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Mongolia Report

(FOUO 3/81)

STATUS OF ELECTRIFICATION OF THE MONGOLIAN NATIONAL ECONOMY

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/Text/ Chapter 3. The Electrification of the National Economy

Electrification is playing an important role in the solution of the problems of the completion of the building of the material and technical base of socialism and the introduction in production of the latest achievements of science and technology. The scientific analysis of the development of the productive forces and the trends of development of technology enabled V. I. Lenin to draw the conclusion that electrification is the basis of technical progress. V. I. Lenin emphasized: "/Communism is Soviet power plus the electrification of the entire country/ /in italics/."[1]

Lenin's ideological legacy is also of invaluable importance because, in personally supervising the work on the formulation of the plan of the State Commission for the Electrification of Russia, he not only substantiated the need for the electrification of the country as the decisive material condition of the transition to communism, but also defined concretely the principle concerning the role of electrification in the creation of the material and technical base of socialism and the accomplishment of scientific and technical progress. Along the path of electrification, which was indicated by V. I. Lenin, the Soviet Union made noteworthy gains in the building of socialism. Historical practice confirms that it is the only correct path of the development of productive forces.

In the European socialist countries the power base of mature socialist society is being formed on the basis of the achievements of the present scientific and technical revolution, while in the Soviet Union power engineering is being developed under the conditions of the creation of the material and technical base of communism. The experience of these countries convincingly shows that only on the basis of electrification is it possible to solve such complicated socio-economic problems as the overcoming of the substantial differences between mental and physical labor, the city and the countryside, the creation of the material and technical base of socialism and its transformation in the future into the material and technical base of communism.

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1. V. I. Lenin, "Poln. sobr. soch." /Complete Works/, Vol 42, p 159.

A fundamental relationship, a specific sequence in development exists between the electrification and industrialization of a country and the development of the material and technical base. It is possible to consider the electrification of the economy to be, on the one hand, a prerequisite and the basis of industrialization and, on the other, the result and a criterion of industrialization and scientific and technical progress. Electrification has become the heart of the building of the economy of socialist society and plays a leading role in the development of all the sectors of the national economy and in the accomplishment of technical progress.

In its economic policy the MPRP is steadfastly guided by the main principles and deductions of the theory of Marxism-Leninism on the role of electrification in the creation and development of the material and technical base of the new society. It believes that the successful solution of such important socio-economic problems as the industrialization of the country, the acceleration of scientific and technical progress, the increase of the efficiency of social production, the change and improvement of the structure of the sectors of the national economy, as well as the acceleration of the rate of development of the productive forces of the country, the gradual convergence and equalization of the level of economic development with the level of highly developed countries is directly dependent on the scale of the work on the electrification of the national economy. The main directions of electrification were reflected in the MPRP Program. The need for the leading rate of development of the fuel and power industry is also indicated in it.

The problems of creating a reliable fuel and power base of the national economy and of building electric power stations and electric power transmission lines were defined concretely in the decisions of the 16th and 17th MPRP Congresses and in the long-range and current plans. This is making it possible to strive for the more and more complete meeting of the increasing needs of the national economy and the population for electric power and fuel.

1. An Analysis of the Level of Electrification of the National Economy

In prerevolutionary Mongolia manual labor predominated, livestock served as the motive power and means of transportation, while firewood and pressed dung served as the main sources of fuel and power.

This attests that Mongolia of those times with respect to the power base was at the lowest level of development.

In the process of building the material and technical base of socialism the new power industry was created. Whereas in 1921 only 800 tons of coal were mined at the only coal mine of the country and 12,000 kWh of electric power were generated at the only diesel electric power station, now a fuel and power industry has been created, which has become one of the technically most advanced sectors of the national economy. It accounts for one-third of the fixed capital, more than 10 percent of the industrial production and the number of workers in industry. Approximately 40 percent of the capital investments being channelled into industry go for the development of this sector. In 1967 the first electric power system was established in the Central Region of the MPR. In this region one-third of the total population of the republic resides and fourth-fifths of the electric power are generated. Therefore the creation of the power system is of great importance for the accelerated development of the economy and culture of this most important economic region of

the country. The connection of the Central Power System with the power system of the Soviet Union promoted the further development of the power base of the MPR national economy. This is another vivid confirmation of the international importance of the indication of V. I. Lenin that "modern advanced technology requires /the electrification of the entire country--and a number of neighboring countries/ /in italics/--according to a /single/ /in italics/ plan...."[2]

Measures on the concentration of the installed capacities of electric power stations and the centralization of electric power supply are being implemented gradually. Whereas in 1965 the installed capacity of the largest electric power stations was 36,000 kW, in 1980 it was 148,000 kW. The construction of high-voltage electric power transmission lines with a tension of 35, 110 and 220 kV, the length of which at the end of 1978 exceeded 1,700 km, is being carried out at the same time as the work on increasing the capacity of electric power stations. Great changes have also occurred in the technical equipment of electric power stations.

A national labor force of workers, employees and engineering and technical personnel, who are successfully working at modern electric power stations and mines and are solving complex problems of the management of production and the development of the sector, has been trained during the years of popular power.

As a result of these qualitative and structural changes the level of electrification is increasing rapidly. During the past decade alone (1970-1980) the generation of electric power increased 2.65-fold and its average annual growth was 10.2 percent. Such a rapid increase of the generation of electric power is making it possible to reduce the gap in the indicators of the per capita generation of electric power in Mongolia as compared with countries which are developed with respect to power engineering.

With respect to the main indicators of electrification the MPR is among the 10 countries of Asia best supplied with power. As is evident from Table 7, in the early 1970's the MPR was considerably ahead of the countries of the Near East, Far East and Africa in the average level of such most important indicators as the per capita consumption of energy resources and electric power and the installed capacity of electric power stations per 1,000 people. Here it is necessary to note that in the 1950's with respect to these indicators the economy of the MPR was at approximately the average level or even below the average level of these countries.

