Solving the transport problem as a basis for preserving the ecology of the popular resorts of the Black Sea coast

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Abstract. The ecological situation in the resorts of the Black Sea coast of the Caucasus and the Crimea cannot but cause concerns. Once these resorts were positioned as climatic ones with a strongly marked therapeutic and health-improving climate. Today, we are no longer talking about the healing properties of the climate of these regions. But it is possible to preserve these regions for future generations as centers of medical and health tourism. One of the factors negatively affecting the ecology of the Black Sea resort areas is the expansion of vehicles with internal combustion engines. Waste exhaust gases from running engines of a huge number of motor vehicles that have appeared in recent years on the Black Sea coast (and not only in the summer holiday season) cause irreparable harm to the ecology of popular resort areas. Substantiation of the possibility of creating a zone free of vehicles with internal combustion engines in the resorts of the Black Sea coast of the Crimea and the Caucasus. To achieve this goal, theoretical methods of scientific research were used: analysis, synthesis and forecasting. The analysis of foreign and domestic experience in the study of the possibility of introducing a high-speed transport system for public and freight transport hyperloop (hyperloop-Eng.) is carried out. A conceptual project for solving the transport problem of the resort regions of the Southern coast of the Crimea is proposed.

1 Introduction

The issues of optimizing the impact of road transport on the ecology of the resorts of the Black Sea coast of the Crimea and the Caucasus are constantly in the field of attention of scientists and specialists. For a number of years, attempts have been made to limit the number of vehicles with internal combustion engines on the territory of the Crimean resorts. So far, we can only talk about one more or less effective project for optimizing the interaction between transport and the ecology of resort regions. We are talking about the

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2 Degree of development of the problem

Hyperloop is a proposed high-speed transportation system for public and freight transport. Hyperloop systems have three essential elements: tube, capsules, and terminals. The pipe is a large, sealed, low pressure system (usually a long tunnel). The capsule is a pressurized car at atmospheric pressure that operates essentially without air resistance or friction inside this tube using magnetic motion (in some cases supplemented by a ducted fan).

The terminal handles arrivals and departures of the container. The Hyperloop has its roots in the concept of George Medhurst of 1799 and subsequently developed under the names of pneumatic railway, atmospheric railway or motorcade. In 1909, the project of ultra-high-speed transport was developed by the professor of the Tomsk Technological Institute B.P. Weinberg. The Maglev technology proposed by the scientist is well studied today and there are many domestic scientific papers with its technical description.

In 2012, the American scientist and entrepreneur Elon Musk showed considerable interest in the hyperloop project. The hyperloop as originally proposed by Musk differs from vacuum trains, relying on the residual air pressure inside the tube to provide wing lift and fan propulsion. Musk first mentioned that he was thinking about the concept of a “fifth mode of transport”, calling it the Hyperloop, in July 2012 at a Pando Daily event in Santa Monica, California. This hypothetical high-speed mode of transportation would have the following characteristics: weather resistance, no collisions, doubling the speed of the aircraft, low...
3 Initial design concepts

Fig. 1. Diagram of a hyperloop capsule: axial compressor in front, passenger compartment in the middle, battery compartment in the tail section and skis of the air capsule at the bottom.

4 Projects of routes and pre-project agreements

USA. In 2018, the Missouri Hyperloop Coalition was formed between Virgin Hyperloop One, the University of Missouri, and engineering firm Black & Veatch to explore a proposed route connecting St. Louis, Columbia, and Kansas City. On December 19, 2018, Elon Musk opened a 3-kilometer tunnel under Los Angeles. In the presentation, the Tesla Model X drove in the tunnel on a dedicated track (rather than in a low-pressure tube).
Musk, the cost of the system is $10 million. Musk said: “The loop is a stepping stone to the hyperloop. The loop is designed for transportation within a city. The Hyperloop is for transportation between cities, and that will go much faster than 240 km/hour.”

The Northeast Ohio Areawide Coordinating Agency, or NOACA, partnered with Hyperloop Transportation Technologies to conduct a $1.3 million feasibility study to develop a hyperloop corridor route from Chicago to Cleveland and Pittsburgh for America’s first interstate hyperloop system in the Great Lakes Megaregion.

