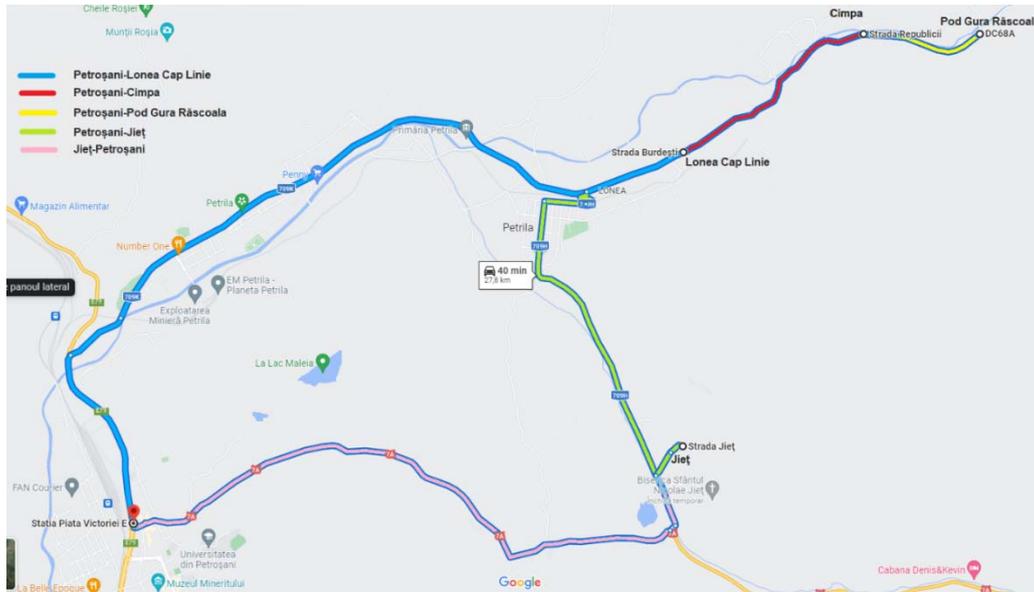


Fig. 14. Petroșani-Petrila public transport routes

Public transport is provided by the company S.C. Stalone Com S.R.L. which has a fleet of 18 minibuses with 16 seats. The working schedule of the trains is from Monday to Sunday, from 6:00 a.m. to 10:00 p.m. (the last train departing from the end of the line at 9:30 p.m.), ensuring trains departing from the ends of the line (Lonea and Petroșani) at intervals of no more than 10 minutes between them. The number of minibuses and the departure interval, 5-10 minutes (Fig. 15), plus the large number of stops (15), makes public transport of people in the city of Petrila to be carried out under usual conditions. The negative aspects are related to the reduced comfort of travellers and the lack of a continuous route to points of interest in the Municipality of Petroșani.

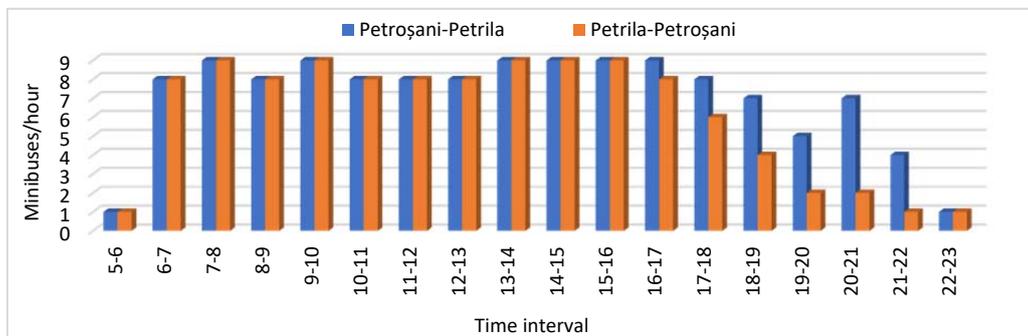
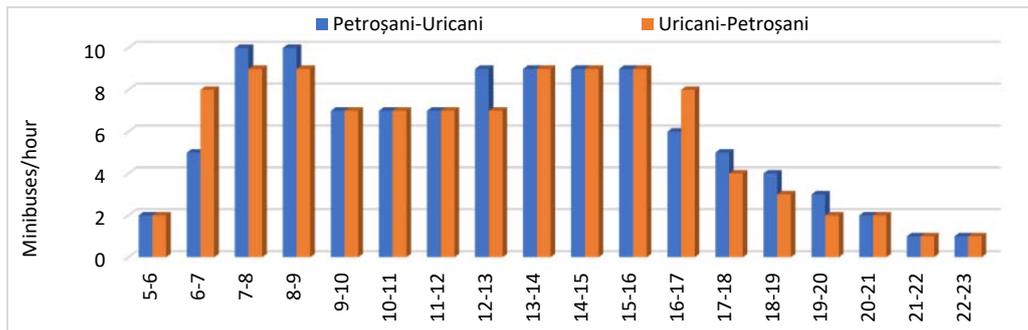


