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URBAN PUBLIC TRANSPORT DEVELOPMENT IN RUSSIA: TRENDS AND REFORMS

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URBAN PUBLIC TRANSPORT DEVELOPMENT IN RUSSIA: TRENDS AND REFORMS

The aim of the article is to present the ways of urban public transport development in Russia within the context of the transition towards the market economy. The article consists of two blocks: the trends of urban public transport development in the Russian Federation and the problems of urban public transport management. The first block presents the survey of urban public transport development trends by transport mode with the attention to the mass transit. The quantitative and qualitative analysis of urban public transport in Russian cities since 1991 is provided. The positive and negative cases of urban public transport development are revealed. The most important features of urban public transport functioning connected to the urban planning and transport planning practice are discussed. The second part presents an overview of the main decisions made by public authorities in the field of urban public transport management. The key questions are: the general logic of administration, the role of private transport operators, funding and risks of the market participants. The general conclusions are made which reveals the place of the Russian Federation within the context of world urban transport development trends.

JEL Classification: R41, R42, R48

Keywords: Russia, public transportation networks, public transportation systems analysis, transportation policy, public transport contracting and regulation.

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A brief history of urban public transport systems development during the Soviet period

Nowadays the development focused on public transport is seen as the most sustainable form of urban spatial development (Cervero & Murakami, 2008). In 1950-1980s former USSR cities saw the intensive development of all public transport modes. This process was determined by urban development peculiarities in the context of the Soviet planned economy, as well as the by the severe restriction of household car ownership characteristic of totalitarian societies (Tarkhov, 2004).

The main feature of the urban development of the period was the emergence of "industrial giants" in almost all major cities of the country. The "*settlement at factories*" (Glazychev, 2008), that is, the group of barracks within the walking distance from the plant, typical of the first decades of the Soviet regime, has been gradually replaced by more comfortable mass housing construction, located often far away from employment concentration. Obviously, all the construction was carried out within the transit oriented development paradigm: 5- and 9-storey houses were built not only in the urban core, but also in the remote suburbs.

The restriction of household vehicle ownership has been a systematically implemented policy during the whole Soviet period. Since the 1930s, transport self-sufficiency of Russian population was almost zero: horses were owned by public bodies or kolkhozes (collective farms); cars had not yet appeared. In 1928 academician E.A. Chudakov wrote *«…in terms of road vehicles our Union occupies the last place among all, more or less industrialized countries»* (Chudakov, 1928); he also provided a very articulate comparison data (Table 1).

Tab. 1. Private vehicle ownership in different countries (1928).

Indicators	Countries				
	USA	Great Britain	France	Germany	URSS
Number of vehicles (thousand)	22137	1023,7	891	319	20,6
Cars per capita	200	29,4	21,7	5,1	0,14

The total number of vehicles in the USSR by 1928 didn't still exceeded the value reached by Russian Empire in 1916. The number of cars per 1000 inhabitants was: 22 in 1970, 52 in 1980, and 60 in 1990. Under these conditions, regular bus routes were mandatory for the maintenance of vital activity in almost any settlement. In 1990 urban routes were organized in 1378 settlements in Russia. 42 cities from the list have also developed trolleybuses and tramways in addition to buses and taxis, 5 cities have created subway systems.

The motives for the mass use of electric transport (trams and trolleybuses) were far from the present-day realities: an artificially low electricity prices for public utilities[3]; chronic shortage of large capacity buses, typical of planned economy; provision of female employment. For urban managers of that time another important argument in favor of the electric transport was the fact that the trams and trolleybuses (unlike buses) could not be removed from the routes by the party leaders decision to serve meetings, transportation of citizens for the harvesting and for other uses specific of the Soviet conditions.

In 1990 24.1% of the world trolleybus networks and 24.2% of the world tram networks were operated in Russia, the total length of lines being 7300 km (Table 2.). (Zyuzin, 2012). In the same year the number of buses, working on urban routes, in the cities of Russia amounted to 80 units per 100 thousand inhabitants.

Tab. 2[1]. General information about public transport in Russian cities (1990).

	Bus	Tram	Trolleybus	Subway	Taxi	Total
Number of settlements	1378	70	85	5	550	1378
Number of routes	9693	703	910	18	—	11324
Length of routes (km)	43373,6[1]	4369,6	3008,9	337,3	—	51089,4
Number of vehicles (thousand)	60,3	14,8	13,8	5,2	54	148,1
Ridership (mln pass)	22869	6020	6000	3695	557	39141

[1]- 536 biggest cities only

Despite the myth about the "*best in the world Soviet public transport"*, the real supply of transport services have never met a demand for public transport at any respectable level of quality. The results of the surveys carried out in Moscow in 1985, showed that 47% of passenger traffic during the peak hours was served under conditions of vehicle free floor space per one passenger being 0.15 m^2, that is 6.67 standee per 1 m^2 of the floor area. Another 15% of passenger traffic during the peak hours were performed in conditions worse than limiting technical characteristics of the bus – 0.125 m^2/passenger, that is, 8 standing passengers per 1 m^2 of the free floor space. Thus, over 60% of passengers were transported in Moscow during the rush hours with crowding exceeding the requirements adopted by the UITP (Blinkin, et al., 1988) In European and North American cities bus crowding was usually about 0.33 m^2/ passenger, or 0.25 m^2/passenger in the worst cases.

Significant overcrowding was also observed at the urban electric transport. Thus, in 1990 in 7 Russian cities trams carried more than 3 million passengers per 1 km of rail tracks, in Izhevsk – 4,3, in

[3] Trolleybuses and trams all Russian cities except Moscow belonged to the jurisdiction of the RSFSR Ministry for Housing and Communal Services.

Vladivostok – more than 4.9. On trolleybus routes figures of 2.0 – 2.5 million passengers per 1 km of lines were typical of Russian cities; a record figure – 3.5 million passengers per 1 km of lines – was observed in Tula. It should be noted for comparison that the average figure for tram networks in EU countries is 0.7 million passengers per 1 km of rail tracks, for EU-15 – 0.6 million passengers per 1 km of rail tracks (Council, The European Rail Research Advisory, 2009).

During the Soviet period, passenger road transport companies, as well as tram and trolleybus operators were public property. The former were the responsibility of the RSFSR Ministry of Road Transport, the latter – of the RSFSR Ministry of Housing and Communal Services of RSFSR. The exception was Moscow, where all the companies of land public transport were the responsibility of municipal authorities. Subways in all cities, including Moscow, were the responsibility of the former USSR Ministry of Railways.

The economy of passenger transport enterprises was based on the planned supply of rolling stock, and also planned *"state capital investments"* in infrastructure and production facilities, made from the central funds of the relevant ministries. Thus, capital costs were almost fully covered from external sources.

Since the beginning of the 1970s, urban public transport in Russia operated with farebox recovery ratio above 1 in terms of operating costs. The actual value of this indicator in Russian cities varied between 0.6 and 0.8 (Blinkin, et al., 1988). The reasons for this situation were artificially low fares, *"frozen"* since the 1950s; the presence of numerous reduced fare categories eligible to free transportation; the presence of the large and growing group of passengers – faredodgers, not paying intentionally or due to the overcrowding.

When the farebox recovery ratio was above 1, the procedure was adopted, according to which *"the planned losses"* of the enterprises serving the city's bus routes, were covered by:

– cross-subsidization, i.e. a partial redistribution of income from profitable modes of passenger and freight road transport, which was made at the level of regional units of the RSFSR Ministry of Road Transport;

– centralized financing, usually within the coverage of costs for the transportation of certain categories of concessionary passengers. This funding was provided within the respective annual plans; the enterprises obtained it through the same regional branches of the Ministry.

In case of trolley and tram operators covering of the *"planned losses"* was carried out by central funding directly from the RSFSR Ministry of Housing and Communal Services.

* * *

In 1991-1992 ownership of transport enterprises has been transferred to the municipalities and/or the regions of Russian Federation (Russian Federation Supreme Council, 1991), while public transport has lost a former source of funding – the centralized subsidies. At the same time, frankly populist

legislative innovations have been made to grant the right of free public transport usage to the considerable share of the citizens. The number of concessionary categories was increased from 32 to 65 (Tarkhov & Derkach, 1999). Taken together, the right to use of public transport for free was received by 27.3% of the population; in some cities the share reached 35% (Rodionov, 2005). According to these innovations the transportation of concessionary categories of passengers should be compensated to operators from the corresponding budget levels: federal – for the concessions established by the federal laws, or local – for the concessions established at the local level.

Given the extremely difficult financial situation faced by public transport operators, the compensations promised by legislators have stimulated large-scale upward distortions. Many cities provided data for the official statistics on the transportation of 6 million or more passengers per 1 km of rail tracks. The record was reached in 1995 in Tula, wherein the figure was 8.4 million passengers per 1 km of rail tracks, exceeding Saint Petersburg subway indicators (7.9). However, all these statistical tricks has soon lost any sense, as compensations for reduced fare, provided by the law, in reality were paid imperfectly, or not paid at all. Thus, the traditional operators, which have been concentrating the entire fleet of trams, trolleybuses and buses of high and extra high capacity, almost simultaneously lost centralized investments and operating subsidies, as well as a significant part of the revenue. Chronic financial problems of these companies led to a reduction in the daily usage of vehicle stock available for service (Gwilliam K. M., 2000, p. 2), and eventually to a radical reduction in ridership and not less radical reduction in the length of the public transport route networks.

There is every reason to say that in the 1990s the smash-up of the public transport systems began in the majority of Russian cities. The trajectory of this process in 1990-2010 (Fig 1.1) in many ways resembled the trajectory observed in the US in 1950-1970 (Fig 1.2).

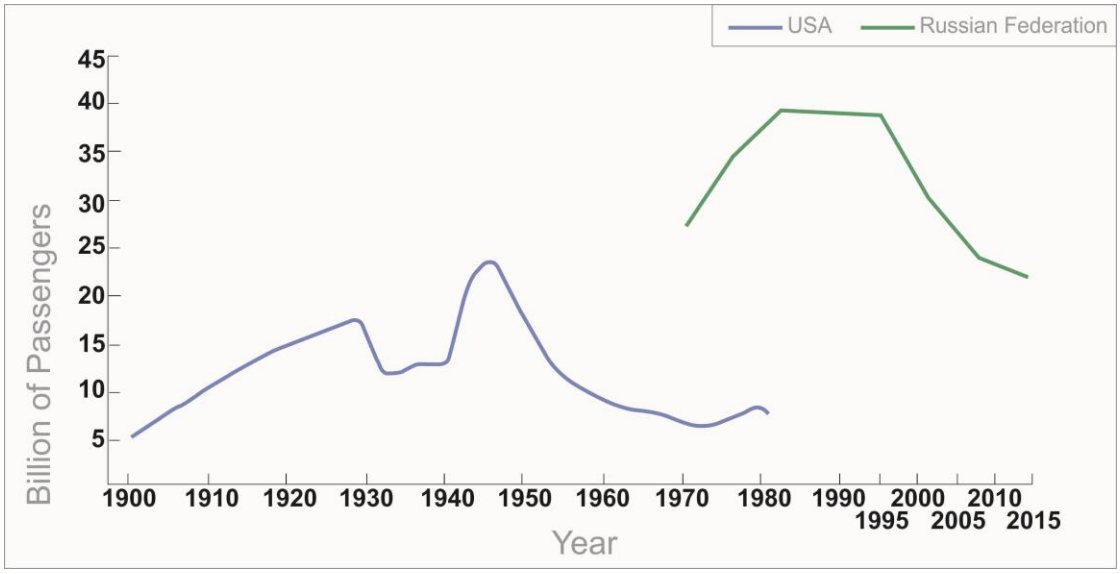

Fig 1. Land public transport ridership in US (1900-1980) (Association, American Public Transit, 1981) and Russian (1970-2015) cities

It is known that in the US smash-up of 1950-1970 was associated with the problems of subsidies and competition from paratransit, but mainly with the radical reformation of the settlement system – the so-called exodus of the middle class into the suburbs, whose residents switched to cars and stopped (fully or partially) using public transport (Jones, 1981). Extensive proportion of residents moved from transit oriented development to car oriented development and, accordingly, chose car oriented mobility, as a more adequate one for the new settlement patterns.

