SkyWay innovative transport system as a possible solution for green mobility initiative

Kiryl Badulin

The latest 2018 annual assessment of the Global Carbon Project (GCP) demonstrates that the global greenhouse gas emissions will increase by 2,7% and are expected to rise to a new high of 37.15 bln tons in 2018 [1], with China and US as the two largest emitters, while China has made the most significant contribution to this growth in 2018. This is the largest increase in last seven years, and it is likely that CO_2 emissions will increase further in 2019. The assessments of GCP members indicate that the increase in CO_2 emissions from fossil fuels in 2018 leaves the world far from the trajectory needed to meet global climate goals.

Transport sector is the second largest atmospheric pollutant (after electricity and heat production). Emissions from the transport sector, contrary to the other sectors, are still growing and have only recently started to decrease in developed countries. According to the International Transport Forum (ITF) Transport Outlook, at 9 bln tons in 2015, the transport sector represents 23% of fuel-burn CO_2 emissions globally, or 18% of all man-made CO_2 emissions [2]. Freight represented slightly less than passenger transport in total. CO_2 emissions in OECD countries amounted to slightly less than 4 bln tons in 2015, representing 42% of all transport-related CO_2 emissions. Global transport emissions grew at an average annual rate of 2% from 1990–2012, and up to now they remain among the fastest growing sectors of CO_2 emissions from fuel [3]. It should be also noted that the countries that have kept gasoline prices above US$1/liter from 2000 to 2012 show clear reductions in transport emissions growth; however, transport CO_2 emissions have grown at a rapid rate in countries that have kept gasoline prices artificially low due to fuel subsidies.

According to the ITF forecasts (baseline scenario), the emissions will increase by 60% by 2050. Emissions from freight increase most and represent half of all emissions in 2050. This takes place even despite the large expected gains in energy

efficiency. Passenger travel emits 60 g of CO_2 for passenger-kilometer in 2050 on average, compared to 100 g in 2015. Similar improvements occur for the freight sector. However, because of the expected strong growth in transport demand, this is far from sufficient to stop the emissions growth. CO_2 emissions grow in almost all sectors. The emissions from road transport, both freight and passenger, grow by more than 70% between 2015 and 2050; those of international modes (aviation and maritime) almost triple. The situation in cities is markedly different: they remain stable between 2015 and 2030 because local governments have already started to eliminate many negative externalities associated with private cars.

Taking the above into account, green mobility and green transportation have become one of the global objectives, which is illustrated by the current global trends. The Green Mobility objective aims to address climate change through mitigation and adaptation, and to reduce both air and noise pollution. It is related to the UN Sustainable Development Goals (SDG), which aim to take urgent action to combat climate change and its impacts. Its targets will be designed to achieve a net-zero emissions economy by 2050, and improve other dimensions such as air quality and climate resilience by 2030, as set forth in the SDG targets [4]. Sustainable transport and mobility are fundamental to progress in realizing the promise of the 2030 Agenda for Sustainable Development and in achieving the 17 SDG. Thus in this article we will try to analyze modern global trends in green mobility and green transportation, and to propose possible solutions.

First of all, green mobility initiative was supported by numerous policy makers. The signature of the Paris Agreement on Climate Change in December 2015 created a political pathway for climate mitigation efforts by setting up a five-year review cycle for national decarbonisation commitments, starting in 2020. This is also reflected in several UN SDG, which are aimed at green mobility. ITF has initiated Decarbonisation Transport (DT) project which will help the economies to establish commonly acceptable pathways to reduce transport CO_2 emissions by 2050.

The growth of electric vehicles (EV) segment is one of the most obvious consequences of green trend in transportation. As it was mentioned above, it's one of the main drivers, which will allow to keep CO_2 emission in the cities at the same level till 2030. The annual growth rate of EV sales is about 70% within 2016-2018, and they already make 2% of the world automotive market, while they just started selling in 2010 [5]. Rapid shift to EV worldwide was pushed by Tesla car sales, this company was a real disruptor in the automotive market. Following this trend, all major automakers have announced developing EV models [6], some of them even announced plans to stop developing new model range based on internal combustion engines in the prospect of 8-10 years. Furthermore, many European countries plan to ban diesel and gasoline engines already since 2025-2030 [7].

