

THE SIMULATION OF RUSSIAN MINING EXCAVATOR MARKET UP TO 2030"

Dr. K. Anistratov

General Director NTC "Gornoe Delo" Ltd.

115054 Dubininskaya str., 71, bld.9, Moscow, Russia

Phone/fax: +7 (494) 504-08-01

Email: Anistratov_k@mail.ru

ABSTRACT

Key words: *surface mining, rope shovels, hydraulic excavators, loading and haulage.*

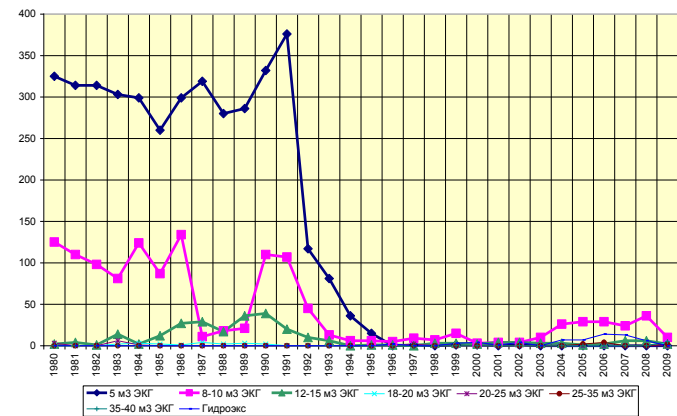
Paper deals with the results of the computer simulation of Russian market demands of mining excavators up to 2030.

The evaluation of the market has been made on the base on the analysis:

1. The world tendencies in the design of mining equipment and development of market demands of excavators and trucks.
2. Production and import of mining excavators (rope and hydraulic) during last 30 years.
3. The population of the surface mining equipment of Russian mines.
4. The prognosis of the total volumes of the extraction of the solid minerals and overburden of the all the branches of Russian mining industry up to 2030 in a glance of the tendencies of the development Russian heavy, manufacturing , processing industries.

1. DEVELOPMENT TRENDS OF OPEN-PIT EXCAVATORS IN MINING ENTERPRISES OF RUSSIA AND CIS-COUNTRIES

According to the returns of domestic open-pit excavator manufacturers and reports on imports, for the period from 1980 to 2009 mining enterprises of the former Soviet Union received 5388 single-bucket electric excavators with the bucket capacity from 4.6 to 42 m³ and for the period from 2000 to 2009 the volume of deliveries was 106 hydraulic shoveling machines with the shovel capacity more than 6 m³ (Fig. 1). By now 70% of excavators in the mining industry of Russia have the above-level service life.



ЭКГ - single-bucket crawler electric excavators
Гидроэкс – hydraulic excavators

Figure 1. Dragline excavator production and supplies of import hydraulic shoveling machines in the Russian Federation during the period 1980-2009

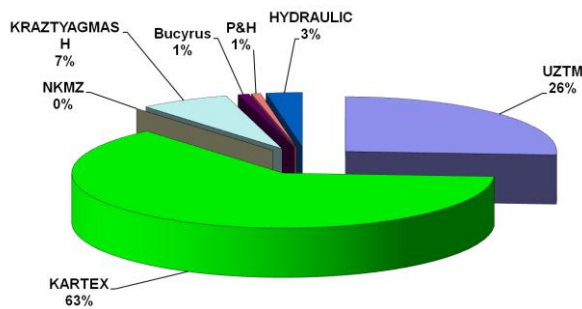


Figure 2. Breakdown of the open-pit excavator fleet by main manufacturers (as of 2009)

The analysis of the open-pit excavator fleet being operated in the mining enterprises of Russia and the largest mining CIS countries (Ukraine, Kazakhstan and Uzbekistan) shows that single-bucket crawler

excavators with electro-mechanical drive (EKG) are still the main extraction-and-loading equipment, and the main fleet (63%) consists of excavators with the bucket capacity from 8 to 15 m³ manufactured by OMZ (IZ-KARTEX, formerly Izhorsky factories) and modifications thereof (Fig. 2 and 3).

The trend of the leading role of open-pit electric excavators with the bucket capacity over 8 m³ in many operational enterprises of Russia and CIS differs significantly from the foreign experience, where for the above size the main purchase volume is accounted for hydraulic excavators.