Fig. 15. The minibuses hourly frequency on the Petroșani-Petrila route and return

The public transport of people on the Petroșani-Vulcan-Lupeni-Uricani route is provided by the economic operator SC ZMK SRL, with its own minibuses on route 95. They run daily, between 05:00 and 22:00, on the Uricani-Petroșani route. The company has 40 means of transport, with a frequency of 5-15 minutes (Fig. 16). The economic operator SC ZMK SRL also carries out public transport of people on route 96 (Lupeni-Cheile Buții).

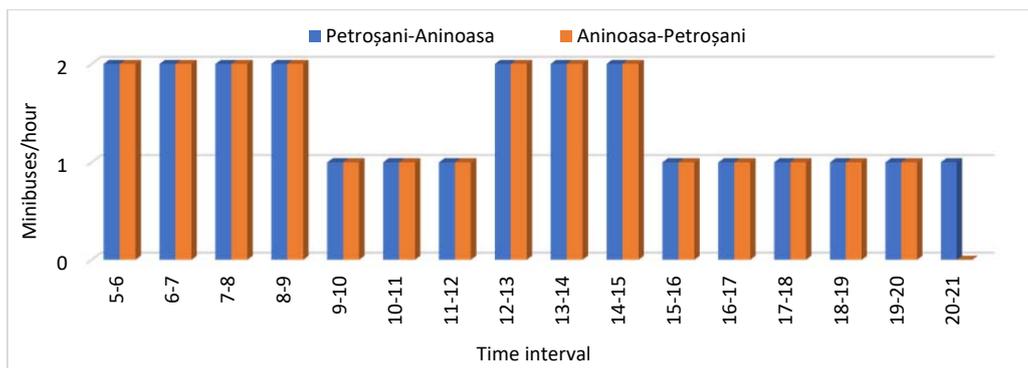


**Fig. 16.** The minibuses hourly frequency on the Petroșani-Uricani route and return

Public transport of people between Aninoasa and the other neighbouring towns (Lupeni, Vulcan, Petroșani, etc., Route 97) is provided by the economic operator SC ZMK SRL, with its own minibuses. They run daily, between 05.00-21.00, on the Aninoasa-Petroșani route with a frequency of 1-2 per hour (Fig. 17).

#### 4. ECONOMIC FACTORS

General economic factors (characterizing the economic system as a whole) and specific to the transport system (vehicle condition, human resources, environmental factors, etc.) are those that influence the public transport system.



**Fig. 17.** The minibuses hourly frequency on the Petroșani-Aninoasa route and return

The financing of the operation of the local public transport in the municipality of Petroșani is borne from the transport operator's own revenues, representing receipts from the sale of IDs and the value of the subsidies granted by the local authority for

different categories of users. According to the Local Council Decision No. 128 of 04/07/2015, the municipality grants facilities (from 20 free trips to total free travel) for local public transport of people carried out by means of public transport, in the municipality of Petroșani, for people from disadvantaged categories.

Regarding the dispatching and the pricing policy, it is not computerized, the passenger tickets are purchased directly from the driver, and the fleet management activity is carried out by script at each individual operator.

The area was based almost exclusively on coal mining employment (over 60,000 employees in 1989), and after the closure and drastic reduction of mining activity (from 15 mines in 1990 to 4 mines in 2021 with just over 4000 employees), the development of the area stopped, the living conditions deteriorated, and the reorientation towards other economic sources was achieved only to a small extent. In 2020, the Petroșani Basin registered approximately 94,000 able-bodied people aged between 15 and 65. Only a quarter of them are employed, compared to 1992, when more than 60% of the population had a stable job (Fig. 18), [1], [6], [17].