The Russian smash-up of 1990-2010 was determined by the same factors, with one important exception: the mass transfer to cars and the abandonment of public transport in Russian cities took place without any significant changes in the settlement system. Citizens, who continued to live in transit oriented development, chose car oriented mobility because of the lack of a worthy alternative.

Thus, there was a process of replacing services previously provided by the municipal electric transport operators and municipal bus operators:

-firstly, by the transport self-provision, the scale of which grew along with the rapid growth of motorization rate;

-secondly, by the specific Russian form of paratransit.

A key competitive advantage of paratransit laid in the fact that Russian paratransit *("marshrutkas")* were not covered by the above mentioned populist legislation for free (concessionary) fares provision. To date, the Russian cities have established a practice of the parallel operation of two public transport systems: municipal operators providing concessionary fares and private operators working on the same routes, but without providing concessionary fares. Since about 2002, the balance in ridership began to shift in favor of private paratransit operators. Official statistical accounting of paratransit ridership is carried out since 2010; the size of the market before that can be evaluated using the circumstantial evidence. For example, in Saint Petersburg the number of paratransit routes has increased more than 30 times (from 12 to 363) between 1989 and 2011, and the length of the streets served has reached 962 km, or about 34.5% of the entire length of the road network of the city (not including local networks) (Zyuzin, 2012).

Paratransit operators work on the routes approved by the city administration, but usually use algorithm "depart when filled up completely" rather than pre-announced route schedules. They operate mostly small capacity buses or minibuses, their ticketing systems are not integrated with the municipal companies' tickets. The competition of private operators *"for passenger"* is also widely observed, both with municipal operators and with each other.

As of 2015, in most Russian cities (except Moscow, Saint Petersburg, Kazan and some other big cities) urban electric transport is maintained primarily as a municipal service that provides almost free transportation for the pensioners, the disabled and other disadvantaged groups. All other categories of the population use paratransit services or prefer their own cars.

In view of the above, there is every reason to talk about the imperfection of the transport regulatory framework, which does not provide reliable public transport management mechanisms in Russia. The situation began to change for the better in most recent years, especially in Moscow and other major cities.

Methodology for post-socialist public transport measurement

The study summarizes the experience gained by Russia in the field of urban passenger transport systems transformation after the collapse of the Soviet Union and the market reforms implementation. The study is mostly focused on the changes occurred in demand for public transportation, in public transport networks and infrastructure and in public transport regulatory system with the emergence of private sector.

The transformation of electric transport (trams and trolleybuses) which for a long time have dominated in the public transport markets in Russia is discussed thoroughly. The study of urban electric transport includes all the cities in Russia where it operates (132). The sources of information include government statistics (Rosstat) and specialized databases (Multistat, Transfoto.ru), as well as authors' long-term observations. The main public transport parameters were used in the study (length of lines, rolling stock and vehicle fleet volumes, and ridership). Specifically calculated indices were used and analyzed for a better understanding of the changes taking place: ridership per1 km of lines, availability of vehicles per 1 km of lines, etc. The identification of the tram network parameters (ROW) and the analysis of priority lanes were performed using satellite images and street photography. The actual condition of tracks and traffic conditions on streets with tram lines have been revealed (Zyuzin, 2016). Separate analyzes of ROW-B type urban transport in Russia (as the highest reached by transport systems) has been carried out. Authors' judgments on the electric transport status and network coverage in the selected cities are based on the experience of a long continuous study of urban transport in Russia which is only partially represented in this work.

The paper also reviews the changes in Russian bus markets. This research includes 15 largest Russian cities with the population over 1 million people and is based on local legal acts and on tender documentation. The study helps to understand the goals of authorities, the issues of public transport funding and the role of traditional publicly owned enterprises and newly founded private companies.

Current trends

The motorization rate growth in Russian cities, which had begun in the early 1990s, accelerated even more around the turn of 2006 (Autostat, 2016). This circumstance has caused the decrease in ridership at municipal public transport operators and public transport in general in 2004-2008 (Fig. 2).

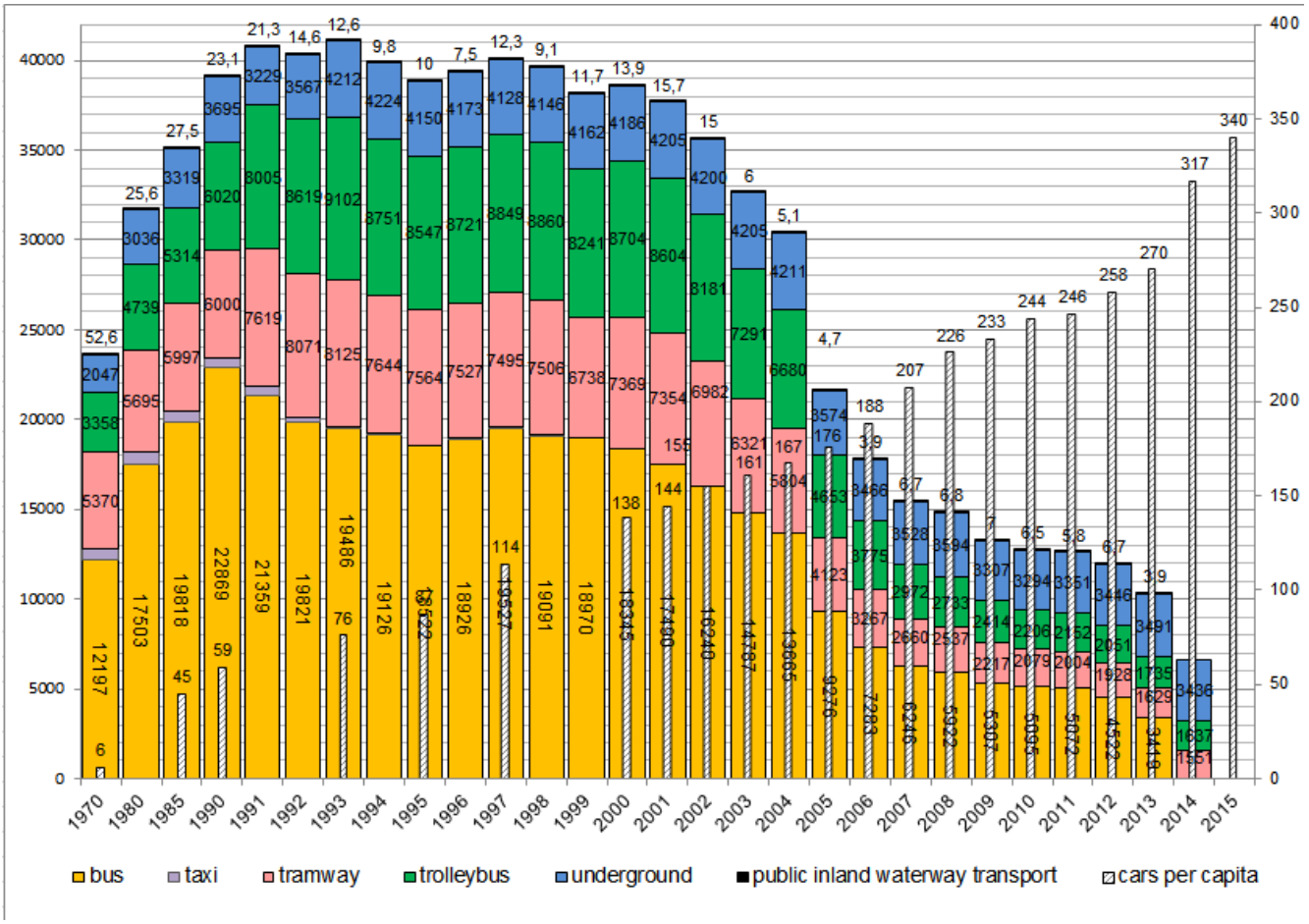

Fig. 2. Public transport ridership, modal split, and motorization rate, 1970-2015

As for 2015 the motorization rate in Russia has exceeded 340 cars per 1 thousand residents, but in some cities it has reached the value of 500, while Vladivostok has the motorization rate of 550. According to the results of the survey conducted in this city in 2014 36 of 224 hectares of the historic city center were occupied by parked cars (Livable Vladivostok, 2014). In Moscow there are 3.8 million cars registered, but when 2.2 million cars exit to the road network impassable traffic jams emerge all over the city (Polyakov, 2016). Under the current traffic conditions the model for urban mobility provision by degrading electric transport and low-quality paratransit exhausts itself. Further viability of urban transport systems is becoming more and more dependent on the public transport attractiveness which can't be achieved without sustainable public transport contracting and regulation. Also, modern transportation planning tools are used only limitedly. For example, only rail modes (subways, railways and some ROW-A and ROW-B sections of the tram network according to the accepted international classification (Vuchic, 2011)) had priority in Russia until recently. However, adaptation of these networks to the changing conditions of motorization is associated with a number problems specific of Russian cities.

Public sector regulation

Russia and other former Soviet Union countries have a distinctively high share of traditional publicly owned enterprises at the public transport markets. All metro, tram and trolleybus services are provided by public operators. In the bus sector the share of public companies is considerably lower. They provide services only on several routes while others are served by many private companies.

At the moment publicly owned companies are regulated and managed by local authorities in a backroom manner. Local bodies do not formally regulate the operators. Usually they do not set short- and medium-term goals for operators, do not monitor the results of their performance and, most importantly, do not formally set the financial obligations of operators and local budgets. It is highly important because public operators receive support from local budgets to reimburse a part of their expenditures. According to the relevant data, the farebox recovery rate of Russian public transport is 0,518 for trams and 0,478 for trolleybuses operations (Higher School of Economics, 2014). Subsidies are granted ex-post to compensate for revenue reductions due to fares regulations and trips of concessionary passengers. At the end of each month (quarter, year) public companies calculate revenue reductions and request authorities for compensation. Deficit compensation does not allow authorities to plan exactly the required amount of public expenditures beforehand. That is the reason why in many cases the planned sums of public expenditures do not meet the estimations of operators. This results in numerous conflicts between operators and authorities in terms of amount of subsidies. So, from operators point of view this granting system does not guarantee the stable financing. From the authorities point of view the problem is the performance of the operators. In this term deficit financing does not incentivize companies to improve the quality of services.

Both of these problems need to be eliminated by increasing the financial responsibility of authorities and operators following the reforms made by developed countries (eg., the European Union countries) 20 – 25 years ago. Before the reforms many developed countries faced the same problems. Public operators received deficit financing and were not incentivized to improve the quality of services (Gwilliam K. M., 1990). Problems were solved by set of regulatory reforms oriented on formalization of relations between authorities and publicly owned companies. Researchers that summarizes the EU experience ((World Bank, 2002, pp. 94 - 100) and (inno-V et al, 2008, p. 18)) usually point out the next reforms:

- The establishment of adequately staffed and skilled public transportation services planning authority;
- The corporatisation of the passenger transport unit of the authority into an in-house operator;
- The exclusion of political pressure of in-house operator aimed to achieve political and social rather than economic goals (reduction of fares, overstaffing etc.);

- The introduction of competitive procurement of equipment and a rage of support services by in-house operator;
- The introduction of a contractual relationship between the owner and/or transport authority and the in-house operator;
- The explicitation of policy and contractual aims within contractual texts;
- The determination of ex-ante lump-sum subsidy amounts to replace the former ex-post deficit compensation;
- The gradual introduction of incentivizing mechanisms linked to the realization of policy and contractual targets;
- In some cases, even the usage of some form of competitive threat.

These reforms can help to achieve clarity of competences of authorities and operators. As a result it allows providing better quality of public transportation services (vehicles, routes, timetables, fares etc.) for available public funds. In Russian case it can also prevent extensive and uncontrolled degradation of public transport infrastructure that was formed in Soviet period.

Trolleybus operators

Trolleybuses in Russia serve more than 800 routes in 83 cities (2016) (Fig 3.1).

