4.3 Industrial and Economic Trends in Neighboring Countries

The European Union countries, except for the United Kingdom, have been in a long recession since 1990. Germany particularly fell into a slump with the implementation of a tight monetary policy to avoid excessive investment and inflation, while the other EU countries also had to continue tight monetary policies to keep pace with Germany in the ERM system. This situation led to a delay in the economic recovery of many EU countries. Since 1993, a trend toward economic recovery has appeared in the EU countries owing to the eased monetary policy of Germany and the increase of exports supported by recovery of the world economy. However, delays in employment adjustment and high unemployment rates have become crucial problems, which might be obstacles to future growth (Figure 4-5).

The economy of the Eastern European countries has fallen to large minus growth since 1990 because of the economic disorder during the transition to a market economy. However in Poland, Hungary, Czech and Slovakia, which started reforms in 1990, hyper-inflation just after price liberalization has ended and signs of recovery have appeared with increased investment and exports. On the other hand, reform has been delayed in Romania compared with these countries, hyper-inflation is continuing, and the economy remains unstable (Figure 4-6).

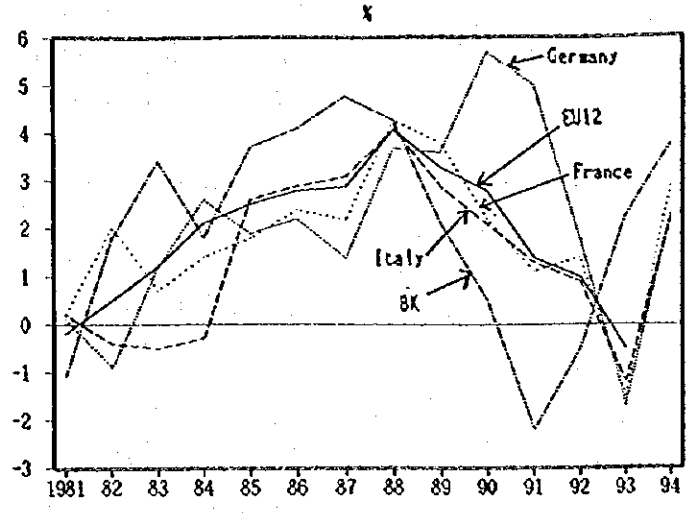
Industrial production in the CIS countries has plunged dramatically since 1990, hyper-inflation and devaluation of the currency are continuing, and there is no sign of recovery yet. If subsidies to national enterprises are reduced because of the financial deficit, industrial production will possibly decrease further.

4.4 Trends in the Steel Industries of Neighboring Countries

Steel demand in the EU countries has been decreasing due to the recession since 1990. The steel companies in the EU countries are trying to maintain production levels by increasing exports outside the EU area. EU countries have been discussing a capacity-reduction plan by which the capacity for crude steel will be reduced by 30 million tons in state-own and private companies. However, this plan might be delayed because of differences of opinion among the various steel companies.

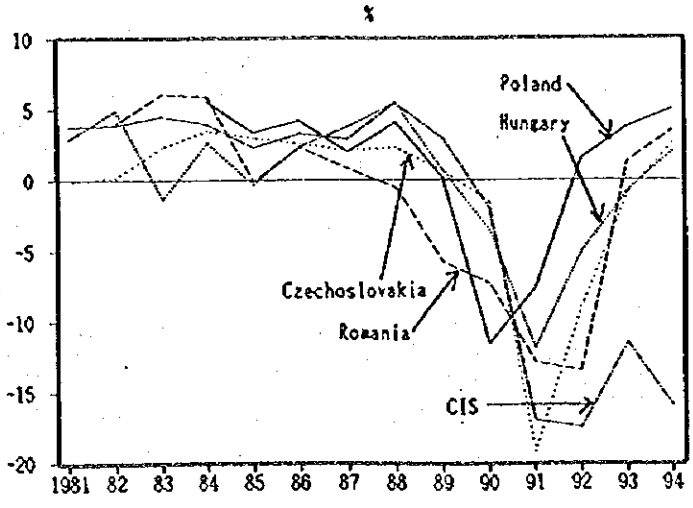
In Eastern Europe, following the economic disorder since 1989, steel demand and supply have declined rapidly. Restructuring to reduce excess capacity has now become important, and steel companies need to increase exports to earn the hard currency that will be used in restructuring.

Figure 4-5 GDP Growth Rate in the EU Countries



Source : Economic Planning Agency of Japan. Overseas Economical Data. 1995.10
(Germany : Former West Germany Area)

Figure 4-6 GDP Growth Rate in the Eastern European and CIS Countries



Source : Economic Planning Agency of Japan. Overseas Economical Data. 1995.10
(Czechoslovakia in 1993 & 1994 : only Czech)

In CIS, steel demand and production have both dropped steeply since 1989. The reasons for this decrease are difficulties in the transactions for raw materials between the various republics in the CIS and the bad condition of the transportation system. The collapse of the former COMECON system has resulted in a decline in exports and imports of finished steel. The Russian government is investigating a restructuring plan for the steel industry up to 2000.

4.5 Steel Products and Output from Steelworks in the Countries of Eastern Europe

Steel product types and output in 1993 from steelworks in Eastern Europe are shown in Table 4-1. Each country has excess capacity and suffers from low capacity utilization, except with the hot strip mills, which show slightly higher operating rates.

Table 4-1 Steel Production in Eastern European Steelworks

The Steel Sector 1993 - Poland

	Plate Mills	Hot Strip Mills	Cold Mills	Coating Lines	Heavy LP Mills	Light LP Mills	Tube Mills	
Huta Katowice					x			
Huta Sendzimira		x	x	g/l		x	x	
Zawiercie					x	x		
Ostrowiec						x		
Czestochowa	x						x	
Luochini-Warsawa					x	x		
Others	x		x		x	x	x	
Capacity	1,76	2,96	1,71	0,72	3,40	3,32	1,03	Million tons
Production 1993	0,60	1,65	0,80	0,30	1,52	1,95	0,48	
Capacity Utilisation	45%	56%	47%	42%	45%	59%	47%	

The Steel Sector 1993 - Hungary

	Plate Mills	Hot Strip Mills	Cold Mills	Coating Lines	Heavy LP Mills	Light LP Mills	Tube Mills
Dunaferr	x	x	x				x
DIMAG					x	x	
Ozd						x	
Csepel							x
Capacity	0,20	1,60	0,40	0,00	0,62	0,54	0,20
Production 1993	0,20	1,25	0,28	0,00	0,10	0,29	0,07
Capacity Utilisation	101%	78%	70%		16%	54%	35%

The Steel Sector 1993 - Czech Republic

	Plate Mills	Hot Strip Mills	Cold Mills	Coating Lines	Heavy LP Mills	Light LP Mills	Tube Mills
Vitkovice	x		x		x	x	x
Trinec					x	x	
Nova Hut		x			x	x	x
Others	x		x		x	x	x
Capacity	0,95	1,01	0,46	0,00	2,70	3,70	1,38
Production 1993	0,71	0,88	0,22	0,00	0,45	2,72	0,82
Capacity Utilisation	74%	88%	48%		17%	74%	59%

The Steel Sector 1993 - Slovakia

	Plate Mills	Hot Strip Mills	Cold Mills	Coating Lines	Heavy LP Mills	Light LP Mills	Tube Mills
Kosice		x	x	g/l			x
Podbrezova							x
Capacity	0,00	3,40	1,80	0,40	0,00	0,00	0,40
Production 1993	0,00	3,16	1,37	0,35	0,00	0,00	0,19
Capacity Utilisation		93%	76%	88%			48%

The Steel Sector 1993 - Romania

	Plate Mills	Hot Strip Mills	Cold Mills	Coating Lines	Heavy LP Mills	Light LP Mills	Tube Mills
Sidex-Galati	x	x	x	g			x
Hunedoara					x	x	
Resita					x	x	
Calarasi						x	
Tirgoviste			x			x	
Samel CT						x	
Easteel			x			x	
Braia						x	
Focsani						x	
Others	x		x			x	x
Capacity	2,49	3,15	1,58	0,10	1,40	5,78	2,84
Production 1993	0,86	1,84	0,47	0,04	0,25	1,97	0,41
Capacity Utilisation	34%	58%	30%	40%	18%	34%	14%

Source : WS Atkins International. The Steel Industry in Bulgaria and Other Countries. 1994.9

Chapter 5 Future Prospects for the Supply and Demand of Steel Products

5. Future Prospects for the Supply and Demand of Steel Products

The mid- and long-term economic growth rate is evaluated in this chapter. Based on the economic growth rate, mid- and long-term domestic steel consumption in Bulgaria is forecast in this chapter in a macro-analysis.
Another analytical method, micro-analysis, which forecasts steel consumption based on changes in the industrial structure and developments in the future, is adopted as a complement to the macro-analysis. The export volume was estimated by forecasting steel equipment utilization rates in the world, including those in the neighboring countries of Bulgaria mentioned in Chapter 4, and forecasting the mid- and long-term demand for steel products in the world. The prospective export volume of Bulgarian products, target export prices and type of products are described.

5.1 Forecast of GDP Growth

During the study of the mid- and long-term economic growth of Bulgaria it was found that there is no data approved by the Government with regard to the forecast of the economic growth rate such as GDP. The National Statistical Institute usually forecasts the one year economic growth rate, and the Agency of Economic Coordination and Development makes a short-term forecast. However, the forecast which is made by the Ministry of Finance in order to submit to international conferences is the only mid- and long-term data available.

In this study, the GDP forecast was done by examining the data of WS Atkins International, which is a British consultant, EIU (Economic Intelligence Unit), OECD, IBRD and especially the data and information obtained from the Ministry of Finance. These data of the institutions mentioned above are shown in Table 5-1.

The Ministry of Finance explained that their forecast, which was submitted to the international institutions, was evaluated very strictly. The GDP forecast figures of the Ministry of Finance are lower than those of other institutions mentioned above. The JICA study team evaluated this data as the most conservative data and adopted these figures as the "pessimistic case" of our study. On the other hand, the team also took into considerations a higher GDP growth rate, such as that in the report of the EIU and WS Atkins International, and the fact that the GDP growth rate has begun to recover since 1992 after falling deeply in 1989 as shown in Section 2.1.1 1) d) and set up an "optimistic case" based on a higher growth rate. Bulgaria seems to have already passed the worst period after a decrease of about 40% in its GDP between 1989 and 1993. According to the Ministry of Finance, the GDP growth rate in 1994 turned to plus 0.5% and attained 1.5% in 1995. The long-term forecast of GDP growth rate is shown in Table 5-2 and Figure 5-1 for both the pessimistic and optimistic cases.

Table 5-1 Forecasts of GDP Growth by International Institutions

(%)

	1994	1995	1996	1997	1998-2000	2001-2004
Published Economic Forecasts						
E I U *	-1.0	-1.5	3.5	4.3	4.5	
O E C D **	0.0	0.0				
Consultant; (O)	0.0	3.0	4.0	4.0	4.5	4.0
WS Atkins (P)	0.0	1.5	3.0	3.0	3.5	3.5
					1997-----2000	
I B R D ***	2.0	2.0	3.0		3.8	
Government of Bulgaria ****	0.0	2.0	3.0	3.25		4.0

* E I UEconomic Intelligence Unit

** (O) Optimistic

(P) Pessimistic

*** World Bank, An Economic Update, May 12-13,1993
Other projections were made earlier.

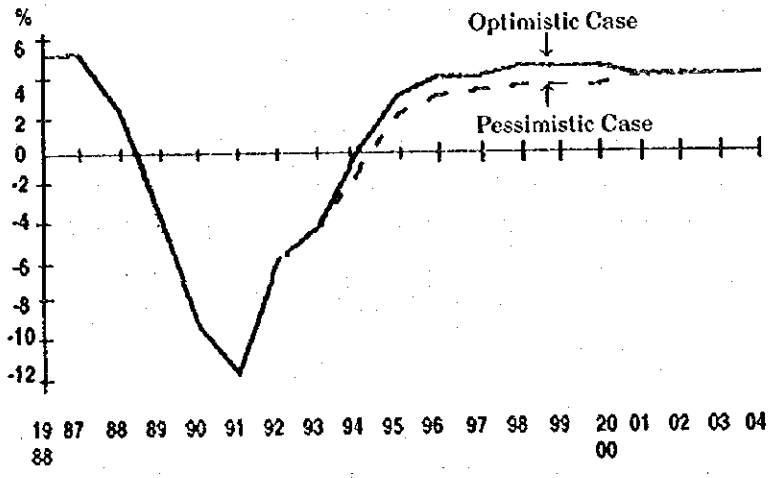
**** Ministry of Finance, with the condition that the figures have not yet been approved by all the ministries.

Table 5-2 Forecast of GDP Growth by JICA

(%)

	1994	1995	1996	1997	1998-2000	2001-2004
Optimistic case	0.0	3.0	4.0	4.0	4.5	4.0
Pressimistic case	-1.0	2.0	3.0	3.25	3.5	4.0

Figure 5-1 Forecast of GDP Growth by JICA



5.2 Methods for Forecasting Future Domestic Demand

There are two methods for forecasting the future domestic demand. One is a macro-analysis method which uses the correlation between GDP and steel demand, and the other one is a micro-analysis method which focuses on the demand categories and product classes.

5.3 Forecasting Future Domestic Demand by Macro-analysis Method

5.3.1 Correlation between GDP and apparent steel consumption

The mid-to-long term economic forecast (GDP growth rate forecast) for Bulgaria is given in Section 5.1. The relationship between real GDP growth and steel consumption was estimated based on this forecast, and apparent steel consumption in Bulgaria was then projected.

The relationship between the real GDP growth rate and the growth rate of steel consumption was formulated below on the basis of "The Steel Industry in Bulgaria and Other Countries" (Sept. 1994), which was prepared by the English consulting firm WS Atkins International.

Among the data from the former USSR and eastern European countries, there is no clear correlation between GDP and steel consumption. This is mainly owing to the instability of the economies concerned (Note). Therefore, we basically used the equation ①, as shown below, which is calculated from the data of the advanced countries. Figure 5-2 shows the relationship between the real GDP growth rate and growth rate of steel consumption in the advanced countries in 1983~92 and can be approximated in linear form using correlation ①:

Growth rate of steel consumption (%) = -6.7% + 3.2 × real GDP growth rate (%) .... ①
(R^2 = 0.52, standard error: 0.39, number of samples: 63)

Equation ① shows the relationship in a group of market economies which were experiencing relatively stable continuing economic growth. The reason why feel it is appropriate to use equation ①, which is calculated from the advanced western countries, is as follows.

As was predicted in Section 5.1, the Bulgarian economy was expected to begin recovering in 1994. As a result, the structure of the Bulgarian economy was expected to gradually approach that of the western countries. Therefore, there is a certain appropriateness to applying equation ①, which uses the data from the western countries, as a precondition for forecasting the conditions in the Bulgarian economy during its recovery period.

However, it is not appropriate to apply the slope and the Y-axis in equation 1 directly to the forecast of the Bulgarian steel consumption for the following reasons.

[Reasons why the slope and Y-axis should be amended]

a) In the advanced countries whose data are used to calculate equation ①, the economic growth rate of more than 3% was not achieved continuously after the latter half of the 1980s. However, for the future economic recovery in Bulgaria, this report forecasts more than 4% economic growth, and the direct application of equation ① might therefore overestimate future Bulgarian steel consumption (For example, an increase of less than 10% in steel consumption can be calculated from the economic growth rate of 5% by equation ①, but this is not consistent with experience or common sense.)

b) The Bulgarian economy will be lead by service industries, not manufacturing industries. Considering this, the increase of steel consumption relative to the economic growth (the slope of the linear regression) in Bulgaria will be rather lower than that in the western countries.

c) Generally, in the advanced countries, where the steel marketing system has been fully developed, the rate of growth in apparent steel consumption exceeds actual demand when the GDP growth rate is high in a good business climate, because users build up their inventories during such periods. Conversely, during recessions, when the GDP growth rate is low, apparent steel consumption drops below actual demand as users draw down their inventories and steel production decreases. Therefore, the slope of equation ①, which is calculated from the data of the advanced countries, might overestimate by this inventory effect. However, because the steel marketing system is not fully developed in Bulgaria, the inventory effect might be small, and it is therefore necessary to adopt a somewhat gentler slope to the line described by equation ①.

d) In Figure 5-1, the average real GDP growth ratio is about 2%. Therefore, 2% can be interpreted as the medium-term and average growth ratio in the advanced countries. This is a neutral level representing neither a boom nor a slump in the economical cycle. At this such level, the inventory effect explained in c) may be virtually nil. Therefore, the point at which (GDP=2%, Steel Consumption=0%) could be appliable to Bulgaria. We therefore adopt a gentler slope to equation ①, using this point. As a result, we adopted a gentler slope and smaller minus on the Y-axis in equation ①.

