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PROCESS AND SITE EVALUATION FOR THE IRON AND STEEL INDUSTRY IN MEXICO

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Part I

EVALUATION OF IRON AND STEEL MAKING PROCESSES

In this part of the paper, the author reports on the methodology used by Nacional Financiera, S.A., the official industrial development agency of Mexico, to evaluate different iron and steel making processes, in relation to the availability and price of several resources. Evaluation of this kind is of great interest to Mexico because the most important iron ore deposits are relatively far from the coking coal sources, and relatively near to hydroelectric power, in one case, and to non-coking coal in another.

Explained in a very few words, the evaluation procedure consists of a) determining physical inputs per unit of production corresponding to all the applicable processes; b) making the prices of those inputs vary between minimum and maximum possible values, and c)finding out the impact of those variations on the total cost of iron and steel. From the very beginning of the investigations, Nacional Financiera wanted to produce a work that would be useful not only to Mexico, but universally. For this reason, the results were given as indexes, instead of absolute cost figures, and the prices of inputs were expressed as maximum (plus sign) minimum (minus sign) and medium (m) prices, instead of using specific figures.

By means of an electronic computer, it was possible to introduce in the study all the possible combinations of iron ore reduction and steelmaking processes, and all the probable combinations of price levels of the inputs. Annex I,

attached to this paper, shows relative costs for 4 332 of such combinations, corresponding to 76 combinations of siderurgical activities described on Table 1, and 57 combinations of input prices. They can be used not only to determine the relative advantages of one process in relation to another, in a particular price situation, but to ascertain the sensitivity of steel costs to input price variation.

The figures of Annex I were used for the preliminary selection of the possible manufacturing processes for the future Mexican iron and steel industry, in relation to all the locations which on first sight seemed to have some advantages as sites for the plants. Once this was done, the production costs were recalculated with more precision, this time using actual prices of the inputs. The use of the tables thus resulted in a considerable saving of time and effort inasmuch as the precise calculations were made only for a relatively small number of alternative locations and manufacturing processes.

The hardest part of the process evaluation work was the determination of input coefficients, starting with the production of sinter and coke and ending with the rolling of sections, flats and seamless pipe. This work was done by Nacional Financiera in consultation with national and foreign experts, and taking advantage of published information, which unfortunately is rather scanty 1/

1/ Books: United Nations, Problemas de la Industria Siderúrgica y de Transformación de Hierro y Acero, México 1957; United Nations, Long Term-Trends and Problems of the European Steel Industry, Geneva 1959; United Nations, Comparison of Steel-Making Processes, New York, 1962; W. Isard, I. Schooler and T. Vietorisz, Industrial Complex Analysis, John Wiley, New York, 1962

Periodical publications: Metallurgist (translated from the Russian), New York; Journal of the Iron and Steel Institute, London; Stahl und Eisen, Düsseldorf; Journal of Metals, New York; Revista Latinoamerica da Siderurgia, Santiago, Chile.

As it may be seen in Tables 2 to 6, the coefficients were arranged so as to form column vectors, which in turn were grouped together in matrices. Each vector corresponds to one manufacturing activity[2/]. The minus sign means an input, and the plus sign means a product or by-product. All the inputs are given as per unit of the main product. The left side of the matrices consists of two parts: the upper, contains the linear inputs, i.e., those who are directly proportional to the level of production; the lower part shows the non-linear inputs, the behavior of which in relation to productive capacity can be represented by means of logarithmic equations, formulated with the data given[3/].

The linear inputs are in turn classified into exogenous and endogenous, depending on whether they originate in activities different from the iron and steel industry, or within the industry proper.

2/ For the purposes of this type of work, an "activity" is defined as the transformation of fixed proportions of inputs, into fixed proportions of products and by-products. It can be expressed as a function of the principal input or the principal product. A column vector is a matrix with only one column.

3/ The equations relating investment and labor, with productive capacity, are the following:

$$\frac{I_n}{I_o} = \left(\frac{C_n}{C_o}\right)^{\alpha}$$

$$\frac{L_n}{L_o} = \left(\frac{C_n}{C_o}\right)^{\beta}$$

I_n, I_o, L_n, L_o, represent the investment and labor requirements which correspond to productive capacity levels of C_n and C_o respectively; α and β are exponents which express the variation in investment and labor, respectively, as a result of capacity changes.

The indirect cost inputs do not appear explicitly in the matrices. They have to be calculated by means of factors, as a function of investment, or labor, or both[4/]

4/ The factors used in this work are the following:

	Labor cost factor	Capital cost factor
Supervision	0.200	—
Maintenance	0.100	0.030
Social security and welfare	0.200	0.005
Administrative cost	0.150	0.006
Depreciation		0.050
Insurance		0.010
Opportunity cost of capital		0.080
Others	0.550	0.010
Totals	1.200	0.190

These factors are related in the following equation, expressed in any monetary unit:

$$C_i = \frac{1.20\ C_L + 0.19\ I}{T}$$

In which, C_i is the indirect unit cost; C_L is the annual labor cost; I is the investment and T is the yearly productive capacity, in metric tons. For the purposes of the Mexican study, the price of labor was estimated at 0.60 dollars per man-hour.

The refractory expense was estimated as follows, in dollars per ton of pig iron, or steel.

Reduction		Steel-making	
Blast furnace	0.75	Open hearth	4.48
Electric furnace	0.80	Converter	0.88
Electric furnace with pre-reduction	0.80	Electric furnace:	
		with scrap	1.12
		with sponge iron	1.28
		with pig iron	1.68

In order to calculate costs in an expedient manner, it is preferable to "integrate" the coefficients of the series of activities that form a total manufacturing process. When this is done, the process can be expressed by a single vector, in terms of exogenous inputs, only. An example of the integration procedure is shown on Table 7 5/.