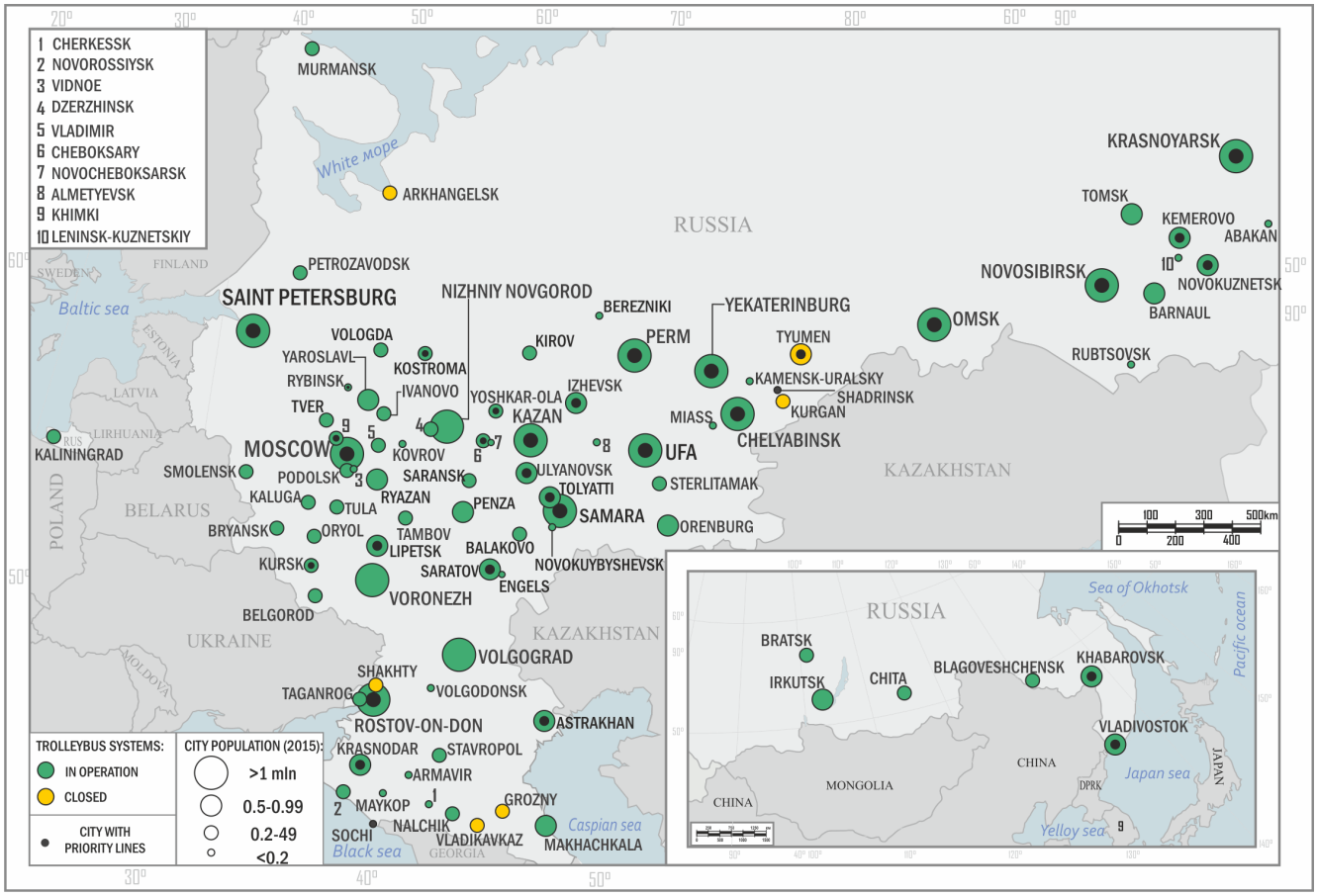

Fig. 3.1. Cities with trolleybus systems and priority lines in Russia

All the operators are exploiting the system with classical trolleybus power supply system from overhead contact network[4]. The length of the networks has increased by 364 km in 1990-2014[5]. This increase has been caused by the inertia of the planned trolleybus networks expansion from the late 1980s, as the majority of new lines had been introduced until 2000 using late Soviet developments. Additional trolleybus depots were created (including depots of increased capacity for 200 vehicles) in Chelyabinsk, Ryazan, Petrozavodsk, Ufa, Cheboksary, Volgograd and Penza at the turn of the 1990s[6]. As a result, 11 cities (in addition to Moscow and Saint Petersburg) operated 3-4 trolleybus depots. The number of storage spaces during the period has increased in Novosibirsk up to 430, Chelyabinsk up to 475. Particularly significant coverage with trolleybus lines by 2016 has been reached (and is maintained) in Cheboksary, Yoshkar-Ola, Sterlitamak, Murmansk, Vladimir, Bryansk, Kaluga, Ryazan, Ivanovo, Kirov, Saransk, Orenburg, Belgorod, Ufa, Tambov and in some other cities.

The expansion of trolleybus networks in Russian cities was supported by the continuing shortage of buses. In some cases the central streets were released from the tramway lines by the 2000s, and the electric assets were adapted for the trolleybus line. The largest amount of new trolleybus lines according to this principle has been introduced since 1991 in Ufa and Kazan, as well as in Lipetsk (Fig. 3.2).

[4] Hybrid types of rail and non-rail public transport (translohr, guided buses) have not been developed yet. In recent years several cities use trolleybuses with autonomous running in test mode (Tula, Armavir, Maykop, Barnaul, Novosibirsk).

[5] In 2008 this transport mode reached a development maximum of 4809,6 km (+ 440km to the 1990 level).

[6] Additional trolleybus parks of a high stage of readiness were finished in Kazan, Makhachkala, Vladimir, Tver, Novorossiysk, Lipetsk, Ulyanovsk (on Volga right bank), Yaroslavl and Grozny. Trolleybus lines were intensively constructed in Kamyshin, Stary Oskol, Cherepovets and Novocherkassk. All these projects have not been realized.

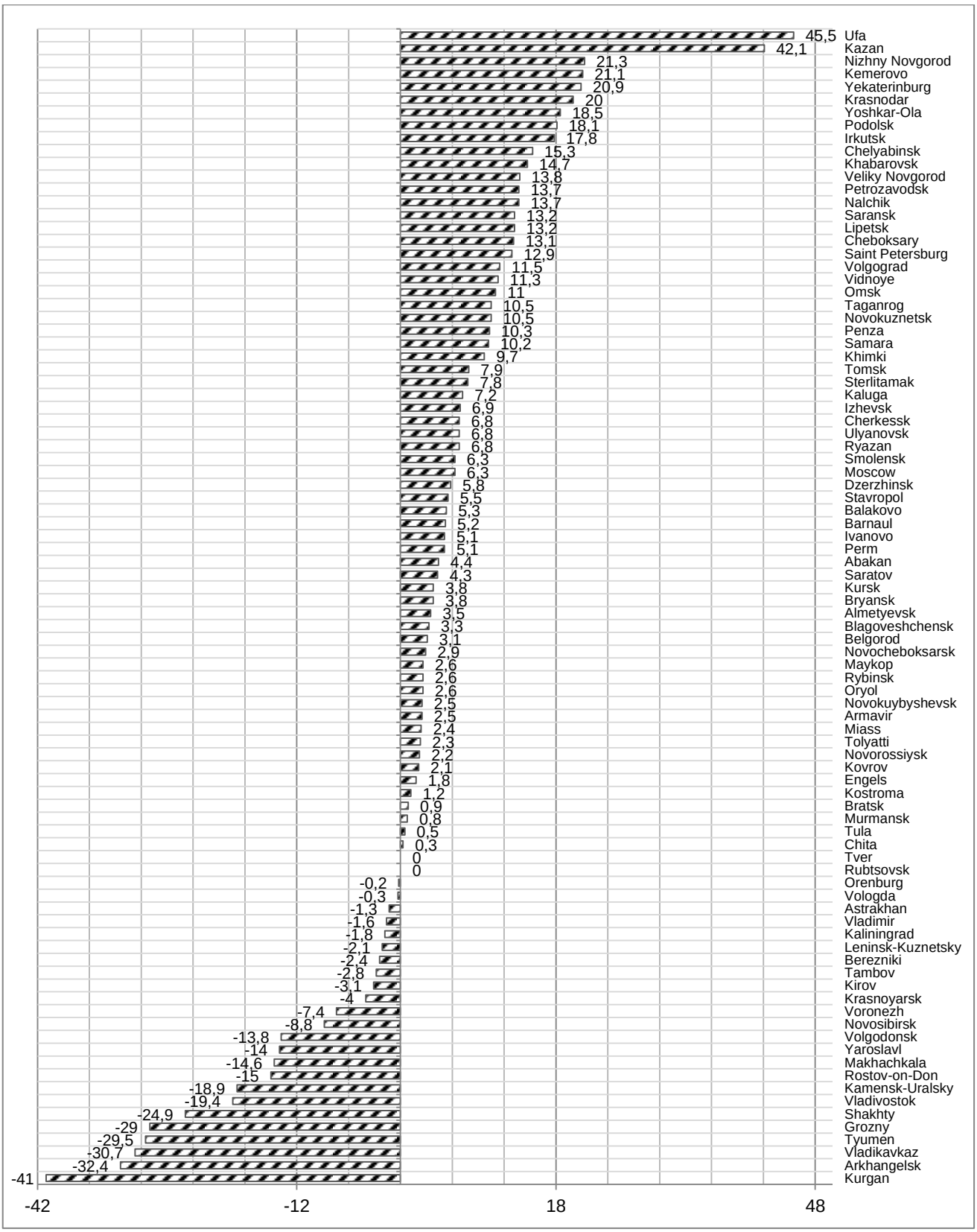

Fig. 3.2. Changes in trolleybus network length (km) between 1990 and 2014

However, the introduction of the new trolleybus routes in these cities had minimal if any positive effects due to tramways removal and increased traffic congestion. For example, in 2014 trolleybuses

transported no more than 190 thousand passengers per 1km of lines in Ufa, Kazan and Lipetsk (Fig. 4), that was 2 times less than in Novosibirsk, where some lines had been closed (about 9 km).

Voronezh implemented the most ambitious urban transport development program in 2008-2014 ((Voronezh City Duma, 2008) and (Duma, Voronezh City, 2012)), which included the restoration of the trolleybus network, but the effect of these investments was minor similar to the above mentioned cities. Trolleybuses continued to operate without priority lanes with minimal efficiency: only 122.6 thousand passengers were carried per 1 km of lines in 2014 (Fig. 4).

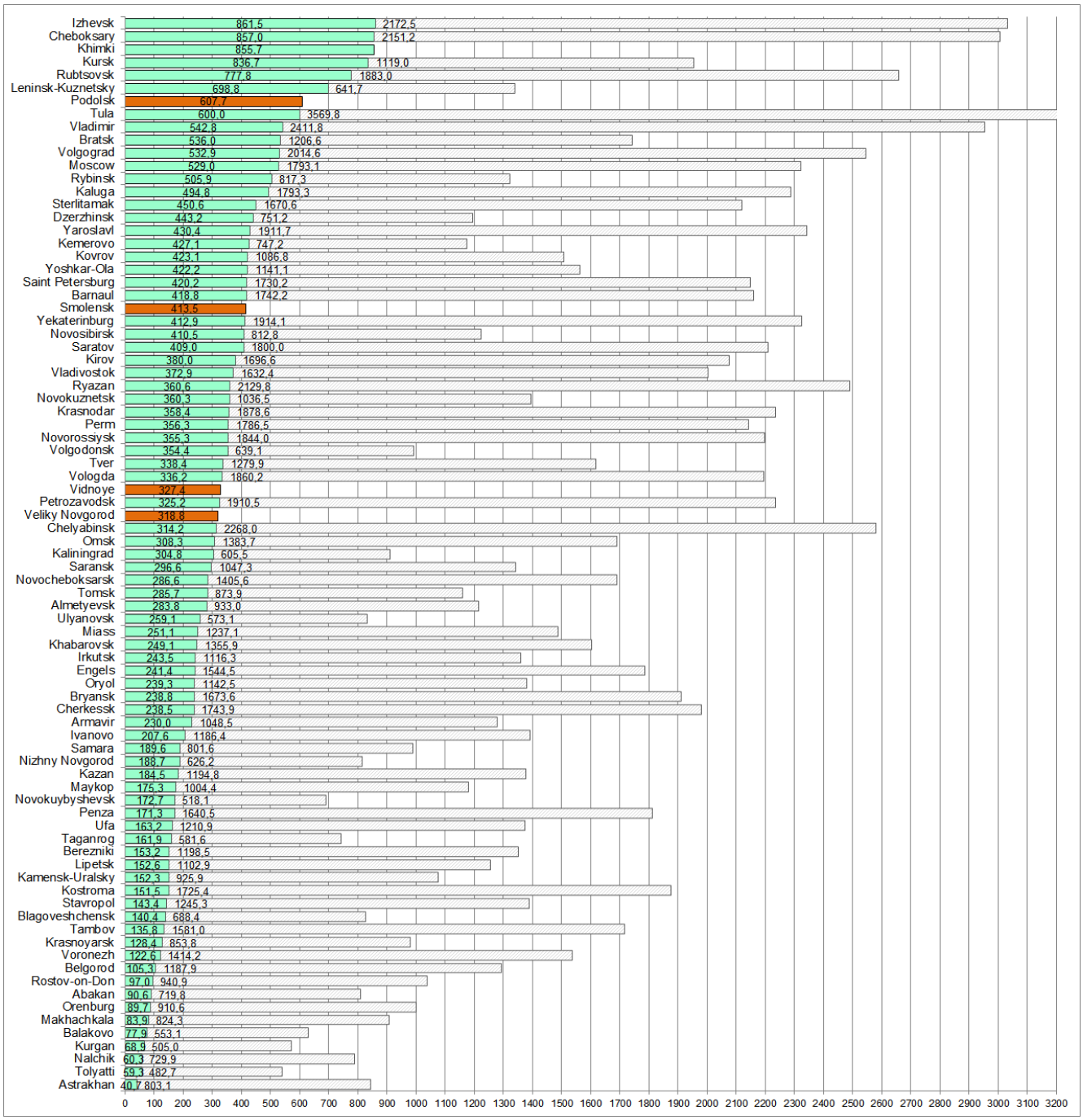

Fig. 4. Trolleybus ridership per 1 km of lines in 2014 (green) and in 1990 (gray), thousand passengers