As transport sector is one of the largest atmospheric pollutants, and volumes of emissions from transport continue to grow, it's crucial to find some zero-emission solutions and to replace fuel engines by them as soon as possible. One of such solutions is innovative transport system SkyWay, which main idea is to put EV pods at the string rail overpass above the ground, to the "second" level. As a result, we get significant advantages in CAPEX and OPEX, ecological sustainability and safety. Besides, SkyWay pods can move at a speed up to 150 km/h (urban solutions), and high-speed unibuses can move at a speed of 500 km/h. According to the expert opinion of the Russian Academy of Sciences, SkyWay is considered as one of the most efficient and ecologically sustainable transport solutions among the existing ones. The main principles and advantages of SkyWay transport systems are described and proved in details in a monography by its founder Anatoli Unitsky [8].

SkyWay (or STU – String Transport of Unitsky) has unique characteristics, including ecological sustainability. Except CO_2 emission, noise and vibration are another negative consequences of transport (especially in the cities) on the ecology. The use of SkyWay transport systems will make possible [9]:

- to reduce environmental pollution as a result of the low specific energy consumption (by 5-10 times less as compared with an automobile); also there

is a possibility to use alternative ecologically sustainable types of energy (wind, solar, etc.) for the provision of SkyWay operation;

- to drop noxious emissions. For example, in electrified SkyWay they will be less than 0.01 g per passenger-km, i.e. less than in the high-speed railways which is attributed to the absence of dust-generating embankments, rubble cushions and lower deterioration level of a rail, wheels and brakes;
- to minimize the level of noise and vibration. SkyWay is a considerably weaker source of noise and soil vibration than, for example, a high-speed train. A string-rail track structure is provided with a system of internal dampers that are also used to install the supports to suppress the low- and high-frequency vibrations of the track. Furthermore, the total mass of any model of a rail car will be considerably less than that of a railway train. A track will be smoother thanks to the elimination of temperature deformation joints on the whole length.

Except the direct environmental effect on emissions, noise and vibration, SkyWay also has significant indirect ecological implications. In particular, it drops the amount of fertile soil excluded from agriculture due to the minimal land allocation requirements for SkyWay transport system (less than 0.1 ha/km). Besides, SkyWay transport preserves natural landscapes and biocenosis, as it does not require construction of embankments, depressions, tunnels, large-scale elevated roads, overpasses and viaducts which produce a negative impact on natural landscapes and biocenosis and are not stable to natural disasters (earthquakes, floods, mudslides); there is no need in cutting forests, removal of peat and vegetable soil cover. At last, SkyWay minimizes all kind of resources for the track construction – at least 10-15 times less compared with conventional transport.

Taking the above into account, let’s compare various types of transport in terms of ecological sustainability. We will compare the conventional transport systems with SkyWay by 3 parameters: material consumption (except soil) for the overpass, rolling stock and infrastructure (1), resulting negative environmental impact from the construction and operation of the transport system (2) and complex

negative environmental impact (from construction and operation of the overpass, rolling stock and infrastructure) (3). The results of the analysis are put into the table below:

Types of Transport	Material Consumption (Except Soil) (1)	Construction+Operation Negative Environmental Impact (2)	Complex Negative Environmental Impact (3)
SkyWay (STU)	100%	100%	100%
Mono-rail transport	1,000-1,500%	200-300%	200-300%
Magnet levitation train	1,500-2,000%	200-300%	300-500%
River transport	-	250-350%	400-600%
Railway transport	1,000-1,500%	300-400%	500-800%
Automotive transport	2,000-3,000%	1,000-1,500%	1,500-2,000%

Thus we suggest considering SkyWay innovative transport (passenger and cargo) as one of the most efficient global solutions, especially in terms of ecological sustainability. Being used worldwide, SkyWay is almost zero-emission transport solution, so it will greatly contribute to the keeping CO_2 emissions at the current level in mid- and long-term, thus contributing to the fulfilment of all the recent ecological initiatives in OECD and worldwide.