For the above reasons, we consider it appropriate to adopt equation ②, which has a gentler slope and reduced minus on the Y-axis compared to those of equation ① in a macro forecast of the Bulgarian steel consumption. (WS Atkins International also adopted this equation.)

Growth rate of steel consumption (%) = -4.0% + 2.0 × real GDP growth rate (%) ...②

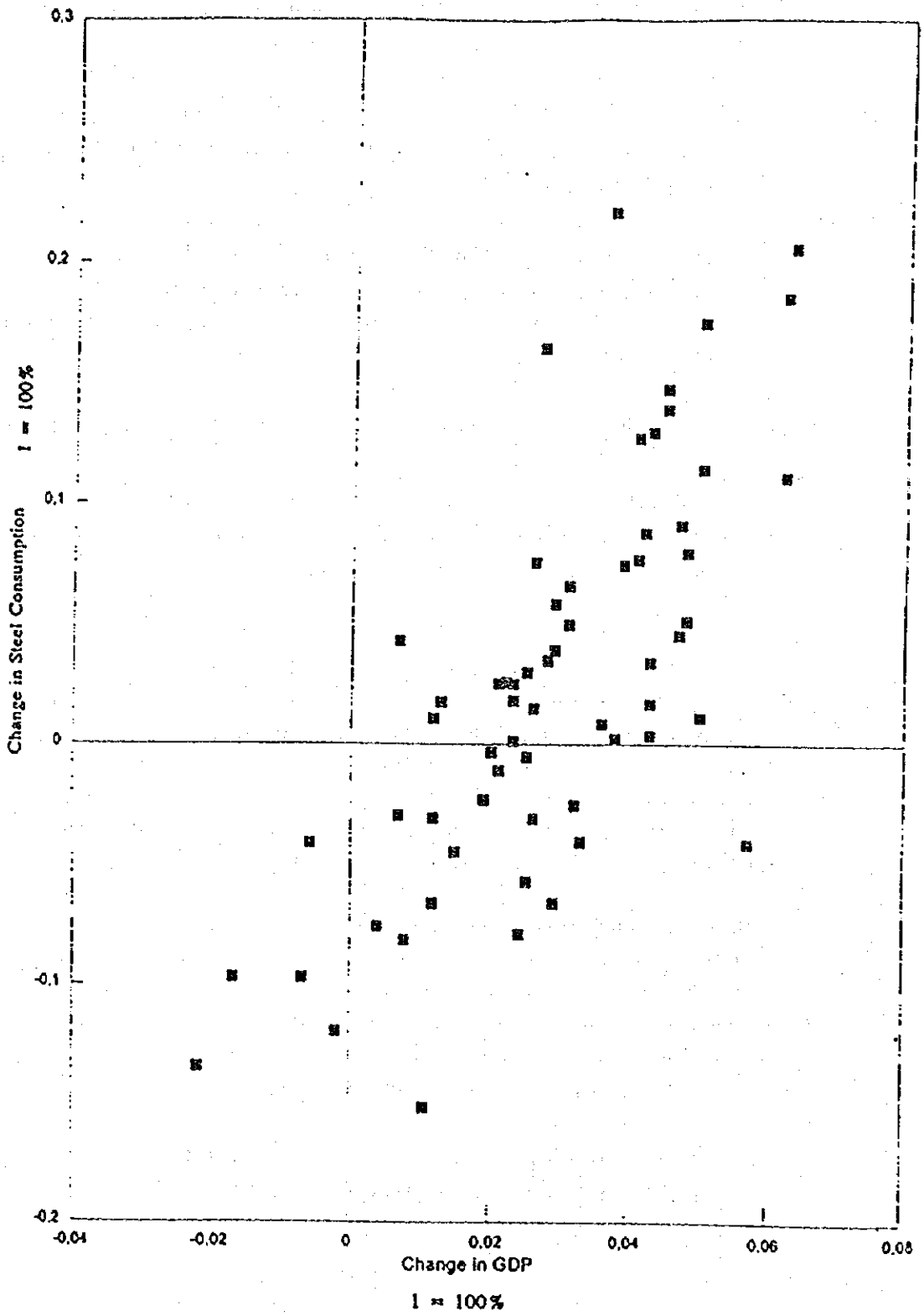
(The real GDP growth rate at which the growth in apparent steel consumption moves from minus to plus is 2%, as shown in the equation ①. Note that only the slope and the Y-axis of equation ① were corrected.)

(Note)
Figure 5-3 shows the relationship between GDP growth and steel consumption in the former USSR and Eastern European countries in the years 1989-92. The trend was basically minus real GDP growth due to the economic instability which accompanied the move from planned economies to market economies, and the rate of decrease in steel consumption was larger than the real GDP growth rate. This was becasuse the steel-consuming industries lost their stable markets in the former COMECON market and suffered even greater stagnation than the general economy.

If the data in Figure 5-3 is approximated in linear form, correlation ③ is obtained. However, the persuasiveness of this correlation is extremely low, considering the small number of samples and major variations among samples. Moreover, equation ③ also indicates that steel demand will not increase until the real GDP growth rate reaches slightly under 7%, which is not a natural conclusion. Equation ③ was therefore not considered appropriate for use in forecasting the steel consumption in Bulgaria.

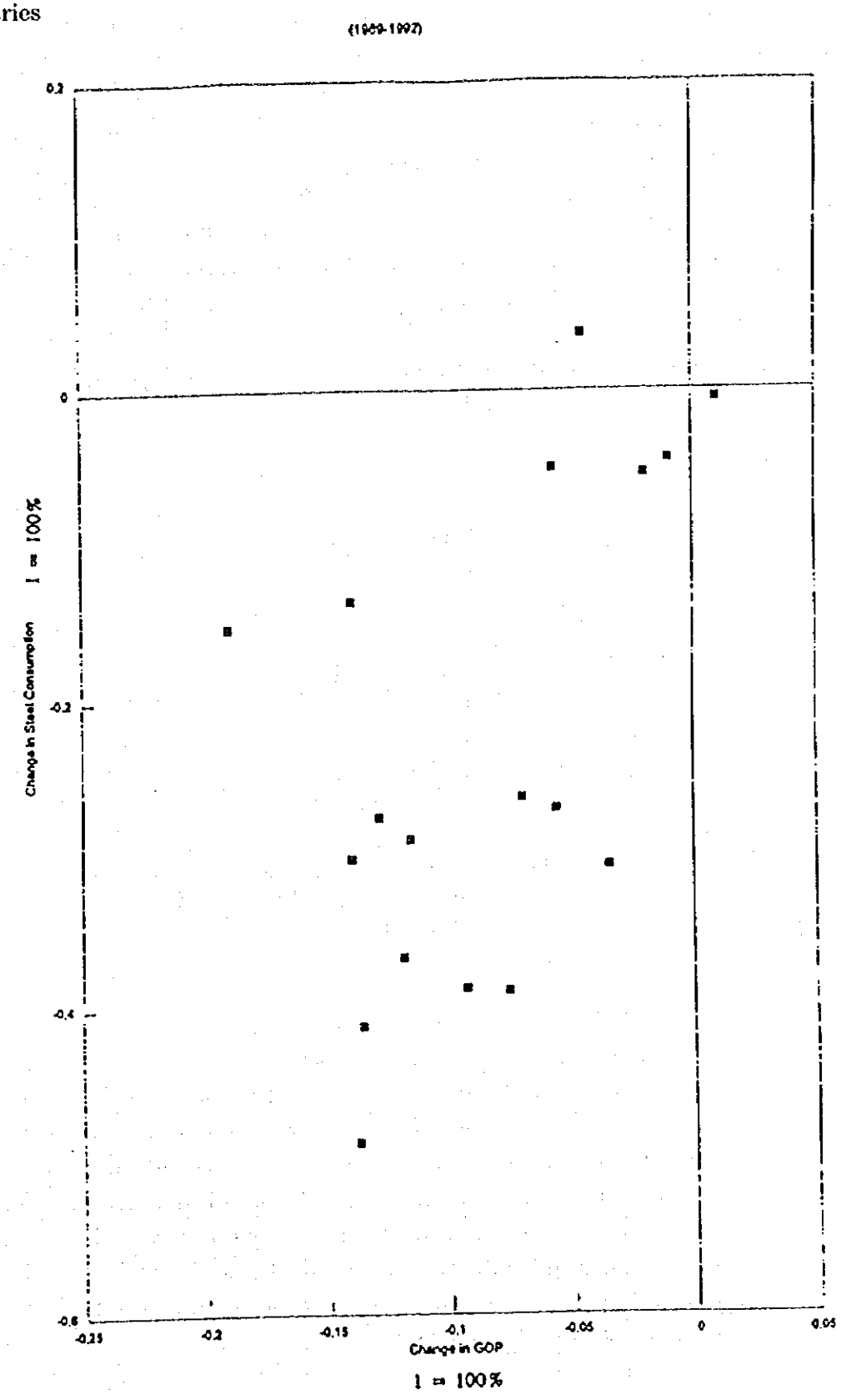
Growth rate of steel consumption (%) = -9.9 % + 1.5 × real GDP growth rate (%) ..... ③
(R^2 = 0.29, standard error: 0.60, number of samples:18)

Figure 5-2 Correlation between GDP and Steel Consumption in Advanced Western Countries
(1983 - 1992)



Source : WS Atkins International, The Steel Industry In Bulgaria and Other Countries, 1994.9

Figure 5-3 Correlation between GDP and Steel Consumption in Eastern European and CIS Countries

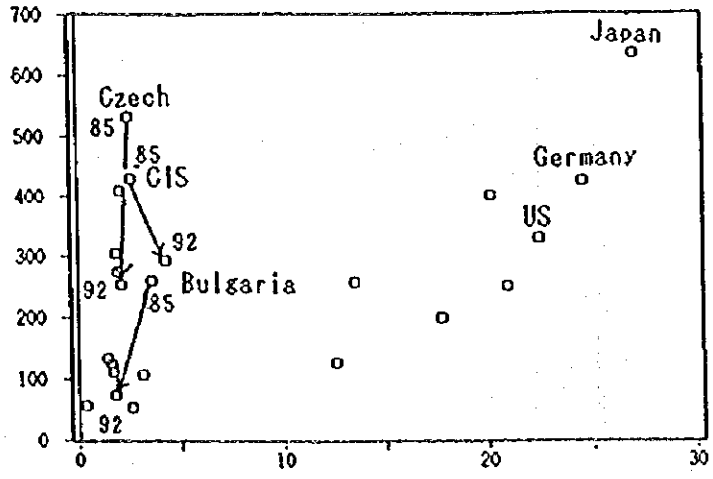


Source : WS Atkins International, The Steel Industry in Bulgaria and Other Countries, 1994.9

5.3.2 Apparent steel consumption per capita

Figure 5-4 indicates the correlation between GDP per capita and the apparent consumption of finished steel per capita in various countries. With a rise in GDP per capita, the apparent steel consumption per capita also usually increases. However, in the former USSR and Eastern European countries until 1989, steel consumption exceeded economic development, supported by the former COMECON regime. Since the transition to a market economy in 1989, steel consumption in those countries has been dropping rapidly. In the future, steel consumption per capita in the CIS and Eastern European countries will gradually increase with the growth of GDP per capita in the same way as in advanced countries.

Figure 5-4 GDP per Capita and Apparent Steel Consumption per Capita



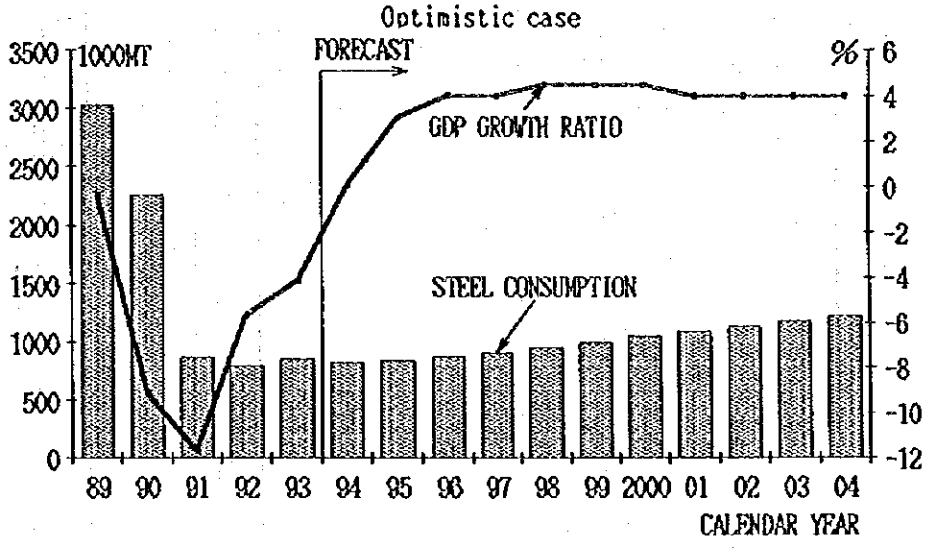
Remark: Apparent consumption of finished steel (1992)
Sources: IISI. Steel Statistical Yearbook 1994

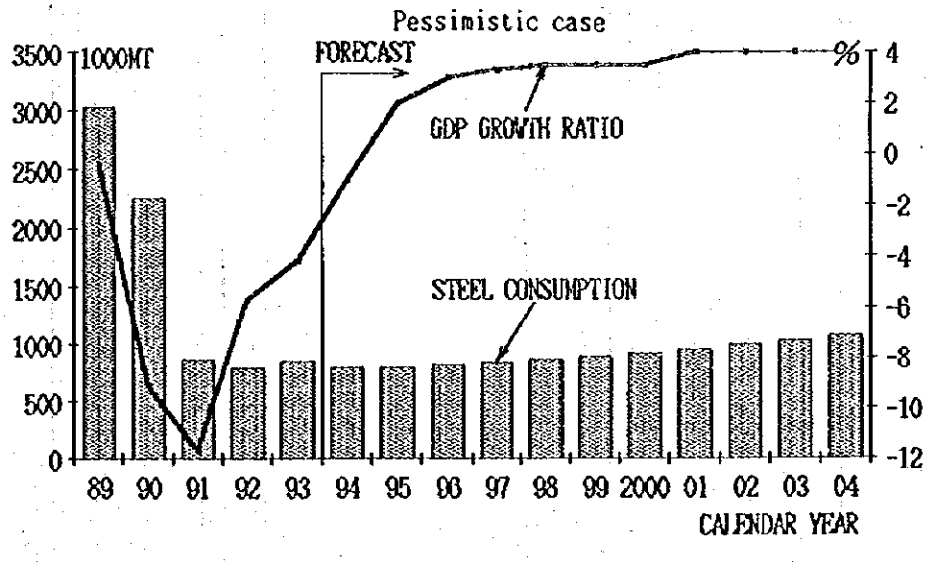
5.3.3 Demand forecast

As mentioned in Section 5.3.1, macro steel demand in Bulgaria was forecast using as a precondition the correlation between steel consumption and real GDP growth in the advanced countries, shown by equation ②. A forecast of steel consumption in the years 1994-2004 was made by applying the real GDP growth rate forecast presented in Section 5-1 to this equation. The results indicated that steel consumption will begin to recover in 1995, but will be limited to a comparatively low level in 2004, reaching 1.23 million tons in the optimistic case, and 1.08 million tons in the pessimistic case (See Table 5-3, Figure 5-5). These results translate into a per-capita apparent steel consumption of 119~136 kg in 2004.

Other forecasts of steel consumption in Bulgaria vary from 0.9 million tons in 2000 ("Steel Industry in Europe," United Nations, April 1994) to 1.22~1.43 million tons in 2004 ("The Steel Industry in Bulgaria and Other Countries," WS Atkins International, September 1994). The average annual growth rate forecast by the JICA study team is almost the same level as that forecast by the two organizations named above.