Decreasing ridership and profitability problem is extremely acute for all trolleybus operators. Indicators of 1 million passengers per 1 km of lines per year in 2014 are continued to be recorded only in Chita. Izhevsk, Cheboksary and Murmansk also manage to maintain a relatively high ridership (Fig. 4). Some cities in order to reduce the trolleybuses losses on certain routes decided not to develop, but to eliminate them. Thus main trunk 20 km trolleybus route leading to the city center was closed in Vladivostok.

The greatest drop in ridership compared to 1990 has occurred in Astrakhan (by 94,9%), Nalchik (by 91,7%), Tambov (91,4%) and Voronezh (91,3%). Trolleybus ridership per 1 km of lines has fallen by 80% in 35 Russian cities between 1990 and 2014. The smallest decline has been recorded in Leninsk-Kuznetsky, Kursk and Rybinsk (1, 25 and 38%, respectively). Kursk experience is especially notable, where in 2014 the priority lane for trolleybuses was introduced in the city center in the opposite direction to the main traffic. As a result, trolleybus ridership in the city has decreased only by 0.7% in 2011-2014, while in neighboring cities without priority lanes more significant reduction has been observed: -49% in Bryansk, -40% in Oryol, -33% in Belgorod, -22% in Kaluga.

Generally the implementation of priority lanes in Russia is constrained by the high cost of administration of such lanes, namely the initial investment in automatic traffic control systems. Priority lanes for public transport have become widespread only in 4 cities[7] (2016): in Moscow, Kazan, and to a much lesser extent in Rostov-on-Don and Saint Petersburg. Only 116.7 km (two-lane) priority lanes has been introduced in the cities with population over 200 thousand inhabitants (except for Moscow and Kazan) by 2016 (Fig. 5.1 and Fig 3.1) and these practice is more in the nature of experiments, often with “risky political consequences”[8].

[7] Special guidelines for the organization of priority lanes for buses and trolleybuses (ROW-C) were released in Russia in 1983, but such lanes remained exotic, and even in Moscow were used only on 3 streets.

[8] In some cities under the pressure of car owners priority lanes have been eliminated shortly after the introduction (Yaroslavl, Voronezh) or are publicly discredited (Barnaul, Kirov, Khabarovsk).

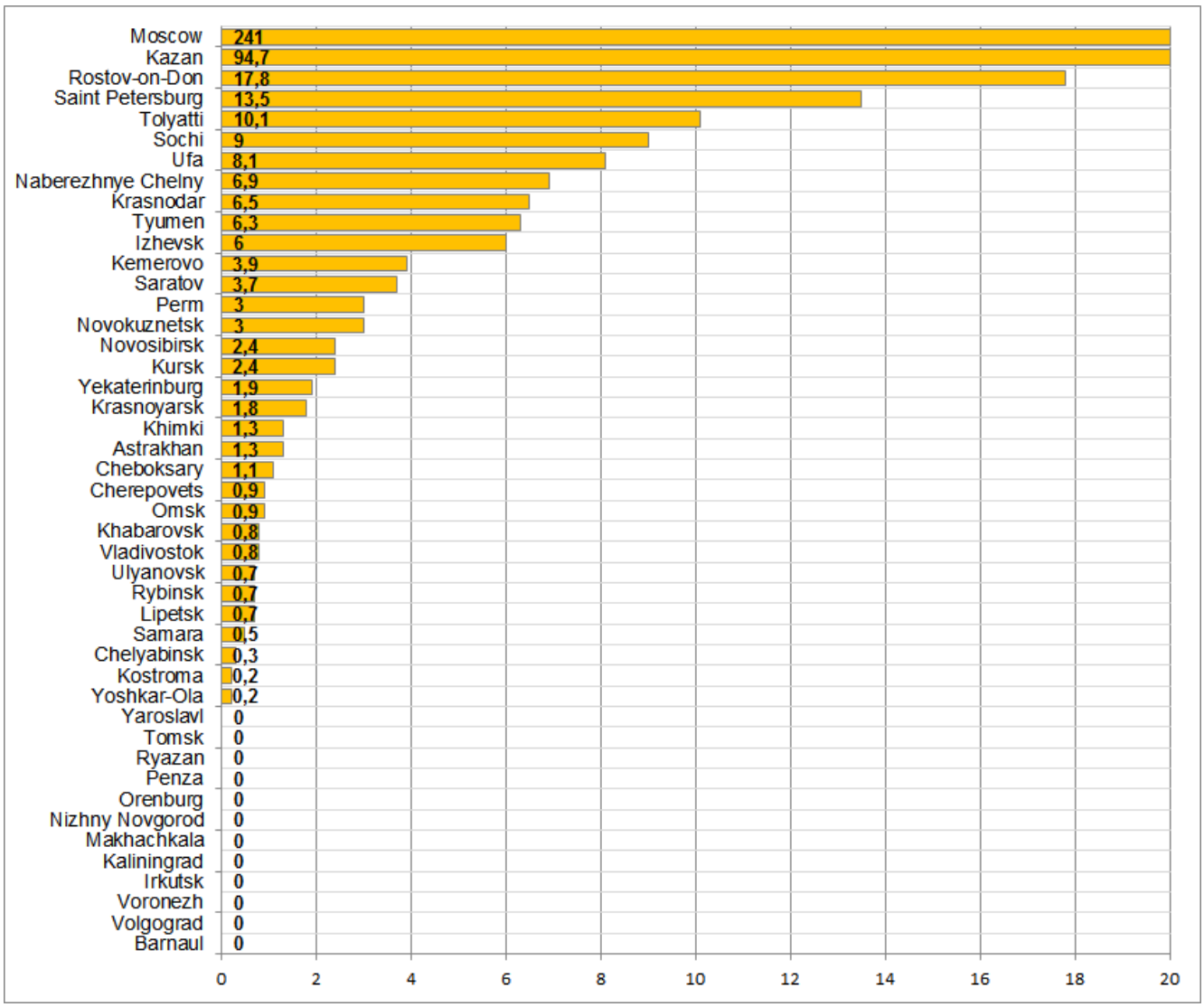

Fig. 5.1. The length of priority lanes (km) for non-rail public transport in major Russian cities, 2016, author' calculations

While Moscow and Kazan has created full networks of priority lanes, in other cities such lanes operate in the test mode and only in certain areas. In fact the whole Russian experience includes only several practices. Thus, Saint Petersburg, Novosibirsk, Krasnodar and Tyumen have tested priority lanes for several years, and preparations are made for their introduction on a greater number of streets. In Chelyabinsk, Izhevsk, Kemerovo, Rybinsk, Cherepovets, Kostroma, and in some other cities there are pilot projects on short road network sections (usually only one lane in one direction). In some cities, priority lanes are used on the central streets in the opposite direction to the main traffic for ease of administration (Kursk, Saratov, Rostov-on-Don, Saint Petersburg, Shadrinsk and Astrahan). On three streets in Rostov-on-Don and Tyumen the practice of exclusive public transport movement in both directions has been implemented. In Saint Petersburg on Ligovskiy Prospect there is the only in Russia pilot combined 2,2 km priority lane for buses and trams in the center of the roadway (Fig.5.2) In Ulyanovsk the same scheme is used for the only Russian 700 m priority lane over the bridge.

Largely for these reasons BRT systems (including those using trolleybuses) are not built and operated in Russia[9].

Fig. 5.2. Priority lane for buses and trams in the center of the roadway (Ligovskiy prospect).

Urban heavy rail and subways

For a long time railways in Russia served primarily industrial freight logistics and were used as urban heavy rail (UHR) very rarely in form of the innovations pushed ahead by advanced local engineers. On the one hand, road traffic situation allowed serving new urban areas by land public transport without significant problems. On the other hand, since the main function of the UHR was to ensure the evacuation of industrial enterprises and emergency mass transportation of the population to the suburban areas, the provision of urban public transport services didn't fit into this scheme.

As a result, the railway routes (with extremely rare exceptions) were not considered within the planning of new urban residential areas (Ulyanovsk, Tolyatti, Naberezhnye Chelny), in some cases passenger stations were not built at all (Novocheboksarsk, Almetyevsk). Krasnoyarsk, Omsk, Novosibirsk, Perm and Chelyabinsk, as well as their suburban areas do not have any "high" platform serving local transport connections.

Thus, the whole Russian experience of using UHR includes only two practices. The first is the usage of a special line to the industrial enterprise for transportation within the city, but such examples

[9] As of the 2015 the discussion of such routes at the level of urban initiatives is conducted only in Moscow and in Novosibirsk.

are rare: Volgograd, Zarinsk, Bratsk and Zheleznogorsk (Krasnoyarsk Krai), Grozny (liquidated), Solnechny (now a part of Krasnoyarsk) and Sayansk (Fig. 8.1). In other cases, suburban routes pass through UHR mainly eliminating at the central railway station. In some cities special transport hubs have been created (Nizhny Novgorod, Volgograd, Bratsk). Even in major nodes UHR with the characteristics most close to German S-Bahn's are used very inefficiently. In Moscow the share of heavy rail transport does not exceed 10%, primarily due to the lack of transport hubs development and the lack of connectivity between the rail lines (Zyuzin, et al., 2016). In Vladivostok in 2013 only 30.1 thousand passengers per 1 km of double-track electrified railway line were carried within the urban area[10] (1385.4 thousand passengers per year). Moscow is close to complete the largest in Russia project of rail infrastructure development to be used us urban public transport in 2016: preparations are made to launch the ring line with planned ridership of 5.5 million passengers per 1 km of track per year. In other cities, even with high potential for the UHR, its capacities are not used for urban transport.

For a long time subways were considered an alternative to rail transport in the major cities. All subways in Russia belong to the HRT category, i.e. to the networks of railway type. Their distinctive feature is the depth of lines and the consequent extreme high cost of new construction. In Moscow the construction cost of 1 km line ranges from 4 to 10 billion rubles (RBC Information, 2011) (129-333 million USD in 2011 prices), in Novosibirsk – 2.5 (2012). Due to the combination of this and other reasons the expansion of subways is carried out very slowly (Fig. 6), and most of them consist of one (Samara, Kazan, Yekaterinburg) or two lines (Novosibirsk, Nizhny Novgorod).

Directions of Russian subways development were generally set in the late 1980s. Since that time in most cities the completion of the previously created construction developments was carried out. The first stages of subway lines construction were completed by 1993; in richer Saint Petersburg Frunzenskiy-Primorskaya Line was being completed until 1998. Since 2000, 1 station was introduced every 3-5 years in cities outside Moscow and Saint Petersburg, except in Kazan, where subway construction was boosted during the celebration of the millennium of the city during 1997-2005 with of 50% of funds coming from the federal budget.

[10] Section between stations Vladivostok/Mys-Churkin and Artyom.