During the Sixth Five-Year Plan (1976-1980) a number of most important measures, among which are the construction of a large-capacity coal pit at the Baga nuur deposit, the renovation of operating mines and pits, the construction of a large thermal electric power station and the increase of the capacity of Thermo-Electric Power Station No 3 in Ulaanbaatar, are being implemented for the purpose of further strengthening the power base of the country. In 1980 the volume of coal mining will come to 4.6 million tons.

In 1980 the generation of electric power will exceed 1.5 billion kWh. More than half a century following the triumph of the People's Revolution was needed for this achievement. In accordance with the anticipated growth rate of electric power consumption not more than 5 years will be needed to generate the second billion, and only 3 years for the third billion.

2. V. I. Lenin, "Poln. sobr. soch.," Vol 44, p 280.

Table 7

Indicators of the Level of Electrification of the MPR and Other Countries*

Countries	Years	Per capita consumption of energy resources, kg of conventional fuel				Per capita consumption of electric power, kWh				Installed capacity of electric power stations per 1,000 people, kW			
		1950	1960	1970	1974	1950	1960	1970	1974	1950	1960	1970	1974
MPR.		122	540	888	1046	29	111	413	528	15	64	175	179
Countries of Far East.		130	238	488	552	76	166	423	515	19	37	91	123
Countries of Near East		147	340	804	1023	32	98	315	434	12	33	86	113
Countries of Africa. .		189	254	309	359	74	146	247	309	18	39	67	75

*Calculated according to the data of the UN statical collection "World Energy Supplies 1950-1974," United Nations, New York, 1976.

All these facts vividly attest to the increase of the scale of electrification of the national economy. However, along with these obvious gains there are also unsolved problems. This is especially evident if we proceed from the tasks of completing the creation of the material and technical base of socialism.

Taking into account the diversity of processes of electrification and the lack of a universally recognized method of determining its level by means of a single generalizing indicator, it is expedient to use a system of indicators for analyzing the level of the electrification of the national economy. It is possible, in our opinion, to express the level of the electrification of the national economy quantitatively by a system of such indicators as the total volume of production of all types of energy; the potential capacity of the fuel and power complex; the per capita generation of power, including electric power; the power-worker and electric power-worker ratios; the structure of the power balance; the degree of coverage of the territory by the power system; the density of the generation and consumption of electric power per km^2 of area of the country; the indicators of the electrification of agriculture, industrial technology and transportation. Let us dwell on these indicators in more detail.

The Potential Capacity of the Fuel and Power Complex and the Per Capita Generation of Power. The scale of development of the power base to a large extent depends on the degree of study of energy resources and their development. By early 1980 the geological prospecting at nearly 40 coal deposits had been completed. The detailed exploration of the coal reserves at the Taban-Tolgoy deposit is being carried out. Mongolia is rich in coal, which both now and in the future will be the basis of power generation. In 1979 50 percent of the coal was consumed by thermal electric power stations, about 20 percent was consumed in construction and industry, 25 percent was consumed in municipal services; the remainder was used as fuel in agriculture.

Highly mechanized coal pits, for example, the Sharyn Gol pit, have been built and are in operation in the republic, new powerful coal pits are being built. The development of coal mining is ensuring the increase of the capacity of electric power stations. By the beginning of 1980 there were 7 thermal and more than 1,300 diesel

electric power stations, the total capacity of which is about 360,000 kW. They supply electric power to all cities, aymag, somon and state economy centers and a large portion of the agricultural brigades.

The volume of the generation of electric power in 1980 will have increased as compared with 1940 by more than 70-fold, while the production of coal will have increased by nearly 15-fold. The generation of electric power doubles approximately every 5 years, while its average annual growth rate during the period of 1950-1979 was 13 percent. Let us note that in recent years the average annual growth rate of the world generation of electric power was more than 7 percent, and the volume of world electric power consumption doubles every 10 years.

In 1980 in the MPR the per capita generation of electric power will be 1,100 kWh, which is less than in the CEMA member countries.

Mongolia, although among the countries with a low per capita consumption of electric power, in the per capita production of coal exceeds the average world level and the level of the member countries of the European Economic Community (EEC).

Table 8

Per Capita Production of Coal, kg of Conventional Fuel*

	1965	1970	1975	1976
MPR	584	910	1065	1142
CEMA member countries	2042	2118	2185	2208
EEC member countries	1795	1375	1487	1073
World average	667	652	644	650

*Calculated on the basis of the data of the Central Statistical Bureau attached to the MPR Council of Ministers and the statistical yearbooks of the member countries of the Council for Mutual Economic Assistance of the corresponding years.

The Structure of the Power Balance. The power balance of the MPR during the years of popular power has undergone significant quantitative and qualitative changes. Whereas on the eve of the People's Revolution firewood, all kinds of scrub and pressed dung were the main fuel and power resources, in 1979 in the overall structure of the power balance coal made up more than 60 percent and fuel of petroleum origin made up 25 percent. The trend toward the "mineralization" of the power balance by the systematic replacement of organic fuel with high calorie mineral fuel is continuing.

The Degree of Coverage of the Territory by the Power System and the Density of the Generation and Consumption of Electric Power Per km^2 of Area of the Country. As has already been noted, an electric power system, which covers more than 10 percent of the territory of Mongolia, is in operation in the central part of the republic. Small-capacity electric power stations, which are isolated from each other, operate in other regions. The electric power system in the aymag centers is based for the most part on diesel electric power stations. A system of centralized heat supply is being developed in the cities of Ulaanbaatar, Darhan, Choybalsan and Erdenet. A heat supply system has also begun to be developed in aymag centers, although in

them there is still no unified centralized heat supply system and numerous small departmental boiler houses are being preserved. The efficiency of the use of fuel and energy resources can be increased substantially with the development of centralized heat supply.

As of 1978 there are 0.2 kW of electric capacity and about 900 kWh of electric power per km^2 of territory of the MPR. Such a situation, on the one hand, is explained by the vastness of the territory and the low population density of the MPR and, on the other, characterizes the inadequacy of electrification, especially in rural regions.