Figure 5-5 Forecast of Consumption of Finished Steel





Sources: National Statistical Institute of Bulgaria, Ministry of Industry of Bulgaria
(Forecast: JICA Consultant)

Table 5-3 Forecast of Consumption of Finished Steel (Macro-Analysis Method)

						Forecast											(1000MT)	(Average annual change)	
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1993-2000	2000-2004
Apparent consumption (Opt case)	3030	2262	870	799	858	824	840	874	909	954	1002	1052	1094	1138	1183	1231	3.0%	4.0%
percentage change over previous year		-25.3	-61.5	-8.2	7.4	-4.0	2.0	4.0	4.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0		
elasticity of consumption to GDP		2.8	5.3	1.4	-1.8		0.7	1.0	1.0	1.1	1.1	1.1	1.0	1.0	1.0	1.0		
Apparent consumption (Pess case)						807	807	823	843	869	895	921	958	997	1035	1078	1.0%	4.0%
percentage change over previous year						-6.0	0.0	2.0	2.5	3.0	3.0	3.0	4.0	4.0	4.0	4.0		
elasticity of consumption to GDP						0.9	0.0	0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0		
Growth rate of GDP (%) (Opt case)	-0.4	-8.1	-11.7	-5.7	-4.2	0.0	3.0	4.0	4.0	4.5	4.5	4.5	4.0	4.0	4.0	4.0		
(Pess case)						-1.0	2.0	3.0	3.3	3.5	3.5	3.5	4.0	4.0	4.0	4.0		

Population (thousand)	8990	8991	8982	9036									9071					9077	
Apparent consumption per capita (Kg)																			
(Opt case)	337	252	97	93									116					136	
(Pess case)				89									102					119	

Sources: National Statistical Institute of Bulgaria, Ministry of Industry of Bulgaria

Forecast of consumption of finished steel by other consultants

「Steel Industry In Europe」(OE, 1994.4)

																	(Average annual change)	
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1993-2000	2000-2004
Average Growth				800								900					1.5%	

「The Steel Industry In Bulgaria and Other Countries」
(US Atkins International, 1994.9)

																	(Average annual change)	
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1993-2000	2000-2004
High Growth					1000	960	980	1020	1060	1110	1170	1230	1280	1330	1380	1430	3.0%	3.8%
Low Growth					1000	960	950	970	990	1020	1050	1080	1110	1150	1180	1220	1.1%	3.1%
Average Growth					1000	960	960	990	1020	1070	1110	1150	1190	1240	1280	1330	2.0%	3.7%

5.4 Forecasting Future Domestic Demand by Micro-analysis Method

5.4.1 Present steel consumption by demand categories and kinds of products

Table 5-4 shows the apparent consumption of finished steel by demand categories and product classes in Bulgaria in 1993. As mentioned in Section 3.1.5, the proportions for industrial machinery, construction, and electrical machinery are high in the demand categories. For kinds of products, the proportion of long products is 56%, flat products is 32%, and tubes is 12%. The category of industrial machinery consumes various kinds of products in a well-balanced way, but construction consumes mainly long products, and electrical machinery mainly flat products.

Table 5-4 Steel Consumption by Demand Categories and Product Classes

(1000KT)

Usage of each product (1993)	Gen	Mine	Non fe	Mach	Elec	Chem	Food	Cons	Agr	Trans	Other	Total
Ingots & semis	1	2	1	34	2	1	1	75	1	1	10	128
Railway	0	0	0	0	0	0	0	1	0	1	0	3
Sections	0	0	1	6	0	1	0	7	0	0	3	17
Bars	1	1	1	28	2	1	0	61	1	0	8	104
Wire rods	0	0	0	76	0	0	0	25	0	0	3	104
Special steel	0	19	2	35	3	1	0	1	0	0	2	62
Hot 3ng. more	1	1	1	45	3	2	0	5	0	0	2	60
Hot 3ng less	0	0	0	20	6	2	0	3	1	0	3	35
Cold rolled s.s.	0	0	0	52	16	5	0	7	2	0	9	91
Electrical s.s.	0	0	0	0	12	0	0	0	0	0	0	12
Stainless sto l.	0	0	0	4	0	1	0	0	0	0	2	7
Steel for tool	0	0	0	1	0	0	0	0	0	0	2	6
Tinplate	0	0	0	26	9	3	1	4	0	0	2	44
Galvanized s.s.	0	0	0	8	0	0	0	5	0	0	1	15
Cold tapes	0	0	0	4	2	0	0	0	0	0	1	7
Sections	0	1	0	2	0	0	0	1	0	0	1	5
Rails	0	0	0	5	0	0	0	0	0	0	0	5
Seamless tubes	3	1	1	24	2	1	1	9	1	0	5	50
Welded tubes	1	0	0	35	0	0	0	11	0	0	4	51
Drawn wires	0	1	0	22	0	3	0	8	0	0	6	52
Total	5	26	7	431	67	23	2	218	4	2	53	858
	0.5%	3.0%	0.8%	50.3%	7.8%	2.7%	0.2%	25.4%	0.5%	0.2%	6.2%	100.0%

Long 55.9%
Flat 32.3%
Tube 11.8%

5.4.2 Micro-analysis method for forecasting domestic demand

As various statistical data are not well prepared in Bulgaria, it was not possible to use the micro-analysis method to forecast domestic consumption of steel products and demand categories as is done in advanced countries.

The following procedure was used to forecast demand by product type. The volume of domestic demand is based on the macro method forecast.

① Analyze the trend in government's mid-and long-term industrial development plan.
② Forecast the changes in the mid-and long-term industrial structure based on ①.
③ Forecast the changes in the composition of steel consumption by demand category based on ②.
④ Forecast the steel consumption by product type based on the above ③ and assumption that the product mix ratio of each demand category will be constant in 1993 and after.

5.4.3 Mid-and long-term industrial development plans

The following informations with regard to industrial development plan were obtained from the ministries concerned of Bulgaria.

a) In 1994, the Ministry of Industry ordered each manufacturing company, including steel company, to make out its own business plan which extends to 1997.
The Ministry has used the results of those plans as basic information for interest relief treatment and other measures.

b) As mentioned in Section 2.2.4, the Ministry of Finance, with cooperation from other ministries and committees, have formulated an investment program. This program indicates priorities, sources of financing, and allocation of investment and was submitted to the World Bank in May 1994. It includes various kinds of infrastructure, for example, roads, bridges, irrigation, dams, railroads, and telecommunications. However, it does not include any investment in the industrial sector. The government expects companies in the industrial sector to find their own sources of investment for their facilities.

c) The Ministry of Trade has no funds to promote exports of industrial products due to the financial deficit. Each company in the industrial sector thus must expand its exports to earn hard currency without government assistance.

These facts lead us to believe that the government's support of companies in the industrial sector is not sufficient mainly because of the huge financial deficit. It will be very difficult to secure sufficient foreign capital into the industrial sector because of this unstable economic situation.

5.4.4 Mid-and long-term forecast of changes in the industrial structure

The information from the Ministry of Industry, Ministry of Finance, Ministry of Trade, Ministry of Agriculture, Ministry of Regional Development and Construction, Energy Committee, and Agency for Economic Coordination & Development has been used to forecast the following changes in the industrial structure up to 2004.

a) Industrial machinery
Industrial machinery production was at a high level up to 1989. Forklifts, hydraulic systems, some kinds of automobile parts, and drills were produced by Bulgaria under the former COMECON regime. The quality was good and their products could be stably exported to the former COMECON countries (See Figure 5-6).

However, after the collapse of the COMECON regime, the machinery industry lost almost the whole export market for its products. The depressed Bulgarian economy has also reduced domestic demand. These adverse effects have resulted in the capacity utilization of this industry declining to around 15% (See Figure 5-

7). This has caused cash flow problems in many companies and no large investment has been made since 1989.

The industrial companies in this sector are trying to find new export markets and also to utilize their facilities by making other kinds of products. However, it will take more than 5 years to develop a stable export market. Domestic demand will narrowly recover after 2000, when we forecast that GDP growth will exceed 4%.

b) Electrical machinery

The situation for electrical machinery is similar to that for industrial machinery. Bulgaria was supplying electric motors, transformers and disks under the former COMECON regime, and electrical machinery production was relatively stable until 1989.

However, this industry also lost its export markets and suffered from depressed domestic demand after 1989. Various kinds of electrical machines are now imported from many western countries. Although the price of imported products is much higher than that of Bulgarian-made ones because of the devalued leva, the quality of imported products is much more sophisticated. It is crucial for the electrical machinery industry to start competing with imported products, and we forecast that the recovery of this industry will begin after 2000.

c) Construction

Investment for infrastructure was drastically reduced after 1989 because of economic instability and the huge financial deficit. As mentioned in Section 5.4.3 b), an investment program has been published by the Government, especially for projects with social need. Realizing these projects will require considerable external borrowing, and several foreign banks are already committed to financing some projects.

There are several big projects which are under construction or planned as mentioned below, and we forecast that construction of the infrastructure will increase stably until 2004.

- Two west-east highways
- One north-south highway, including a long tunnel through the Balkan mountains
- Three bridges across the Danube River
- Repairs to Sofia International Airport
- Underground railway in Sofia

Investment for residential buildings also plunged rapidly after 1989 (See Figure 5-8). Traditional Bulgarian residential buildings are constructed of reinforced con-

crete and their average life is 60-80 years. Since the Bulgarian population is gradually decreasing, new housing construction will not recover early. Most housing is owned by the residents themselves, most of whom lack funds to invest in repairs, so it is also difficult to expect a large amount of repair investment.

d) Agriculture

Agricultural production also plunged deeply after 1989. Land is now being returned to the original owners and management units are being downscaled. Agricultural production will increase gradually until 2004 in parallel with the recovery of the whole economy. However, there are not large investment plans for this industry, except for several small irrigation projects.

e) Electrical power supply

According to a long-term plan for the electrical power supply from the Energy Committee, 3 thermal and 1 hydro-electric power plants will be constructed from 1999 to 2003.

f) Transportation

There is an investment plan in the Bulgarian railway system by introduction of foreign fund. However, no details are available.

In conclusion, the industrial structure will not change rapidly until 2004. Among the sectors, construction will increase stably with the support by the government's investment program, although the recovery of industrial sectors such as industrial and electrical machinery will be delayed until after 2000.

Figure 5-6 Production of Machinery

Thousands

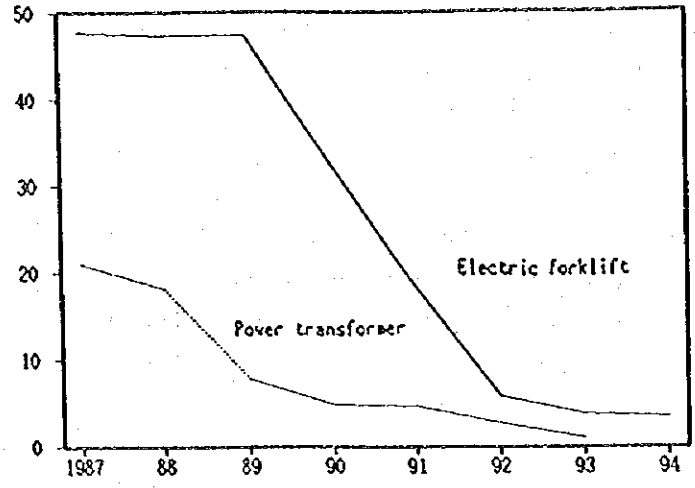


Figure 5-7 Exports of Work Trucks

Thousands

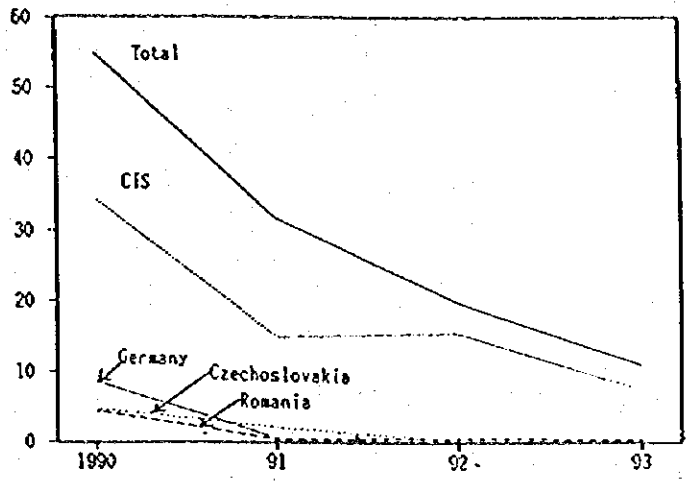
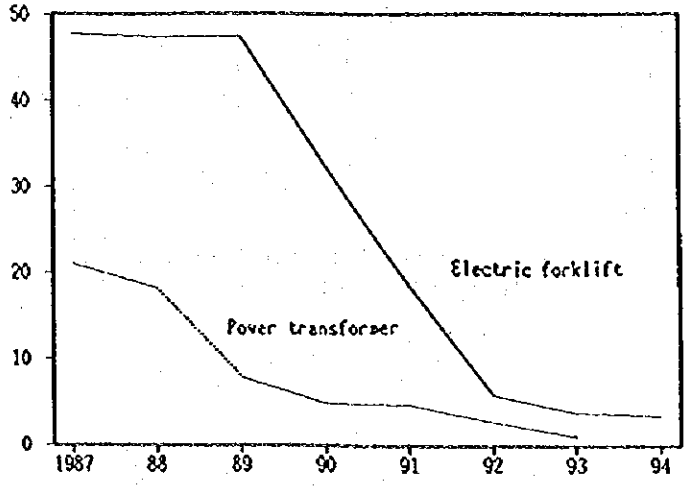


Figure 5-8 Dwellings Completed

Thousands



5.4.5 Changes in the relative shares of demand categories

Based on the mid- and long-term forecast of changes in the industrial structure as mentioned in Section 5.4.4, the mid- and long-term share of each industrial sector in steel consumption was analyzed. The machinery sector, which consists of industrial and electric machinery companies, etc. will see its share of steel consumption shrink from 50% in 1993 to 46% to 2000, and it will regain share to some extent, to about 48%, after 2000 when the domestic economy is expected to become stable. On the contrary, the construction sector is expected to be the most stable consumer of steel products because of development programs expected by 2000, extending its share from 25% in 1993 to about 30% in 2000. However, the share of this sector will then fall to about 28% as the machinery sector recovers, as mentioned above.

Table 5-5 Forecast of Steel Consumption by Demand Categories

Forecast of steel use (Optimistic case) (1000MT)

	1993		1995		1999		2004	
Generator	5	0.6%	6	0.7%	8	0.8%	7	0.6%
Mining	26	3.0%	24	2.8%	27	2.7%	31	2.5%
Non ferrous	7	0.8%	6	0.7%	8	0.8%	10	0.8%
Machinery	431	50.2%	403	48.0%	461	46.0%	591	48.0%
Electric	67	7.8%	61	7.3%	68	6.8%	96	7.8%
Chemistry	23	2.7%	23	2.7%	27	2.7%	33	2.7%
Food	7	0.8%	7	0.8%	9	0.9%	12	1.0%
Construction	218	25.4%	236	28.1%	305	30.4%	341	27.7%
Agriculture	4	0.5%	5	0.6%	6	0.6%	7	0.6%
Transportation	6	0.7%	7	0.8%	8	0.8%	10	0.8%
Others	64	7.5%	63	7.5%	75	7.5%	92	7.5%
Total	858		840		1002		1231	

Forecast of steel use (Pessimistic case)

	1993		1995		1999		2004	
Generator	5	0.6%	6	0.7%	7	0.8%	6	0.6%
Mining	26	3.0%	23	2.8%	24	2.7%	27	2.5%
Non ferrous	7	0.8%	6	0.7%	7	0.8%	9	0.8%
Machinery	431	50.2%	379	47.0%	403	45.0%	512	47.5%
Electric	67	7.8%	59	7.3%	61	6.8%	84	7.8%
Chemistry	23	2.7%	22	2.7%	24	2.7%	29	2.7%
Food	7	0.8%	6	0.8%	8	0.9%	11	1.0%
Construction	218	25.4%	235	29.1%	281	31.4%	304	28.2%
Agriculture	4	0.5%	5	0.6%	5	0.6%	6	0.6%
Transportation	6	0.7%	6	0.8%	7	0.8%	9	0.8%
Others	64	7.5%	61	7.5%	67	7.5%	81	7.5%
Total	858		807		895		1078	

Sources : National Statistical Institute & Ministry of Industry of Bulgaria
(Forecast: JICA Consultant)

5.4.6 Forecast of domestic demand by product type

The distribution of steel product types in each demand category in 1993, as explained in Section 5.4.1, will not change before 2004. This is based on the assumption that the steel consumption structure in each category will not change widely within a 10-year period.

Then, based on changes in the relative shares of demand categories until 2004 explained in Section 5.4.5, the forecast of apparent consumption of finished steel by kinds of products was made. The result is shown in Table 5-6. (We have forecast both the optimistic and pessimistic cases.) In both cases, the share of long products will be high at 57%, and that of flat products low at 32% in 2004. (Appendixes 5-1 and 5-2 for forecasts of demand categories and steel product types)

In "Steel Industry in Europe" (UN, April 1994) and "The Steel Industry in Bulgaria and Other Countries" (WS Atkins International, Sept. 1994), the share of long products in the product mix is predicted to fall to below 50% in the years 2000-2004, while the share of flat products is seen as rising to above 40% in the same period. This is a forecast made on the assumption that the composition of product classes in Bulgaria will gradually approximate that in the Western European nations. This report based its forecast of the composition of the product mix on the study of change in the industrial structure of Bulgaria, as mentioned in Sections 5.4.4 and 5.4.5.