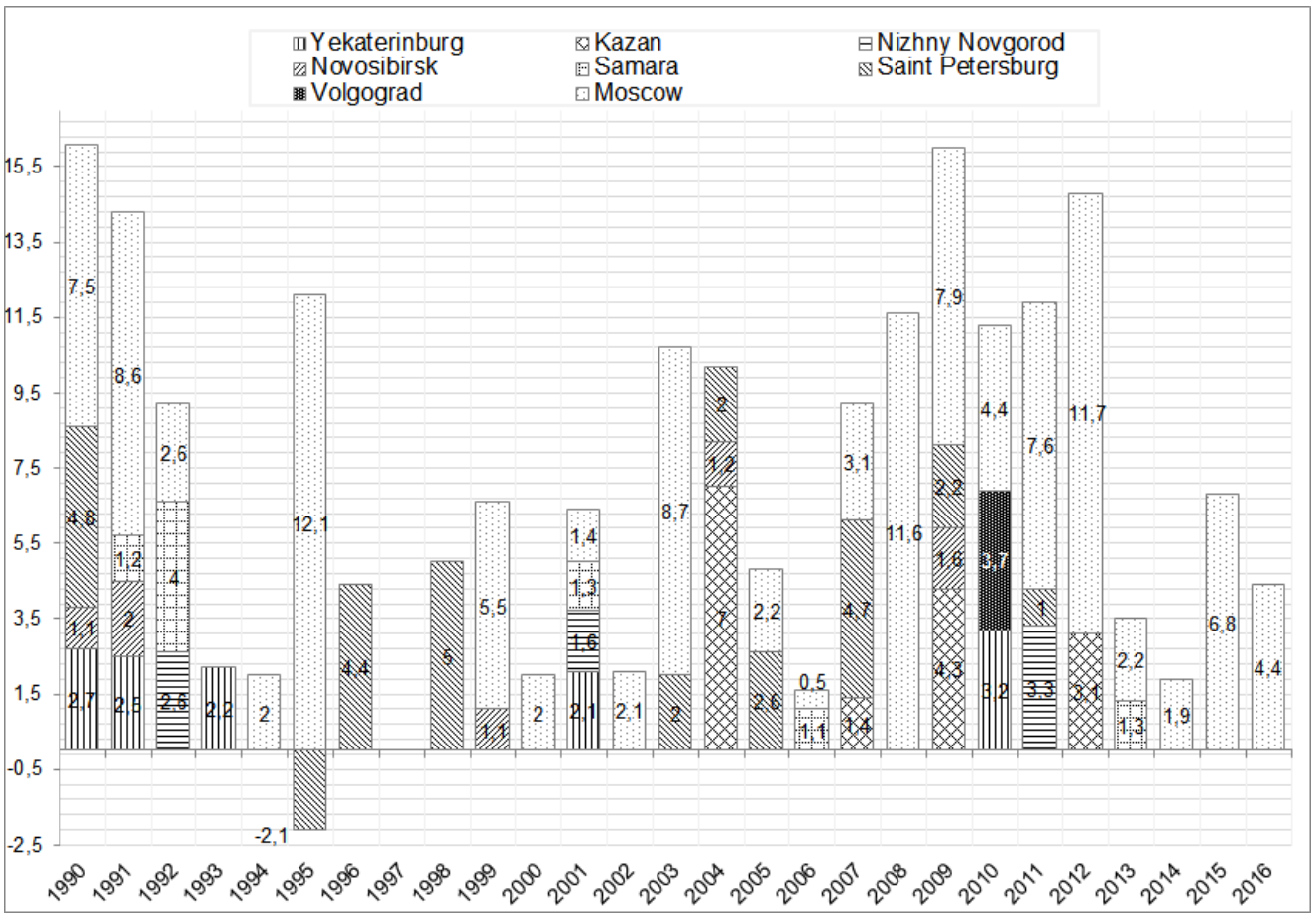

Fig 6. Construction rates of metro networks in Russia (km per year during 1990-2014).

The second stage of the completion of construction developments made before 1990 started after 2007: the main lines were completed (Yekaterinburg, Kazan, Novosibirsk); the powerful effect was observed in cities where subways were built from the outskirts to the city center (Nizhny Novgorod and Volgograd[11]). Thus, in Nizhny Novgorod subway ridership has increased by 24.8% after the construction of the station in the city center. In Samara the subway line hasn't been extended to the central part of the city. As a result, the cost of transportation of 1 passenger was 41.25 rubles (0.63 USD) (2014), making Samara subway the most inefficient subway system in Russia. In 2007, about 260 million rubles were spent to cover the operating costs, while the revenues amounted only to 80 million rubles. Coverage of losses of this enterprise in some years amounted to a quarter of all budget expenditures on urban transport in Samara, and its mode share does not exceed 9.6% (2014) ("Metro" The International Association, 2014). Largely because of this the modernization of the more popular tram infrastructure is not performed (Fursov, 2015). The results of the studies show that in Russian conditions the break-even point is achieved when subway ridership ranges from 6 to 8 million passengers per lines 1 km of lines (Yakushkin, 1982). These ridership values have been achieved only in Moscow and Saint Petersburg; Novosibirsk is close to achieve them (Fig. 7).

[11] In Volgograd has LRT line which has ROW-A category within the city center and goes through tunnels built according to the subway requirements (transformation into subway has been suggested).

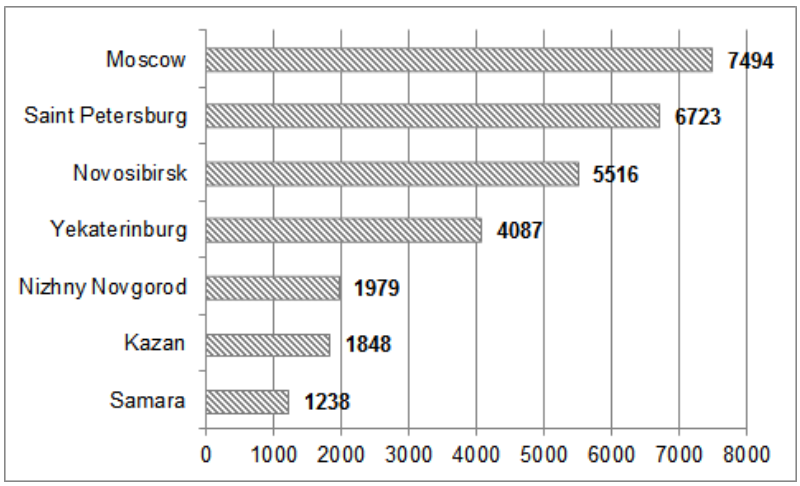

Fig. 7. Subway ridership in 2014 (thousands passengers per 1 km of lines)

In other cities ridership is much lower than the break-even point. It is not clear yet whether the break-even point can be achieved in Nizhny Novgorod, Samara, Kazan and Yekaterinburg, since subways in some of them are focused to a greater extent than others on servicing large industrial enterprises. The mode share of subway in the total amount of passengers carried amounts for 9; 9.6; 12.5% and 24% respectively (2014).

Thus, the previously used model of subway construction with a focus on HRT networks has exhausted itself in Russia outside the capitals[12] and the demand is formed for the less resource demanding hybrid systems: LRT on physically separated tracks, priority lanes for buses and trolleybuses. Such a program is being implemented since 2008 in Kazan along with the completion of the only subway line.

Tram operators

In 1991 — 2015 531 km of tram lines (17.8%) has been eliminated in Russia. In 8 cities it has led to the termination of tram transport, while in some cases such actions are forced optimization (fig 8.1).

[12] Russia also has a small pilot monorail line operating since 2005 in Moscow, which brings annual losses of several hundred million rubles. This form of transport has not been further developed and its liquidation has been announced.

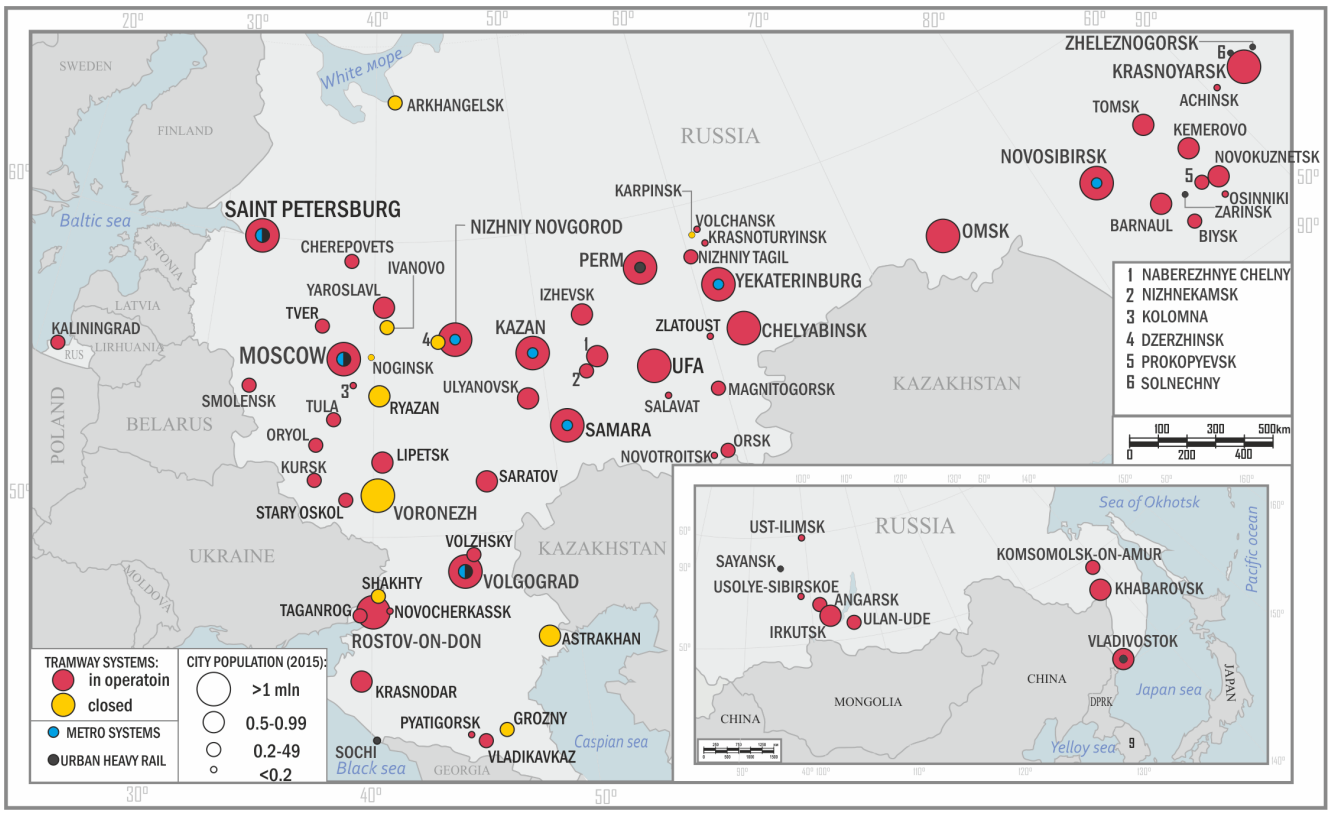

Fig. 8.1. Cities with tram, metro and heavy rail transit systems in Russia

Thus in some cases, tram operators were owned by local industrial enterprises and provided transport services specifically between factories and subordinated surrounding urban areas. After the transfer of tram transport to the municipalities the operations in these cities stopped, but such cases are rare (Ryazan, Karpinsk). In other cases, it comes to the worst practices, including the liquidation of the tram operator either due to the high value of certain property assets, primarily land parcels (Voronezh, Arkhangelsk), or to release road network under the conditions of growing motorization rate (Astrakhan, Ivanovo). To do this, municipal operators were deliberately not funded (Dzershinsk) which led to the termination of operation being conditioned by security requirements (Shakhty, Karpinsk). Some cities in 2000s started campaigns to eliminate tram lines and to release road networks for private vehicles. The cities that have especially succeeded in this are Kaliningrad (76.4% of the tram network has been eliminated), Tver (72.9%), Vladivostok (69.6%), Rostov-on-Don (43%), Ufa (40%), Lipetsk (37%), Yaroslavl (33%) and Smolensk (29%). All these cities have removed lines on the main streets in the city center first of all. In some cities, the reduction of the tram networks was realized at the expense of low-demand sections in industrial zones without reducing the coverage of residential areas. Thus in Angarsk in spite of the elimination of 31% of the tram network in total, the lines has been closed only within the industrial areas. The tram networks have been similarly optimized in Usolye-Sibirskoye, Perm, Osinniki, Salavat and in some other cities. In some cities the percentage of removals of the total network length hasn't exceed 5%, but the liquidated lines had a key

role in the network topology, which significantly worsened it. Thus, in Kursk in 1991 only 3.9% of the network was eliminated (the single 1,6km line was closed in the city center). This led to the disintegration of the cyclic framework (Tarkhov, 2002) and reduction of the tram ridership by 67% the year latter. Closings with the formation of topological defects occurred in Smolensk, Saint Petersburg, Novosibirsk, and in 10 more cities, in 4 of them the operation was subsequently stopped completely.