The Electrification of Agriculture. By 1978 the total power capacity in agriculture came to 2.1 million hp. Its total exceeded by many times the installed capacity at the electric power stations of the country. This attests to the rapid development of nonstationary power engineering in connection with the "motorization" of the labor of rural workers. The mechanization of the labor of livestock breeders and the further development of farming will undoubtedly lead to an increase of the consumption of electric power in agriculture.

2. The Main Directions of the Further Electrification of the National Economy

The state of the economy of the country as a whole and the level of industrialization substantially influence the rate of development, the structure and the distribution of the fuel and power complex. In turn, the level of its development, the provision of the needs of the national economy with energy resources and the economic indicators of the production, transportation and consumption of electric power and fuel have a decisive influence on the development of the economy.

In the area of the electrification of the national economy the new gains indicated in the MPRP Program have to be coped with.

It is a matter of the assurance of the leading rate of development of the fuel and power industry by the maximum utilization of internal resources, the increase of the number and capacity of electric power stations, the construction of high-voltage electric power transmission lines, the organization of centralized power systems in a number of regions of the country by the working of deposits of hard coal and the use of other types of fuel and sources of energy, as well as of the more and more complete satisfaction of the demands of the national economy and the population for energy and fuel.

It remains, first, to complete the initial period of electrification and to improve substantially and strengthen the existing power base of the national economy; second, on this basis to carry out extensive electrification; third, to shift gradually to the solution of the problems of thorough electrification. Of course, considerably more time will be required for the accomplishment of extensive and thorough electrification than for the completion of the industrialization of the country.

The prospects of the development of electrification in the MPR have already been studied in a number of works. Thus, "The Plan of the Power Supply of the MPR for 1965-1970 With Allowance Made for the Further Prospect," "The Plan of the Development of the Power System of the Central Zone of the MPR for 1971-1975 With Allowance Made for the Prospects to 1980" and "The Plan of the Heat Supply of the City of

Ulaanbaatar for the Period of 1971-1975 With Allowance Made for the Prospects to 1980" were drafted jointly with planning organs of the USSR. A group of specialists of the CEMA member countries elaborated a forecast to 1990 of the fuel and power balance of the MPR and "Preliminary Considerations for a National Program of the Development of Electric Power Engineering of the MPR to 1990." The main directions of the development of power engineering of the country for the future are being elaborated with the assistance of scientists of the Soviet Union.

The questions connected with the forecasting of the long-range level of consumption of fuel and power and the more precise specification of the fuel and power balance on the basis of the study of the reserves of fuel and energy resources were taken into account first of all when elaborating the prospects of the development of electrification. The careful substantiation of the plans of the power supply of the country, the heat supply of the main cities and centers, the location of fuel and power enterprises and the use of water resources in power engineering and the analysis of the trends of development of power engineering were also carried out.

The consideration of new trends is necessary, for example, when selecting the types, capacities and sites of electric power stations. Whereas previously heat and electric power stations were built directly in the regions of the consumption of power and ran on brought-in fuel, under the conditions of the vigorous development of electric power engineering the need for their construction in the immediate vicinity of deposits of fuel has arisen. This circumstance is dictated by the need to reduce the expenditures on the delivery of fuel, as well as to decrease the level of pollution of the air basin.

The question of the establishment of such basic technical and economic ratios as the coefficient of the lead of the growth rate of the output of the fuel and power industry as compared with the growth rate of the national income and the gross industrial output, the proportion of the capital investments in this sector in the total amount of capital investments in the national economy, the proportion of standby capacities in the total amount of capacities of power equipment and so on is of theoretical and procedural importance when formulating the long-range and annual plans of the development of power engineering.

At this stage of development the establishment of the coefficient of the lead of the development of power engineering with respect to the need of the national economy for power is a fundamentally new question which is governing the development of this sector during the current five-year plan; at the same time this question is closely connected with the specific nature and economic potential of the country, which requires a comprehensive calculation and study, on the basis of which its optimum value could be determined. Here a careful study of the experience of the fraternal socialist countries and other industrially developed states is necessary. Some scientists of the Soviet Union consider correct an increase of the generation of electric power by 15-18 percent for every 10 percent increase of industrial output. According to data of the United Nations, a 1 percent increase of the industrial gross output of world production accounts for a 1.3-1.4 percent increase of the generation of electric power.

By the end of the current, initial period of electrification of the MPR a relatively developed power base should be created in the Central Economic Region of the country, the supply of rural inhabitants with high calorie, transportable fuel, as

well as the supply of electric power should be improved substantially in all the economic regions.

Here the concentration of the capacity at electric power stations, the increase of the voltage of electric power transmission lines and the centralization of electric power supply will be of great importance. Of course, the concentration of capacities in electric power engineering depends to a very great extent on the concentration of the capacities of the consumers. Therefore the concentration of electric power engineering of the MPR has and will have its specific features and difficulties, since the power consumers of the MPR are characterized by great diversity; a low density of the electric power loads transferred over the entire territory of the country distinguishes them.

Under such conditions the possibility of concentration is limited.

The appearance in the future of new industrial centers with a comparatively large consumption of power creates, as was stated above, not only the condition of the concentration of the capacity, but also the condition for the centralization of electric power supply and the development of the power system. For example, the creation of a power system, which will cover the territory of 13 aymags, is planned in the Central Region of the MPR. The creation of such a power system will make it possible to complete in the shortest possible time, with fewer expenditures and at a high technical level the initial period of the electrification of the MPR and to transfer electric power from the Central Region to the eastern and southern parts of the country. This, in turn, will have a decisive influence on the improvement of the distribution of the productive forces in these regions, the use of natural resources and their comprehensive development.

The search for means of using efficiently natural and secondary sources of energy and, consequently, the improvement of the structure of the power balance are one of the most important national economic tasks. Here the formulation of a long-range power balance, which would be the basis for the determination of the feasible location of new industrial enterprises, is of great importance.