Table 5-6 Forecast of Steel Consumption by Product Classes

Optimistic case (1000MT)

	1993	1995	1999	2004
Ingot & semis	128	132	164	192
Railway	3	3	4	5
Sections	17	17	21	25
Bars	104	107	133	156
Wire rods	104	101	120	148
Special steel	62	57	66	82
Hot 3mm more	60	57	66	84
Hot 3mm less	35	33	39	49
Cold rolled s.s.	91	87	101	129
Electrical s.s.	12	11	12	17
Stainless steel	7	7	8	10
Steel for tool	6	6	7	8
Tinplate	44	42	48	63
Galvanized s.s.	15	15	18	22
Cold tapes	7	7	7	10
Sections	5	5	6	7
Balls	5	5	5	7
Seamless tubes	50	49	59	72
Welded tubes	51	50	59	72
Drawn wires	52	51	60	75
Total	858	840	1002	1231

Long products	55.9%	56.5%
Flat products	32.3%	31.8%
Tubes	11.8%	11.7%

Pessimistic case (1000MT)

	1993	1995	1999	2004
Ingot & semis	128	129	148	169
Railway	3	3	4	4
Sections	17	16	19	22
Bars	104	105	121	137
Wire rods	104	97	106	129
Special steel	62	54	58	71
Hot 3mm more	60	54	59	73
Hot 3mm less	35	32	34	43
Cold rolled s.s.	91	83	89	112
Electrical s.s.	12	11	11	15
Stainless steel	7	6	7	9
Steel for tool	6	5	6	7
Tinplate	44	39	43	55
Galvanized s.s.	15	14	16	19
Cold tapes	7	6	7	9
Sections	5	5	5	6
Balls	5	4	5	6
Seamless tubes	50	47	53	63
Welded tubes	51	47	52	63
Drawn wires	52	49	53	66
Total	858	807	895	1078

Long products	55.9%	56.7%
Flat products	32.3%	31.7%
Tubes	11.8%	11.7%

(Sources: Data of steel consumption from National Statistical Institute and Ministry of Industry)
(Forecast : JICA Consultant)

Forecast of other consultants

「Steel Industry in Europe」 (UN, 1994.4)

	1992	2000
Long products	55.0%	48.0%
Flat products	38.0%	43.0%
Tubes	8.0%	9.0%

「The Steel Industry In Bulgaria and Other Countries」
(WS Atkins International, 1994.9) Average case

	1993	2004
Long products	58.0%	48.1%
Flat products	32.0%	42.1%
Tubes	10.0%	9.8%

5.5 Forecast of Future Exports

5.5.1 Method of forecasting exports

The following procedure was used in forecasting exports

① Mid- and long-term forecast of world steel demand centering on Bulgaria's target export destinations

② Forecast of world effective operating rate by region based on ①.

③ Forecast of supply and demand by product type in neighboring European nations.

④ Analysis of possibility of Bulgarian exports based on ① through ③.

⑤ Analysis of target export price of Bulgarian steel products

⑥ Forecast of exports by product type in consideration of ④ through ⑤ (Based on an estimate of imports by product type, a forecast of net exports by product type was also made.)

5.5.2 Forecast of mid- and long-term world steel demand

In the IISI Mid- and Long-Term Outlook for Steel Consumption (September 1995), world steel consumption is predicted to rise from 660 million tons in 1995 to 720 million tons in the year 2000. Although the growth rate will be low in Europe, the US, and other industrialized nations, a high growth rate (averaging 3.4% per year from 1995 to 2000) is foreseen in Asia, centering on China. (See Table 5-7.)

On the other hand, World Steel Dynamics, Steel Strategist (Paine Webber, May 1994), in its mid- to long-term outlook for crude steel consumption, foresees growth from 720 million tons in 1993 to 810 million tons in 2000. A decrease in the advanced countries is foreseen, but a high growth rate is predicted in the developing nations, and particularly in Asia. (See Table 5-8.)

Table 5-7 Forecast of World Consumption of Finished Steel

(Million tons)

	1995 Estimate	1996 Forecast	2000 Trend	1995-2000 percent per year
European Union	124.7	123.9	122.0	-0.4
Other W. Europe	11.3	11.4	12.0	1.2
Eastern Europe	15.7	16.4	19.0	3.9
Former USSR	44.0	45.0	49.0	2.2
Total Europe	195.8	196.7	202.0	0.6
United States	99.2	95.6	95.0	-0.9
Canada	13.3	12.7	13.0	-0.5
Latin America	31.5	32.3	38.0	3.8
Total America	144.0	140.6	146.0	0.3
China	90.0	94.0	110.0	4.1
Japan	78.3	76.3	80.0	0.4
Other Asia	115.7	122.7	145.0	4.6
Total Asia	284.0	293.0	335.0	3.4
Oceania	6.6	6.5	7.0	1.2
Africa	13.6	13.8	15.0	2.0
Middle East	11.5	11.6	12.0	0.9
World Total	655.4	662.1	717.0	1.8

Table 5-8 Forecast of World Consumption of Crude Steel

Crude steel equivalent

Year	Developed World	Developing World	Western World	CIS/East Europe	China/ North Korea	Ex-Communist World	Total
1993	367.7	136.3	504.0	124.2	96.7	220.9	724.9
1994E	361.5	141.7	503.2	121.1	98.2	219.3	722.5
1995E	372.3	148.6	520.9	124.0	105.8	229.8	750.7
1996E	382.7	156.1	538.8	130.4	114.2	244.6	783.4
1997E	380.3	162.8	543.1	133.5	119.8	253.3	796.4
1998E	365.1	166.7	531.8	129.7	127.4	257.1	788.9
1999E	353.9	176.3	530.2	126.9	131.1	258.0	788.2
2000E	359.2	183.8	543.0	129.5	133.9	263.4	806.4

Growth rates

Percentage change per annum

	Developed world	Developing world	Western world	Ex-Comm. world	Total
1947-74	+5.4%	+10.6%	+5.5%	+9.0%	+6.3%
1974-86	+2.4	+7.7	+1.1	+2.5	+0.1
1986-90	+2.8	+5.4	+3.3	-0.4	+1.9
1990-95	-0.5	+6.0	+1.1	-3.7	-0.5
95-2000	-0.7	+4.3	+0.8	+2.8	+1.4

* Forecast is based on slow growth scenario for the Western World economy

Source : Paine Webber, World Steel Dynamics, Steel Strategist, 1994.5

5.5.3 Forecast of world effective operating rate

According to the forecast for the world effective operating rate presented by World Steel Dynamics and Steel Strategist (Paine Webber, May 1994), the effective operating rate in the developing world will trend as high as 98% with a stable increase in demand until the year 2000, while the rate in industrialized world, including the US and European countries, will not reach 90% due to flat demand and delays in capacity reduction. (See Table 5-9)

Table 5-9 Forecast of World Effective Operating Rate

Effective Operating Rate	1992	1993	1994E	1995E	1996E	1997E	1998E	1999E	2000E
USA	84.2%	86.0%	88.0%	91.1%	92.2%	88.5%	84.2%	84.8%	88.8%
Japan	85.6%	89.2%	86.6%	92.0%	95.2%	93.7%	92.0%	90.6%	93.0%
EU	86.2%	87.6%	88.1%	91.4%	93.3%	95.7%	92.8%	89.8%	89.5%
Rest of Developed	90.8%	94.5%	96.1%	94.9%	95.7%	97.7%	92.6%	88.7%	92.6%
Developed World	86.1%	88.3%	88.8%	92.0%	93.8%	93.5%	90.4%	88.6%	90.6%
Developing World	97.3%	97.5%	98.3%	98.1%	99.4%	99.2%	98.1%	98.6%	98.1%
Western World	88.7%	90.6%	91.3%	93.6%	95.4%	95.1%	92.7%	91.7%	93.0%
Ex-Communist World	80.7%	76.7%	78.4%	80.6%	85.8%	88.6%	88.3%	88.5%	88.6%
World Total	86.0%	85.8%	86.9%	89.2%	92.2%	93.0%	91.2%	90.6%	91.5%

Source : Paine Webber, World Steel Dynamics, Steel Strategist, 1994.5

5.5.4 Forecast of steel supply and demand by product type in European nations

The excess capacity in the steel industry of Western and Eastern Europe and the CIS will remain until 2004 (Table 5-10), the excess capacity for long products being especially large. The background to this situation is that steel demand in Europe will be low, and the planned capacity reduction in each country will be difficult because of employment problems.

Table 5-10 Capacity Utilization of Steel Equipment in Europe

Production for Domestic Consumption in 2004
Compared with Present Capacity

	Capacity (Mt)	Production (Mt)	Capacity Utilisation (%)
Western Europe			
Plate	14	8	57%
HR coil	92	61	67%
CR coil	56	34	61%
Coated sheets	29	19	66%
Heavy longs	17	9	50%
Light longs	77	44	57%
Pipes	28	12	44%
Crude steel	219	137	63%
Central Europe			
Plate	6	2	32%
HR coil	14	9	66%
CR coil	7	5	62%
Coated sheets	2	2	138%
Heavy longs	8	2	23%
Light longs	15	6	41%
Pipes	6	2	33%
Crude steel	46	23	50%
Former Soviet Union			
Plate	11	4	38%
HR coil	42	27	64%
CR coil	18	14	77%
Coated sheets	4	7	181%
Heavy longs	26	8	31%
Light longs	39	22	57%
Pipes	19	7	40%
Crude steel	154	74	48%

Note: Production includes material for downstream processing and pipe manufacture. Typical yields have been assumed. Production is for domestic consumption only.

Source : WS Atkins International, The Steel Industry In Bulgaria and Other Countries. 1994.9

5.5.5 Possibility of export of Bulgarian steel products

Based on the study of the mid- and long-term world steel markets mentioned in the previous sections, the possible markets for the Bulgarian steel products are summarized as follows.

① The world mid- and long-term demand for the steel products will decrease in the developed countries, such as the U.S. and European countries, and increase in the developing countries, such as the Asian countries.

② The mid- and long-term operating rate will decrease in the developed countries and be higher in the developing countries. Large excess capacity will exist in Europe, especially at bar mills.

③ From the above ① to ③, the European markets are not expected to be possible markets for Bulgarian steel products, and more remote markets such as Asia should be Bulgaria's target markets.

On the other hand, the following restrictions will apply to exports.

① Severe competition at the export markets will make exporters unprofitable. This will make exporters turn away from excessive exports.

② The high export ratio of as much as 90% prevailing currently in Bulgarian cannot be maintained, disregarding cooperation with the other countries, especially with the neighboring European countries. Bulgaria will have to adjust its exports to the level of other European countries, where the export ratio is about 50% currently. (See Table 5-11)

③ Non-price competitiveness: Quality, after-service, delivery control and geographical merits are important factors for successful exports. Bulgaria will have to establish most of these factors.

Table 5-11 Exports Ratio vs. Steel Production

(1991)

	Hot rolled production (1000MT)	Exports of products (1000MT)	Exports ratio
France	18005	11957	66.4%
Germany	40795	19649	48.2%
Italy	30100	8954	29.7%
Spain	11645	4810	41.3%
UK	13706	7961	58.1%
Czech	7451	4686	62.9%
Poland	8080	3689	45.7%
CIS	55245	5354	9.7%
US	88000	3720	4.2%
Japan	104860	17916	17.1%
Korea	26531	7670	28.9%

Source : IISI. Steel Statistical Yearbook 1993

5.5.6 Target export price of Bulgarian steel products

As explained in Section 4.2, steel prices in the world market rise and fall in about a ten-year cycle according to changes in supply and demand. After 1990, steel prices dropped drastically owing to the world economic recession and to the increased steel exports from the former USSR, Eastern Europe, and other countries. However, during 1993-94, there have been signs of recovery. It is unlikely until 2004 that steel prices will become much lower than those in 1993-94, taking into account the recovery of the world economy and efforts to reduce steel industry capacity in various countries.

Under these market circumstances, it will be appropriate to set the mid- and long-term target export price based on the market price as of 1994 in Bangkok, Thailand where the export competition is the most severe as shown in Table 5-12. The Bulgarian steel companies have to streamline their business so that they can still earn a reasonable profit in the most competitive export market.

Table 5-12 Bulgarian Target Export Prices

(US$/MT)

	① CIF Bangkok (Market price in 94)	② Ocean freight	③ Insurance (C&FX110XX0.6%)	④ Inland freight	①-②-③-④ Export price (ex works) Target prices in 1999 & 2004 ⇩
Slab	235	30	1.6	10	193
Bloom	235	30	1.6	10	193
Billet	235	30	1.6	10	193
Rebar	286	40	1.9	10	234
Wire rod	365	40	2.4	10	313
Plate	315	40	2.1	10	263
Hot coil	295	40	1.9	10	243
Cold coil	365	40	2.4	10	313

Ocean freight : from Burgas to Bangkok
Inland freight : from Kremikovtzi to Burgas

Source : JICA Consultant's Estimation

5.5.7 Forecast of future exports by steel product type

Based on the possibility of exporting Bulgarian steel products and the target export price mentioned in Sections 5.5.5 and 5.5.6 respectively, the export volume by product type is forecast as shown in Table 5-13. The mid- and long-term export ratio of steel products of Bulgaria will fall to around 55% or 1,030 thousand tons in 2004, which is close to the level of the other European countries.

Steel imports will be 400 thousand tons, so net steel exports will drop from 740 thousand tons in 1993 and 1,110 thousand tons in 1994 to 630 to 640 thousand tons in 2004. "The Steel Industry in Bulgaria and Other Countries" (WS Atkins International, Sept. 1994) also forecasts that steel net exports will drop sharply to 490 thousand tons in 2004.

Table 5-13 Forecast of Exports and Imports of Steel Products

			Optimistic Forecast (1000KT)		Pessimistic Forecast (1000KT)	
		1993	1999	2004	1999	2004
Long & flat semis & products	E	1387	955	955	955	955
(= Hot rolled production)	M	598	351	350	348	345
Long products	E	817	326	305	325	305
	M	463	274	275	274	274
Ingots & semis	E	342	120	120	120	120
	M	108	80	80	80	80
Railway-track material	E	0	0	0	0	0
	M	3	4	5	4	4
Sections	E	92	10	10	10	10
	M	103	20	20	20	20
Bars	E	200	100	80	100	80
	M	102	80	80	80	80
Wire rods	E	165	80	80	80	80
	M	119	80	80	80	80
Special steel	E	18	15	15	15	15
	M	30	10	10	10	10
Flat products	E	570	630	650	630	650
	M	135	77	75	74	71
Hot rolled sheets & strip (More than 3mm in thickness)	E	543	560	560	560	560
	M	47	30	30	30	30
Hot rolled sheets & strip (3mm and less in thickness)	E	0	0	0	0	0
	M	0	0	0	0	0
Cold rolled sheets & strip	E	25	70	90	70	90
	M	60	20	10	20	10
Electrical sheets & strip	E	0	0	0	0	0
	M	12	12	17	11	15
Stainless steel	E	1	0	0	0	0
	M	8	8	10	7	9
Steel for tool	E	2	0	0	0	0
	M	8	7	8	8	7
Flat products	E	74	86	71	86	71
	M	119	48	46	48	46
Tinplate	E	7	15	15	15	15
	M	39	10	10	10	10
Galvanized sheets & strip	E	12	18	18	18	18
	M	0	0	0	0	0
Cold Tapes	E	3	6	6	6	6
	M	2	1	1	1	1
Sections	E	1	2	2	2	2
	M	3	0	0	0	0
Balls	E	0	0	0	0	0
	M	0	0	0	0	0
Seamless tubes	E	19	15	10	15	10
	M	45	20	20	20	20
Welded tubes	E	18	15	10	15	10
	M	9	5	5	5	5
Drawn wires & bars	E	14	15	10	15	10
	M	21	10	10	10	10
Steel products total	E	1461	1041	1026	1041	1026
	M	717	397	396	384	381
Net exports		744	644	630	657	645

E:Exports, I:Imports, Net exports= Exports-Imports

Sources : National Statistical Institute & Ministry of Industry of Bulgaria
(Forecast: JICA Consultant)

5.6 Steel Product Production Plan (Production Quantity and Product Type)

The apparent consumption and exports and imports of each type of finished steel product up to 2004 have been forecast in Sections 5.3.3 and 5.5.7 respectively. From these data, the forecast production for each product up to 2004 can be calculated using the following equation;

(Production = Apparent consumption - Imports + Exports)

The total production of finished steel will increase gradually from 1,600 thousand tons in 1993 to 1,860 thousand tons (in the optimistic case) or 1,710 thousand tons (in the pessimistic case) in 2004 (See Table 5-14). The production of long products will fall slightly due to the decrease in net exports, while the production of flat products will rise. The ratio of exports to the production of finished steel will decline from 91% in 1993 to 55-60% in 2004 due to recovery of domestic demand. As Table 5-11 shows, the ratio of exports is now 50-60% in the Western and Eastern European countries. The proportion of steel exports from Bulgaria will gradually approach that of typical European countries.

