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GREEN ECONOMY METHODS IN A LARGE CITY INNOVATIVE TRANSPORT-LOGISTIC DEVELOPMENT

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Abstract

Actuality of the research and the analysis of practical method implementation in particular can be justified by the fact that ecologizaton of transport and logistic system nowadays is one of the main strategic aims in sustainable development of any large city. The research aim was identification and systematization of methods for 'green' economy principles integration into transport and logistic development policy of large foreign and Russian cities for determination of tendencies, risks and barriers of the process. The methodological basis of the study was a combination of the statistical and comparative analysis, content analysis of program documents and local government's measures in the sphere of green economy implementation for a large city transport system. Conceptual basement and actual methods in green economy development of a large city transport-logistic system have been retraced in this paper. Side effects of transport development for city dwellers have been summarized. Foreign and Russian practice of a large city transport-logistic system ecologization with a use of green economy methods have been described. Risks for business community during the period of transport-logistic system sustainable modernization have been shown. The recommendations for local authorities based on the analysis of several green economy methods in the development of Krasnodar and Sochi transport-logistic systems have been formulated.

Keywords: Green economy, transport infrastructure, local communities.

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1. Introduction

Introduction of principles, methods and technologies of green economy into vital activities of urban communities is a critical process needed for the achievement of sustainable socio-economic development, ecologization of local industry and solving of system environmental problems that characterize the life of large industrial and transport centers. Different groups of actors can initiate this implementation, however the results of the process influence in the long term all community subjects: people, business and power.

The works of Hovavko (2011) contributed greatly to the development of theoretical ideas in the field of public transport expenses regulation based on external effect internalization.

Green economy methods presuppose cardinal changes in business formation, linked to the problem of sustainable industrial technologies implementing, energy generation and goods shipping. Innovative concept realization demands rethinking of major business production and technological processes, increases a company's expenses at the stage of development (purchase) and introduction of new technical equipment, as well as raises risks of business leading in the short term.

Green economy means innovative concept of business creation, novelties in vital activities of locals throughout changing city space, as well as innovations in the methods of city government and development. In this connection constant monitoring of changes, initiated by public policy actors on local level is necessary, for the results can be both positive and negative for local community, as well as generate several risks.

2. Problem Statement

Contradictions between ecologic and economic development aims are more obvious in large cities and metropolises as opposed to agrarian communities, small towns and medium-size cities. Urban population experience ecologic side effects of industrial growth and transport-logistic system development. Side effects of a city's transport development for a city dweller:

- Considerable air and soil pollution by oxocarbon, lead, benzopyrene, nitrogen oxide, sulfur monoxide, carbon black, aldehydes lead to health and life expectance decline of local people.
- Loss from road accidents, anthropogenic damages of logistic infrastructure.
- Time loss and low human physical activity side effects related to traffic jams.
- Individual vulnerability to rising costs of vehicles, fuel, parking, as well as transport tax increase.
- Soft negative influence of transport – noise pollution and decrease of oxygen in the air due to the concentration of working vehicles, as well as non-toxic carbon dioxide and water vapor emissions.

Megalopolis expansion presupposes proportional or even advanced increase of vehicles leading to the growth of side effects for city dwellers. Thus, the research of transport and logistics systems ecologization is one of strategic aims for sustainable city development.

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3. Research Questions

Authors put the following research questions:

- What concepts and methodological points present theoretical basis for the implementation of green economy tool set in the process of city transport-logistic development?
- Is there common directions in the practice of green economy concept dissemination in the cities of Russia and other countries?
- What main methods of local transport-logistic system ecologization are being used for the decrease of pollution in large cities?
- Do the measures taken by local authorities in the sphere of green transport and a city's sustainable modernization really improve quality of life there?
- What new risks emerge for the local communities in the process of green economy implementation in the sphere of transport?

4. Purpose of the Study

The research aim is identification and systematization of methods for green economy principles integration into transport and logistic developmental policy of large foreign and Russian cities for determination of tendencies, risks and barriers of the process.

5. Research Methods

Please replace this text with context of your paper.