In the solution of the problems of improving the structure of the power balance of the country the intensive expansion of the open-cut mining of coal, the launching of prospecting work for the exploration of such natural energy resources as petroleum, natural gas and oil shale and the establishment of the energy resources of rivers are the priority directions.

At the present stage of the industrialization of the MPR the rapid development of the coal industry is of especially great importance. Coal should become the main type of fuel. The problem of the gasification of coal and its treatment for the obtaining of liquid and gaseous fuel and of the liquefaction of coal by means of hydrogeneration or heat dissolution is arising. In this respect coal should become for the MPR not only the main type of fuel in the next few years, but also the fuel of the future.

Hydroelectric power stations would play an important role in the improvement of the structure of the power balance and the meeting of the peak part of the load curve. However, the reserves of water resources as a source of power have been studied little. According to preliminary estimates, the basins of the Orhon, Selenge

and Moron rivers and the Eglyn Gol hold energy reserves in the amount of 3.3 million kW, while the Onon and Kerulen rivers hold reserves of about 0.6 million kW.

The most efficient means of electrifying MPR agriculture are: the connection of some portion of the stable consumers to the central power system, the construction of diesel electric power stations, as well as the use of the latest achievements of "small-scale power engineering."

Here it is necessary to take into account the fact that under the present conditions of Mongolia, where for the present a portion of the population still leads a nomadic way of life, it is impossible to electrify all the regions in a short time by the building of electric power transmission lines and large electric power stations. In this connection the need is arising to perform research work on the study of the feasibility of building small-capacity electric power stations and of using all possible sources of energy. The introduction in the daily life of rural inhabitants of the achievements of science and technology presumes the search for advanced methods of heating, lighting, as well as the supply of power for household needs and household equipment.

The creation and efficient organization of a system of the power supply of small consumers who are dispersed over a large distance, especially livestock breeders living in yurts, are a complicated scientific and technical problem of the development of power engineering of the MPR.

For these purposes it is possible to use extensively coal and brick fuel, as well as to introduce gradually in daily life heat-retaining electric ovens, liquified gases and so forth. Along with this in regions poor in fuel, such as the Gobi, the use of electric boilers for centralized heat supply is of great importance. Moreover, such new sources of energy for the MPR as the energy of small rivers, the wind and the sun can be used for the supply of electric power to local small consumers.

The energy of small streams is one of the renewable sources. In the massifs of Arhangay, Bayan-olgiy, Ubs, Hobsgol and Hentiy Aymags there are more than 3,500 permanent streams with a total length of about 60,000 km. The use of mobile microhydroelectric power stations on these streams seems possible.

In recent years a pilot batch of mobile hose microhydroelectric power stations with a unit capacity of 0.5 and 1.5 kV, which are designed for the supply of electric power to dispersed agricultural consumers with a small unit load, was developed and produced in the USSR. These plants meet the conditions of the supply of electric power to nonstationary agricultural consumers. Using large natural inclines, the head of water, which is necessary for the operation of the microhydroelectric power station, is created by means of a flexible hose. The use of a flexible hose, which is a part of the assembly of the microhydrolectric power station, eliminates the performance of excavation and earth moving.

The results of the tests conducted in the USSR on the pilot batch of microhydroelectric power stations under generating conditions (among shepherds and herdsmen) show that the installation of these hydroelectric power stations is accomplished in 2-3 hours. The microhydroelectric power station is simple, reliable and safe in operation. Under winter conditions it operates reliably to a temperature of -35° C.

The resources of solar energy are another source of renewable energy resources in the MPR. According to the data of the altas of the heat balance of the world, the total solar radiation a year on the territory of the MPR is 100-140 kcal/cm^2 a year, while the number of sunny days a year is 100-300 more than in the zone of the USSR, which is at the same latitude as the MPR. The resources of solar energy in the MPR are making it possible to use solar energy extensively for the desalinization of water, its heating, the drying and cooling of various items, the cultivation of vegetables and fodder plants in hothouses.

In some regions of the country there are opportunities to use the wind as a source of energy. The wind is a free energy source. Therefore among some people the opinion still exists that the power obtained by means of a wind mill is also practically "free." A peculiarity of the wind as an energy source consists first of all in its variability, the great changeability of the velocity and, consequently, the energy. Wind power plants are used most often as a power drive among agricultural consumers, for example, as watering places, mills and so forth.

In recent years wind electric power stations, including high-speed wind electric power stations like the Berkut, as well as units of the series of general-purpose wind electric power plants (UVEU's) with a unit capacity of 4 and 16 kW, have been produced in the USSR.

The main drawback of this type of sources of electric power is their dependence on the availability and velocity of the wind. Therefore their use for the supply of electric power to agricultural consumers with set schedules of electric power consumption is possible only when batteries and standby sources of electric power are available.

It is quite understandable that the use of the enumerated sources, which are united under the overall concept "small-scale power engineering," may be mainly of a seasonal nature. Therefore the more reliable supply of power to numerous nonstationary consumers in rural areas is necessary. In all likelihood it is possible to consider gasoline and diesel electric power stations as one of the main reliable sources of electric power for such consumers.

Gasoline and diesel electric power stations of a small unit capacity, which it is possible and more convenient to use for the supply of electric power to nonstationary agricultural consumers, especially for the needs of livestock breeders, are being produced or are being developed in the CEMA member countries and other countries.

The accomplishment of electrification is, in the words of V. I. Lenin, "the first important step on the path to the communist organization of the economic life of society." He believed that "electrification is the most important of all the great tasks facing us."[3] In carrying out this behest of Lenin, the MPRP and the Mongolian people are gradually solving the problems of the electrification of the country.

3. The Complete Mechanization and Automation of Production Processes, the Improvement of Production Technology on the Basis of Electrification

At the present stage of the building of the material and technical base of socialism in the MPR the problem of increasing labor productivity is acquiring particular

3. V. I. Lenin, "Poln. sobr. soch.," Vol 40, p 156.

urgency, since the available manpower resources cannot ensure without this the necessary scale of development of production and the nonproductive sphere. The increase of labor productivity is being achieved primarily on the basis of the introduction of advanced equipment and technology, the automation and complete mechanization of production processes and the electrification of production. These directions of the development of production are interconnected.