"The Steel Industry in Bulgaria and Other Countries" also forecasts that the total production of steel products will be 1,710 to 1,920 thousand tons, this being almost the same as this report.

Although two cases were set up, the optimistic case is considered more probable in terms of the current operational level, production capacities, and desires of the concerned parties in Bulgaria. Therefore, this production plan will in principle be hereinafter adopted in this study. (The production plan is described in Section 9.2)

Table 5-14 Forecast of Supply and Demand of Steel Products

			Optimistic Forecast (1000MT)			Pessimistic Forecast (1000MT)	
		1993	1999	2004	(*)	1999	2004
Long & flat steels & products (= Hot rolled production)	P	1602	1647	1883	1883	1543	1713
	E	1387	955	955		955	955
	K	598	351	350		348	345
	AC	813	1043	1258		936	1103
	AAC	629	741	905		662	791
Long products	P	844	683	782	638	618	684
	E	817	325	305		325	305
	K	463	274	275		274	274
	AC	490	632	752		567	657
	AAC	418	508	604		458	532
Joists & seals	P	354	204	232	232	188	209
	E	342	120	120		120	120
	K	106	80	80		80	80
	AC	128	164	192		148	169
Railway-track material	P	0	0	0	0	0	0
	E	0	0	0		0	0
	K	3	4	5		4	4
	AC	3	4	5		4	4
Sections	P	6	11	15	15	9	12
	E	92	10	10		10	10
	K	103	20	20		20	20
	AC	17	21	25		19	22
Bars	P	224	207	218	156	189	190
	E	200	100	80		100	80
	K	102	80	80		80	80
	AC	127	187	218		169	190
	AAC	104	133	156		121	137
Wire rods	P	195	185	223	148	164	195
	E	185	80	80		80	80
	K	119	80	80		80	80
	AC	149	185	223		164	195
	AAC	104	120	148		106	129
Special steel	P	55	76	94	87	68	82
	E	18	15	15		15	15
	K	30	10	10		10	10
	AC	67	71	89		63	77
	AAC	62	66	82		58	71
Flat products	P	758	964	1081	672	925	1025
	E	570	630	650		630	650
	K	135	77	75		74	71
	AC	322	411	506		389	448
	AAC	211	233	297		206	259
Hot rolled sheets & strip (More than 3mm in thickness)	P	620	673	700	614	658	679
	E	543	580	580		580	580
	K	47	30	30		30	30
	AC	124	143	170		128	149
	AAC	60	60	84		59	73
Hot rolled sheets & strip (3mm and less in thickness)	P	35	39	49	49	34	43
	E	0	0	0		0	0
	K	0	0	0		0	0
	AC	35	39	49		34	43
Cold rolled sheets & strip	P	104	252	332	209	233	303
	E	25	70	90		70	90
	K	50	20	10		20	10
	AC	139	202	252		183	223
	AAC	91	101	129		89	113
Electrical sheets & strip	P	0	0	0	0	0	0
	E	0	0	0		0	0
	K	12	12	17		11	15
	AC	12	12	17		11	15
Stainless steel	P	0	0	0	0	0	0
	E	1	0	0		0	0
	K	8	8	10		7	9
	AC	7	8	10		7	9
Steel for tool	P	0	0	0	0	0	0
	E	2	0	0		0	0
	K	8	7	8		6	7
	AC	6	7	8		6	7

			Optimistic Forecast (1000MT)			Pessimistic Forecast (1000MT)	
		1983	1999	2004	(*)	1999	2004
Final products	P	184	302	353	353	274	312
	E	74	88	73		88	73
	N	119	48	48		48	48
	AC	229	262	328		234	287
Tinplate	P	12	53	68	68	48	60
	E	7	15	15		15	15
	N	38	10	10		10	10
	AC	44	48	63		43	55
Galvanized sheets & strip	P	27	38	40	40	34	37
	E	12	18	18		18	18
	N	0	0	0		0	0
	AC	15	18	22		16	19
Cold Tapes	P	8	12	15	15	12	14
	E	3	6	8		6	8
	N	2	1	1		1	1
	AC	7	7	10		7	9
Sections	P	3	8	9	9	7	8
	E	1	2	2		2	2
	N	3	0	0		0	0
	AC	5	6	7		5	6
Balls	P	5	5	7	7	5	6
	E	0	0	0		0	0
	N	0	0	0		0	0
	AC	5	5	7		5	6
Seamless tubes	P	23	54	62	62	48	53
	E	19	15	10		15	10
	N	46	20	20		20	20
	AC	50	59	72		53	63
Welded tubes	P	61	69	77	77	62	68
	E	18	15	10		15	10
	N	9	5	5		5	5
	AC	51	59	72		52	63
Drawn wires & bars	P	45	65	75	75	58	66
	E	14	15	10		15	10
	N	21	10	10		10	10
	AC	52	60	75		53	66
Steel products total	P	1602	1047	1803	1803	1543	1713
	E	1481	1041	1028		1041	1028
	N	717	397	388		394	391
	AC	858	1003	1233		890	1078
Long	AAC	480	579	697		519	610
Flat	AAC	278	306	392		272	342
Tube	AC	101	118	144		105	126
Total	AC	858	1003	1233		890	1078
Long	AAC	55.9%	57.7%	56.5%		57.9%	56.8%
Flat	AAC	32.4%	30.5%	31.8%		30.4%	31.7%
Tube	AC	11.7%	11.8%	11.7%		11.7%	11.7%
Total	AC	100.0%	100.0%	100.0%		100.0%	100.0%
Export/Production		91.2%	63.2%	55.1%		67.5%	59.9%
Net exports		744	644	630		647	635

(*) Production which excludes material for downstream processing

P: Production
E: Exports
N: Net exports
= Exports - Imports
AC: Apparent consumption

Sources: National statistical institute & Ministry of Industry of Bulgaria
(Forecast : JICA consultant)

Chapter 6 Supply of Raw Materials and Energy

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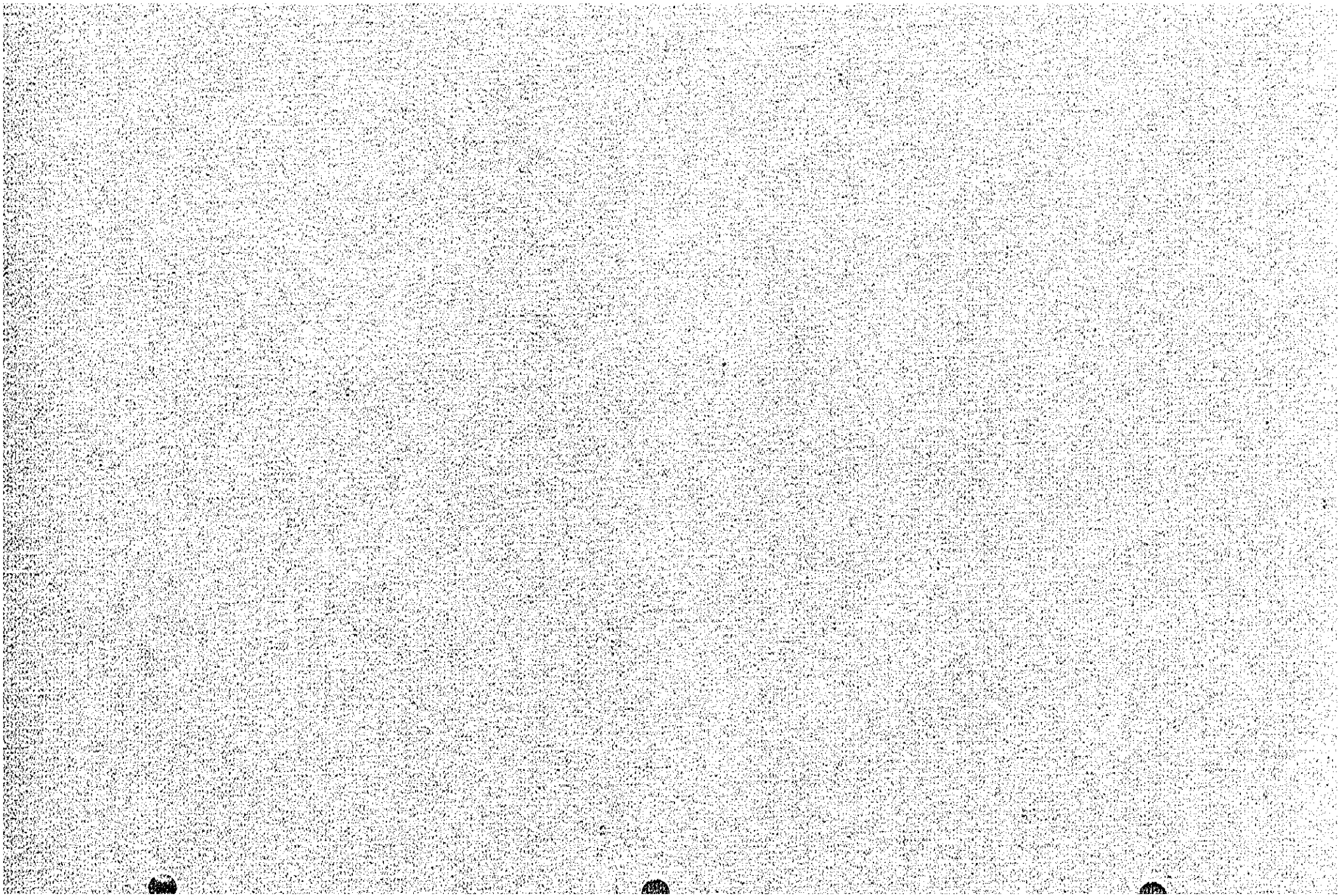


6. Supply of Raw Materials and Energy

In this chapter, the current situation of procurement of raw materials, sub-materials and energy at each steelworks is described. The future supply of these materials and energy will be studied from the view point of availability of these resources. Although Bulgaria has iron ore mines, iron ore is mostly imported from the Ukraine and South Africa because of the low quality of Bulgarian ore. The demand for lumpy ores and pellets will be tighter, but sufficient supply capacity for the powdery iron ores is available for the long term.

Currently, each steelworks purchases the necessary scrap in the domestic market, when the return scrap recycled in the steelworks is not adequate. As the export of commercial scrap is prohibited by law, the domestic price is about one third the international level. To increase the production of steel by electric furnaces, Bulgaria must resort to imported scrap, which will be far more expensive.

With regard to energy (coal, natural gas and electricity), coal is currently imported from the U.S.A. and Poland, and natural gas is supplied from Russia through a pipeline. These resources are bought at international prices, and there seems to be no problem of supply in the long term. There seems to be no obstacle with regard to the supply of electricity in the long term. The price of electricity will near the international level in the long term, reaching to US$48/Mwh in 2005 from the current level of US$17.6/Mwh.

6.1 Present Situation for Raw Materials

6.1.1 Iron ore and submaterials

1) Kremikovtzi Steelworks

a) Iron ore

① Table 6-1 shows the production and reserves of Bulgarian mining companies in 1993. Reserves and production volumes are too small at the present scale.

Table 6-1 Bulgarian Mining Companies

(Unit : 10^6 MT)

Mining Company (Country)	Production/Y	Reserves
1) Kremikovtzi (Bulgaria)	0.38	100
2) Chiprovizi (Bulgaria)	0.07	0.9

Source: Kremikovtzi Steelworks

② Table 6-2 shows the specifications of iron ore of some suppliers.
The Fe content of domestic iron ore is lower than that of foreign ores (Fe of foreign ore: 64~59%, Fe of domestic powdery iron ore: 38.82%). Domestic ore also contains a high percentage of lead (Pb), making it unsuitable for steelmaking.

Table 6-2 Specifications for Iron Ore of Each Supplier

Spec. \ Type	Powdery-Krem	Powdery-Kriv		Powdery-Serr	Powdery-Ore
Fe	38.82%	A-64.34%	B-50.91%	64.82%	64.00%
SiO_2	4.69%	9.07%	15.49%	1.87%	4.50%
Al_2O_3	0.77%	0.47%	3.17%	0.97%	2.50%
P	0.80%	-	0.01%	-	0.07%
S	0.96%	-	0.06%	-	0.055%
Moisture	14.37%	8.00%	8.00%	7.35%	2.50%
Pb	6.55%	-		-	-
MnO	11.71%	-		-	-
$BaSO_4$	18.40%	-		-	-
As	0.15%	-		-	-
Size	Max: 0.31mm Min: 0.025mm	0.07mm	Max: 8.0mm Min: 0.1mm	Max: 10.0mm Min: 0.1mm	Max: 2.50mm Min: 0.20mm

Suppliers: Kremikovtzi, Krivoy Rog, Serro Bolivar, Ore & Metal

Source: Kremikovtzi Steelworks

③ Table 6-3 shows the specifications of lumpy ore and pellets.
Lumpy iron ore from the Ukraine, which is the major supplier, is lower in Fe content (50.42%) than that of Australia, Brazil and South Africa (Fe 62%~64%), and includes much silicon, causing low yield in steelmaking.

Table 6-3 Specifications of Lumpy Ore and Pellets

Spec. \ Type	Lumpy	Pellets
Fe	50.42 %	61.50 %
SiO_2	21.74 %	9.00 %
Al_2O_3	2.72 %	0.50 %
P	0.05 %	0.023%
S	0.05 %	0.027%
Moisture	3.00 %	–
Size	Max: 40 mm Min: 5 mm	Max: 0 mm Min: 5 mm

Supplier: Krivoy Rog (Ukraine)

Source: Kremikovtzi Steelworks

b) Submaterials

(1) Current situation of procurement

All electrodes are imported, but the other submaterials are mostly national products.

Limestone .....All domestic products. The mine is located within 50-60km from Kremikovtzi Steelworks.

Fluorspar .....This material had been used until 1992, but is no longer used.

Aluminium .....All domestic products called "Secondary" have been used.

Electrodes .....All imported products. Kremikovtzi is importing from Germany, Italy and Japan at the prevailing international prices.

Refractories .....All domestic products.

Dolomite .....All domestic products.

(2) Supply of submaterials

The supply of submaterials except electrodes is all domestic, so there is not any obstacle to purchase. It is also possible to purchase electrodes at the international market price.

(3) Government policy for materials

A high import tariff will be applied to imports which are similar to domestic products, but the import duty on other materials has been decreasing.

2) Stomana Steelworks

a) Limestone, fluorspar, aluminium, electrodes, refractories and dolomite are consumed at this steelworks.

3) Kamet Steelworks

a) Consumption of submaterials

Table 6-4 shows the consumption of submaterials in the past three years. It seems that the operation has frequently been stopped because the consumption volumes of submaterials are quite small.

Table 6-4 Consumption of Submaterials of Kamet (Unit : MT)

	1991	1992	1993
Limestone	69	19	20
Fluorspar	123	51	55
Aluminium	14	1	4
Electrode	230	102	83
Refractories	3,079	1,272	797
Dolomite	658	296	222

Source: Kamet Steelworks

b) Actual supply sources

Limestone, fluorspar, refractories and dolomite: All domestic products.

Aluminium : The major portion of this material is a domestic product called "Secondary", but a small portion is imported from the former U.S.S.R.

Electrodes : All products are imported from Germany and the former U.S.S.R.

c) Supply situation of materials

No problem with the supply of materials, but Kamet has frequently faced a shortage of funds to purchase.

4) Promet Steelworks

This is a rolling mill company, and the main materials are therefore billets and blooms.

5) Leko ko Steelworks

a) Consumption of submaterials

Table 6-5 shows the consumption of submaterials in the past five years. It seems that Leko ko has lost a number of clients since the collapse of the COMECON regime in 1989.

Table 6-5 Consumption of Submaterials of Leko ko (Unit : MT)

	1989	1990	1991	1992	1993
Limestone	3,990	1,659	466	724	1,010
Fluorspar	3,093	1,445	130	123	295
Aluminium	70	45	14	10	21
Electrode	529	199	67	87	113
Refractories	3,653	2,094	924	616	1,042
Dolomite	622	214	63	18	209

Source: Leko ko Steelworks

b) Actual supply source

Limestone, fluorspar and dolomite :	All domestic products.
Aluminium .....:	All domestic products are used.
Electrodes .....:	All products are imported from Germany.
Refractories .....:	90% are national products, the balance of 10% being imported.

c) Supply situation of raw materials

Supply is not a problem because each lot is small.

6.1.2 Steel scrap

1) Kremikovtzi Steelworks

a) Consumption (in 1993)

EAF	:	342,706 tons
Converter	:	261,399 tons
Total		604,105 tons

Scrap was procured as follows:

Purchased scrap	:	152,539 tons (not including pig iron)
Home scrap	:	451,566 tons
Total		604,105 tons

b) Price

Kremikovtzi has its own scrap purchasing price list which is based upon the grade of scrap and the distance of transportation.