For achievement of aims and purposes, the following methods were used:

- The analysis of statistic data, characterizing dynamics of electric car number in the cities studied, as well as examination of data concerning green transport infrastructure.
- Structural analysis of local and regional concepts, strategies and programs in the sphere of ecologically neutral transport-logistic system of a large city directed at finding green transport developmental methods.
- Analysis of local government's measures and implemented NGO initiatives aimed at step-by-step ecologization of a city's transport and logistics.
- Comparative analysis of basic indicators in the process of green transport development in Krasnodar and Sochi.
- Synthesis of statistics, as well as results analysis of program documents and local government's measures in the sphere of green economy implementation for a large city transport system.

6. Findings

6.1.Green economy concept extension on local transport system

Theoretical foundations of green economy implementation for the development of a large city transport-logistic system can be found in the concept of sustainable development, degrowth theory, concept of eco-city with minimal carbon footprint, ecologically neutral mobility theory and sustainable transport concept. Green economy practices activate investment and innovations, which not only produce new economic opportunities, but also become the base for structural shifts in favor of resource-saving,

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technologically advanced sectors and kinds of activity (Tereshina, Tambovceva, & Khalafyan, 2018). Studies often emphasize, that economy modernization is being more and more described as the providing of technological process for the long-term socio-economic development based on lowered ecological risks and maintenance of favourable environment (Samarina & Skufyina, 2015).

Scientific and technical advance of the last decade made sufficient conditions for a qualitative leap in the sphere of green transport, which can be reached by realization of two technological concepts for integration of electric cars into a city and household power grid:

- Concept of two-sided use of electric cars and hybrids Vehicle2Grid (V2G), that implies connection of cars into common power grid for charging in the periods of low demand (for example at night) and sending power back to the grid when demand is high (in the morning or in the evening).
- Concept of two-sided energy exchange between a car and a private house Vehicle-to-Home (Vehicle-2-Home, V2H), which implies their use by the owner as energy-producing and energy-consuming subsystem depending on current individual needs and day-night energy demand fluctuations (Karlsson, Bergqvist, & Brigelius, 2014).

Integration of electric cars and hybrids into a city and house power grid creates the base for more responsible and rational actions of a proprietor as a producer and consumer of energy, stimulates the growth of green energy generation within households or organizational and institutional infrastructure, as well as stabilizes the functioning of local power grid. The owner collects revenue from surpluses of car energy during the period of high day tariff and cuts costs thanks to the night low-price charging (Figure 01).