In 2015 some tram operators in Russia continue to exploit the remaining lines laid on specific and sometimes unneeded transport directions, but as a whole Russian tram transport has the highest share of priority and physically separated lanes (Fig. 8).

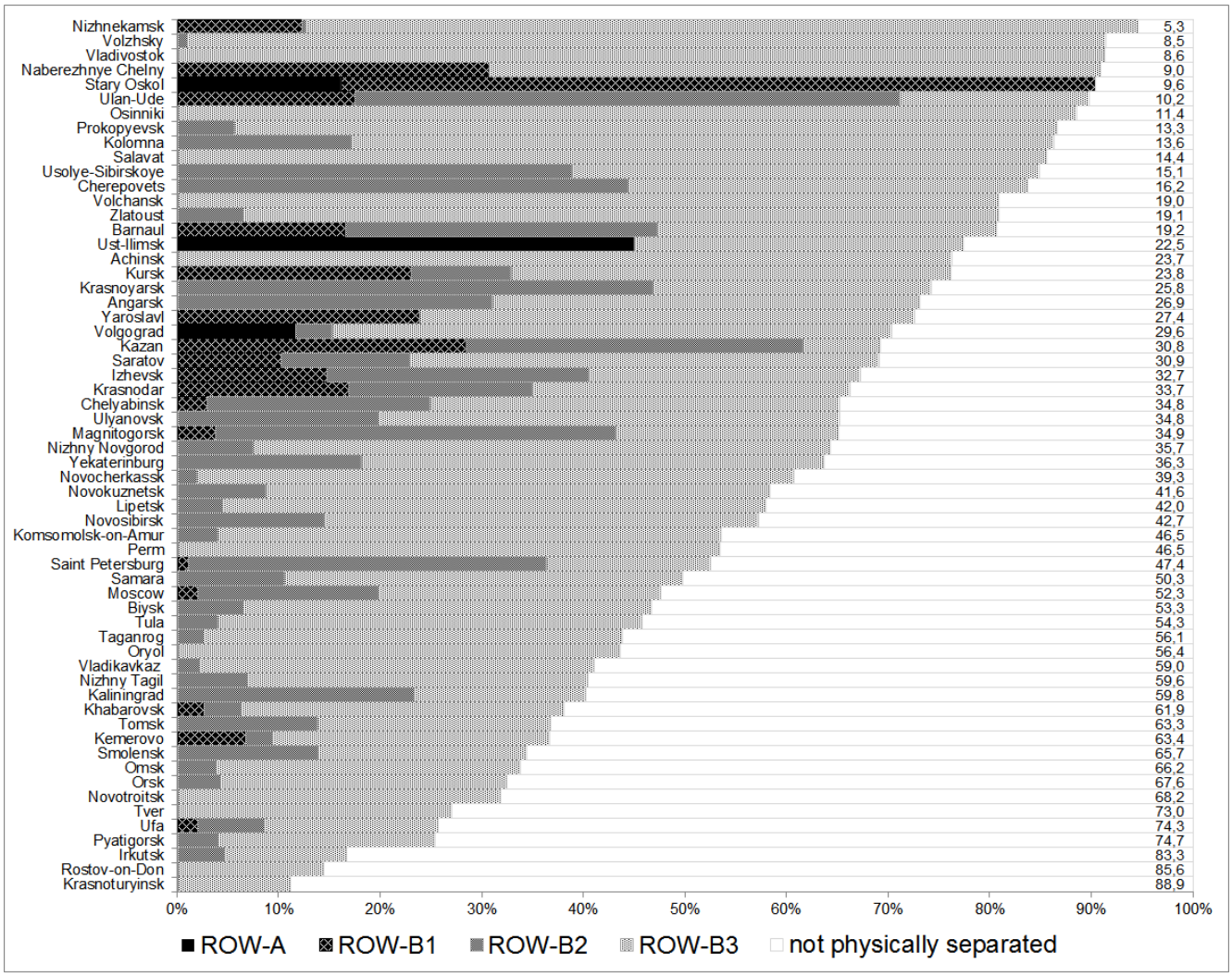

Fig. 8. The share of priority lanes for trams of ROW-A and ROW-B categories in Russian cities (%)

With the increase in congestion this advantage has in some cases contributed to the cancellation of plans for the total elimination of tram operators (Lipetsk, Vladivostok, Omsk, Saint Petersburg, Moscow, Tver, Kazan, Novocherkassk, Rostov-on-Don). However, only a few cities have reconstructed tramway lines and increased the percentage of separated sections in total length. The share of separated sections (ROW) (Vuchic, 2011) of all types (A and B1-3) ((Zyuzin, 2016) and

Annex A)) is currently the largest (over 90% of the total network length) in the networks of tram operators of some "late Soviet" industrial centers: Nizhnekamsk, Volzhsky, Naberezhnye Chelny, Stary Oskol, that in some cases (Volzhsky) still has no effect because of insufficient service of residential areas (Fig. 9). Despite the fact that in three Russian cities (Volgograd, Stary Oskol and Ust-Ilimsk) there are modern light rail lines, in two of them the potential of trams in urban transport is not fully used. 80% of the modern tram lines go outside the residential areas in Stary Oskol, and 78,4% in — Ust-Ilimsk. For this reason, only 62.8 thousand passengers are transported per 1 km of lines in Ust-Ilimsk, and 253 thousand passengers — in Stary Oskol[13]. In some cities tram lines have been reconstructed and the share of separated sections (B1-3) has been increased: in particular, in Ulan-Ude, Kazan, Kolomna, Zlatoust, Barnaul, Kursk, Izhevsk and Saratov. In some metropolitan areas separated tram lines are laid on specific routes outside roads between distant residential cores, thereby increasing the autonomy from the traffic flows: Novokuznetsk, Prokopyevsk, Volchansk. In some cities only separated tram lines serving the most popular routes has been preserved from once more extensive network after the optimization. Such optimization has been held in Yaroslavl, Moscow, and Saint Petersburg. Despite the fact that by 2014 the tram ridership in Russia fell to 20.2% of 1991 volume, in some cities it is maintained at a high level. For example, in Kemerovo tram ridership comprises 83.2% of 1990 value (Fig. 9), but in other cities it is much lower.

[13] This is due to the orientation of tram transport in these cities to the needs of industrial enterprises.

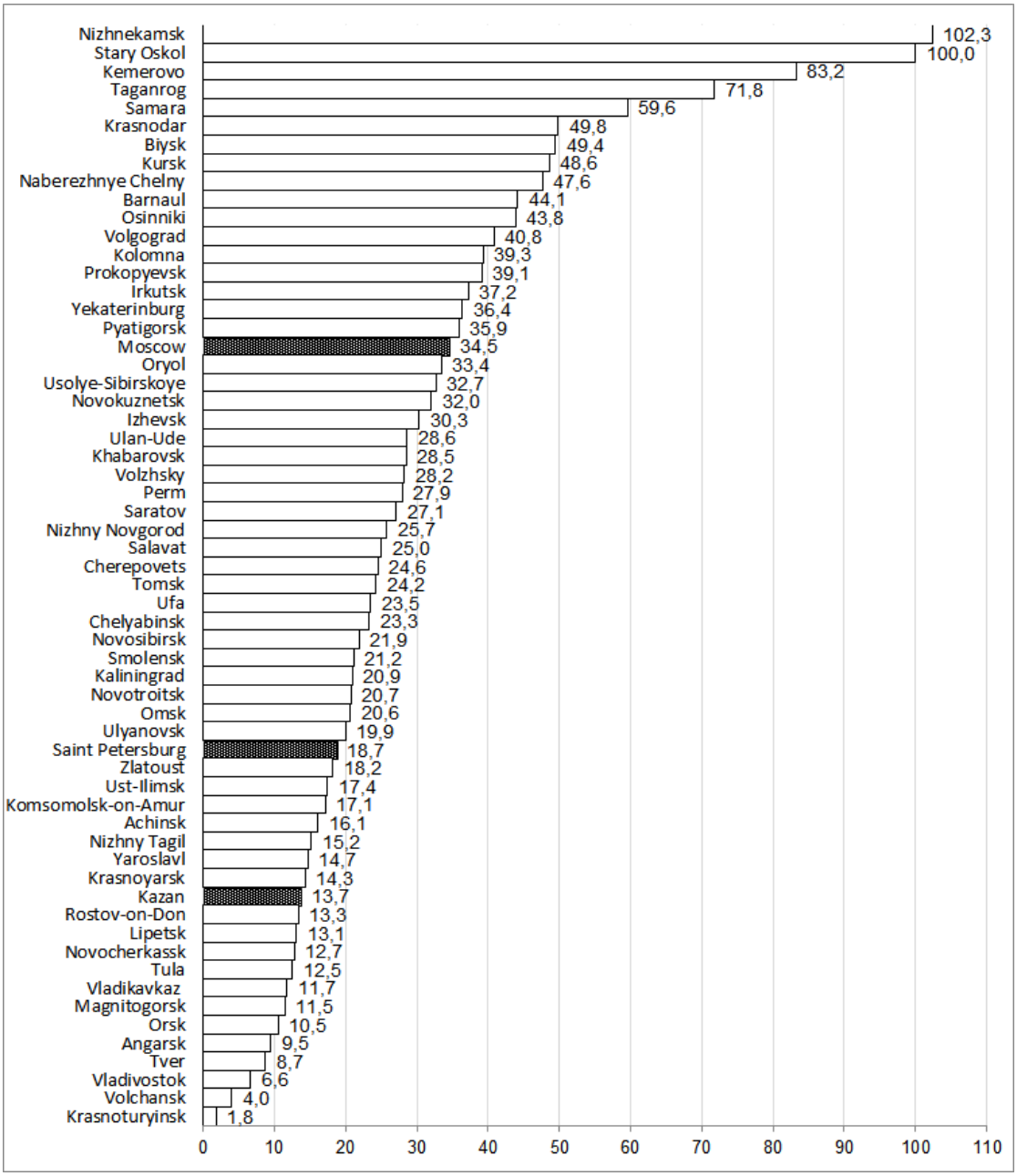

Fig. 9. Tram ridership in 2014 (in % compared to 1990)

Despite a significant decrease in total passenger volumes compared with 1990 in most cities, it can be explained by the previously observed ultrahigh overcrowding of the tram lines. Thus in 2014, despite the significant outflow, 7 tram operators still carry more than 1 million passengers per year per 1 km of lines, 20 — more than 500 thousand passengers per year per 1 km of lines (Fig. 10).