There are 226 different prices classified into fourteen grades of scrap and the distance of nineteen points of origin. Assuming that the mixed ratio of scrap should be 70%; No.1 HMSS / 20%; No. 2 bundle / 10%; other scrap, the average price of scrap was calculated by using the prevailing exchange rate of US$/Bulgarian leva, this being US$43.50 / MT as of October 1994.

c) Scrap yards

There are three different type of scrap yards at Kremikovtzi Steelworks:

① Pressing machine yards for steel bundle making
② Skull crushing yards
③ Off-grade ingot crushing yards

The monthly capacity of the above scrap yards is 30,000~35,000 tons.

The distance from the scrap yards to EAFs is about 10km (round trip).

2) Stomana Steelworks

a) Consumption

1989: 500,000 ~ 580,000 tons
1991: 300,000 ~ 320,000 tons
1993: 400,000 ~ 500,000 tons
1994: 410,000 tons (to September 1994)

b) Purchased scrap (in 1994)
550,000 tons (estimated)

c) Home scrap
About 100,000 tons, with the monthly generated scrap being 7,000~8,000 tons

d) Price
The average price of scrap prevailing in the domestic market is about US$50, this price being quite different from the current international price of US$160/MT. It will approach the international price in the near future.

e) Scrap yards

① Various types of scrap are delivered by rail car in 58-60 ton loads, 5 ton containers and by truck to the steelworks. This scrap has either already been treated by the distributor or is delivered untreated.
The delivery quantity is 1,500~2,000 tons/day.

② The scrap accumulated in the yards is mixed, comprising both heavy and light and some with paint or rust. Skull, large sizes of secondhand pipe and machining scrap are treated by the workers at Stomana for EAF use.

③ The scrap yards comprise those with two cranes for skull crushing, scrap treatment yards with a covered storage area separated into the six sections, open-air scrap yards separated into three sections where scrap is delivered by rail car, and gas-cutting yards with covered storage.

f) Scrap generated
According to a scrap distributor who is handling about 15,000 tons of scrap per year, amount of steel scrap generated in the area near Stomana is limited, so that the volume of scrap will not increase even if the price rises.

3) Kamet Steelworks
The quantity of steel scrap actually purchased is as follows, despite the operating capacity now being 100,000 tons per year:

1991 : 39,916 tons
1992 : 15,279 tons
1993 : 9,800 tons

EAF operation has been stopped several times since 1993 because of a shortage of funds for the purchase of non-ferrous materials.

4) Promet Steelworks

Promet is a rolling-mill company, and so does not need to purchase steel scrap.

5) Leko ko Steelworks

a) 1993 consumption

High-grade scrap including No.1 HMSS (Leko ko spec. 101-104 and 109/110)	: 5,644 MT
Scrap equivalent to No.2 HMSS (Spec.105~107)	: 1,309 MT
Machining scrap	: 6,156 MT
Home scrap	: 1,550 MT
Total	: 14,659 MT

b) Quality

Leko ko has its own grade list for scrap, the grades being classified into ten (10) according to specification 101-110.

c) Price

The average purchase price of scrap is US$50/MT. Leko ko is buying scrap based on the above-mentioned grade list from 28 locations, resulting in 280 different prices for scrap.

d) Scrap yards

Scrap accumulated in the yards is separated by grade. There is no obstacle to purchasing scrap due to the small tonnage used at the moment.

6.2 Prospect for the Supply of Raw Materials

6.2.1 Iron ore

1) Prospect for future supply

It is forecast that the demand for lumpy iron ore and pellets will be tighter in the long term, especially for DRI (Direct Reduction Iron) plants, as the installation of DRI plants has been increasing.

With regard to powdery iron ore, there is an excess supply capacity and there will be no obstacle to the Bulgarian steelworks in the long term in this regard. The trend of supply and demand in the past years has been well balanced, as shown in Appendixes 6-1 and 6-2.

2) Price outlook

The price of pellets and lumpy iron ore will go up because demand will continue to be strong, as above mentioned. With regard to powdery iron ore, the price trend will be stable in the long term. (Recent price trends are shown in Appendix 6-3)

6.2.2 Scrap

1) Prospect for future supply

The estimated steel scrap generated in Bulgaria is 1.3 million tons per year, which consists of about 600,000 tons of home scrap (return scrap at steelworks) and 700,000 tons of market scrap. As the national stock of steel structures is low in Bulgaria, the supply of market scrap will not rise above the present level of 700,000 tons in the long term.

On the other hand, Bulgaria will be able to import the necessary scrap for the following reasons:

a) In view of environmental pollution problems, a shift to EAF (Electric Arc Furnace) steelmaking has been seen in recent years. New EAF installations in Europe in the near future are expected in France, because of the lower electric power tariff, and Germany, because of the large availability of steel scrap; however, the trend will be delayed in other countries because of high electric power cost.

b) Although EAF mills have begun to produce flat products as well as the traditional long products, they will substitute DRI iron for high-grade scrap.

c) As shown in Table 6-6, Europe has an excess supply capacity of scrap. It seems that there will be enough room for Bulgaria to import some of this excess scrap in the future.

d) The world supply volume of scrap is more than world demand, as shown in Table 6-7, and this trend seems likely to continue in the future.

Table 6-6 European Main Scrap Exporting and Importing Countries

Export country		Import country	
① Germany	6,500	① Italy	2,900
② France	2,600	② Spain	2,130
③ U.K.	2,100	③ Turkey	2,930
④ Belgium/Luxembourg	850	④ Belgium	1,000
		⑤ Netherlands	1,980
	12,050		10,490
Remarks: U.K. has exported 1.3 million tons of scrap to Turkey, South-east Asian countries and European countries.		Remarks: Turkey has imported 1.72 million tons of steel scrap from U.S.A. (main supplier), Germany, U.K. and Belgium/Luxembourg.	

Source: Statistics of each country

Table 6-7 Demand and Supply Quantity of Steel Scrap in the World

(Unit : Thousand ton)

Supply			Demand		
U.S.A	:	9,000	Turkey	:	5,400
EC (Out of)	:	5,400	Korea	:	3,000
CIS/Eastern Europe	:	4,000	EC	:	2,000
Japan	:	1,500	NIES	:	2,000
Canada	:	800	India	:	2,000
Australia	:	300	Taiwan	:	1,800
Hongkong	:	300	Central and Latin America	:	1,500
			Canada	:	1,000
			China	:	500
Total	:	21,300	Total	:	19,200

Source: Statistics of each country

2) Price outlook

A law which prohibits the export of scarp is in effect in Bulgaria, and the domestic price is extremely cheap compared with international prices. For example, the domestic price of the most typical scrap of No. 1 HMSS is about US$50/MT, or about one third the international level, as shown in Table 6-8.

Although the mid- and long-term scrap price will fluctuate according to economic conditions, the JICA study team forecast the mid- and long-term imported scrap price will be US$145/MT on average. With regard to the domestic price, it is calculated to be US$95/MT after deducting freight and insurance from the international price.

Domestic market price : US$ 95/MT
International price : US$ 145/MT

Table 6-8 Estimated Price of Steel Scrap

Rotterdam FOB		
	Highest price (May,1990)	Lowest price (Dec.1992)
Scrap price	US$124/MT	US$ 80/MT
Estimated freight (Rotterdam-Burgas)	$ 30/MT	$ 20/MT
C&F price	$154/MT	$100/MT
U.S.A. FOB		
	Highest price (May,1990)	Lowest price (Dec.1992)
Scrap price	US$138/MT	US$ 94/MT
Estimated freight (East coast-Japan)	$ 40/MT	$ 30/MT
C&F price	$178/MT	$124/MT

Remarks: Shipping ports of U.S.A. are Philadelphia, New York and Boston.
Source : Metal Bulletin

6.3 Present State of the Energy Supply

6.3.1 Coal and natural gas

1) Coal

a) Kremikovtzi Steelworks

The contracted volume of coking coal in 1994 is shown below.

① Contracted quantity

American metallurgical coal	:	950,000 tons
Polish metallurgical coal	:	400,000 tons
Total	:	1,350,000 tons

② Specifications

	American coal	Polish coal
Moisture	8.0% max.	8.0-9.0%
Ash	7.65-8.5	5.5-7.5
Volatile matter	25-28	26-28
Sulphur	1.0	0.60-0.75
Phosphorus	0.025 max.	0.03-0.05
FSI	6-9	Min.7
Size	0×5 mm	0×20 mm

③ Price

Coking coal was imported at low price from the former U.S.S.R. in the past, but with the collapse of the COMECON regime, coal is now imported from the U.S.A. and western European countries. The price is now at the international market level.

American coal:

US$47.50 ~ US$47.60/MT FOB Baltimore or Newport News, U.S.A.
US$57.50 ~ US$59.60/MT C&F Burgas Port
Unloading charge and inland freight from Burgas Port to Kremikovtzi Steelworks: US$4.34/MT

Polish coal:

US$57.50/MT C&F Burgas port
Price negotiation starts three months before the shipments every year.

④ Stock yards

Capacity: 140,000 ~ 160,000 tons
Present stock: 100,000 tons (about 20 days use)

2) Natural gas

a) Consumption

The volume of natural gas consumed in Bulgaria began to decrease in 1989, mainly due to a reduction in industrial consumption, but this decline ended in 1992. Quantities consumed from 1989 to 1993 are shown in Table 6-9.

Table 6-9 Natural Gas Consumption

(Unit : 1 Million ton)

	Unit	1989	1990	1991	1992	1993
Consumed volume	GNm^3	7.1	6.79	5.81	5.12	5.18

Source: Bulgaria energy statistics issued by Energy Committee of Bulgaria

57.7% of the actual volume in 1993 was consumed for heat generation, 15.6% for electric power generation and 17.4% for industry. Others were for household uses and agriculture.

b) Calorific value and composition

Unit calorific value: 7,980 to 8,000 Kcal/Nm^3

Composition : $CH_4$98.54% $C_2H_4$0.32% $C_3H_8$0.09%
C_4H_{10}- C_5H_{12} 0.04% $CO_2$0.03%, $N_2$0.98%

c) Suppliers and method of purchase

Natural gas is supplied through a pipeline from Russia via the Ukraine and is also produced in small quantity in Bulgaria. The domestic network of pipelines is well established, as shown in Figure 6-1. Bulgar Gas Co. (state-own gas supplying company) imports and distributes natural gas in the country. Table 6-10 shows the purchased volumes. The difference between supply and demand is due to stock and discharge.

Table 6-10 Natural Gas Purchases

(Unit : GNm^3)

	Unit	1989	1990	1991	1992	1993
Domestic production	GNm^3	0.01	0.02	0.01	0.04	0.07
Imported	GNm^3	6.83	6.83	5.66	5.11	5.16

Source: Bulgaria energy statistics issued by Energy committee of Bulgaria

d) Government's energy policy and purchase prices

① The price of natural gas rose 3.7 times during the 6 months from the end of 1993 and 1.7 times in US dollars. Today's prices of natural gas are changed every 15 days due to the changing value of the leva against the US dollar. The price as of Oct. 1993 was 6,605 Leva/Nm^3, which is equivalent to 110\$/10^3 Nm^3, including 18% tax. This price in Mcal is 0.01375 \$/Mcal, which is similar to that of LNG in Japan, and has already reached the international level. Therefore, the trend in the price of natural gas in Bulgaria will depend on international prices.

② There is no plan for reinforcement of the main distribution pipeline supplying to domestic customers, and the government policy seems to be to maintain the current condition. However, a new pipeline to third countries through Bulgaria from Russia is planned.

6.3.2 Electric power

1) Electric power consumption

Actual electric power consumption for 5 years is shown in Table 6-11. Maximum electric power per hour is calculated from the actual load factor of Bulgaria in 1992, that was 0.61. For reference, the Japanese load factor is 0.595. The decline in power consumption almost ended.

Table 6-11 Actual Electric Power Consumption

	1989	1990	1991	1992	1993
Consumed electric power (Gwh)	48,717	45,920	41,014	38,239	38,000
Annual average electric power (Mw)	5,561	5,242	4,682	4,365	4,338
Maximum electric power per hour (Mw)	9,163	8,637	7,715	7,192	7,148

Source: NEK (National Electric Company of Bulgaria)

2) Composition of power supply

The composition of the power supply, such as domestic power, imported power, and exported power, is shown in Table 6-12. More than 80% of imported power is supplied by Russia.

Table 6-12 Composition of Power Supply

	1989	1990	1991	1992	1993
Domestic power generation (Gwh)	44,328	42,130	38,834	35,547	37,870
Imported power (Mw)	4,937	5,387	4,013	3,498	1,620
Exported power (Mw)	548	1,597	1,833	806	1,490

Source: NEK (National Electric Company of Bulgaria)

3) Available capacity of power generation (in 1992)

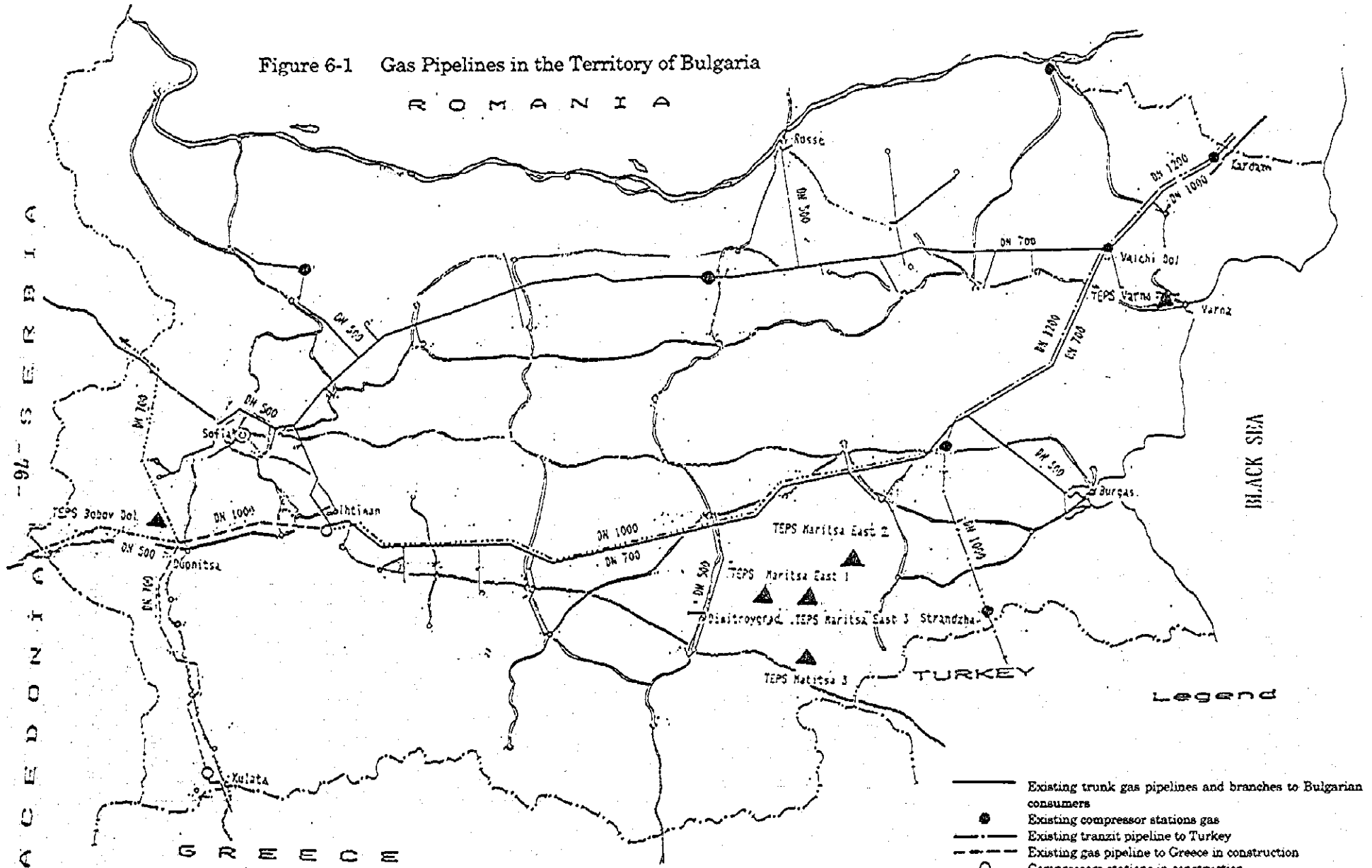
The composition of power generation is shown in Table 6-13.