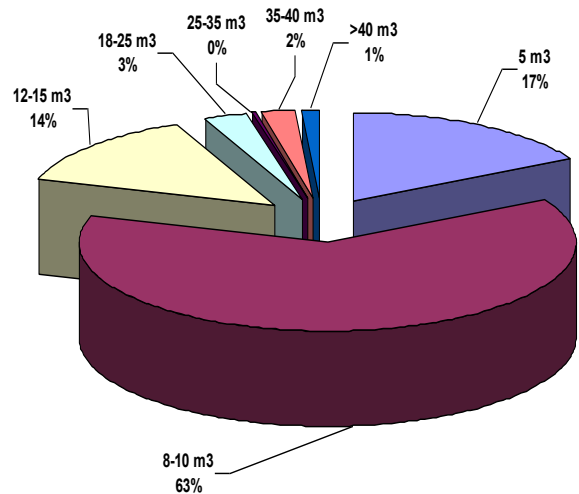


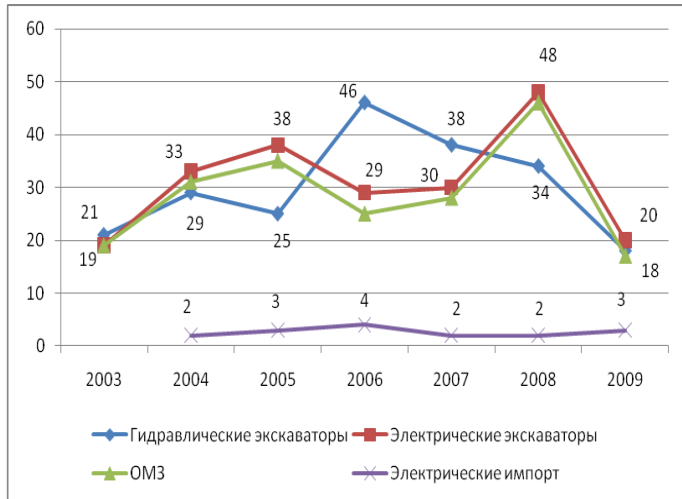
Figure 3. Segmentation of the excavator fleet of the main mining enterprises by the bucket capacity (estimation of IZ-KARTEX as of 2009)

To a large extent this can be explained by the existing infrastructure of operational mining enterprises, established repair and maintenance systems for EKG-10 and EKG-15 excavators, their relatively low price in comparison with foreign hydraulic excavators, higher suitability of domestic open-pit excavators for heavy-duty operation.

An important and often crucial factor is poor preparation of mined rock to excavation, deviation from respective design parameters, low level of mining machine service and maintenance, which in total makes inefficient and sometimes impossible to operate hydraulic excavators in main excavations of hard rock and half-rock. The experience of hydraulic excavators operation in some mining enterprises of the Russian Federation and CIS-countries shows that under heavy conditions in open pits hydraulic excavators, having smaller mass and less strong metal structures in comparison with their electric counterparts, break down quickly, their repair expenses increase exponentially and operation thereof becomes lossmaking.

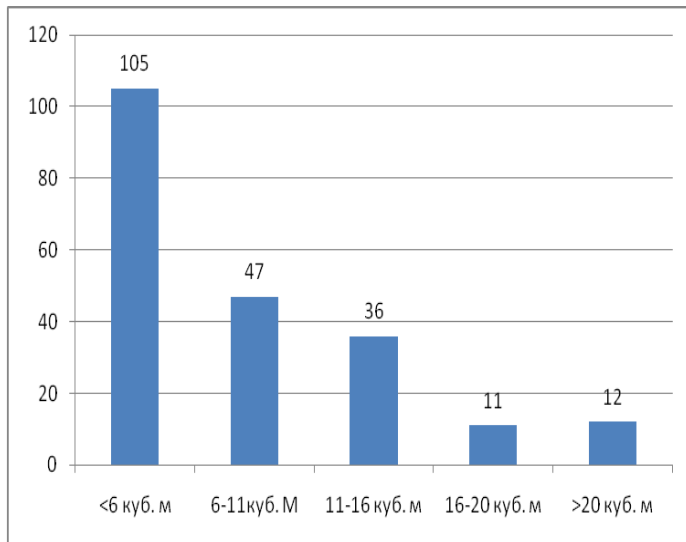
Analysis of open-pit excavator deliveries (Fig. 4) shows that for recent 6 – 7 years the shares of

electric and hydraulic excavators in the total volume of deliveries to the RF and CIS have been gradually equalizing. For the period of 2003 – 2009, 217 electric excavators and 211 hydraulic excavators were supplied. However, half of the supplied excavators had the bucket capacity less than 6 m³ (see Fig. 5), with the lower limit of electric excavator capacity being 10 m³.