Although this paper deals only with the methodological aspects of the subject, it is important to state some of the assumptions made regarding the nature of the exogenous inputs. The figures are based mainly on Mexican data; they reflect average characteristics of the resources. Thus, iron ore is supposed to have 60 per cent iron. Although sulphur, phosphorous and silica are not recorded in the matrices, they were taken into account implicitly in the calculations. The ash content of coke is about 20 per cent. The manganese content of the manganese ore is 35 per cent, and the heating value of natural gas and fuel oil were taken as 900 000 kilocalories per hundred cubic meters, and one million kilocalories per hundred liters, respectively. Other assumptions may be seen in the parenthetical figures on the tables.

5/ The calculation mechanism is as follows: If "N" tons of pig iron (besides many other inputs) are required to produce a ton of steel, "N" has to be multiplied by all the coefficients pertaining to the pig iron activity. The coefficient "M", expressing the sinter necessary for pig iron will have to be multiplied by the coefficient corresponding to the iron ore which goes into the making of sinter, in order to obtain the coefficient expressing the amount of iron ore which in the form of pig iron is necessary for one ton of steel. The coefficient indicating the iron ore introduced directly to the steel-making furnace will have to be added to the coefficient thus calculated.

Investment includes construction, basic and auxiliary equipment, service equipment, shops, spare parts, engineering, erection and offices.

We think it is pertinent to say that a determination of physical input coefficients for several industries is a task that one institution alone cannot do properly, if the coefficients are to be kept constantly up to date. This meeting provides a good opportunity for organizing cooperative work of this kind among institutions whose job is to evaluate projects and to program the development of the industry.

Besides their use in process evaluation the input-output coefficients were employed as tools for the projection of the future needs for raw materials and productive capacity of the industry. This was done by means of physical input-output tables or matrices, which not only reflect the demand for the different materials, intermediate products, fuel and electric power, but express the interrelationships among different sectors of the industry, and even with other industries which either supply materials to siderurgy, or use iron and steel products as raw materials.

The fact that the matrices represent conditions of equilibrium between inputs and products, considering return scrap and non-recoverable waste; and between production and consumption, considering imports and exports, helps keep under a sort of accounting control the estimates that usually have to complement scarce statistical data.

Imports and exports of siderurgical materials or products are of little importance in the case of Mexico. For this reason, they are taken into account only in the balance, at the bottom of the matrices. For countries with considerable foreign trade in this respect, each of the input and product lines of the matrix can be trebled, to show production, imports and exports.

Table 8 shows the basic matrix for the Mexican iron and steel industry in 1963, and Table 9 is the projected matrix for 1975. The latter is based on the input coefficients of tables 2 to 6, but it is just an illustration made specially for this paper, inasmuch as the decisions on locations and processes for the future Mexican iron and steel industry have not been yet made.

It will be of interest for this audience to know that in its industrial programming, Nacional Financiera is trying to use physical input-output matrices for most of the industries. By means of price tables, and the inclusion of monetary inputs which are not expressed in the coefficient matrices, the input-output tables are transformed from physical into monetary units, in order to be able to interrelate tables belonging to different industries, and to interrelate industry with other sectors, by means of the general input-output matrix for the Mexican economy, which is being prepared as a joint effort of the ministries of Finance and of the Presidency of the Republic, the Bank of Mexico, and Nacional Financiera.

Part II

SITE EVALUATION

Once one or more process combinations are selected by the procedure explained earlier in this paper, the more accurate calculations of steel ingot costs for different sites and several manufacturing processes was made by means of two sets of figures. For one of the sets, the transportation of iron ore and coal was computed with the actual freight rates of the Mexican railroad system. The results obtained this way express the worth of the site from the point of view of private enterprise. The other set of figures was based on freight rates adjusted so as to reflect "shadow prices" or "accounting prices" for transport, which represent what the Nation actually spends in fuel, labor, materials and depreciation, when transporting a load from one place to another of her territory. Although shadow prices were used only for transport, it may be said that the results arrived at by using them reflect the worth of the site from the point of view of national interest. The results obtained by employing virtual prices reflect better the interest of private enterprise.

The reason for using shadow prices is that in Mexico actual freight rates do not reflect the national expenditure. The general average of what the railroads collect is less than the cost of transport, and, as far as siderurgy is concerned, the rates for transport of minerals are too low and those for finished products too high, in relation to the actual cost of moving those materials. Graph 1 shows the differences between actual and shadow freight rates for Mexico.

Due to the fact that total costs or prices of minerals, coke, etc., as influenced by the present freight rates, cannot be called actual, because in most cases the buying or selling of them is not yet established, it was decided to name them "virtual" costs or prices, in order to avoid confusing them with those handled by the existing iron and steel companies, which would be truly "actual".

When estimating costs, no attempt was made to get close to the figures actually recorded by the existing mills. The objective was rather to arrive at a set of figures calculated all with the same criterium, since in a study of this sort what matters most are the relative values, not the absolute ones. Furthermore, actual costs are generally distorted by factors which do not belong to the realm of the economics of the industry.

Table 10 illustrates the relative costs of steel ingots in some preselected locations, as computed for what resulted to be the most suitable manufacturing processes. It is interesting to point out that, as the distance between the site and the iron ore deposits increases, the costs differences computed with shadow prices of the inputs tend to be more significant than those obtained by using virtual prices. The location of other factors of production, such as coal, coke, limestone and electric power do not seem to matter very much in this respect.