Hundreds of thousands of dollars have been allocated for the project. The NOACA Board of Directors awarded a $550029 contract to Transportation Economics & Management Systems, Inc. (TEMS) for a feasibility study of the Great Lakes Hyperloop and to evaluate the feasibility of an ultra-high-speed passenger and freight hyperloop initially linking Cleveland and Chicago.

India. Hyperloop Transportation Technologies reviewed in 2016 with the Indian government a proposed route between Chennai and Bengaluru, with a conceptual travel time of 345 kilometers in 30 minutes.

HTT has also signed an agreement with the Andhra Pradesh government to build India’s first hyperloop project connecting Amaravati to Vijayawada in a 6-minute drive.

On February 22, 2018, Hyperloop One entered into a memorandum of understanding with the government of Maharashtra to establish a hyperloop transportation system between Mumbai and Pune, which will reduce travel time from the current 180 minutes to 20 minutes.

Saudi Arabia. On February 6, 2020, the Ministry of Transport of the Kingdom of Saudi Arabia announced a contract with Virgin Hyperloop One (VHO) to conduct an innovative pre-feasibility study on the use of hyperloop technology for the transport of passengers and cargo. The research will serve as the basis for future hyperloop projects and will build on the developer’s longstanding relationship with the kingdom, which peaked when Crown Prince Mohammed bin Salman viewed a VHO passenger capsule during a visit to the US.

Italy. On December 29, 2021, the Veneto Regional Council approved a memorandum of understanding with MIMS and CAV to test hyper-transfer technology. The feasibility study by the company selected by CAV should be completed by mid-2023, and the development of the first prototype should be completed in 2026. 4 million euro have been allocated for this stage.

Canada. The Canadian group Trans Pod is exploring the possibility of hyperloop routes that would connect Toronto and Montreal, Toronto and Windsor, and Calgary and Edmonton. Toronto and Montreal, Canada’s largest cities are connected by Ontario Highway 401, the busiest highway in North America.

The Province of Alberta has signed a memorandum of understanding (MOU) to support the TransPod hyperloop project between Calgary and Edmonton. TransPod plans to promote the project and has provided $550 million in private capital funding for the first phase, which will create an airport link for the Edmonton area.

In other countries of the world. In 2016, Hyperloop One published the world’s first detailed business case for a 500 km route between Helsinki and Stockholm, which would be a tunnel under the Baltic Sea to connect the two capitals in less than 30 minutes.

Hyperloop One conducted a feasibility study with DP World to move containers from its Jebel Ali port in Dubai. In late 2016, Hyperloop One announced it was conducting a feasibility study with the Dubai Roads and Transport Authority on passenger and cargo routes connecting Dubai to the greater United Arab Emirates.

Hyperloop One also considered passenger routes in Moscow during 2016 and a cargo hyperloop to connect Hunchun in northeast China with the port of Zarubino, near Vladivostok and the North Korean border in the Russian Far East.

In May 2016, Hyperloop One launched its Global Challenge calling for universal proposals for hyperloop networks around the world. In September 2017, Hyperloop One
selected 10 routes from the 35 most promising proposals: Toronto - Montreal, Cheyenne - Denver - Pueblo, Miami - Orlando, Denver - Laredo - Houston, Chicago - Columbus - Pittsburgh, Mexico City - Guadalajara, Edinburgh - London, Glasgow - Liverpool, Bengaluru - Chennai and Mumbai - Chennai. European routes were also envisaged, including a route starting in Amsterdam at Schiphol Airport to Frankfurt. In 2016, a team from the Warsaw University of Technology began evaluating potential routes from Krakow to Gdansk following a proposal from Hyper Poland. Hyperloop Transportation Technologies (HTT) reportedly signed an agreement with the Slovak government in March 2016 to conduct studies on potential connections between Bratislava, Vienna and Budapest, but no further developments have occurred. In January 2017, HTT signed an agreement on the Bratislava - Brno - Prague route project in Central Europe. In 2017, Scandinavia's largest independent research organization, SINTEF, announced that it was considering setting up a test laboratory for the hyperloop project in Norway. In June 2017, an agreement was signed for the joint development of hyperloop between Seoul and Busan, South Korea. On November 8, 2020, at the Dev Loop test site in Las Vegas, Nevada, Virgin Hyperloop conducted the first successful passenger transportation test using hyperloop technology with two company employees, where the unit reached a maximum speed of 172 km/h. Following successful passenger-carrying testing, Virgin Hyperloop unveiled its commercial vehicle design in January 2021. Designed in collaboration with Seattle design firm Teague, each vehicle plans to accommodate approximately 28 passengers for Hyperloop transportation. In 2022, The Boring Co., a company founded by Elon Musk, was negotiating in Texas about the possibility of implementing three tunnel projects that are in the early stages of development. By 2023, the activity of expanding project activities to promote hyperloop projects in the United States decreased slightly. Well-known financial and political problems took their toll. 5 Conceptual projects for organizing a high-speed transport process (HTP) in the Crimea