Гидравлические экскаваторы – hydraulic excavators
 Электрические экскаваторы – electric excavators
 ОМЗ – OMZ
 Электрические импорт – imported electric excavators

Figure 4. Dynamics of open-pit excavator supplies to RF and CIS mining enterprises



Куб.м – m³

Figure 5. Distribution of hydraulic excavator supplies to RF and CIS in 2003 – 2009 by the bucket capacity

Fig. 6 shows that in the RF and CIS market products of all largest world manufacturers of open-pit mining hydraulic excavators are presented.

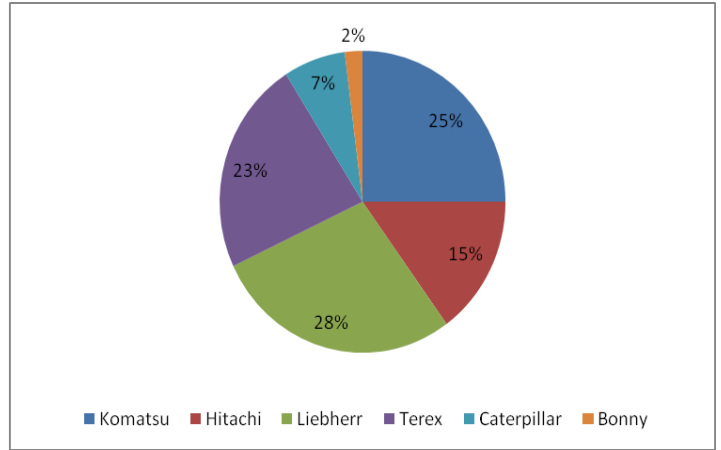


Figure 6. Market shares of open-pit hydraulic excavator manufacturers in RF and CIS (2006 – 2009)

The segmentation of the excavator fleet with the bucket over 4 m³ having been supplied to RF and CIS by weight classes (or sizes) is shown in Fig. 7. According to these data more than half of the fleet is represented by the models with the working mass from 80 to 120 tonnes.

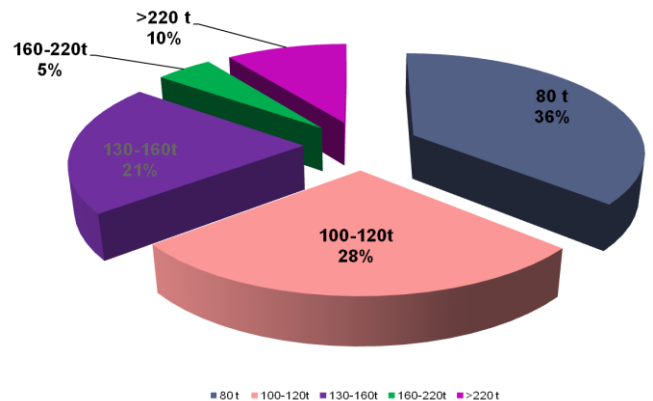


Figure 7. Segmentation of the hydraulic excavator fleet by weight classes

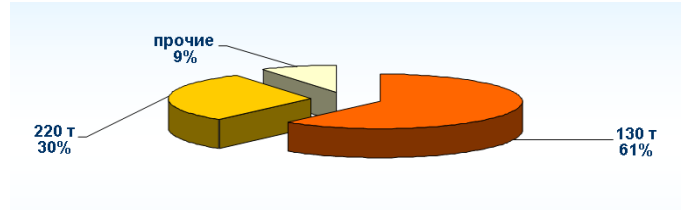
Also, the open pit mining excavator market of Russia and CIS-countries differs drastically from the market of largest mining world countries by much less rates of growth of unit capacity of the supplied open-pit machines. Excavators with the bucket of 5 – 10 m³ amount to 80% of the whole fleet in the open-pit mines of the RF and CIS-countries, while abroad a stable growth of supplies of excavators with the bucket of more than 20 m³ has been observed for a long period (Fig. 8).