Manufacturing costs are not, of course, the end of the story. Finished products will have to be transported to the steel users, which are not concentrated in one point but widely distributed, according to a particular

geographical structure of the market. From the national point of view, the best site is that which would minimize the total national cost of producing and distributing steel from all the plants -the projected new one and the existing ones- to a market defined by its given geographical structure. The problem was thus one of classical transportation linear programming, and it was solved with the aid of a Control Data 170-A computer, in approximately four hours of computing time.

The calculations of minimum cost were referred to a distant date because a large steel project started now will not be in normal production before five to seven years. As it was not possible to forecast with accuracy the future geographical structure of the market, it became necessary to play with several hypotheses of structures, as indicated in Table 11. The conclusion in this respect, as may be seen in Table 12, is that although the geographical distribution of the market is an important locational factor, significant but reasonable changes in this respect do not alter sensibly the results of the minimization of the total national cost of producing and distributing steel for a given location. Furthermore, in general, relative differences in total virtual costs are not very significant, but absolute differences in monetary terms are quire relevant. In the case of total shadow costs, differences are important in both, relative and absolute terms.

Graph 1

Actual freight rates and shadow prices of the rates, as used in weight to transport costs

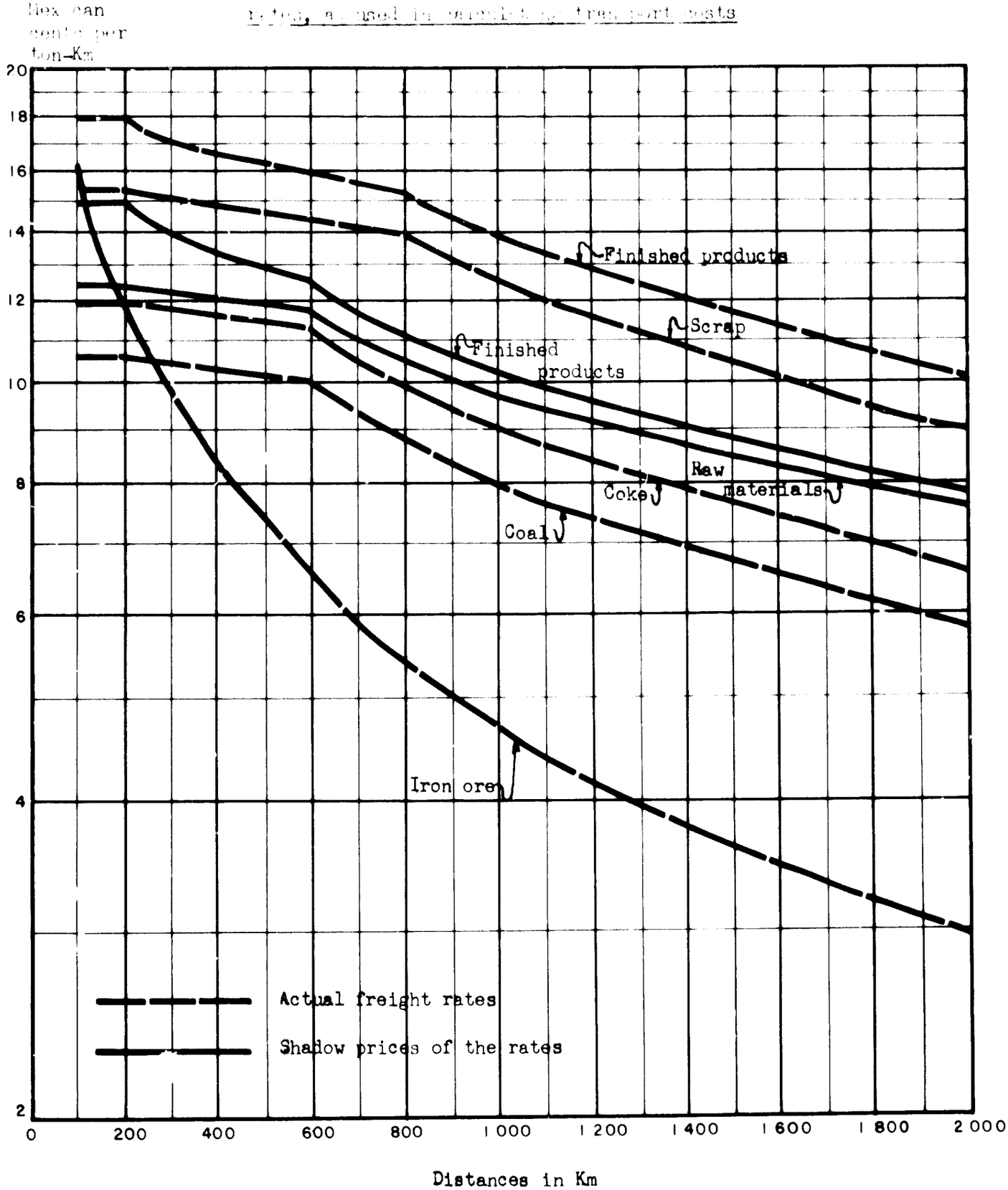

Table 1

List of the 67 steel mill activities included in this study

Activity number	
1.	**Sinter processes:**
1.1	Washed coal and natural gas
1.2	Small scale plants
1.3	Washed coal and fuel oil
1.4	Coke breeze and fuel oil
1.5	Coke breeze and natural gas
1.6	Iron ore fines, coke breeze and fuel oil
2.	**Coke**
2.1	Normal coke production vector
3.	**Pig iron**
	a) **Blast furnace:**
3.1	100% sinter; natural gas acting as fuel and as reducing agent
3.2	100% sinter; fuel oil
3.3	100% sinter; without using hydrocarbons
3.4	50% sinter and 50% iron ore; natural gas
3.5	50% sinter and 50% iron ore; fuel oil
3.6	50% sinter and 50% iron ore; without hydrocarbons
3.7	100% iron ore; natural gas
3.8	100% iron ore; fuel oil
3.9	100% iron ore
	b) **Electric furnace:**
3.10	100% sinter; coke and coke breeze
3.11	100% sinter; anthracite
3.12	50% sinter and 50 iron ore; coke and coke breeze
3.13	50% sinter and 50 iron ore; anthracite
3.14	100% iron ore; coke and coke breeze
3.15	100% iron ore; anthracite
	c) **Electric furnace with pre-reduction:**
3.16	100% iron ore; coke
3.17	100% iron ore; anthracite