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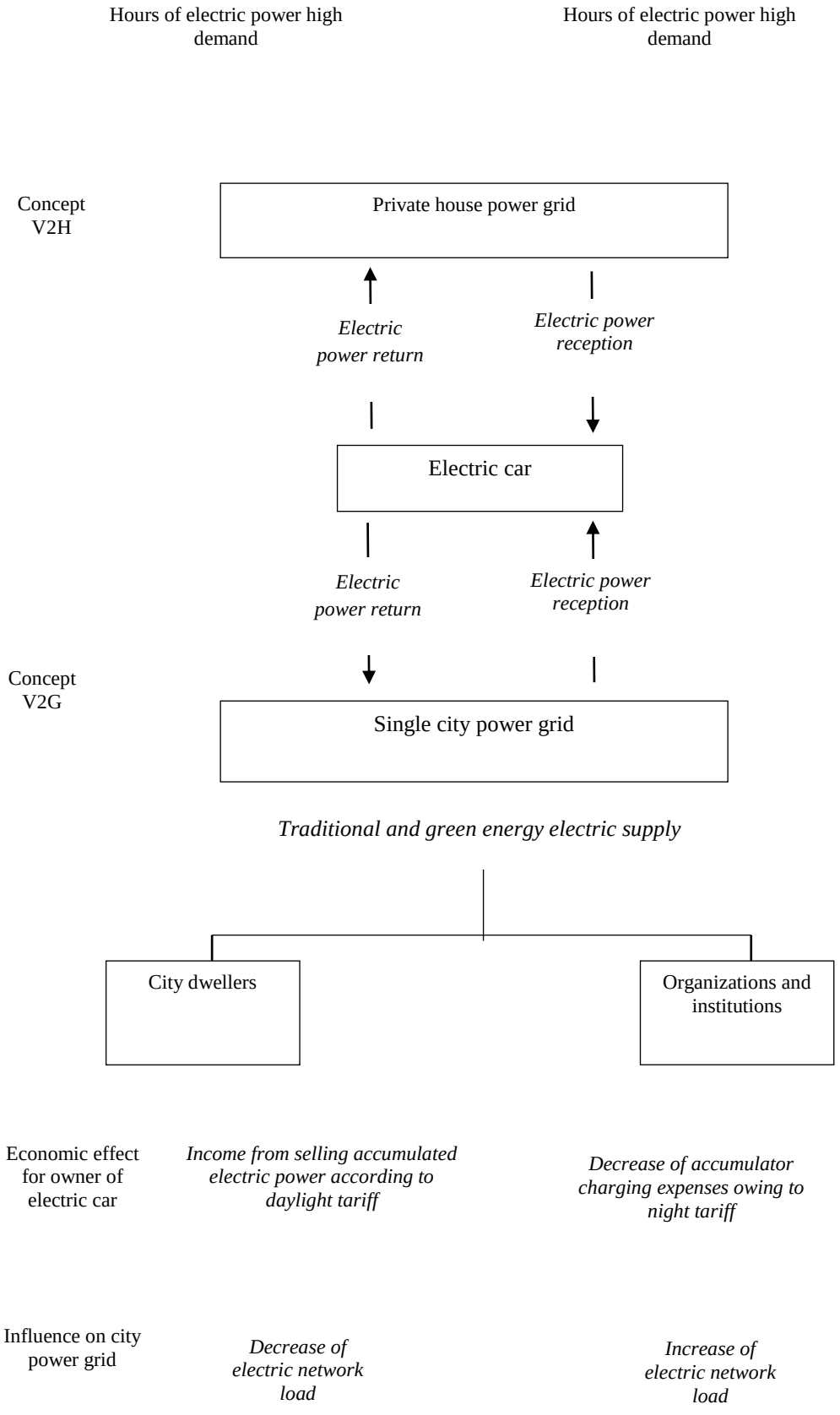

Figure 01. Simple structure-graphic model of V2H and V2G concept realization (charted by authors)

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Introduction of V2H and V2G concepts in particular, as well as building of green transport infrastructure in the short and medium-term is economically unreasonable. This fact fosters new type of investment – reliable or sustainable investment, which takes into account non-financial factors and harmonizes economic and ecologic interests of urban community actors (Bobylev & Goryacheva, 2017).

Pobedinskiy, Vukovich, & Zubkova (2018) emphasize the need to create criteria for assessing the state and level of the green economy development.

The analysis allowed making a conclusion that a state and municipal power in the practice of developed and developing countries use common methods of assistance in the development of clean transport-logistic system (Figure 02).