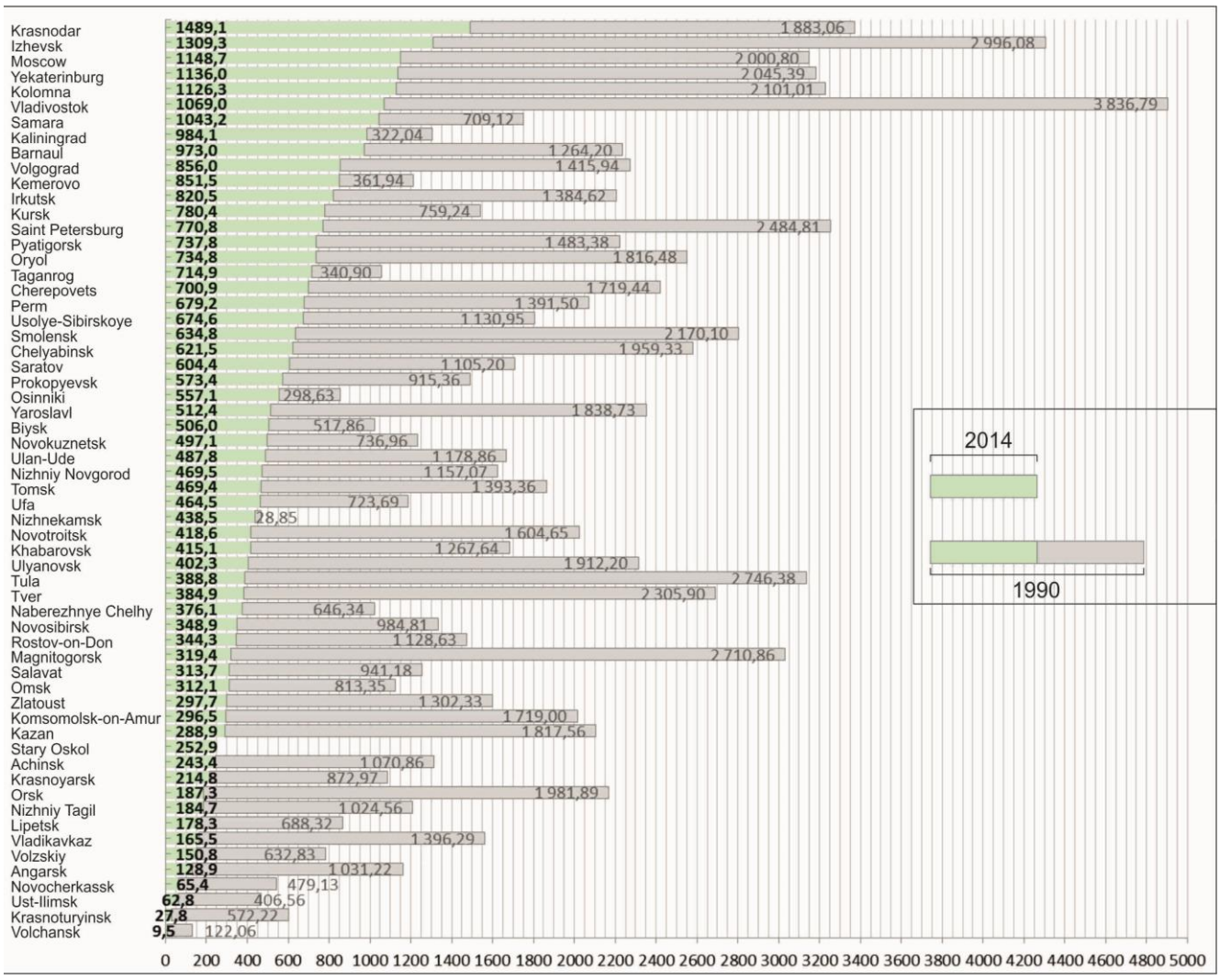

Fig. 10. Tramway ridership per 1 km of lines per year in 2014 and in 1990 (million passengers)

In some cities, tram operators have a certain resource for increasing ridership in terms of infrastructure; however, the significant problem is the disposal of the rolling stock. Totally, since 1990, 50% of tram cars were excluded from service (6594 cars). Only 7380 trams out of the remaining 8168 are operated, and the rest are not used in operation (Zyuzin & Shpakov, 2016). Thus, in Tver, Vladikavkaz, Rostov-on-Don and Lipetsk there is less than 1.6 car per 1 km of tram lines, while in 7 strongest tram enterprises in the country this figure exceeds 4,5: Yekaterinburg, Izhevsk, Samara, Volgograd, Oryol , Izhevsk, and Moscow. In a number of cities the volume of the rolling stock has declined significantly relative to the servicing possibilities, despite the implementation of the program of renovation of the rolling stock with the federal co-financing under the scheme 80/20. As a result, in some cities there was a surplus of servicing capacity: in Rostov-on-Don, Kaliningrad and Vladivostok existing fleet of cars is less than 25% of the nominal capacity of the depot (Fig. 11). In Cherepovets and Izhevsk on the contrary, the existing depots lacks the capacity for high-quality rolling stock servicing. Despite the fact that 32 depots and 3219 plots for tram cars has been eliminated in Russia since 1990, only a minor part of the cities has eliminated new depots built in 1980s (Saratov and Orsk).

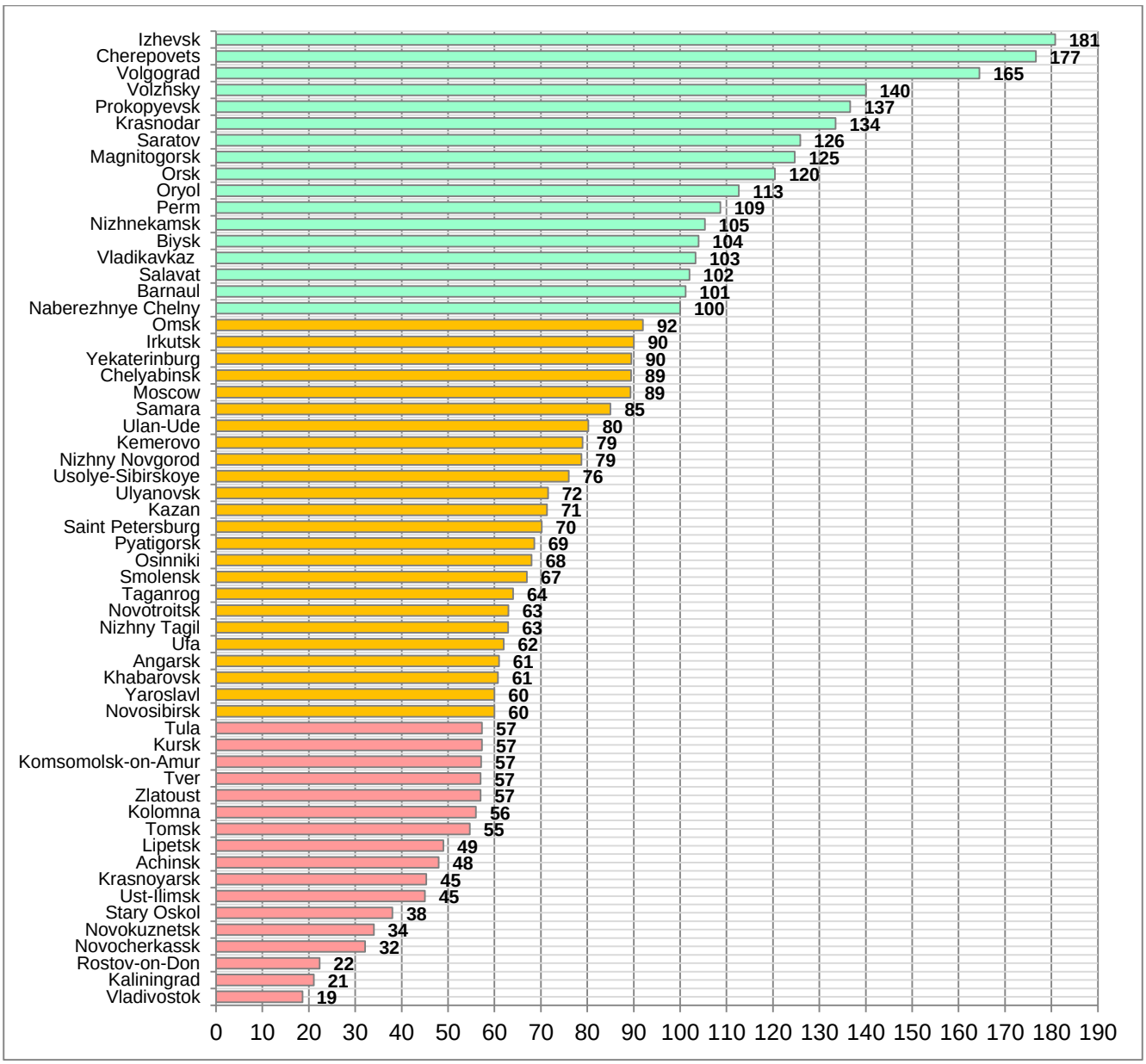

Fig. 11. The volume of rolling stock per depot (in % to the capacity as of 2016)

In large Russian cities tram operators which operate networks with high shares of ROW-A and ROW-B sections are still promising for investment and reconstruction, most of them are presented in top of the list in fig. 8 and 9. In such large cities as Rostov-on-Don, Irkutsk, Ufa, Omsk, Tver and Tomsk tram networks will require almost complete renovation and reconstruction and expansion of the network to the areas with the highest transport demand.

Private bus sector: challenges and perspectives

Privately owned companies emerged at Russian bus and minibus markets after reforms in Russian economy in the beginning of 1990s. Their development was also largely stimulated by the deterioration of traditional former Soviet Union companies that stopped to receive subsidies from the central funds. That meant that local authorities needed to find new and less expensive way to provide

public transportation services to people. That is why during 1990s and 2000s private companies experienced an enormous growth. In 2000 private companies were involved in providing bus services in 307 out of 1290 cities of Russia (Rodionov A., 2000, p. 5). In 2015 private companies provided bus services almost in every municipality. As a result traditional bus enterprises lost their monopoly status.

Nowadays bus markets of big Russian cities are based on 2 types of players. Usually there are a big publicly owned operator and about 20 - 30 small private companies. Public company usually serve around 30 - 40 routes while every private company serve 2 or 3 routes. Some exceptions, however, occur. For example, in Perm all bus services are provided by many private companies while the in-house operator was eliminated during 2005 - 2009 years. The opposite situation is observed in Moscow and Kazan, where the share of private companies is relatively low (Table 3).

Tab. 3. General information about bus markets of 15 largest cities of Russia

City	Population (01.01.2016) *1000	Number of operators		Number of routes	
		Public	Private	Public	Private
Moscow	12 325	1	61	660	506
Saint Petersburg	5 222	1	16	198	543
Novosibirsk	1 584	3	65	23	103
Ekaterinburg	1 444	1	29	29	60
Nizhny Novgorod	1 272	1	39	59	60
Kazan	1 217	2	8	40	24
Chelyabinsk	1 197	1	27	32	50
Omsk	1 180	4	96	47	133
Samara	1 171	1	18	28	69
Rostov-on-Don	1 118	1	11	41	89
Ufa	1 115	1	13	31	75
Krasnoyarsk	1 069	3	65	26	73
Perm	1 036	-	46	-	71
Voronezh	1 033	1	15	15	123
Volgograd	1 018	1	67	36	184

During 1990s and 2000s the public transport regulatory system was fragmented in Russia. There was no comprehensive federal legislation on procurement of public transportation services and on regulation of private sector involvement to bus markets. That is why at this period privately owned operators were involved under local legal acts. These acts were mostly oriented on minimizing the amount of public transport financing from local funds. It resulted in considerable reduction of quality of public transport services in Russia.

At the moment the quality of bus services greatly depends on the operator's ownership. Public operators mostly use conventional buses and reduce fares for some groups of passengers. Private operators, in contrast, provide less convenient paratransit-type services. These services are poorly planned and are less safe for passengers. Drivers mostly use poorly maintained minibuses and do not accept concessionary fares. They do not follow the timetable and compete with each other for waiting passengers at bus stops. Generally, privately owned bus operators have a weak image from passengers perspective. Nevertheless, there are some exceptions in several cities. For example, in Perm private companies provide traditional public transport services with conventional buses, fixed timetables and regulated fares. In Ekaterinburg both private and public operators accept EKARTA smartcard. The most drastic changes occurred in Moscow where private companies were forced to provide services under gross cost route-based contracts with extensive service quality requirements.

The right to provide public transportation services in Russian cities is tendered by local authorities in a specific way. Operators are competing to get the franchise to operate on a particular route (or a bundle of 2 or 3 routes) and to collect fares on it. In most cases the duration of contracts is 5 years. In some cities both private and public operators are involved to tendering process on equal terms. In others (eg, Moscow) public operators does not participate in tenders as they have a privileged right to operate on their route bundle. Another important feature is that in most cities (except Moscow) contract texts do not include any financial obligations of local authorities. However, most cities are granting ex-post deficit subsidies. The problem is that deficit financing does not allow authorities to plan exactly the required amount of public expenditures beforehand. The planned sums of public expenditures do not usually meet the estimations of operators. As a result, subsidies play a minor role in financing of bus and minibus operators compared to farebox revenues. Subsidies, in fact, do not incentivize operators, particularly privately owned, to eliminate competition "in the market" or to improve their services in other way.