Table 1 (continuation)

	d) Sponge iron:
3.18	100% sinter
3.19	50% sinter and 50% iron ore
3.20	100% iron ore
4.	Steel ingots
	a) Open heart (Siemens Martin) furnace:
4.1	65% pig iron and 35% scrap; with iron ore
4.2	65% pig iron and 35% scrap; oxygen
4.3	60% pig iron and 40% scrap; oxygen
	b) Converters:
4.4	Linz-Donawitz (L-D)
4.5	Kaldo
	c) Electric furnace:
4.6	Sponge iron and iron ore
4.7	Sponge iron; oxygen
4.8	Scrap and iron ore
4.9	Scrap; oxygen
4.10	Pig iron and scrap; oxygen
5.	Castings
5.1	Ingot moulds (normal vector)
5.2	Other products (average inputs)
5.3	Steel castings (average inputs)
6.	Flats
	a) Slabs:
6.1	Blooming mill
6.2	Continuous casting mill
	b) Hot rolled products:
6.3	Strip; Steckel, or reversing mill
6.4	Strip; semicontinuous mill
6.5	Strip; continuous mill
6.6	Sheets over 3 mm thickness
6.7	Sheets under 3 mm thickness
	c) Cold rolled products:
6.8	Strip; semicontinuous mill
6.9	Strip; continuous mill
6.10	Sheets

Table 1 (continuation)

	d) Tinplate:
6.11	Immersion process
6.12	Electrolytic process
7.	Rolled sections
7.1	Blooms; blooming mill
7.2	Blooms; continuous casting mill
7.3	Billet; reversing mill
7.4	Billet; continuous mill
7.5	Heavy weight sections; semicontinuous mill; height over 76 mm
7.6	Heavy weight sections; continuous mill; height over 76 mm
7.7	Rails; semicontinuous mill
7.8	Rails; continuous mill
7.9	Medium weight sections; semicontinuous mill; height over 38 mm
7.10	Medium weight sections; continuous mill; height over 38 mm
7.11	Light weight sections; semicontinuous mill; height under 38 mm
7.12	Light weight sections; continuous mill; height under 38 mm
7.13	Wire; semicontinuous mill
7.14	Wire; continuous mill
8.	Seamless pipes
8.1	Seamless pipes; pilger rolling mill

Table 2

Physical input-output coefficients for the production of sinter and coke

(Metric tons)

Inputs \ Activities	Sinter 1.1	Sinter 1.2	Sinter 1.3	Sinter 1.4	Sinter 1.5	Sinter 1.6	Coke 2.1
LINEAR EXOGENOUS INPUTS							
Iron ore (60 % Fe)	-0.936	-0.936	-0.936	-0.936	-0.936		
Washed coal	-0.075	-0.075	-0.075				-1.370
Electric energy (100 Kwh)	-0.100	-0.100	-0.100	-0.100	-0.100	-0.100	
Natural gas (100 m^3=0.9 x 10^6 KCal)	-0.055				-0.055		
Limestone	-0.110	-0.110	-0.110	-0.110	-0.110	-0.110	
Fuel oil (100 lts = 10^6 KCal)		-0.050	-0.050	-0.050		-0.050	
Mineral fines						-0.936	
LINEAR ENDOGENOUS INPUTS							
Coke fines				-0.055	-0.055	-0.055	
PRODUCTS AND BYPRODUCTS							
Sinter	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	
Coke							+1.000
Coke gas (1000 m^3 N)							+0.249
Coke fines							+0.110
NON-LINEAR EXOGENOUS INPUTS							
Annual capacity (10^6 t/year)	1.500	0.170	1.500	1.500	1.500	1.500	1.000
Investment (10^6 Dolls.)	5.760	0.979	5.760	5.760	5.760	5.760	40.400
Exponent investment equation	0.610	0.700	0.610	0.610	0.610	0.610	0.600
Labor (m-h/t)	1.500	3.000	1.500	1.500	1.500	1.500	1.500
Exponent labor equation	0.500	0.600	0.500	0.500	0.500	0.500	0.500
Capacity limits considered:							
Lower (10^6 t)	0.500	0.170	0.500	0.500	0.500	0.500	0.250
Higher (10^6 t)	2.500	0.500	2.500	2.500	2.500	2.500	1.250

Source: Industrial Programming Division, Nacional Financiera, S.A. (Mexico)

Table 3

Physical input-output coefficients for the production of primary iron

(Metric tons.)