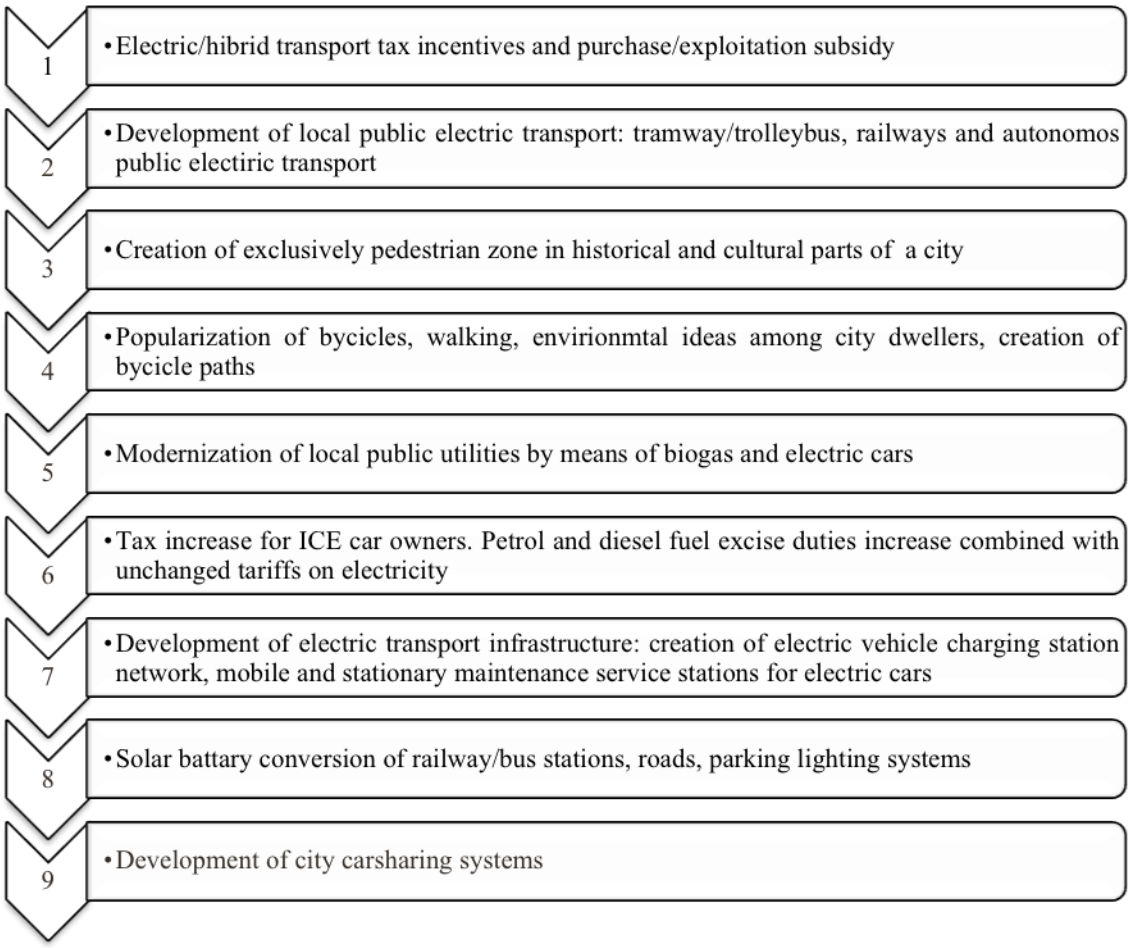

Figure 02. Main methods of local transport-logistic system ecologization (charted by authors)

As a rule, administrations combine administrative, economic and town planning methods, as well as support green initiatives of local people and organizations to increase ecological security of urban transport-logistics system.

6.2.Practical methods of local transport-logistic system ecologization in large foreign cities

Analysis of local transport-logistic system ecologization methods in large foreign cities allow us to make several conclusions.

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The first effective method is to move polluting industries from a city to satellite suburbs, which leads to deindustrialization, reduction of environmental pollution and sharp decrease of commercial goods transportation. All cities with highly developed industry use this method, for example, the biggest carmakers of Detroit during last decade move their production complexes from downtown to outskirts or to the country. Job reductions and decrease of tax incomes are the negative effects of this process.

The second widespread green economy method is the creation of pedestrian zones and step-by-step ban on commercial and private vehicles in a city center. For example, according to general plan of Madrid urban development, local authorities are going to complete creation of 2 square kilometers pedestrian zone, which implies transport reorganization on 24 streets in the city center (Amaro, 2017). Also, in recent years, the headquarters of many big companies in Los Angeles are moving to satellite suburbs to lower the traffic in the city center.

As a rule, use of instrument reflects the aspirations for environmental values and healthier life style, based on shift from private cars to bicycles or hiking. Rejection of vehicles with great cubic capacity can be associated with economic crisis and higher petrol costs (Sobrino & Monzon, 2014). Lower individual mobility within a city and transport problems for commercials in a city center is a negative outcome of this.

The third important method of ecologization is the transition of local transport to renewable energy sources. This process implies spread of hybrid and electric transport, distribution of electric vehicle charging stations, as well as use of solar energy at a bus and railway stations, roads and parking. Several researchers and practitioners indicate that it is reasonable to equip the roofs of transport infrastructure buildings with big size solar batteries or do the planting there (Telichenko, Benuzh, & Mochalov, 2017). Scholars use different mathematic models for assessment of investment effectiveness in a transport system, estimation of medium-term financial economy for a city and time saving for local people (Sharav & Shiftan, 2017).