Let’s try to assess the possible impact of SkyWay implementation worldwide. At present the global transport system consists of 1 mln km of railways and over 30 mln km of motor roads. The soil under these roads (about 1 mln km^2) is buried in asphalt and thus excluded from the agriculture and oxygen production. Just to give an example, this territory exceeds the total area of such countries as Japan, Germany, UK and the Netherlands. According to the recent reports, one hectare of pine forest produces about 30 tons of oxygen per year – as much as it is needed for breathing of 19 persons during a year. 1 hectare of deciduous forest provides approximately 16 tons, and a hectare of agricultural land – from 3 to 10 tons of oxygen per year. Therefore, approximately 100 mln acres (1 mln km^2) of soils, "rolled into the asphalt", will not produce each year at least 1.5 bln tons of oxygen, sufficient for breathing of 1 bln people [10].

Let’s suppose that due to SkyWay advantages described above, this transport system is applied globally, and the length of SkyWay high-speed tracks has reached 25 mln km worldwide. Complete combustion of 1 kg of gasoline requires 3.4 kg of

oxygen, or about 15 kg (12 m^3) of air. Taking into account the efficiency of SkyWay rolling stock, it can save annually 31.2 bln tons of fuel for 25 mln km of tracks. 106 bln tons of oxygen will not be further withdrawn from the atmosphere for burning that quantity of fuel. That is enough for breathing of 67 bln people. In addition, the waiver of annual burning of 31.2 bln tons of fuel will prevent further release of toxic and carcinogenic substances into the environment, and there are over 100 of them: carbon monoxide – 650 mln tons, nitrogen oxide – 550 mln tons, sulfur dioxide – 238 mln tons, aldehydes – 30 mln tons, soot – 155 mln tons (data for a diesel engine). So, the resulting emission to the atmosphere will be about 1.7 bln tons of harmful substances.

Summing up, we have considered the current trends in modern transport in terms of ecological sustainability. All the described trends explain the necessity of recent green mobility and green transportation initiatives. The article shows that SkyWay is an innovative transport system, which can significantly contribute to the green transportation initiatives and realization of the UN Sustainable Development Goals. Taking the above into account, SkyWay has a great potential for future implementation worldwide, especially in the countries supporting green technologies.

References:

1. Analysis: Fossil-fuel emissions in 2018 increasing at fastest rate for seven years, CarbonBrief, https://www.carbonbrief.org/analysis-fossil-fuel-emissions-in-2018-increasing-at-fastest-rate-for-seven-years (access date May 28, 2019)

2. ITF (2017), ITF Transport Outlook 2017, OECD Publishing, Paris, https://doi.org/10.1787/9789282108000-en

3. Analysis of National Transport Sector Emission Trends 1990 – 2012, PPMC 2015, http://www.ppmc-transport.org/wp-content/uploads/2015/08/Analysis-on-National-Transport-Sector-Emissions-1990-2012.pdf

4. Sustainable Mobility for All. 2017. Global Mobility Report 2017: Tracking Sector Performance. Washington DC, License: Creative Commons Attribution CC BY 3.0

5. Global EV Sales for 2018 – Final Results. 2019. EV-volumes, Sweden http://www.ev-volumes.com/country/total-world-plug-in-vehicle-volumes/ (access date May 28, 2019)

6. World’s 10 Biggest Automakers & Their EV Plans. 2018. CleanTechnica https://cleantechnica.com/2018/10/29/worlds-10-biggest-automakers-their-ev-plans/ (access date May 28, 2019)

7. Survey of Global Activity to Phase Out Internal Combustion Engine Vehicles. 2018. Center for Climate Protection, Santa Rosa, CA, USA https://climateprotection.org/wp-content/uploads/2018/10/Survey-on-Global-Activities-to-Phase-Out-ICE-Vehicles-FINAL-Oct-3-2018.pdf

8. Anatoly Unitsky. String Transport Systems: on Earth and in Space, Silakrogs: PNB print, 2019, http://yunitskiy.com/author/2019/2019_26en.pdf

9. Anatoly Unitsky. Unique competitive characteristics of STU product, Moscow, 2009, http://yunitskiy.com/author/2009/2009_32.pdf (access date May 28, 2019)

10. Anatoly Unitsky. Environmental friendliness: let us increase the "green lungs" of the planet by the area equal to 4 territories of Great Britain, www.yunitskiy.com, 2014, http://yunitskiy.com/news/2014/news20140127_en.htm (access date May 28, 2019)