The works of the classics of Marxism-Leninism contain valuable assumptions and methodological approaches to the study of the problem of the improvement of the technical base of production and the change of the nature and conditions of labor in the case of the mechanization and automation of production processes on the basis of electrification. Speaking about labor productivity as the most important and main thing for the triumph of the new social system, V. I. Lenin emphasized the need for the extensive use of technology, this decisive means of increasing labor productivity.

"The more highly technology is developed," he wrote, "the more the manual labor of man is supplanted, being replaced by a series of more and more complex machines...."[4] K. Marx repeatedly emphasized the importance of machine technology and its role in the acceleration of the rate of progress of productive forces and in the use of scientific knowledge in production. "As a machine the means of labor," K. Marx noted, "acquires such a physical form of existence, which governs the replacement of human power by the powers of nature and of empirical routine techniques by the conscious application of natural science."[5]

The saving of national labor by means of technology and the facilitation of the labor of workers are being achieved first of all by means of the complete mechanization of production processes. Complete mechanization, in turn, is a mandatory prerequisite of the automation of production in all sectors of the national economy. New technology presumes the use of an advanced processing method. Only in this case is it possible to achieve a significant increase of labor productivity.

The development of the complete mechanization and automation of production is being carried out on the basis of its electrification. Electric power is the only power carrier which is capable of providing the required speed and connection of production operations in the case of the complete mechanization and automation of production.

The MPRP and the MPR Government attach great importance to the further improvement of the technical base of production and to the increase of the level of the mechanization and automation of production processes--the basis of the increase of production efficiency and labor productivity and the improvement of product quality. The importance of technology, which always played an important role in the development of social production, is especially increasing during the present period, when the problems of completing the building of the material and technical base of socialism are being solved. As a result of the steps taken in all the sectors of the national economy modern technology is being introduced extensively, the number of completely mechanized industrial enterprises is increasing with each year. In 1979 about

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4. V. I. Lenin, "Poln. sobr. soch.," Vol 1, p 100.

5. K. Marx and F. Engels, "Soch." /Works/, 2d edition, Vol 23, p 397.

250 complete automated and semi-automated lines, more than 1,000 automatic machines and semi-automatic equipment were in operation at industrial enterprises.

The level of the mechanization of production in the national economy has increased significantly, first of all at power, coal, mining and wool processing enterprises, in flour milling and at meat combines. According to the level of the mechanization of labor-consuming jobs and the automation of production processes power engineering holds one of the leading places. Practically all the processes at electric power stations, except the unloading of coal from cars, today are completely mechanized. At Thermo-Electric Power Station No 3 in Ulaanbaatar this process was mechanized after the placement into operation of a car tipper.

The main and auxiliary equipment of electric power stations is equipped with electronic governors and technological protection, automatic field rheostats have been installed on the generators, electric power transmission lines are equipped with high-speed relay protection and automatic reconnection equipment, the substations of key consumers are equipped with automatic connections of reserve power supply.

Such features of power generation as the simultaneity of generation and consumption, the brevity of technological processes and the ever increasing demands on the reliability of power supply dictated the need for extensive automation along the entire "generation-transmission-distribution and consumption" chain of electric power and thermal energy. With respect to the level of automation of the main production processes at heat and electric power stations (management, protection, monitoring and warning) the MPR is at the level of the other CEMA member countries.

In recent years measures aimed at the mechanization of operations and the facilitation of the labor of miners have been taken at coal and mining enterprises, which have labor-consuming production processes. One of the major achievements of recent years in the area of the mechanization of labor in the coal industry is the use of mechanized stope complexes with small-cut continuous miners, which considerably increased the labor productivity of the miners. The average daily productivity of one longwall increased 4.2-fold as compared with a longwall equipped with a wide-cut continuous miner and wooden supports. Powerful walking excavators and other types of modern mine transportation equipment are being used in open-cut coal mining.

The mining industry of the country is a sector which is equipped with highly productive modern equipment. The new stage in technical progress in the sector is connected with the establishment of joint Mongolian-Soviet enterprises. Thus, powerful highly productive equipment, which is produced in the USSR (excavators, drilling rigs, dump trucks with a load capacity of 40 tons and other equipment), is being used at the Erdenet Mining and Concentration Combine for the performance of mining. The labor productivity here is at the level of the best foreign enterprises of this sort. Highly productive Soviet-made equipment is also being used at the mines and open pits of the Mongolsovtsvetmet Association.

A number of measures on the increase of production efficiency, the improvement of the quality and the enlargement of the assortment of goods on the basis of the introduction of advanced equipment and technology have been implemented in light industry, owing to which considerable progress has been achieved in the area of the mechanization and automation of production.

In the wool processing industry, for example, twin-blade carpet looms, highly productive spinning and doubling machines, draw looms, automatic and semi-automatic spinning machines, machines for the dyeing of wool and chemical fibers under pressure, units for nonwoven materials and other model equipment have been introduced and assimilated. The complete mechanization of the transportation of wool between the operations divisions has been carried out.

Highly productive and special sewing machines, semi-automatic machines and ironing presses and presses for sizing have been introduced in the sewing industry.

Considerable technical progress has been achieved in the leather footwear and fur industry as a result of the introduction and assimilation of individual types of modern equipment, for example, vibrating staking machines, polishing and dust-removing units for the surface coloring of leather, electronic measurers of the area of finished goods, machines for the lasting of the toes of footwear by the sizing method and the forming of a shoe which has been stretched on a last, integrated machines for the production of lasts, hydraulic presses, equipment for hot vulcanization and others.

In the food industry integrated equipment of automatic action is being introduced, large mechanized refrigeration services and highly productive flow lines are being established.

In spite of the definite gains in the mechanization and automation of production processes in many sectors, as a whole the state of mechanization and automation does not meet present requirements. In industry about 50 percent of the workers are engaged in manual labor. The level of mechanization at aymag food combines and brick plants is especially inadequate. The inadequate mechanization of repair, loading and unloading operations and intraplant transportation is the most characteristic bottleneck in the mechanization of production in all the sectors of the national economy.