Partnership of electric car producer BYD Auto, accumulator producer BYD Company and Shenzhen city administration can be a good example of interaction between electric transport companies and local authorities.

The necessity of green transport development in Shenzhen was conditioned by high anthropogenic load from chemical, biochemical, car, shipbuilding industries, as well as construction sphere and highly developed transport system, serving 11 million people. Municipal projects of electric transport priority development were based on internal production of electric engines and cars by BYD Company in industrial parks of Shenzhen. Shenzhen city program in this sphere includes following instruments:

- The development of electric vehicle charging station network within the city.
- Step-by-step replacement of ICE public buses by electric buses during 2011-2017 years. Around 80% of deliveries were made by BYD, which is the biggest taxpayer for the city.
- Purchase of electric cars for the local police.
- Joining to state financial aid program of ‘new energetic means of transport’ (‘Made in China 2025’) within which hybrid, plug-in hybrid and electric car producers gain state support.
- Tax incentives for taxi companies and cargo transportation companies using electric cars.

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From its side BYD Company is devising technologies of alternative energy effective use, developing in a joint venture with Daimler AG batteries with longer life span, introducing fast charging technologies, as well as decreasing costs of hybrids and electric cars, making them attractive for customers.

Presence of two nuclear power plants and two gas-fired thermal plants fulfils the needs of the city, enables export of energy to other cities and allows development of hybrid and electric transport system (Yao, Luo, & Zhang, 2013).

Apart from use of green economy in transport-logistic sphere Shenzhen administration also creates parks in old industrial districts as well as outdated residential areas.

The forth method is to reduce the amount of traffic in a city center. Local administrations can develop park and ride system for commuters, as well as disincentive tariffs for those who use private vehicles in a historical center or downtown.

The fifth green transport method is the priority development of underground and fast low-floor tram. For example, in Madrid during the last decade new lines and stations of underground system were actively developed. Now there are 13 underground lines, two loop lines, linking downtown and suburbs, industrial parks and satellite towns into common economic space.

The sixth actively used method is the ban on small and medium-sizes buses, as well as exploitation of biodiesel buses and compressed gas buses (Golubchikov, 2011).

The seventh method is to combine different green economy, administrative, economic and logistic instruments for solving significant municipal problems.

Thus, one of the biggest problems of Beijing during last 10 years is the excessive pollution and inferior quality of the air in the city, as well as smog as a result of industrial fumes, seasonal dust storms, existing wind rose of The North China Plain and the development of motor transport. In particular, every December high concentration of smog paralyses traffic on the highways and loop roads of the city. That leads to decrease of business activity and tourist attractiveness, as well health problems. For the problem resolution, Beijing authorities implement following measures:

- Beijing city administration has forced key industrial producers to cut emissions or move their factories to other Chinese cities.
- The number of service vehicles belonging to Beijing House of Representatives and People's Government has decreased by 50% or more.
- Private vehicles restrictions for locals, who are able to use their cars in even or uneven days only, depending on number plate.
- The prohibition of cars from other cities.
- Recurrent restrictions of construction work that lead to air pollution within the city.
- Increase of railway and underground carrying capacity, railway station functionality growth, rapid development of rail network in Beijing.
- Use of population reduction instruments such as strict order of gaining residence permits, domicile registration regime, access restriction for non-residents.
- Support of households who decided to move from downtown to suburbs.

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- Realization of these administrative and transport-logistic instruments allowed to stabilize the problem and evade deterioration.

Several authors point out that green transport measures should be combined with local government activities concerning economic transition to more ecologic industries producing less CO2 emissions (Matsuhashi & Takase, 2015).

6.3.Adoption of green transport concept in Russian cities

Administrations of large Russian cities use such green economy methods in the development of transport-logistic system as creation of exclusively pedestrian zones in a historical part of a city, extension of electric vehicle charging stations networks, tax incentives for electric vehicle owners, bicycle lanes construction, use of solar batteries for transport, lighting of rail and bus stations, roads and parking, creation of green zones around big transport complexes.

For instance, the current leaders in creation of electric charging infrastructure are the cities of Moscow (42 charging stations, end of 2017 data), Saint Petersburg (15 stations), Sochi (11 stations), Samara (5 stations). Analysis showed that considerable growth in construction of charging infrastructure has happened in these cities during 2016-2017 years.