The main reasons explaining the existing differences of the excavator market situation in Russia and CIS-countries from world market trends are as follows.

- Faster historical (since the USSR) development rates of open-pit dump trucks BelAZ in comparison with electric excavators EKG. Initially, EKG-8M and EKG-10 excavators were designed for dump trucks BelAZ with the capacity of 75 – 90 tones. By now the capacity of the open-pit dump trucks of the most RF and CIS mining enterprises has evolved up to 130 – 136 tones (Fig. 9 and 10), with the bucket capacity of the dominating open-pit excavators in medium-scale and large-scale mining enterprises being 10 m³.
- Conservatism of design organizations, which include mining-and-vehicular equipment of commonly used sizes into most of existing and new projects.
- Conservatism of engineering personnel and managers of mining enterprises making decisions on procurement of mining equipment.
- Unavailability of accessible domestic excavators with the bucket capacity over 15 m³ being in demand in the market and representative experience of operation thereof.

enterprises - 11 m³.
 более 140 т – more than 140 t
 менее 100 т – less than 100 t

Figure 9. Breakdown by the capacity of the production dump truck fleet of RF and CIS iron-ore mining enterprises



прочие - other

Figure 10. Breakdown by the capacity of the production dump truck fleet of RF and CIS coal strip mines

2. FORECAST OF OPEN - PIT EXCAVATORS CONSUMPTION BY THE RUSSIAN MARKET

With a view to increase production efficiency and reduce expenses mining enterprises shift and will keep shifting the demand towards increasing the unit capacity of mining-and-vehicular equipment in order to reach rational parameters of the excavator-and-vehicle complex (EVC).

Many iron-ore mining and processing integrated works (GOK) declare renovation of their fleets and consider excavators of 18 – 20 m³ class as the main and perspective extraction-and-loading unit. The same is true of some medium-scale coal strip mines. The reason is that in order to improve mining efficiency and create rational EVCs the above mines and enterprises need just to increase the bucket capacity and bring it to the optimal value, i.e. to the value, which, based on the world practical experience and theoretical research, allows providing optimal expenses and production costs of extraction-and-loading and transportation. As is known, the ratio between the vehicle capacity and the capacity of excavator bucket is 1 to 3 – 5, i.e. one dump truck should be loaded by excavator in 3 – 5 shots.

For this purpose, without changing the transport component and development system parameters (width of working sites, width of haulage benches), it is necessary to raise the excavator bucket capacity from existing 10 m³ up to 18 – 20 m³, the latter value providing the optimal production load of the prevailing fleet of the Russian and CIS mining industry.

Today three groups of mining enterprises can be defined, on which open-pit excavators of “20 m³” and higher class might be efficiently used.

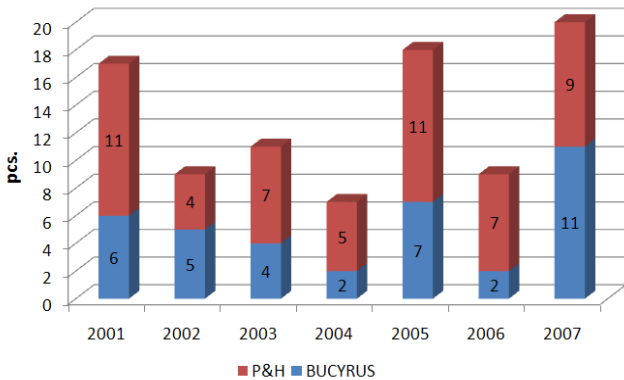
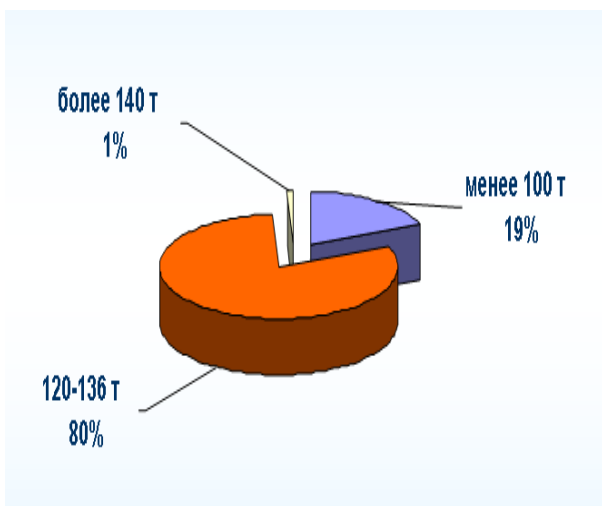


Fig. 8 Dynamics of world supplies of P&H and Bucyrus excavators with the buckets of 40 – 63 m³, pcs.