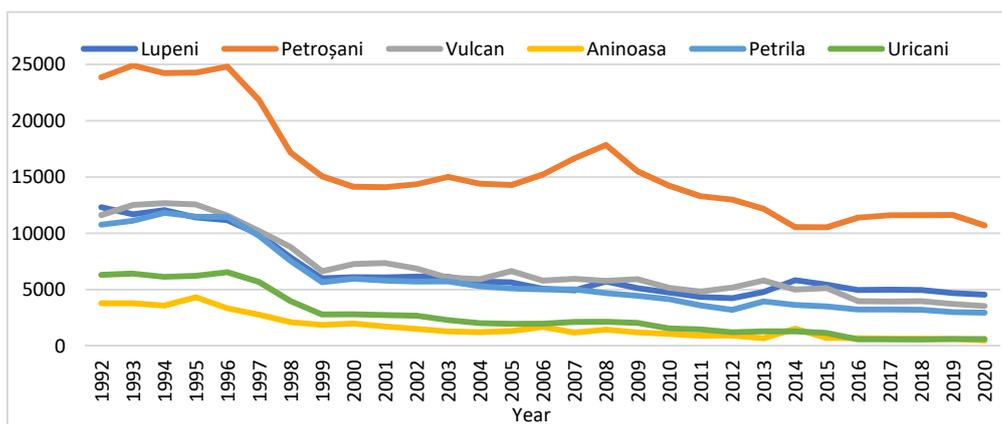


Fig. 18. The number of employees evolution in the cities of the Petroșani Basin

In the Petroșani Basin, the share of the employed population represents 17% of the total number of inhabitants (Fig. 19).

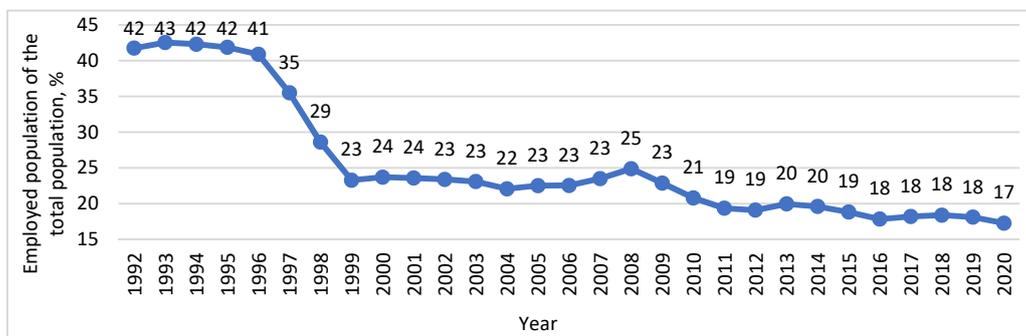


Fig. 19. Employed population evolution in relation to the total population in the Petroșani Basin

Currently, for human society, transport is an essential activity, but with negative consequences on environmental factors. According to the Life GySTRA project, urban traffic represents one of the most important sources of atmospheric pollution at European level, over 60% of NOX emissions being caused by it. Another worrying statistic cited by the project is that 6.5% of Euro V vehicles are responsible for 35% of all emissions. [18]. The volume, nature and concentration of emitted pollutants depend on the type of vehicle, the nature of the fuel and the technical operating conditions [19].

The pollutant emissions of motor vehicles present two major particularities:

- the elimination is done very close to the ground, which leads to the achievement of high concentrations at very low heights, even for gases with low density and high diffusion capacity in the atmosphere;
- emissions are made over the entire surface of the analysed area, the concentration differences depending on the traffic intensity and the ventilation possibilities of the traffic arteries.

The vehicles in the inventory park fall within the EURO 5 and EURO 6 pollution standards.

#### **4. CONCLUSIONS**

The transport of people constitutes one of the important components of the transport service, and the transport costs have a sufficiently large weight in the general costs, which justifies the orientation of the research in order to reduce them.

The paper presents the research carried out in the Petroşani Basin regarding the exploitation, economic and infrastructure and superstructure factors on the activity of public transport of people. The urban mobility study carried out led to the conclusion that the current public transport system satisfies the transport demand in terms of capacity and frequency, but not in terms of the technical condition of the fleet, spatial accessibility, comfort and safety of passengers (stations inadequate, lack of air conditioning in means of transport, lack of a modern fare system, lack of means of information in stations, etc.).

Over 60% of NO<sub>x</sub> emissions and 40% of CO<sub>2</sub> emissions from road transport are generated by urban traffic. It is necessary to consider measures to reduce air pollution, especially since the study shows that road traffic will increase significantly in the coming years.

In conclusion, the economic evolution of the Petroşani Basin and the environmental conditions imposed by the need for sustainable transport lead to the need to reorganize the public transport system. Under these conditions, the redesign of the public transport system takes on particular importance.

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