The practice of electric vehicle use for public transport and municipal services vehicles is also extending. In some Russian cities local authorities support initiatives in electric taxi (for example in resorts of Stavropol region) and use of electric vehicles in port and warehouse services of commercial organizations.

Unfortunately, regional officials rarely use tax incentive methods for electric car owners. Moscow oblast and Saint Petersburg are exceptions to the rule. In Moscow oblast electric car owners have been exempt from transport tax since 2015, in Saint Petersburg in the period from 2018 to 2020 transport tax was abolished for electric cars up to 150 horsepower or up to 110 kilowatts electric car equivalent.

Use of some green economy methods in the development of Krasnodar and Sochi transport-logistic system will be considered next. Currently the main source of air pollution in both cities is motor and cargo transport. Polluting industries have moved outside the cities or modernized their purifying facilities.

Analysis allowed us to determine the following instruments of transport-logistic system ecologization, used by local administrations of Krasnodar and Sochi (Table 01):

Table 01. Use of green economy methods in the development of Krasnodar and Sochi transport-logistic systems (charted by authors)

Use of green economy methods in development of city transport-logistic systems	**Krasnodar**	**Sochi**
Number of cars used	Not more than 65 electric cars in region or 3,6 cars on 100 thousand cars with ICE (end of 2017 data)	
Subsiding and tax incentives for electric vehicle purchase and use	Mechanisms of budget subsiding and tax incentives are lacking on Krasnodar region level	
Presence of electric vehicle charging stations (end of 2017 data)	2 stations (at Teatralnaya square and in OZ-Moll)	11 stations (in Central, Khosta and Adler districts of Sochi)

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Presence of electric vehicle charging station business projects in big cities and on federal roads	Development of electric vehicle charging station network in the region stipulated within the framework of agreement between Krasnodar regional administration, state corporation 'Rostec', PAO 'Rosseti', Groupe Renault, 'Electo Group'	
Modernization of public transport and extension of pedestrian zones for the reduction of motor vehicle emissions	Step-by-step quality improvement of public transport and creation of green public spaces (pedestrian zones, parks, improvement and planting of squares)	
Creation of exclusively pedestrian zone in a historical part of a city, free of all transport	Exclusively pedestrian zone on Krasnaya street during weekends and celebrations	Exclusively pedestrian zone on Navaginskaya street
Level of solar battery use for transport infrastructure lighting	Low	Low (medium level in coastal and mountain Olympic clusters of Sochi)
Development of public electric transport	Presence of potent city tram and trolleybus network	Considerable extension of passenger rail service within Greater Sochi in 2012-2017 years
Level of bicycle lane construction	Low	Medium
Measures of public bus ecologization	Wider use of large capacity buses running on biogas	
Ecologization mechanisms for municipal services vehicles	Wider use of compressed methane	

For Krasnodar as a submillion city, the existing electric vehicle charging facilities are inadequate. It is impossible to have a trip longer than 200-250 km from Krasnodar or Sochi due to the absence of charging stations on the main roads of the region.

In both cities analyzed, the level of solar battery use for transport infrastructure lighting is very low. However, there are positive changes concerning the processes of green public places creation, construction of bicycle lanes, formation of exclusively pedestrian zones, as well as ecologization of public buses and municipal service vehicles.

6.4.Recommendations for the development of Krasnodar and Sochi transport-logistic systems with a use of green economy methods.

In authors' opinion, the legislative and law enforcement measures of Krasnodar regional authorities such as nullification of transport tax for electric cars can be reasonable and stimulating instruments for electric cars owners. Regional budget will not lose revenues due to insignificant number of electric cars in the region. It is important to continue developmental activities of state and businesses in the sphere of electric vehicle charging stations in big cities and on federal roads. Charging stations are needed on federal automobile roads M-4 'Don', A-146 'Krasnodar – Verhnebakanskiy', A-147 'Dzhubga – Sochi – Russia's border with Abkhazia', A-149 'Adler – Krasnaya Polyana' and A-290 'Novorossiysk – Kerch'.