Inputs \ Activities	Pig iron production in blast furnaces									Electric reduction furnaces						Electric furnace with pre-reduction		Sponge iron		
	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	3.16	3.17	3.18	3.19	3.20
LINEAR EXOGENOUS INPUTS																				
Iron ore (Fe 60 %)				-0.800	-0.800	-0.800	-1.600	-1.600	-1.600			-0.800	-0.800	-1.600	-1.600	-1.600	-1.600		-0.750	-1.500
Pellets																				
Washed coal																				
Anthracite											-0.425		-0.425		-0.425	-0.480				
Limestone	-0.200	-0.200	-0.200	-0.300	-0.300	-0.300	-0.400	-0.400	-0.400	-0.150	-0.150	-0.225	-0.225	-0.300	-0.300	-0.400	-0.400			
Quick lime																				
Manganese ore (35 %)	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045			
Fluorespar																-0.020	-0.025			
Graphite																				
Soderberg electrodes										-0.016	-0.016	-0.018	-0.018	-0.020	-0.020	-0.010	-0.010			
Natural gas (100 m^3=0.9 x 10^6 KCal)	-1.000			-1.000			-1.000											-6.300	-6.300	-6.300
Steam	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000											
Electric energy (100 Kwh)	-0.350	-0.350	-0.350	-0.350	-0.350	-0.350	-0.350	-0.350	-0.350	-20.500	-20.500	-22.500	-22.500	-24.500	-24.500	-11.100	-11.100	-0.100	-0.100	-0.100
Water 100 m^3	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.150	-0.500	-0.500	-0.500	-0.500	-0.500	-0.500	-0.500	-0.500	-0.040	-0.040	-0.040
Fuel oil (100 lt = 10^6 KCal)		-0.810			-0.810			-0.810												
LINEAR ENDOGENOUS INPUTS																				
Sinter (Fe 56 %)	-1.710	-1.710	-1.710	-0.855	-0.855	-0.855				-1.710	-1.710	-0.855	-0.855					-1.500	-0.750	
Coke (20 % ash)	-0.500	-0.570	-0.700	-0.550	-0.620	-0.750	-0.600	-0.670	-0.800	-0.200		-0.200		-0.200						
Coke breeze (20 % ash)										-0.200		-0.200		-0.200						
PRODUCTS AND BYPRODUCTS																				
Pig iron	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000			
Sponge iron																		+1.000	+1.000	+1.000
Blast furnace gas (10^3 m^3 N)	+2.624	+2.772	+2.800	+2.824	+2.972	+3.000	+3.024	+3.172	+3.200											
Electric furnace gas (1000 m^3 N)										+0.600	+0.600	+0.600	+0.600	+0.600	+0.600	+0.600	+0.600			
Slag	+0.591	+0.611	+0.631	+0.601	+0.621	+0.631	+0.611	+0.631	+0.651	+0.472	+0.472	+0.497	+0.497	0.522	+0.522	+0.471	+0.471			
NON-LINEAR EXOGENOUS INPUTS																				
Capacity (10^6 t/year)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Investment (10^6 Dlls.)	40.000	43.300	48.100	43.000	47.300	51.100	48.900	49.300	54.000	38.900	38.900	39.400	39.400	40.000	40.000	38.500	38.500	39.500	39.500	39.500
Exponent investment equation	0.640	0.640	0.640	0.640	0.640	0.640	0.640	0.640	0.640	0.750	0.750	.750	.750	0.750	.750	.750	.750	.750	.750	.750
Labor (m-h/t)	0.760	0.760	0.760	0.760	0.760	0.760	0.760	0.760	.760	0.950	0.950	.950	.950	.950	.950	.950	.950	.950	.950	.950
Exponent labor equation	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	.500	0.500	.500	.500	.500	0.500	.500
Capacity limits considered:																				
Lower (10^6 t/year)	0.400	0.400	0.400	0.400	0.400	0.400	.400	0.400	0.400	0.385	.385	.385	.385	.385	0.385	0.385	.385	.385	.385	0.385
Higher (10^6 t/year)	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400

Source: Industrial Programming Division, Nacional Financiera, S.A. (Mexico)

Table 4

Physical input-output coefficients for the production of steel ingots and castings

(Metric tons)

Inputs \ Activities	Open hearth furnace (65-35) 4.1	Open hearth furnace (65-35) 4.2	Open hearth furnace (60-40) 4.3	Converters L-D 4.4	Converters Kaldo 4.5	Electric furnace[a] With sponge iron 4.6	Electric furnace[a] With sponge iron 4.7	Electric furnace[a] With scrap 4.8	Electric furnace[a] With scrap 4.9	Electric furnace[a] With pig iron 4.10	Foundry[b] Ingot moulds 5.1	Foundry[b] Cast iron 5.2	Foundry[b] Steel castings 5.3
LINEAR ENDOGENOUS INPUTS													
Scrap	-0.360	-0.385	-0.430	-0.272	-0.260	-0.267	-0.275	-1.090	-1.099	-0.360	-0.373	-0.85	-1.618
Iron ore (60 % Fe)	-0.115				-0.081	-0.050		-0.015					-0.025
Limestone	-0.040					-0.040		-0.040			-0.045	-0.064	-0.067
Fluorspar	-0.005	-0.005	-0.005	-0.004		-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.006	-0.009
Aluminum	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001			-0.002
Graphite electrodes						-0.008	-0.007	-0.005	-0.005	-0.004			-0.010
Oxygen (100 m^3 N)		-0.270	-0.300	-0.550	-0.620		-0.040		-0.040	-0.270			
Fuel oil (100 lt = 10^6 KCal)	-1.396	-1.000	-1.000										
Electric energy (100 Kwh)	-0.200	-0.180	-0.165	-0.140	-0.160	-6.600	-5.280	-5.000	-4.000	-2.800			
Water (100 m^3)	-0.020	-0.020	-0.020	-0.020	-0.020	-0.020	-0.020	-0.020	-0.020	-0.020	-0.900	-1.000	-10.000
Lime	-0.038	-0.060	-0.060	-0.060	-0.050	-0.038	-0.060	-0.038	-0.040	-0.060			
LINEAR ENDOGENOUS INPUTS													
Hot metal	-0.670	-0.714	-0.650	-0.818	-0.781					-0.670	-0.869	-0.568	
Sponge iron						-0.891	-0.916						
Ferromanganese	-0.010	-0.010	-0.010	-0.008	-0.008	-0.010	-0.010	-0.010	-0.010	-0.010	-0.002	-0.002	-0.020
Ferrosilicon	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.006	-0.006	-0.014
Coke								-0.004	-0.004		-0.150	-0.214	-0.007
Return scrap											-0.150	-0.315	-0.567
Ingot moulds	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	-0.025	+1.000		
PRODUCTS AND BY-PRODUCTS													
Steel ingots	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000	+1.000			
Return scrap	+0.047	+0.047	+0.047	+0.025	+0.025	+0.022	+0.022	+0.022	+0.022	+0.022	+0.150	+0.315	+0.567
Non recoverable waste	+0.219	+0.219	+0.222	+0.143	+0.161	+0.282	+0.274	+0.183	+0.189	+0.210	+0.300	+0.398	+0.258
Cast iron												+1.000	
Steel castings													+1.000
NON LINEAR ENDOGENOUS INPUTS													
Capacity (10^6 t/year)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	50.000	100.000	100.000
Investment (10^6 Dolls.)	33.000	29.000	27.500	17.000	18.500	27.300	24.300	21.000	21.000	17.500	3.000	12.500	30.000
Exponent investment equation	0.600	0.600	0.600	0.620	0.620	0.620	0.620	0.620	0.620	.620	0.700	0.700	0.700
Labor (m-h/ton)	4.000	4.000	4.000	3.000	3.000	4.500	4.500	5.200	5.200	4.000	6.000	16.000	30.000
Exponent labor equation	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.580	0.760	0.760
Capacity limits considered:													
Lower (10^6 t/year)	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	3.750	15.000	15.000
Higher (10^6 t/year)	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	50.000	100.000	100.000