The winners of tenders are determined by a list of quality parameters. These parameters are usually related to the operator's buses, assets and reputation. Thus, tenders do not simply determine the winner but also largely determine the quality of services that will be provided on the route during contract execution. Quality parameters are used in the tender documentation in two ways:

- As minimum (obligatory) quality requirements to bidders;
- As criteria for bids evaluation.

For example, the minimum requirement may be the availability of 10 minibuses, and the criterion may be the age of this buses. The participant who meets all the minimum requirements and who received the highest number of points for the criteria within a special grading system will become the winner of tender. The grading systems of Russian cities vary greatly (fig. 12). Some cities have a "strict" grading system (the left side of the chart). In these cities (eg, in Moscow) operators must fulfill

a long list of obligatory requirements (eg., vehicles type, color, floor level, emission standard) before their bid will be evaluated by a very limited number of criteria. Other cities have a “flexible” grading system (the right side of the chart) with a few obligatory requirements and, in contrast, a numerous criteria for bids evaluation. Authorities who organize tenders in these cities (eg, in Ufa, Chelyabinsk, Krasnoyarsk etc.), in fact, does not set any significant target requirements to the quality of public transport system.

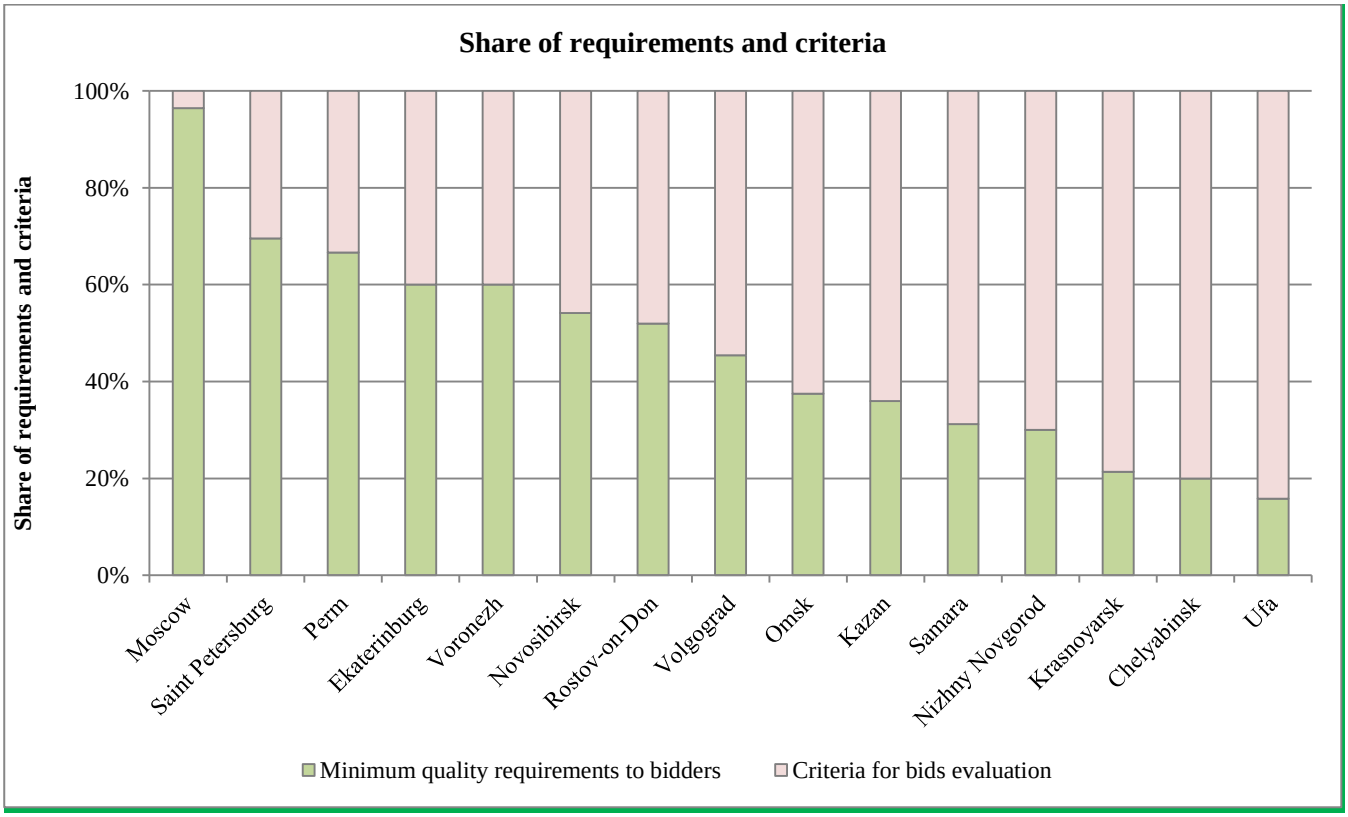

Fig. 12. Share of requirements and criteria

One of the most important factor to make public transport attractive to people is to provide a standardized and high quality services. That is why in many cities with developed public transport systems operators use only one or two models of buses (trolleybuses, trams) which are painted in unified color, have the same equipment and are maintained similarly. If the public transport network is served by many private operators it can be achieved using extensive list of obligatory requirements to operators and using a single criterion of winner determination - a tender price.

In Russia these principles are followed only in Moscow under the framework of the so-called "new model of partnership with private operators" reform. Within this reform Moscow authorities determined comprehensive obligatory requirements to operators (27 requirements representing buses type, equipment etc.) and only tender price criterion to determine the winner.

The opposite situation is observed in other cities of Russia. Authorities mostly do not require operators to use modern and customer-oriented buses, for instance, low-floor buses, buses with modern

emission standards, buses equipped with air conditioning etc. Authorities prefer to use "flexible" grading system without strict requirements. The number of criteria prevails over obligatory requirements in many cities (Fig. 12). For example, administration of Ufa determined 3 requirements (quantity of buses, their capacity and their maximum age) and 16 criteria. This policy results in the use of completely different, poorly maintained and poorly safe buses on different routes.

In most Russian cities the winners of tenders are determined by a list of quality parameters that usually represent:

- Buses quality (age, equipment, emission standard, floor level);
- Route capacity (buses capacity and quantity);
- Operator's assets, reputation and other criteria.

The value of each criterion is determined by a number of points that may be earned for achieving certain indicators. For example, operator will receive more points under the criterion of buses age for using brand new buses. The grading system usually provide that if the operator's buses were produced 2 years before the start of contract execution he will get, for example, 5 points, if from 2 to 4 years before – 4 points, from 4 to 6 years – 3 points and so on.

The calculation of the maximum number of points that a participant may receive at tenders in different cities is presented in table 4. Table shows that cities have unique grading systems. Which one of them is better or worse is a question for further discussion. But from the passengers perspective the optimal criteria should probably be those which have a direct impact to the quality of services. This aim can be achieved by using criteria incentivizing operators to use brand new low-floor buses with modern equipment and eco-friendly engines. These criteria, however, have a high value not in all cities. They are intensively used in Perm (100% of all points on tender) and Nizhny Novgorod (77% of all points).

In other cases, on the contrary, the most valuable criteria represent the route capacity (Omsk, Volgograd) or the assets and the reputation of operator (Ufa, Novosibirsk, Kazan, Rostov-on-Don). For example, in many cities operators receive points representing the number of years of experience on the market. This criterion neither improves the public transport service quality nor helps to invite new operators to the markets. It gives privileged position to in-house operators that mostly have extensive assets and work on the market for decades.

Krasnoyarsk is a special case. Local regulatory act (Krasnoyarsk Administration, 2006) only sets a list of criteria that a commission of local authorities must consider during bids evaluation but does not set a grading system with a value of each criterion. This system is the most unreliable of all mentioned above.

Tab. 4. Value of criteria for bids evaluation

City	Tender price	Buses age, equipment, emission standard and floor level	Buses capacity and quantity	Operators assets, reputation and other
Moscow	100%	0%	0%	0%
Perm	0%	100%	0%	0%
Nizhny Novgorod	0%	77%	10%	13%
Voronezh	0%	52%	25%	22%
Chelyabinsk	0%	52%	13%	35%
Saint Petersburg	0%	47%	0%	53%
Ekaterinburg	0%	46%	54%	0%
Samara	0%	40%	25%	35%
Rostov-on-Don	0%	35%	0%	65%
Volgograd	0%	27%	52%	21%
Kazan	0%	23%	5%	72%
Novosibirsk	0%	18%	0%	82%
Omsk	0%	16%	73%	11%
Ufa	0%	14%	0%	86%
Krasnoyarsk	-	-	-	-

Compared to other Russian cities, Moscow experience looks innovative. The government of Moscow reformed the public transport services procurement system. In 2015 Moscow authorities forced private companies to work under 5-year gross cost route-based contracts according to the so-called "new model of partnership with private operators". Private companies are financed through the lump-sums defined in the contract while the farebox revenues are transferred to Moscow budget (Moscow Government, 2014). Thus, the Moscow Government fully integrates private operators in the transport system. The quality of services provided by private operators became similar to Moscow in-house operator MOSGORTRANS. Private operators use brand new buses and minibuses painted in a blue color scheme of Moscow land passenger transport (Fig. 13). They accept smartcards and provide services for concessionary passengers. During the execution of the contracts operators are also incentivized to follow the timetables under the threat of penalties from the department of transportation.

The active stage of reform was performed during 2015 and 2016 years. In 2015 the Moscow government performed 58 tenders to serve 211 routes. Buses and minibuses started to provide services in spring and summer of 2016. The remaining routes that are served by private companies under the old rules will be gradually cancelled or included in the "new model" tendering list.

Fig. 13. Minibuses of private operators working under “new model” in Moscow (Syomkin, 2015)

Private sector plays a significant role in Russian transportation systems. In many cities private operators had surpassed traditional publicly-owned companies by a number of quantitative indicators (number of routes, routes capacity, coverage of urbanized area). At the same time, the emergence of private sector set new challenges and issues to authorities. After 25 years of Russian market reforms these issues were not solved. In most cities private operators still provide paratransit-type services. The only exception is observed in Moscow with its successful reform. Hopefully, Moscow experience will become the foundation for institutional reforms of public transport in other Russian cities in the nearest future.

Discussion and conclusion

In recent decades, urban passenger transport in Russia has undergone significant changes after the transformation of the economic and political systems, and has lost the status of a monopolist in the market of transport services. In smaller towns, it had completely lost any significant role in urban transport systems. The main reason for this is the acquisition of larger civil freedoms in Russia, in particular the freedom of movement. This factor, stimulated by the availability of private cars, has expressed itself in the growth of Russian motorization rate up to a level comparable with the developed countries. These fundamental changes have had some painful consequences for urban transport systems. Movement of the population to private vehicles because of the public transport overcrowding has soon led to an excessive reduction in demand for the latter and the emergence of the opposite

extremes. The systems of land electric transport (trams and trolleybus) have been affected worst, because they were not able to respond flexibly to changes in transport demand. The problems of land electric transport were aggravated by the inconsistent municipal and state policy: electric transport has been overloaded with social commitments and has been losing competition with the new bus operators, breaking into the market. In the course of this process many land electric transport routes and networks have been closed along with the overall quality of service decline as a result of aging infrastructure and rolling stock. In addition, the increased individual mobility has had a very negative impact on the traffic conditions for both private and public transport in big cities. This has created a lot of new challenges for authorities. Public transport is still not competitive in comparison with the private cars. Public transport often doesn't have physical priority (priority lanes and separated tracks) on key routes, and its consumer qualities are absolutely not comparable to those of private cars. The elimination of these defects is impossible without addressing the planning of routes and infrastructure, issues of sustainable funding and regulation, questions about the role of authorities, public and private operators. Authorities to date have not yet determined the basic role of public transport in Russia under the new conditions. It is most likely that in future this role will be in a safe and comfortable service provision on the busiest routes, mainly linking high-density residential areas with city centers. To fulfill this goal, public transportation should go through further transformation, however, no longer under the pressure of external circumstances, but due to the purposeful transport policy of the urban authorities.

Annex A: Types of priority lanes for trams of ROW-B categories in Russian cities

ROW-B1. Kazan, Prospekt Pobedy

ROW-B2. Kolomna, Deviche Pole str.

ROW-B3. Oryol, Komsomolskaya str.

ROW-C. Kaliningrad, Oktyabrskaya str.

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