The mechanization of production processes in such an important sector of the national economy as animal husbandry is acquiring particular importance.

Difficult physical labor is still being retained in the performance of some basic and auxiliary operations. Along with the introduction in production of automated and mechanized assembly lines, loading and unloading operations and intraplant transportation should also be mechanized by means of the use of mobile materials-handling devices.

Although machines and equipment, which make it possible to completely mechanize and automate production processes, are being introduced in all the sectors of the national economy, the production process as a whole at enterprises often is still not covered by complete mechanization. The partial mechanization or automation of production processes at times has the result that it is necessary to increase the number of those working in that area of production, in which labor is still not mechanized. The advantages of individual highly mechanized processes in some sector of the national economy to a considerable extent are reduced by the presence of processes with a low level of mechanization.

In some sectors of the national economy with an extensive list of items, an individual nature of production and a great complexity of technological processes the complete replacement of manual labor in basic production is not achieved even with complete mechanization. The point is that the expenditures on the development of machines for some operations exceed by many times the impact from their use. The level of mechanization in this case is determined both by the technical potentials and by the economic feasibility. For the MPR with its small population practical and theoretical research on questions of the effectiveness of the automation and mechanization of production and management is of especially great importance. The study of the economic problems of mechanization and automation and the drawing up of the corresponding proposals are of no less importance than the development and improvement of equipment.

The conditions characterizing complete mechanization are not stable. The technical base of production is constantly being improved. On the basis of the definition of mechanization as the process of the replacement of manual labor by the work of machines, as well as of obsolete machines by improved machines, it is expedient to distinguish, first, primary mechanization, which comes to replace manual labor, and, second, the secondary, higher stage of mechanization, when its level is increased by the replacement of functioning means with new, more productive means.

In the former case it is a matter of the development of mechanization "in breadth," in the latter it is its development "in depth," which pertains to both partial and complete mechanization.

This differentiation is of substantial importance for the study of the nature of the mechanization of production, the choice of its ways and means and the evaluation of the socio-economic results. At present primary mechanization, which is characterized by the introduction of machines in the main production processes, is being implemented in many sectors of the MPR national economy. Much work has to be done on primary mechanization in auxiliary processes and operations.

As a result of the implementation of primary mechanization labor productivity is increasing sharply. It would be incorrect, however, to believe that primary and secondary mechanization should proceed in a strict sequence. In the MPR they are being implemented both in sequence and in parallel or even without the first stage.

The higher level of mechanization is characterized by the fact that some types of machines are replaced by others, by equipment of greater capacity and productivity. Now along with mechanical connectors hydraulic, pneumatic, electronic, electromagnetic and other connectors are being used extensively in the designs of machines, which ensures a high stability and quality of the machines and in the end substantially increases the productivity of the tools of labor.

Whereas the release of workers of manual labor is decisive in mechanization, for automation this is not the main specific trait. In the changeover to automation the center of gravity shifts from the problem of the replacement of the manual labor of man in the technological process to the problem of the replacement of his mental functions by equipment. Moreover, in the case of automation it is important to ensure the continuity of the production process in the case of an advanced technological mode.

At all the stages of the improvement of automation equipment, in the use of semi-automatic and automatic equipment and automatic lines we have attempted to increase the degree of continuity of the work. A qualitative jump was recently made in this direction. The development of automatic equipment with a feedback system (machines with automatic control and adjustment) increased significantly the continuity of its operation.

At the present stage of the building of socialism in the MPR both the complete mechanization and the automation of production processes are equally important. This is also the heart of the technical policy in this area. The scientifically sound planning of the construction of new industrial enterprises, the renovation and modernization of operating ones is of great importance for the pursuit and implementation of such a policy. The drafted plans should ensure the complete mechanization and automation of production processes. Taking into accounting the great social and economic importance of automation, when constructing new enterprises its level should correspond to the level of the enterprises of developed countries. In industry the development and adoption of automated control systems of technological processes will also be of great importance.

Complete mechanization and automation are making it possible to radically improve and facilitate working conditions, to eliminate difficult physical, and then all unskilled, manual labor in the performance of basic and auxiliary production operations.

Under present conditions, when the number of production enterprises and the list of products being produced by them are constantly increasing and multilateral relations are developing on the domestic and foreign markets, the problem of the mechanization and automation of computing and calculating work and the mechanization of administrative labor as a whole is pressing. As the achievements of scientific and technical progress are introduced in different sectors of the national economy, the need arises for the automatic control and regulation of various technological processes and the operating mode of machines.

The effectiveness of the management of the national economy is inseparably connected with the questions of the development of automated control systems, the introduction of modern computers for the gathering, storage and processing of information, as well as the extensive use of mathematical economics methods. A State Computer Center is already in operation in the MPR.

A computer station, which is equipped with small Robotron-1720 and Robotron-4201 computers for the primary and integrated processing of information and the production of machine carriers, is being established in the production association of the leather footwear industry. An automatic control system of production is being adopted for the first time at the joint Mongolian-Soviet Erdenet Mining and Concentration Combine. The use of modern automatic data processing equipment and mathematical economics methods will make it possible to increase the effectiveness of the solution of the main problems of the management of the production operations of the combine.

The establishment of computer centers and computer stations is the begining of much work on the improvement of the management of the economy and the automation of the processing of economic information. However, the organization of the centers does

not entirely solve the problems of the centralized automatic processing of statewide, scientific and technical information and the mechanization of the calculating work of industrial enterprises and institutions. Therefore, the establishment of collective-use computer centers and computer stations, which are equipped with modern computer hardware, and the mechanization of data processing on the basis of the extensive use of small computers are an immediate task.