According to the state project of electric transport development in Krasnodar region, electric vehicle charging stations should be installed on every 50-70 kilometres of the road 'Krasnodar – Sochi'. As a stimulus for electric car owners project developers also suggest giving them the right to use bus-only

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lanes and municipal parking for free (The concept of electric vehicles development in the Krasnodar Region, 2017). Nevertheless, debatable question is whether local administrations should determine green zones that would be accessible for ecologically clean transport. It is perspective for Sochi as a resort city to develop electric taxi and car rentals.

Municipal and regional administrations should pay more attention to financially unstable municipal unitary enterprise 'Direction of Krasnodar's tramway and trolleybus', which endangers in the long-term unique heritage of the city's public transport. It is reasonable to construct new tramway lanes into growing suburbs of Krasnodar, which will make the city center more accessible, abate traffic jams, and stimulate the people to use electric public transport more often.

Authors consider ineffective and damaging for businesses to put a ban on entering Russian resort cities for cars with ICE. This measure, which is currently being discussed in government circles, combined with hotel occupancy tax can decrease the attractiveness of Black Sea resorts for Russian and foreign tourists, destroy the system of cargo transport shipping, as well as lower economic activity in recreational sphere.

For bus and railway stations of Sochi and Krasnodar, it is sensible to install solar battery systems on tops of the buildings and thereby reduce medium term expenditures.

6.5.Risks of business community, people and local government during formation of ecologically clean transport-logistic system.

As a part of study, the risks for business linked with the green economy methods implementation in the process of transport system modernization have been determined:

- Purchase and exploitation of hybrids and electric cars can increase expenditures of businesses.
- Short driving time, lack of charging and repair stations for electric cars lead to less reliable shipping operations.
- The priority development of pedestrian and cycling infrastructure in a city center make it less accessible for transport.
- Risks of energy, petrol and diesel high costs and other risks that may increase cost price of electric cars and hybrids.
- Risks of excessive state control in the process of local business community involvement into the projects of ecologically clean transport infrastructure (e.g. the prescription for parking operators to use solar batteries for lighting or the order for owners of shopping malls to construct electric vehicle charging stations on their territory).

Local people in the process of ecologically clean transport-logistic system formation can face the risks related to electric car design deficiency, underdevelopment of charging stations network, rising energy costs (sometimes even faster than those of petrol and diesel). Risks can be also connected with current cost price and reliability of equipment that is needed for sending excess power of electric car accumulator to house power grid as a part of conception V2H.

Local government can have the risk of increasing municipal debt due to necessity to raise budget expenses in such measures concerning green economy development of transport-logistic system as pledging of ecologically clean public transport or construction of green road infrastructure.

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Some authors point out that for decrease of risks it is reasonable for people to use semiconservative strategy, which implies purchase and exploitation of hybrids instead of electric cars (Panday & Bansal, 2014). Current period can be characterized as investment and innovation flow to electric car development made by world's major car producers. This process builds the foundation for electric car cost price decrease, vehicle driving time rise, improvement of accumulator capabilities in 3-5 years' time.

It is reasonable to use semiconservative strategy in introduction of self-driving electric cars to Russian cities until average self-driving electric car becomes more reliable in terms of safety than professional driver does.

7. Conclusion

Nowadays socio-economic space of a large modern city is becoming more and more complex. That implies the use of municipal green economy tool set in a field of rational passenger and cargo transportation system, as well as decision making in such spheres as ecologic transport, decrease of energy consumption and quality improvement of urban space.

It is important to make quantitative estimation of green transport development in a city space based on indexes of sustainable development and ecologic footprint of a territory (Kostina, Rosenberg, Rosenberg, & Hasaev, 2014).

Currently, key elements in transport policy of foreign countries are the return to public transport, active development of pedestrian and bycicle zones, car-shering, car-free communities, etc. The majority of ecologization methods studied in the article is now being realized in Russia, justifying the universal character of green economy tools implementation for solving large city transport problems.

Nevertheless, in the period of a new transport-logistic system development there are several risks for business community, local people and administration, which are produced in the first place by uneven allocation of governmental decision outcomes. Therefore, the possibility and necessity of ecologization methods in a city transport system should be determined by specific socio-economic conditions.

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