The mountainous terrains of Crimea and the Caucasus are similar in many ways. Therefore, at this stage we are currently considering only the Crimean project. Russian scientists have been working for a number of years to create projects on high-speed transport. There is already a development similar to Hyperloop. We can expect that a domestic landmark test site will appear in the nearest future. At the moment, the HTP project in a vacuum environment no longer looks like utopia. This gives us the opportunity to look 10–20 years into the future. In this regard, it is extremely necessary today to create projects related to the replacement of local transport with electric ones: use electric buses for urban transport, electric ships for maritime transport, use environmentally friendly equipment in public utilities, etc. These measures are already possible for implementation in the coming years. What to do with the large numbers of vehicles with internal combustion engines constantly arriving from the mainland? In what direction should we work to preserve the unique ecosystem of resorts on the Southern Coast of the Crimea? In our deep conviction, it is necessary to be able to study the transport system from the point of view of the entire space, and within the framework of the general concept of the transport process, to develop a categorical apparatus for the spatial characteristics of infrastructure and rolling stock. Therefore, in parallel with the formation of a new environmentally friendly transport network on the sea coast, the closest attention should be paid to the formation of a promising transport system that provides environmentally friendly...
and dynamic transport communication between Simferopol (the main transport hub) and resort towns and settlements on the Black Sea coast. It is assumed that at the first stage, HTP will be created between Simferopol airport and Yalta with a length of about 50 km, which will pass under the main ridge of the Crimean Mountains. Technologies for building tunnels through the Crimean Mountains have been sufficiently developed (by 2024 it is planned to complete the construction of the second hydrotunnel under the Yalta Yayla to supply water to the city). The estimated delivery time for passengers from Simferopol airport to Yalta will not exceed 15–20 minutes.

At the second stage, it is proposed to connect a new HTP line from the Simferopol railway station to the first line. By the third stage, it is necessary to build a sufficiently spacious intercepting parking lot at the exit from Simferopol in the area of the village of Perevalnoye, where tourists arriving on the southern coast of the Crimea will leave their personal vehicles and then travel in carriages of the third line of the STK (Fig. 2). A comfortable trip time is 10–15 minutes. Implementation of the project will require multi-billion costs. To financially support the implementation of the project, it is necessary to create a cluster with interested business structures based on public-private partnership [33–36].

Fig. 2. Passenger capsule design

6 Conclusions

At the present stage of economic development, competition is increasing in all sectors, including the markets of transport, resort, tourism, health and other services. Competition is seen as a continuous process in a free market. However, competition in the services market should not lead to the violation of the natural and environmental unique features of the regions, especially resorts. In economic life, competition is not the goal: it is a means of organizing economic activity to achieve a goal. Economic competition takes place in markets where potential suppliers and buyers meet. A high level of competition helps to increase the economic efficiency of activities and the competitiveness of individual organizations. The organization of business activity in resort areas should be aimed, first of all, at creating favorable conditions for recreation and preserving natural resources. In this regard, an important scientific task is to analyze the possibility of organizing recreation areas without transport in the most popular Black Sea resorts of the Crimea and the Caucasus and preserving these unique natural areas. Proposals for the development of theoretical foundations for organizing a high-speed transport process for delivering tourists to the resort areas of the Crimea and the Caucasus from industrial centers to the coastal zone.
will significantly reduce the damage caused to the ecology of resort regions from the use of modern vehicles.

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