Source: Industrial Programming Division, Nacional Financiera, S.A. (Mexico)

a/ Capital investment for electric power generation is not included.

b/ Capacity expressed in thousands of tons.

Table 5

Physical input-output coefficients for the production of flat rolled products

(Metric tons)

Inputs \ Activities	Slabs		Hot rolled strip coils			Hot rolled sheets		Cold rolled strip coils		Cold rolled sheets	Tinplate	
	Blooming mill 6.1	Continuous casting 6.2	Reversing mill 6.3	Semi-continuous mill 6.4	Continuous mill 6.5	More than 3 mm 6.6	Less than 3 mm 6.7	Semi-continuous mill 6.8	Continuous mill 6.9	6.10	Immersion 6.11	Electrolytic 6.12
LINEAR HEDOGENOUS INPUTS												
Rolls (Kg)	-2.000		-2.900	-3.400	-2.400			-2.700	-1.400			
Tin											-0.011	-0.005
Water (100 m^3)	-0.100	-0.050	-0.013	-0.027	-0.045			-0.019	-0.017			
Steam								-0.080	-0.070			
Electric energy (100 Kwh)	-0.220	-0.100	-1.600	-1.400	-0.850	-0.080	-0.080	-1.300	-0.900	-0.080	-0.050	-0.200
Fuel oil (100 lts = 10^6 KCal)	-1.760	-0.266	-0.960	-0.860	-0.690			-0.484	-0.374			
Copper (Kg)		-0.200										
LINEAR HEDOGENOUS INPUTS												
Steel ingots	-1.111	-1.053 a/										
PRODUCTS AND BY-PRODUCTS												
Slabs	+1.000	+1.000	-1.190	-1.180	-1.111							
Plates or hot rolled strip coils			+1.000	+1.000	+1.000	-1.109	-1.028	-1.163	-1.087			
Hot rolled sheets of more than 3 mm						+1.000						
Hot rolled sheets of less than 3 mm							+1.000					
Cold rolled strip coils								+1.000	+1.000	-1.021		
Cold rolled sheets										+1.000	-0.989	-0.995
Tinplate											+1.000	+1.000
Return scrap	+0.089	+0.050	+0.166	+0.156	+0.099	+0.109	+0.028	+0.163	+0.087	+0.021		
Mill scale	+0.022											
Non recoverable waste		+0.003	+0.024	+0.024	+0.024							
NON LINEAR HEDOGENOUS INPUTS												
Annual capacity (10^6 t/year)	1.000	1.000	0.290	0.660	2.000	0.800	0.800	0.525	1.050	0.800	0.500	0.500
Investment (10^6 Dolls.)	22.700	16.500	32.000	49.000	96.000	2.000	3.000	33.200	43.500	2.500	8.000	7.000
Exponent investment equation	0.620	0.700	0.530 b/	0.530 b/	0.530 b/	0.600	0.600	0.650	0.600	0.600	0.600	0.600
Labor (m-h/ton)	0.190	0.110	0.120	0.100	0.080	0.900	1.200	1.430	1.200	0.900	1.200	1.000
Exponent labor equation	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Capacity limits considered:												
Lower (10^6 t/year)	0.500	0.500	0.100	0.400	0.700	0.200	0.200	0.150	0.700	0.200	0.200	0.300
Higher (10^6 t/year)	2.000	2.000	0.350	0.800	2.000	1.500	1.500	0.600	1.750	1.500	0.600	0.800

Source: Industrial Programming Division, Nacional Financiera, S.A. (Mexico)

a/ Liquid steel.

b/ This is an average for the three processes. It cannot be used for calculating the scale factor of anyone of them.