However, since 2000th foreign manufacturers of hydraulic and electric excavators have penetrated into the market. The average bucket capacity of excavators presently delivered to Russian coal producers is already 20 m³ and to iron-ore mining



1st group. Enterprises, where mining-and-transport equipment of high unit capacity has been already operated: excavators with the bucket capacity over 20 m³ and dump trucks with the capacity of 170 – 220 tones and more. These enterprises have accumulated a positive experience of powerful excavator-and-vehicle complexes operation; they own a necessary repair base and have an appropriate amount and front of mining operations. So far this group includes only large Russian coal producers – Yakutugol, Kuzbassrazrezugol, South Kuzbass, Kuzbass Fuel Company.

2nd group. Mining enterprises with the prospect to realize projects of production facilities modernization and projects of open-pit mine and opencast reconstruction. Today only separate open-pit mines can be included in this group, such as SUEK, SFS, Siberian Anthracite, Kuzbassrazrezugol, open joint-stock company “Karelian Pellet” (Korpagan and Central open-pit mines), SSGPO (Kacharsk open-pit mine), Almalyk mining-and-metallurgical integrated works (Kalmakyr open-pit mine), Navoisk mining-and-metallurgical integrated works (Murantau open-pit mine) Poltava mining-and-processing integrated works, etc.

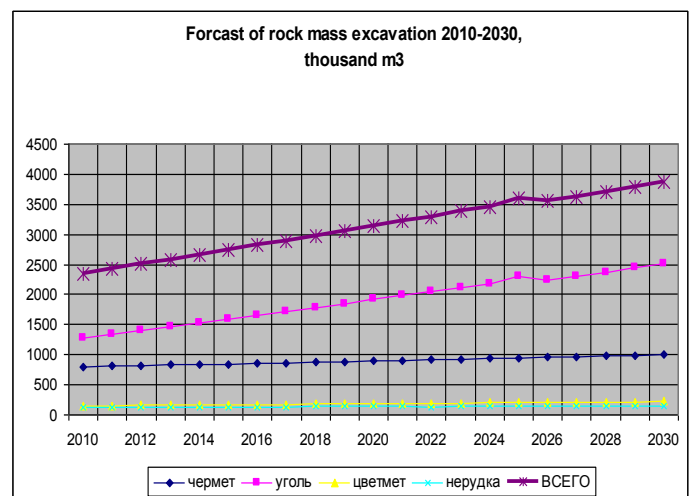
3rd group. New mining enterprises being designed for development of large minefields with unique mineral reserves. This group includes Elginsk, Nikolsk, Kolyvan coal fields; Sukhoy Log and Natalkinsk gold field; Udokan, Bozshekul and Aktogaisk copper fields; Prioskol and Chineysk iron-ore deposits, etc. Minefields of such scales in the territory of Russia and CIS-countries have not been put into operation for more than 30 years. It is obvious that in new economical conditions they will be designed and developed with attraction of the most advanced world experience in the mining industry and there is no doubt that for developing these large minefields modern high-capacity and efficient mining equipment will be acquired.

Specialists of the research and development center “Gornoye Delo” have developed a forecasting model of open-pit excavator consumption by the Russian market based on integrated calculations. The model is based on two original behaviors: the behavior of supplies in the period from 1980 till 2030 (Fig. 1) and the behavior of shoveling machine consumption in Russia and CIS-countries till 2030 (Fig. 11) by four main mining industries - coal industry, ferrous metallurgy, non-ferrous metallurgy and non-metal mining.

The second behavior was received based on forecast data of mining operations of respective industries, which forecasts were performed on request of the Ministry of economic development

and trade of the Russian Federation and the main mining CIS-countries for the period till 2030.