Table 6-13 Composition of Power Generation

	Total power generation	Thermal power	Hydro power	Nuclear power	Heat generation
Otuput (%)	8,703 Mw	48.86%	18.38%	20.81%	11.95%

Source: NEK (National Electric Company of Bulgaria)

Figure 6-1 Gas Pipelines in the Territory of Bulgaria



Source : Energy Committee

4) Reserve margin of power generation

① The actual reserve margin was 21% in 1993. Restrictions on power consumption cannot be expected because the actual reserve margin exceeds 8% to 10% of the required reserve margin for a stable power supply.

② One of the main reasons for power imports/exports is to balance supply and demand in the overall network interconnected with other countries.

5) Transmission line

The main transmission line, whose tension is 400 KV, distributes power in a roop system in the country and is interconnected with other countries such as the Ukraine, Turkey, Greece, Romania, and Serbia. A 750 KV transmission line has already been installed, interconnected with the Ukraine, and was put into operation in 1988. There is now no plan to electric power system of Bulgaria.

Transmission system of electric power in Bulgaria is shown in Figure 6-2.

6) Government electric power policy and purchase prices

a) Electric power price system

The actual power price as of Oct. 1994 was 0.0188 US$ /Kwh. The following shows the power price system.

- No power demand contract
- Seasonal differences in summer (April 1 to Sept. 30) and winter (Oct. 1 to March 31)
- Difference by time periods: peak time (6 hours), day time (10 hours), and night time (8 hours).
- Difference by tensions, ultra-high tension (over 110KV), high tension (1KV to 60 KV), and low tension (less than 1KV)

Table 6-14 shows the electric power rate structure as of Oct. 1994.

Table 6-14 Electric Power Unit Prices (Unit ; Leva/Kw)

Season	Winter			Summer		
Voltage	HV	MV	LV	HV	MV	LV
Peak time	2.00	2.08	2.17	1.75	1.80	1.89
Day time	1.09	1.12	1.17	0.94	0.97	1.02
Night time	0.54	0.55	0.58	0.46	0.48	0.50

Source: NEK(National Electric Company of Bulgaria)

b) Government electric power policy

Electric power rates, now set to relatively low levels (0.0188$/kwh), will rise gradually to prices which meet costs and generate a profit for the national electric company. Revisions in power prices will be carried out every 6 months. Estimated electric power prices in the long term are shown in Figure 6-3.

7) Government electric power reinforcement plan

a) Forecast for domestic power increases

The forecast for domestic power increases until 2010 is shown in Table 6-15.

The rate of increase in electric power output per year is estimated at approximately 3% from 1995 to 1999 and 1.3% from 2000 to 2010.

Table 6-15 Forecast for Domestic Power Increases

		1995	2000	2005	2010
Annual consumption power	(Gwh)	39,800	46,000	49,000	52,000
Average con. power per hour	(Mwh)	4,543	5,251	5,594	5,936
Max. power demand per hour	(Mwh)	7,487	8,654	9,219	9,782

Source: Energy Committee of Bulgaria

b) Forecast for imported power

The forecast for imported power until 2004 is shown in Table 6-16.

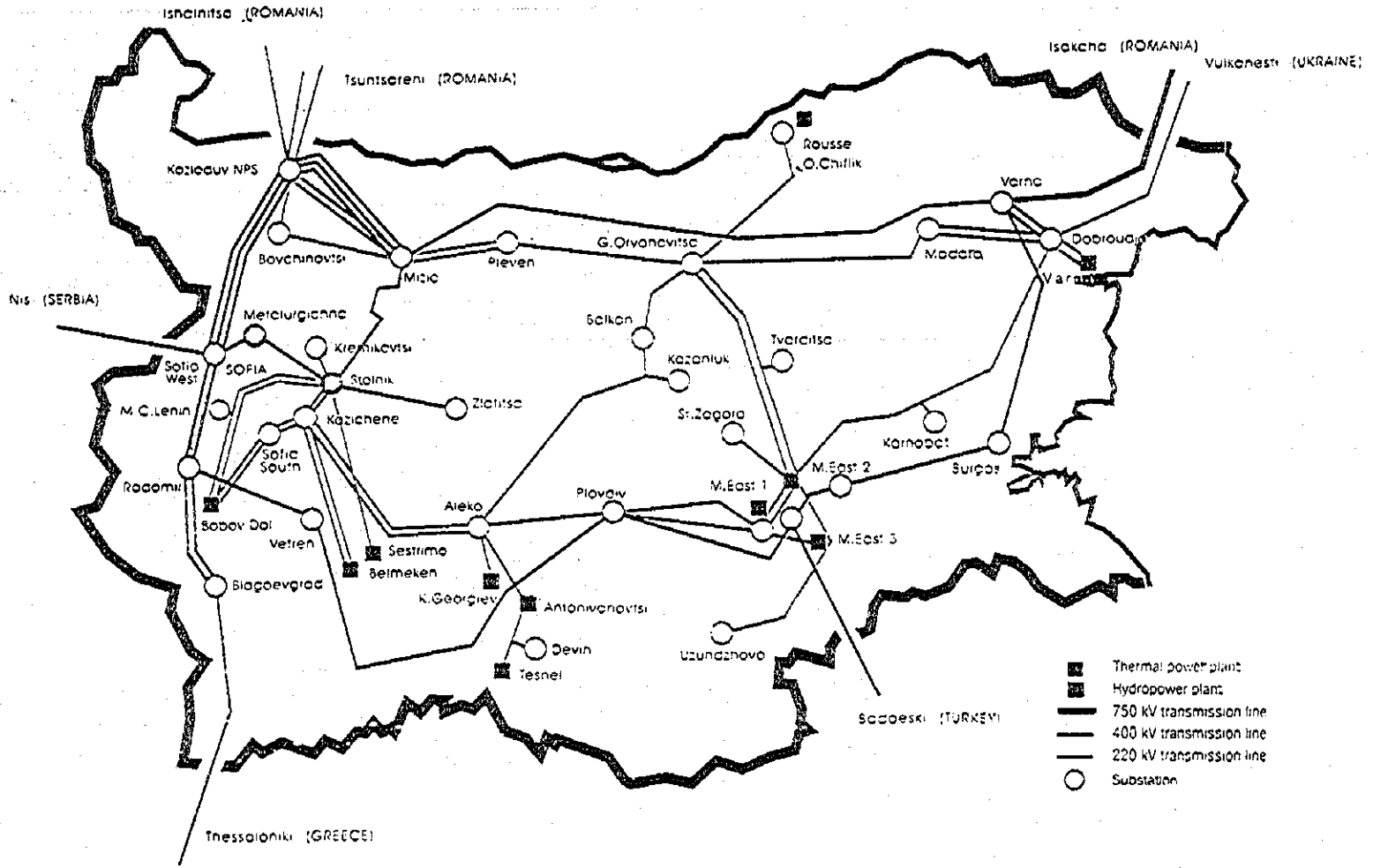
Annual power imports, estimated at 5% of domestic power consumption, increase sharply in 1997.

Table 6-16 Forecast of Imported Power

Year	1994	1995	1996	1997	1998	1999
Power consumption in year(Gwh)		263	1619	2331	657	17
Year	2000	2001	2002	2003	2004	
Power consumption in year (Gwh)	1	43	991	695	810	

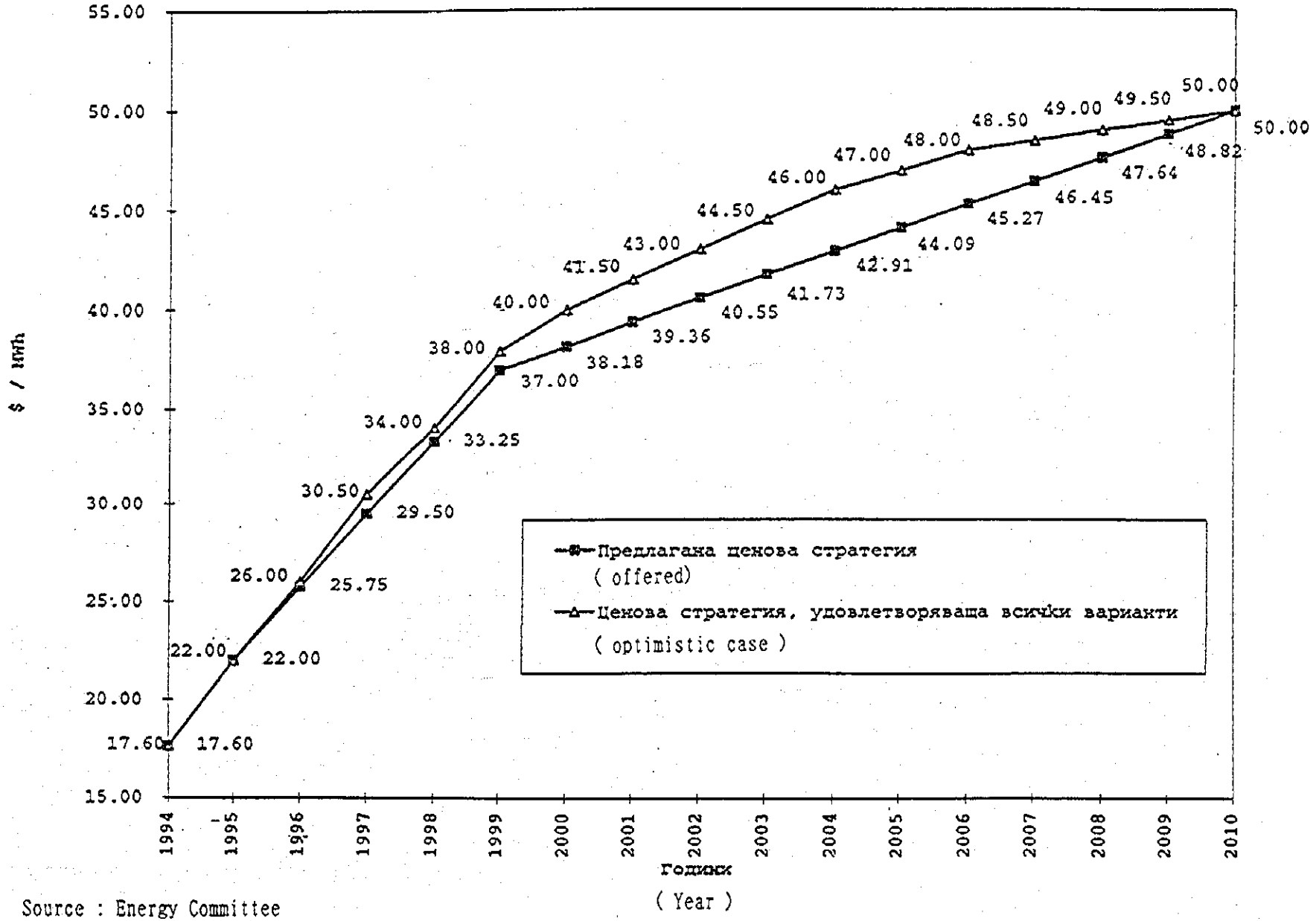
Source: Energy Committee of Bulgaria

Figure 6-2 Electric Power System of Bulgaria



Source : Energy Committee

Figure 6-3 Estimated Electric Power Prices



Source : Energy Committee

c) Reinforcement plan of power generation

Table 6-17 shows the future reinforcement plan for power generation.

Table 6-17 Reinforcement Plan for Power Generation

Year		1996	1997	1998	1999	2000
Increased power generation (Mw)	New installation				165 (THP)	
	Improvement	420	630	2740	840	630

Year		2001	2002	2003
Increased power generation (Mw)	New installation		194 150-THP 44-HYD	500 THP
	Improvement			

THP : Thermal power plant
HYD : Hydro power plant

Source: Energy Committee of Bulgaria

d) Reinforcement plan for power transmission line

There is no reinforcement plan for the main power transmission network, which has already been completed.

6.4 Future Prospect for Energy Supply

6.4.1 Coal

1) Prospect of supply

New blast furnace installations are expected in the developing countries, because of the expected increase in steel consumption. On the other hand, several blast furnaces must be shut down in the developed countries in the near future due to environmental problems. In the future, EAF installations, involving a relatively small investment compared with blast furnaces, will increse. Under the above-mentioned circumstances, the demand for metallurgical coal will not change greatly in the future.

The need for semi-soft coking coal will be increased by PCI installations and changes in blending ratio, while the demand for hard coking coal may decrease. Refer to Appendixes 6-4 and 6-5 which show that supply and demand trends are almost equivalent.

2) Coal prices

The contract price for coal per ton by Kremikovtzi is high (US$57.50/MT ~ 59.50MT on a CIF basis) in comparison with the average price for coking coal imported into the

European countries and Japan. The average price of coal imported in the first quarter of 1993 by European countries was US$54.14/MT on a CIF basis. (See Appendixes 6-6 and 6-7) Prices will be stable in the mid and long terms.

3) Government (MOI) policy

Measures to reduce energy consumption:

Rationalize the use of blast furnace gas and coke gas
Rationalize pre-heating systems
Improve electric power stations
Increase gas pipelines

Measures to reduce pollution:

Change from oil to natural gas

4) Requred improvements

It is desirable to diversify supplies from various countries, reduce costs by installing PCI and change blending ratio of expensive midium volatile coal.

6.4.2 Future prospect for natural gas supply

1) Consumption

Estimated consumption in Bulgaria is 6.69GNm^3 in 2000 and 7.76 GNm^3 in 2005, as predicted from the electric power estimates. Figure 6-4 shows actual consumption and future consumption. The steel industry will consume approximately about 4 ~ 7% of the total in the future.

2) Suppliers and supply capacity

It can be said that Russia will supply the required quantity to Bulgaria because former Soviet Union and East Europe which occupy 40% of the estimated amount of possibile production of natural gas in the world have enough potential capacity to supply natural gas and new reinforcement plans like the installation of new pipe line supplying western Europe via Bulgaria have been announced (See Table 6-18).

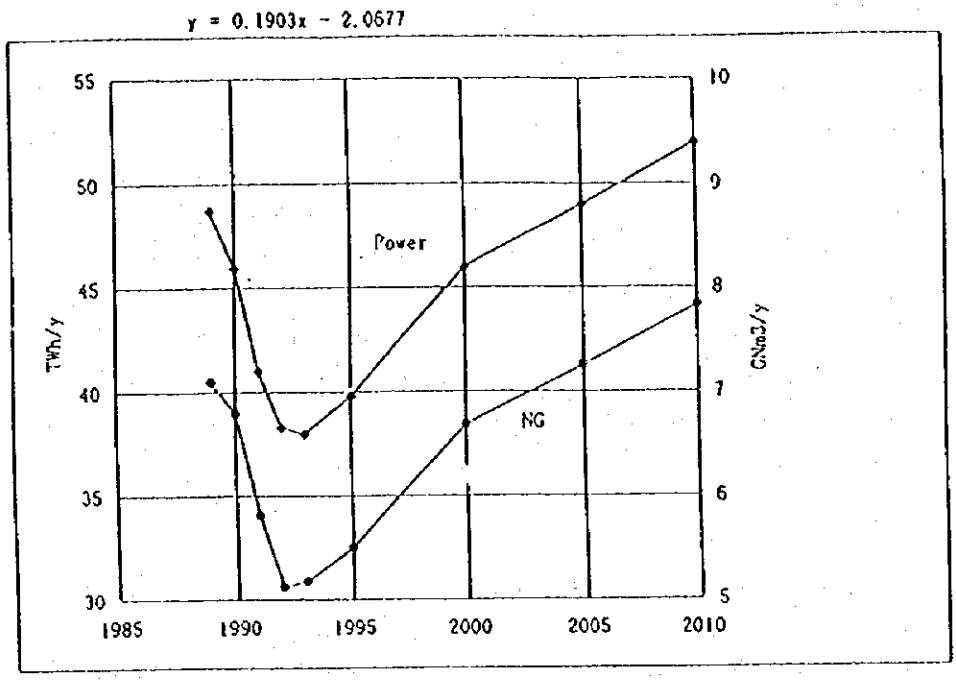
3) Purchase price

As of Oct. '94, the unit price of natural gas was 6,605 leva/ 10^{3}Nm^3, or 0.01376 US$ / Mcal. The Bulgrian price has already reached international levels compared to the Japanese price of imported LNG, which is from 0.013 to 0.015 US$/ Mcal. Approximately 0.015 US$ / Mcal is assumed as the purchase price in the future.

4) Required improvements

Kremikovtzi Steelworks reported that low pressure at the receiving end occurs frequently in the winter season, but the actual value of the lowered pressure is unknown. Improvement will be required when consumption increases.

Figure 6-4 Actual Consumption and Estimated Consumption in Future



Source: JICA Consultant estimation

Table 6-18 Estimated Amount of Natural Gas Deposit in the World

Estimated amount of possibility production of NG deposit, as of Jan. 1, 1993, in the world		138,000 Gm³
Percentage of each areas	North America	5.4%
	Middle and South America	5.3%
	Europe	3.9%
	Middle East	31%
	Asia・Pacific ocean	7.0%
	Africa	7.1%
	Former Soviet union, and East Europe	40.2%
Annual production ('92)		2.16 Gm³
Period of production		64 years

Source: Oil & Gas Journal (December 28, March 8, 1992)

6.4.3 Future prospect for electric power supply

1) Consumption

Estimated consumption in Bulgaria is 5,251 Mwh/h on average and 8,654 Mw at maximum power per hour in 2000, and 5,594 Mwh/h on average and 9,219 Mw at maxi-

mum power per hour in 2005. The steel industry will account for approximately 4% of the total.