Table 6

Physical input-output coefficients for the production of rolled sections and seamless pipes

(Metric tons)

Activities / Inputs	Blooms		Billets		Heavy sections [a]		Rails [a]		Medium sections [b]		Light sections [b]		Wire [c]		Seamless pipes
	Blooming mill	Continuous casting	Reversing mill	Continuous mill	Semi continuous mill	Continuous mill	Semi continuous mill	Continuous mill	Semi continuous mill	Continuous mill	Semi continuous mill	Continuous mill	Semi continuous mill	Continuous mill	Pilger mill
	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	7.10	7.11	7.12	7.13	7.14	8.1
LINEAR ENDOGENOUS INPUTS															
Rolls (Kg)	-0.200		-1.200	-1.000	-2.500	-1.500	-2.500	-1.500	-3.000	-2.000	-3.000	-2.000	-3.000	-2.000	-2.500
Tin															
Water ($100\ m^3$)	-0.100	-0.050	-0.100	-0.150	-0.100	-0.150	-0.100	-0.150							-0.030
Steam									-0.300	-0.250	-0.300	-0.250	-0.300	-0.250	
Electric energy (100 Kwh)	-0.220	-0.100	-0.250	-0.125	-0.300	-0.150	-0.300	-0.150	-0.900	-0.500	-0.900	-0.500	-0.900	-0.500	-1.800
Fuel oil (100 lts = 10^6 KCal)	-1.760	-0.266							-1.760	-1.650	-1.760	-1.650	-1.760	-1.650	-1.700
Copper (Kg)		-0.200													
LINEAR HETEROGENOUS INPUTS															
Steel ingot	-1.111	-1.053													
PRODUCTS AND BY-PRODUCTS															
Blooms	+1.000	+1.000	-1.022	-1.022	-1.111	-1.053	-1.111	-1.053							-1.280
Billets			+1.000	+1.000					-1.109	-1.105	-1.109	-1.105	-1.105	-1.105	-1.109
Heavy sections					+1.000	+1.000									
Rails							+1.000	+1.000							
Medium sections									+1.000	+1.000					
Light sections											+1.000	+1.000			
Wire													+1.000	+1.000	
Seamless pipes															+1.000
Return scrap	+0.089	+0.050	+0.020	+0.020	+0.109	+0.051	+0.109	+0.051	+0.076	+0.074	+0.076	+0.074	+0.076	+0.074	+0.272
Rolling mill scale	+0.022														
Non recoverable waste		+0.003	+0.002	+0.002	+0.002	+0.002	+0.002	0.002	+0.033	+0.031	+0.033	+0.031	+0.033	+0.031	+0.008
FOR LINEAR ENDOGENOUS INPUTS															
Annual capacity (10^6 t/year)	1.000	1.000	0.500	1.000	0.525	1.000	0.525	1.000	0.500	1.000	0.500	1.000	0.500	1.000	0.600
Investment (10^6 Mls.)	22.700	16.500	20.000	31.000	28.400	46.000	28.400	40.000	26.000	38.000	26.000	38.000	15.000	24.000	70.000
Exponent investment equation	0.620	0.700	0.620	0.630	0.640	0.625	0.660	0.625	0.660	0.625	0.660	0.625	0.620	0.620	0.650
Labor (m-h/t)	0.190	0.110	1.000	0.700	1.360	0.950	1.360	0.950	1.200	0.900	1.200	0.900	1.300	0.800	3.000
Exponent labor equation	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Capacity limits considered:															
Lower (10^6 t/year)	0.500	0.500	0.150	0.600	0.200	0.600	0.200	0.600	0.200	0.600	0.100	0.600	0.100	0.600	0.150
Higher (10^6 t/year)	2.000	2.000	0.600	1.500	0.650	1.700	0.650	1.700	0.650	1.700	0.650	1.700	0.600	1.300	0.600

Source: Industrial Programming Division, Nacional Financiera, S.A. (Mexico)

a/ The same rolling mill may be used for heavy sections and rails.

b/ The same rolling mill may be used for medium and light sections.

c/ A separate rolling mill for wire.

Table 7

Example of the integration of Input-Output coefficients of several activities, in order to express their combination in terms of exogenous inputs only. a/

(Metric tons.)

Inputs	Sinter vector (1.3)	Sinter/ton pig iron vector (1.3) x 0.855	Coke vector (2.1)	Coke/ton pig iron vector (2.1) x 0.550	Pig iron vector (3.4)	Total inputs per ton of pig iron (8)	(a) x 0.818	Steel vector (4.4)	Total inputs per ton of steel
Iron ore (Fe 60 %)	-0.936	-0.800			-0.800	-1.600	-1.308		-1.308
Washed coal	-0.075	-0.064	-1.370	-0.754		-0.818	-0.669		-0.669
Anthracite coal									
Limestone	-0.110	-0.094			-0.300	-0.394	-0.322		-0.322
Lime								-0.060	-0.060
Manganese ore (35%)					-0.045	-0.045	-0.037		-0.037
Fluorspar								-0.004	-0.004
Aluminum								-0.001	-0.001
Oxygen (100 m^3 N)								-0.550	-0.550
Soderberg electrodes									
Graphite electrodes									
Fuel oil (100)ts = 10^6 KCal)	-0.050	-0.043				-0.043	-0.035		-0.035
Steam					-1.000	-1.000	-0.818		-0.818
Electric energy 100 Kwh)	-0.100	-0.086			-0.350	-0.436	-0.356	-0.140	-0.496
Water (100 m^3)					-0.150	-0.150	-0.123	-0.020	-0.143
Scrap								-0.272	-0.272
Ferromanganese								-0.008	-0.008
Ferrosilicon								-0.002	-0.002
Ingot moulds								-0.025	-0.025
Natural gas (100 m^3 N = 0.9×10^6 KCal)					-1.000	-1.000	-0.818		-0.818
Sinter (Fe 56%)	+1.000				-0.855				
Coke (20% ash)			+1.000		-0.550				
Coke breeze (20% ash)			+0.110						
Hot metal					+1.000			-0.818	
Sponge iron									
Coke gas (1 000 m^3 N)			+0.249	+0.137		+0.137	+0.112		+0.112
Blast furnace gas (10^3 m^3 N)					+2.824	+2.824	+2.310		+2.310
Electric furnace gas (1 000 m^3 N)									
Return scrap								+0.025	+0.025
Non-recoverable waste								+0.143	+0.143
Steel ingots								+1.000	+1.000

a/ Integration of the following activity vectors are considered: Steelmaking = LD; reduction = Blast furnace using 50% sinter and natural gas.