In addition to the technical aspect, the complete mechanization and automation of production have an aspect which is connected with the change of the nature of labor and the role of man in the production process. The new equipment and technology require a new worker. A person, when participating in the production process, now does not directly affect the object of labor, but is linked with the latter through a complex technical system. The worker is removed, as K. Marx predicted, from the technological process itself. The number of workers engaged in mental labor, which is saturated with a great intellectual content, is increasing rapidly. With the development of science and technology profound structural changes are occurring in aggregate national labor, the use of simple labor is decreasing and the area of application of complex labor is expanding considerably.

This process takes the form of the gradual increasing of the proportion of skilled and highly skilled personnel and the decrease of the proportion of unskilled workers.

Under the influence of technical progress all the components making up the production process undergo progressive changes. Technology is one of the most important components and at the same time is often the most "conservative."

The technology of industrial production up until the last decade was developed along the line of the greater and greater subdivision of operations. The mechanical methods of machining--cutting, grinding and so on--played the main role here. A turn in production technology, which was simultaneously both a consequence and a prerequisite of the efficient use of new means and objects of labor, is now taking place. Production technology is being developed by the changeover from discrete (noncontinuous) multioperational processes of machining to continuous processes of high precision, which are based on the physicochemical and biological processing of the objects of labor in the presence of closed flow charts with the complete processing of the intermediate products. As practice shows, the automation of the production process without a change in the production technology does not provide the proper impact.

The radical improvement of the technological principles of the processing of materials is a social necessity, it serves at the same time as a powerful stimulus for the designing of new tools of labor. In this connection we should quote the words of K. Marx, who directed attention to the importance of not only tools of labor, but also the technological process. "Economic eras," he wrote, "are distinguished not by what is produced, but by /how it is produced/ /in italics/ (emphasized by us--Ts. G.), by what means of labor."[6] The importance of the technology of "how it is produced" is especially increasing in our times. The changeover from modern tools of labor to fundamentally new tools can be accomplished only on the basis of a comprehensive approach, the introduction of fundamentally new technological

6. K. Marx and F. Engels, "Soch.," 2d edition, Vol 23, p 191.

processes. The technology predetermines the nature of the interaction between the tool of labor, the object of labor and the worker, which is subordinate to the main goal--to transform the object labor into a finished product by means of the tool of labor. The improvement of the methods of the output of products, the development of new types of production and the improvement of its organization are the main content of technological progress. As a result of the development of technology on the basis of the achievements of science new types of materials and energy are being used in production, technological methods are being based on new principles.

The application of science in all the sectors of production and the increase of the level of its technological effectiveness are being advanced as one of the main factors of the acceleration of the development of the productive forces of the MPR.

Owing to the technical and economic policy of the party and the government modern technology is being introduced in the sectors of the national economy and new types of technology are being developed. However, in spite of the placement of new enterprises into operation and the renovation of operating ones, the problem of the use of new technology has not yet found a comprehensive solution. The use of chemical, biochemical, electrical, physical and other advanced technology is typical of new and renovated enterprises. At the same time mechanical technology still predominates in some sectors of industry. Thus, at a number of enterprises of light and the food industry the group of processes with a mechanical technology is more than 55 percent, while the proportion of chemical technology fluctuates within the range of 2-9 percent and that of electrical technology--2-6 percent. The predominance of mechanical technology at such enterprises causes the incomplete processing of raw materials and materials and lenghtens the production cycle. The improvement of product quality is being complicated due to the inadequate introduction of automated systems of the monitoring and regulation of technological processes and due to the violations of the flow charts, which are still encountered.

In countries with a great scientific and technical potential theoretical and experimental work is being performed on an extensive scale for the purpose of developing fundamentally new technological processes, the technological basis of the changeover to integrated automated production is being formed. The development of technological progress in the MPR both by the introduction of new technology and by the improvement of the technology being used presumes their optimum combination. For the most complete utilization of the potentials of advanced equipment it is necessary to ensure the adoption of new technological processes.

The use of diverse equipment, which converts electric power into thermal energy, affords a great opportunity to transform the technology of many sectors of the national economy. The electrification of technological processes is connected with the need to perform a certain amount of work on the use of currents of superhigh frequency, ultraviolet and infrared radiation, ultrasonics, superhigh and superlow temperatures, electron and ion beams, laser and radioactive rays and other methods, which are based on electric power. This especially pertains to works, which use fast-spoiling raw materials and produce products which are not to be stored for a long time. The treatment of food products with ultraviolet rays, that is, the use of the so-called method of cold sterilization, promotes the preservation of the quality of fast-spoiling food products during the period of storage in warehouses and at stores in the presence of temperatures above 0° C. With the treatment of products by this method the losses are less than in the case of storage in

refrigerators. The successful solution of this problem will lead to major changes in the technology of the present refrigerating industry.

Such methods of rapid thawing (methods of internal heating) as the microwave, dielectric and electrocontact methods, which are based on the dielectric properties of the frozen products themselves, are being used in industry. These methods differ from traditional methods by the prevention of the excessive increase of the temperature in the surface layers of the product, the decrease of the moisture loss and the shortening of the duration of the process of thawing.

The deep freezing of food products in a medium of liquid nitrogen and khladon-12 (freon-12) in recent years has proven itself to be a promising method of processing food products.

The great shortening of the duration of freezing, the decrease of the drying, the simplicity of the used equipment and the improvement of the public health state of production are an advantage of this method, which in the end increases the quality and cost effectiveness. With the introduction of this method under the conditions of the MPR particular attention is being devoted to the problem of the creation of a refrigerator chain from the producer to the consumer, without which it is impossible to solve the problem of the complete retention of the initial qualities of food products.

The use of infrared radiation for drying and heating is important in the production technology of a number of sectors of industry. The use of this type of radiation when drying products not only requires considerably less time as compared with the method of steam and hot air drying or with the ordinary natural method, but also makes it possible to free production areas, to improve working conditions, to increase the product quality, to decrease the production cost and, finally, to change over the production process to a continuous flow system.

In the food industry the use of ultrasonics makes it possible to eliminate high temperature sterilization, which guarantees the complete retention of all the nutritive and taste properties of products.