2) Suppliers and supply capacity

The latest electric power reinforcement plan is shown in Section 6.3.2. 7). The estimated maximum power demand and available power generation in 2005 are 9,219 Mw and 9,562 Mw respectively. The ratio of reserve margin is 3.7%, calculated from the above figures. Considering imported power, this value shows a capacity to supply power to Bulgaria stably. However, it is necessary to implement the electric power reinforcement plan as it is scheduled. In supplying power to each steelworks, the transmission lines have an adequate design margin for supplying the required power to each steelworks. The National Electric Company is in charge of the supply of power to the whole country.

3) Purchase price

The purchase price as of October 1994 was 17.6 US$/Mwh and will rise to 48US$/Mwh in 2005,and to 50 US$/MWH in 2010.The unit price differs by time, but 24 US$/Mwh at night, 48 US$/Mwh in day time, and 88 US$/Mwh in peak time are assumed.

4) Required improvements

a) Increase in reserve margin

The ratio of reserve margin ((Available power generation--Max. power demand)/Max. power demand ×100)) is estimated at 2.5% in 2000 and 3.7% in 2005 without increasing power or improvement in existing power stations.

It is generally said that the required reserve margin is more than 8% to 10%, with a shortage of power covered by imported power.

For a more stable power supply, the reserve margin should be raised by raising the load factor (Average power per hour/max. power per hour).

The actual Bulgarian maximum reserve margin was 60.7% in 1992. That in Japan was 59.5 % in 1993. It is necessary to depress the maximum power demand at peak demand, considering the Bulgarian situation.

Table 6-19 shows the actual load factor in Japan.

Table 6-19 Actual Load Factor in Japan

	1970	1975	1980	1985	1990	1993
Actual load factor	68%	61.3%	63.8%	59.7%	57.4%	59.5%

Chapter 7 Environmental Pollution Prevention Measures

Chapter 7 Environmental Pollution Prevention Measures

7. Environmental Pollution Prevention Measures

To make a plan for environmental pollution prevention measures in the Bulgarian steel industry, the situation and the control level were investigated.
The future environmental pollution control measures should be considered under Bulgarian regulations. As to measures not designated in Bulgarian law, the criteria should be based on that of western Europe from the viewpoint of relations with the western European countries in the future.

7.1 Environmental Pollution Prevention Measures of Bulgaria

7.1.1 Pollution control laws

The Environmental Protection Act stipulates basic matters relating to environmental policy. It also contains stipulations relating to a system of fines and assessments. And the Ministry of the Environment (MOE) is preparing a program to meet the multilateral treaty on SOx and NOx. Those facts indicate that they are positive about environmental affairs, bearing the EU level in mind. Articles related to the steel industry are shown below.

(Scope of Provisions)

Article 1 prescribes the following five provisions for regulations.

① Obtaining and furnishing information concerning the state of the environment
② Control of the state of the environment
③ Assessment of the impact on the environment
④ Planning and implementation of environmental protection activities
⑤ Rights and duties of central and local authorities, bodies corporate, and physical persons as regards environmental protection

(Basis for Determining Ecologic Policy)

Article 2 says that the reduction of risk for human health and for the environment and its relation to suffered damages and missed benefits shall be the basis for determining ecologic policy.

(Cross-border Pollution and EU standards)

Article 6 states that, in relation to cross-border pollution, conditions and standards ratified by Bulgaria are to be applied. Matters not covered by specific stipulations are to be handled per EU conditions and standards.

(Environmental Assessment)

Article 20 designates the projects and/or facilities necessary to make the environmental assessment. In accordance with article 20, environmental assessments are covered by the "Regulation on the Environmental Impact Assessment," a document administered under the joint jurisdiction of several agencies, including the Ministry of Territorial Development. Projects, facilities, and activities designated to make assessments are decided to be adopted and one of them is integrated met-

allurgical plants for the production of cast iron and crude steel.

7.1.2 Standards for atmospheric pollution/emissions

There are standards for atmospheric pollution and emissions (Environmental standard for ambient air; State Gazette No.16/1984, amended No.17/1992 Emission standard; State Gazette No.81/1991). Table 7-1 shows the environmental standard and Table 7-2, the emission standard as for each equipment at the steelworks.

The environmental standard is the same as that of the working environment, having regulations for annual average, daily average and short-term exposure levels of over 152 chemicals. This is very strict, because the number of chemicals designated in the environmental standard is thirteen in Germany including cadminium and CO, six in the USA including ozone, and five in Japan including SOx and NOx.

Emission standards for eighty five chemicals, including dust, are also regulated. For example, the standard for dust concentration in converter off-gas is 30mg/Nm^3. However, this standard should be reconsidered because it will not be easy to meet for a boiler-type arrangement; moreover, the harmful component of the gas is very small, with little effect on the environment. In relation to a revision in dust concentration standards for LD converter off-gas (for example, to 50 mg/m^3 as in Germany and Japan), the MOI has consented to the revision and the MOE is prepared to study the issue if it is brought up formally.

As for sulfur oxides and nitrogen oxides, there are emission standards for boilers and heating furnaces, but none for sintering machines and other plants.

The Bulgarian government has signed and ratified a multilateral agreement on SOx and NOx emissions. A committee has been appointed for concrete planning and implementation within the country, and is currently formulating policy. It appears that the efforts of the committee to control SOx and NOx emissions are centered on power plants; the contributory effect of automobiles on NOx emissions is also considered to be large.

Reduction targets for SOx and NOx emissions under multilateral agreement:

(1) SOx : 30% reduction (compared to 1980) by 1993

(2) NOx : Reduction to 1987 level by 1994
30% reduction by 1998 (compared to any year from 1980 to 1986)

Table 7-1 Environmental Standard for Air Pollution in Bulgaria, EC and Other Countries

Substance	Bulgarian annual mean	Daily mean	mg/m³ maximum	EC Directive (limit value) annual daily-median	winter -time	mg/m³ annual daily 98%	Germany annual mean	mg/m³ 30-minute mean	Japan annual hourly 98%
SO2	0.05 (0.018 ppm)	0.15	0.50	0.08 (SPM>0.04) 0.12 (SPM<0.04)	0.13 (SPM>0.06) 0.18 (SPM<0.06)	0.25 (SPM>0.15) 0.35 (SPM<0.15)	0.14	0.40	(0.11mg/m³) 0.04 ppm
NO2	0.05 (0.024 ppm)	0.10	0.20	·····	·····	0.20	0.08	0.20	(0.08 ···0.12mg/m³) 0.04 ···0.06ppm
SPM	0.15	0.25	0.50	0.08	0.13	0.25	0.15	daily mean 0.30	0.10
O_3	····· 8-hours value:	····· 0.10 mg/m³	0.16	·····			·····		one-hour(0.13mg/m³) 0.06 ppm
CO	·····	10	60	·····			10	30	(13mg/m³) 10 ppm
Cd	0.00001	0.00002	·····	·····			0.00004	·····	·····
Cℓ	·····			·····			0.10	0.30	·····
HCℓ	·····	0.2	0.3	·····			as Cl 0.10	0.20	·····
F、HF	·····	0.005	0.02	·····			0.001	0.00	·····
Pb	0.001	0.001	·····	·····			0.002	·····	·····
NH_3	·····	0.04	0.20	·····			·····		·····
HCHO	·····	0.003	0.003	·····			·····		·····
CH_3OH	·····	0.5	1.0	·····			·····		·····
H_2S	0.008	0.008	0.008	·····			·····		·····
C_6H_6	·····	0.1	1.5	·····			·····		·····
$CH_3C_6H_5$	·····	0.6	0.6	·····			·····		·····
C_6H_5OH	·····	0.01	0.01	·····			·····		·····
Ni	·····	0.003	0.003	·····			·····		·····
Tℓ	·····			·····			0.01 mg/m² d		·····
Other chemicals	Including the above, over 152 chemicals are designated			·····			·····		·····

(Unit mg/m³ in the citations means mg/Nm³)

Table 7-2 Emission Standard for Steelworks in Bulgaria, EC and Other Countries

Plant	Bulgaria	EC Directive	Germany	Japan
Ore stocking yard・dust	.....	.....	.....	Equipment (water spray)
Conveyor, conveyor junction・dust	Equipment (conveyor for powder)	.....	.....	Ditto (cover)
Coke-oven charging・dust	.....	.....	Desirable (prevention)	Ditto (collector)
Coke-oven guide-car・dust	.....	.....	Equipment (collector) 5g/coke t	Ditto (collector)
Coke-oven door emission	.....	.....	ditto (sealed type)	.....
COG・S-content	.....	.....	COG・S: 0.8 g/m³	.....
Sinter main・dust	General** : 80mg/m³	.....	Equipment (collector)	( ):city. newly 150(100)mg/m³
SOx	.....	.....		k-value**
NOx	.....	.....	NO2: 400mg/m³	NO2: 220ppm
Sinter cooler・dust	General** : 80mg/m³	.....	.....	.....
BF material bin・dust	Equipment (enclosure for powder) (conveyor for powder)	.....	.....	Equipment for screen and crusher
BF casting house・dust	Dust collector : 30mg/m³	.....	Equipment (collector)	.....
BF house secondary dust	.....	.....	.....	.....
Converter main・dust	Emission : 30mg/m³	.....	Desirable (collector) General: 50mg/m³	100(50)mg/m³
Converter mouth・dust	..... Dust collector : 30mg/m³	.....	.....	.....
CV house secondary dust	.....	.....	.....	.....
EAF main・dust	Emission : 30mg/m³	.....	Desirable (collector) Emission: 20mg/m³	100(50)mg/m³
EAF house secondary dust	.....	.....	..... Voluntary collection	..... Voluntary collection
Lime kiln main・dust	General** : 80mg/m³	.....	General standard	100(50)mg/m³

(Unit mg/m³ in the citations means mg/Nm³)

Plant		Bulgaria	EC Directive	Germany	Japan
Boiler		Heat power 500Kw--5Mw mg/m³ D. Coal / Oil / Gas	mg/m³ Solid 500Mw-- 50 --500Mw 100 general 650 v<10% 1300	Coal / Oil / Gas	On fuel. gas-volume :200-500 Km³/H
	Dust	100 / 50 / 10		50 / 50 / 5mg/m³	100 / 50 / 50mg/m³
	SOx	650 / 650 /		140 / 140 / 12ppm	(50 / (40 / (30
	NOx	600 / 450 / 300		199 / 75 / 50ppm	K-value 250 / 150 / 100ppm
Reheating furnace. Soaking pit		Heat power 5--50Mw mg/m³ Solid / Oil / Gas	Oil 50-100 450	On figure of pre-heating temp. i.e. 600℃ NOx: 1100mg/m³	Gas-volume Km³/H 100- / 10- / --10
	Dust	120 / 50 / 10			100 / 100-200 / 200
	SOx	2000 / 1000 /			(80 / (80-100 / (100
	NOx	500 / 450 / 200			K-value / ppm 100 / 130 / 150-180
		Heat power 50Mw-- mg/m³ Solid / Oil / Gas	Gas 5- 50		
	Dust	150 / 80 /			
	SOx	2000 / 1000 /	general 35 LG 5 B.C gas 800		
	NOx	500 / 450 / 200	.....		
Notes		** General dust standard Gas rate m³/H / Standard --20.000 / 150 mg/m³ 20.001--60.000 / 130 ① 60.001-- / 80 ② Sinter :①, lime :② Emission standards are also applied to other chemicals.		General: Dust / Standard 0.5-- kg/H / 50mg/m³ --0.5 / 150	SOx・K-value $q=K*10^{-3}*He^2$ k=3.0--17.5 He:effective H of stack

(Unit mg/m³ in the citations means mg/Nm³)

7.1.3 Standards for water pollution/effluent

The environmental standards for water were instituted in 1986. Table 7-3 shows the standards. (Regulations No.7 August 8.1986 For Standard and Norms for Surface Water issued by Environmental Protection Committee, Ministry of Public Health, Regional Development Committee)

Environmental standards of eighty-seven items and chemicals are regulated, but there are not effluent standards. The standard is indicated by the concentration. There is no quantity control regulation in Bulgaria, as seen in some countries. Therefore, as the effluent standard, the environmental standards (category 2) are applied to the effluent of steelworks. The regulations also include a fine system.

The MOE is preparing an effluent standard (Water Act) referring to that in Germany. The basic concept for the standard is the purification capacity of the water basin such as river, lake, or sea. Thus, effluent standards would differ according to the basin into which the effluent is discharged. Not only the capacity but also the BAT is considered for the treatment of water containing hazardous chemicals.

The procedure for preparing the standard value is as follows.

- Minimum levels by industry will be determined on a nationwide basis (for example — oil content (steel industry): 8 mg/*l*).
- Specific standards by river (where do they flow, what are they used for?), by business installation size, and by plant will also be instituted.

These values will be stricter than the nationwide standards. A effluent standard will not be stricter than the environmental standards.

In the future, the Bulgarian standard should be similar to the EU level, for example, Germany. Germany has a federal 'water control act', and minimum standards (See Table 7-3) for each industry are designated in the 'governmental regulation on waste water', depending on the federal law. A fine system is also used. Regions have their own regulations for water prescribing effluent standards for each water basin, industry and its size, and will use the standards with regard to the BAT.

7.1.4 Environmental problems at specific steelworks

Important matters relating to environmental problems at steelworks as perceived by the MOE, are outlined below.

1) Kremikovtzi Steelworks
   a. Coke oven emissions
   b. BF casting house emissions

c. Modification/renewal of pollution control equipment throughout the steelmaking shops
d. Dust emissions from calcinating shop
e. Rolling mill waste water recycling and elimination

2) Stomana Steelworks
a. Replacement of EP by bag filter (No.1 EAF)
b. Recycling of rolling mill waste water
c. Improvement of lime kiln dust collecting system
d. Reuse of dust collector dust

Table 7-3 Water Quality Standard (Principal items)

Items		Bulgaria	Germany	
		Environmental Standard Category II	Minimum regulated Industrial standard	
			Steel Industry	Coke from coal
1. pH		6.0 - 8.5		
2. COD (Mn)	(mg/l)	< 30	< 100	< 300 **
3. Suspended Solid	(mg/l)	< 50		
4. Oil content	(mg/l)	< 0.3		
5. Dissolved T-Fe	(mg/l)	< 1.5	< 20	
6. Phenols	(mg/l)	< 0.05		< 1 **
7. CN	(mg/l)	< 0.05		< 0.5 **
8. T-CN	(mg/l)	< 0.5		
9. NH_3	(mg/l)	< 2.0		< 100 **
10. Zn	(mg/l)	< 5	< 4	
11. Pb	(mg/l)	< 0.05	< 0.5	
12. BOD	(mg/l)	< 15		< 75

** are figures for emissions (g)/coal (t) ; the figure in (mg/l) is approximately 2.2 × that given in the table.

7.2 Criteria for Environmental Pollution Prevention Measures of the Steel Industry

7.2.1 Criteria for air pollution prevention

The existing criteria in Bulgaria are strict compared with those of the developed countries, especially for chemicals. However, there are some problems in environmental equipment, compared with the international level, especially as represented by the EU countries such as Germany. (There is no-dedusting system for the coke oven and no-dedusting system for BF casting house.)

Therefore, the criteria for environmental countermeasures should be improved in terms of system performance, for example, by setting up efficient dust removal systems for coke ovens, to create environmental control systems which are not far behind the currently accepted standards in the EU.

7.2.2 Criteria for water pollution prevention

If the present environmental standard in Bulgaria is satisfied, there will be no effluent problem. Therefore, in this context, the pollution control measures in this report are based on the following provisional preconditions. This effluent standard is almost comparable to that in the EU nations.

a: The facilities should satisfy the Bulgarian environmental standard (at the drainage ditch of a steelworks).

b: The coke gas liquor treatment discharges phenol and other harmful substances, so the wastewater should be independently treated, and its standard must conform to the minimum regulated industrial standard (See Table 7-3) defined in the "General Administrative Rules for Drainage" in Germany.

The effluent from Kremikovtzi Steelworks is discharged into the Lesnovska River, the capacity of this river being almost completely taken up by the wastewater from the steelworks. The discharge standard for this plant seems to be at the same level as the environmental standard, which is similar to the Stomana Steelworks.

Therefore, although the Ministry of Environment of Bulgaria is studying the effluent standard, it will not affect the investment cost for pollution prevention countermeasures.