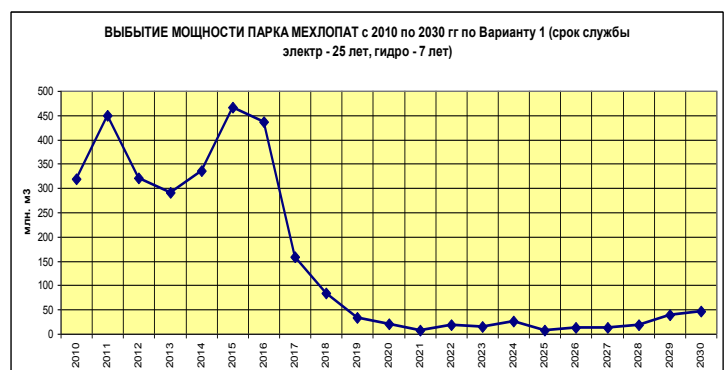
Based on the data of shoveling machine supplies there were plotted graphs of retirement of single-bucket shoveling machines with the bucket more than 5 m³ in the period from 2010 till 2030 for two options – with the dragline excavator service life of 25 and 30 years and hydraulic excavator service life of 7 years in both options (Fig. 12). For defining the excavator fleet capacity an average relative productivity of shoveling machines (“per a cube-bucket”) was assumed: in the coal industry – 300 thousand m³/m³; in the ferrous and nonferrous metallurgy – 250 thousand m³/m³; in the non-metal mining – 220 thousand m³/m³.



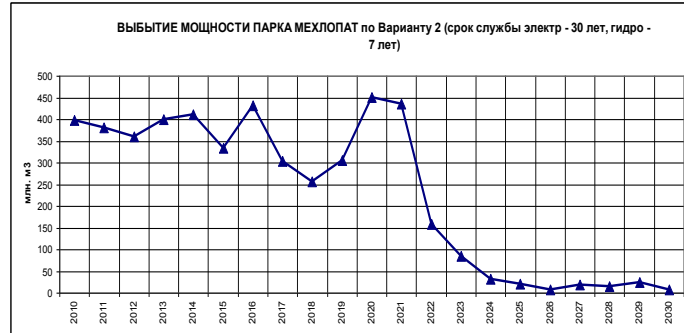
Чермет - ferrous metals
Уголь - coal
Цветмет - nonferrous metals
Нерудка - nonmetallics

Figure 11. Forecast of rock mass excavation in open-pit mines of Russia and CIS-countries in 2010 – 2030.

The excavator consumption forecast was made for 6 size groups (with the bucket capacity being 5 m³, 8 – 10 m³, 12 – 15 m³, 18 – 25 m³, 25 – 35 m³ and 35 – 50 m³) as a ratio between the forecast volumes of rock mass to the excavator fleet capacity per each year according to the percentage relationship between the size groups to be assumed based on expert estimates.



ВЫБЫТИЕ МОЩНОСТИ ПАРКА МЕХЛОПАТ с 2010 по 2030 г.г. по Варианту 1 (срок службы электр – 25 лет, гидро – 7 лет) – RETIREMENT OF SHOVELING MACHINES CAPACITY from 2010 till 2030 according to Option 1 (service life of electric exc. 25 years, of hydraulic exc. - 7 years);



ВЫБЫТИЕ МОЩНОСТИ ПАРКА МЕХЛОПАТ по Варианту 2 (срок службы электр – 30 лет, гидро – 7 лет)лет) – RETIREMENT OF SHOVELING MACHINES CAPACITY to Option 2 (service life of electric exc. 30 years, of hydraulic exc. - 7 years)

Figure 12. Retirement of single-bucket shoveling machines capacity in open-pit mines of Russia and CIS-countries in 2010 – 2030

The final plot of the mine excavator consumption forecast in CIS-countries till 2030 is given in Fig. 13. It is particularly remarkable that the peak periods for big-size groups of shoveling machines with the buckets more than 20 m³ fall on 2021 and on 2025 – 2028, with production of 20 and more machines per annum by each size.

прогноз потребления экскаваторов в странах СНГ до 2030 г. – consumption forecast for excavators in CIS- countries till 2030

годы - years

Figure 13. Consumption forecast for single-bucket excavators - shoveling machines in open-pit mines of Russia and CIS-countries in the period till 2030

ПРОГНОЗ ПОТРЕБЛЕНИЯ ЭКСКАВАТОРОВ В СТРАНАХ СНГ ДО 2030 Г