Chemical technology is affording new prospects, since a large portion of the chemical processes take place continuously in closed equipment; semimanufactures and finished products are transferred by the least expensive type of intraplant transportation--pipelines. Chemical technology is being used more and more extensively not only at chemical plants, but also at enterprises of the most diverse sectors of industry, as, for example, the leather, the shoe, the sewing and the food industries.

The increase of the level of chemicalization can be accomplished by the assimilation of new chemical methods of the production of output and the improvement of existing technological processes. The use of enzymes is urgent. In highly developed countries enzymes have already found application in more than 30 sectors of industry. The use of enzymes shortens the production cycle of many types of products and increases their quality noticeably. In particular, it is possible to use the enzyme method in tanning when treating hides, which increases the yield of plant wool and improves working conditions. For the improvement of bread and meat products it is also necessary to conduct further research on the use of enzymes. The pilot experimental center for microbiology and entomology attached to the meat

canning combine in Ulaanbaatar has begun the production of various enzymes and biologically active substances from endocrine-enzyme raw materials.

An enzyme shop, in which new modern technology is used, is in operation at the alcohol, starch and molasses combine in Dzuunharaa.

The production of enzymes and biologically active substances and their use in production are the basis of the creation of a new and advanced microbiological sector.

In the technology of tanning in recent years more attention has begun to be devoted to the improvement of the combined methods of tanning with the use of chromium, aluminum, zirconium and titanium salts and synthetic tannins, which are not harmful to the health of man. The complete use of valuable scraps and the improvement of technological processes when coloring products with cold-resistant and polychromatic bright dye are also one of the main tasks of the leather industry.

Chemical methods of attaching the sole of a shoe have practically replaced the traditional method. Thus, in 1963 the glue method was introduced; in 1979 it accounts for nearly 90 percent in the total volume of output.

Table 9

Proportion of Methods of Binding Shoes

(percent of total)

Methods of binding	1960	1970	1979
Glue	--	40.9	89.2
Open	34.4	21.0	--
Welt	65.6	31.5	10.8
Sandal	--	6.3	--
Underside	--	0.3	--

The use of new materials for the sole is another direction of the chemicalization of the technology of producing shoes. The production and processing of microporous, as well as leatherlike rubber are comparatively inexpensive. Whereas 35,000 man-hours are required for the processing of the leather for the production of 2,000 pair of shoes, 3,400 man-hours, or one-tenth as much, is required for the sewing of the same number of shoes with the use of material produced by the chemical method.

Along with the introduction of new types of advanced technology the skillful combination of traditional methods of the production of consumer products with scientific and technical achievements is also required. In Mongolia, for example, the traditional method of producing dried meat (borts), which is based on the principle of natural sublimation--under the conditions of the lower atmosphere pressure and low air temperature during the winter period--has been used since times of old. The combination of the traditional method of producing dried meat (borts) with modern freeze drying will make it possible to expand the production of this valuable food product. A number of favorable techniques, which make it possible to use efficiently the components of milk, exist in the domestic technology of producing Mongolian national dairy products. For the purpose of improving and mechanizing this traditional technology two specialized plants have already been built in the country.

The improvement of the technology of repairing equipment and producing spare parts is an urgent problem. The machine processing of parts should be replaced by electric processing: electric welding, electromachining, the electric-spark and electrohydraulic machining of metals.

The creation of closed technological processes, of so-called waste-free technology, which ensures the complete use of raw materials, is another important direction of the improvement of technology.

It is important to combine the introduction of advanced technologies with efficient means of the reuse of waste products, especially those made of agricultural raw materials. For example, the waste products of the meat, dairy, milling and elevator, alcohol and other sectors of the food industry upon further processing are valuable fodders for livestock.

The introduction of the results of scientific and technical progress in production in many ways is governed by the level of the improvement of the methods and means of the technological preparation of production. The higher its level is, the more rapidly and economically the assimilation of new items is accomplished and the higher the quality indicators of production and the output being produced are.

The creation of a unified system of the technological preparation of production will promote the increase of production efficiency. This is an important problem, the solution of which is conducive to the shortening of the length of the entire cycle of planning and the preparation of production for the output of an item with stable indicators of quality, which meet the needs of the national economy. The improvement of the system of the technological preparation of production not only provides an appreciable social and economic impact, but also is of decisive importance for the adoption of automated control systems and the improvement of the management of the national economy.

The party and the government are persistently pursuing a policy of the systematic updating of the products being produced and the increase of their technical level and quality. By the beginning of 1980 16 percent of the industrial output was being produced with the State Seal of Quality. A number of measures aimed at the increase of product quality and the improvement of quality control have been implemented in recent years. A unified system of the certification of product quality and a system of the planning and stimulation of the increase of product quality have been set up. The organization of the quality service at all levels of management of the national economy has been improved, a system of product quality control is being adopted at individual enterprises. The development and adoption of an integrated quality control system according to the experience of leading Soviet enterprises and the development on this basis of a unified product quality control system in the national economy are a pressing problem.

The role of standardization and state standards as the technical standards base for the most efficient use of the available resources and the practical introduction of the latest achievements of science and technology is increasing. By the beginning of 1980 97 percent of all the products being produced were regulated by state and sectorial standards.

In recent year a unified state system of standardization has been set up, the plan of standardization has become a component of the national economic plan, intersectorial systems of standardization are being developed.

The further improvement of the system of standardization and the increase of the scientific and technical level of standards are of fundamental importance for the increase of the efficiency of social production and the improvement of product quality. The systematic updating of the standards, the elaboration of advanced and leading standards, the carrying out of overall standardization and the introduction of the goal program method of planning in the work on standardization are an important condition of the solution of this problem. The increase of the organizing role of standardization is inseparably connected with the adoption in practice of the standards of enterprises. The main function of the standards of enterprises is the assurance of the effective adoption and strict observance of state and sectorial standards by the appropriate correlation of their requirements to the specific nature of the enterprise.

The solution of the main problems of the improvement of production technology will increase not only the technical level of products, but also the overall technical level of industry of the MPR and thereby will play an important role in the increase of the efficiency of social production.

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