Table 8

Physical Input-Output Matrix of the Steel Industry in 1963

(Metric tons)

Products / Inputs	Self finished products a/						Finished products b/					Final uses c/						GENERAL TOTAL
	Crude iron		Steel									Industries		Mining and petroleum industries	Railroads	Exports	Total	
	Pig iron	Sponge iron	Open hearth furnace	Electric furnace	Ingot moulds	Total	Flat rolled products	Rolled sections bars and wire	Rails	Seamless pipes	Total	Mechanical	Construction					
LINEAR EXOGENOUS INPUTS																		
Iron ore	1 333 000	254 550	13 283	39 860		1 640 963												1 640 963
Exogenous scrap			174 780	513 124	25 211	713 115												713 115
Coke	600 500				8 068	608 568												608 568
Limestone	333 200		46 200	34 080	2 017	415 597												415 597
Lime			43 890	12 464		56 354												56 354
Manganese ore	308 300			10 224		318 524												318 524
Ferroalloys			13 860	11 250	403	25 513												25 513
Fluorspar			5 775	4 260		10 035												10 035
Graphite electrodes			7 380	5 244		12 624												12 624
Soderberg electrodes		6 788				6 788												6 788
Fuel oil (10^6 lts.)			(161.2)			(161.2)	(120.7)	(159.7)	(5.4)	(24.0)	(309.8)							471.0
Natural gas (10^6 m³)	(12.0)	(47.3)				(59.3)												59.3
Electric energy (10^6 Kwh)	(29.1)	(1.4)	(23.1)	(494.0)	(5.0)	(552.6)	(141.1)	(61.9)	(2.0)	(25.4)	(230.4)							783.0
TOTAL ENDOGENOUS MATERIAL	2 266 700	261 338	305 168	630 506	35 699	3 499 411												3 499 411
LINEAR ENDOGENOUS INPUTS																		
Pig iron for steel making			794 640		36 103	830 743												830 743
Sponge iron				169 700		169 700												169 700
Return scrap			241 605	216 816		458 421												458 421
Open hearth steel							736 210	397 108	21 382		1 154 700					300	300	1 155 300
Electric furnace steel							234 800	423 407		185 693	843 900							843 900
Ingot moulds			28 875	21 548		50 423												50 423
TOTAL ENDOGENOUS MATERIAL			1 065 120	408 064	36 103	1 509 287	971 010	820 515	21 382	185 693	1 998 600					300	300	3 508 187
FINISHED PRODUCTS																		
Flat rolled products												468 622	79 792	10 986	15 300	153 600	728 300	728 300
Rolled sections, bars and wire												303 200	363 000	4 000	4 700	400	675 300	675 300
Rails															83 500		83 500	83 500
Seamless pipes														133 100		7 500	140 600	140 600
TOTAL FINISHED PRODUCTS												771 822	442 792	148 086	103 500	161 500	1 627 700	1 627 700
TOTAL INPUTS	2 266 700	261 338	1370 288	1038 570	71 802	5 008 698	971 010	820 515	21 382	185 693	1 998 600					300	300	7 007 598
-Return scrap			31 185	22 785	5 042	59 012	218 829	134 106	3 260	43 214	399 409							458 421
-Wastes and others	1 433 600	91 638	184 103	171 885	16 337	1 897 563	46 281	47 809	1 322	15 379	110 791							2 008 354
=National production	833 100	169 700	1155 000	843 900	50 423	3 052 123	705 900	638 600	16 800	127 100	1 488 400							4 540 523
+Imports							22 400	36 700	66 700	13 500	139 300							139 300
=Total supply	833 100	169 700	1155 000	843 900	50 423	3 052 123	728 300	675 300	83 500	140 600	1 627 700							4 679 823
-Exports			300			300	153 600		400	7 500	161 500							161 800
=Apparent consumption	833 100	169 700	1154 700	843 900	50 423	3 051 823	574 700	674 900	83 500	133 100	1 466 200							4 518 023

a/ The total supply of pig iron and scrap is slightly different from their sum as inputs in steel making. This is because their supply as materials for iron and steel castings was not considered

b/ The production figures of rolled products expressed as ingots have been adjusted so they agree with the availability of steel ingots.

c/ The totals are based on the relative participation of the steel consuming industries in 1962. See on this subject: Nacional Financiera, S.A., El Mercado de Valores, Núm.22, Mexico, June 1963

Table 9

<u>Physical Input-output Matrix of the Steel Industry in 1975</u>

(Thousands of metric tons)

Inputs \ Products	Semifinished products: Crude iron: Pig iron for steel making	Crude iron: Pig iron for foundries	Sponge iron	Steel: Electric furnace	Steel: Other types	Ingot moulds	Total	Finished products: Gray iron castings	Steel castings	Flat rolled products	Rolled sections bars and wire	Rails	Seamless pipes	Total	Final uses: Industries: Mechanical	Industries: Construction	Mining and petroleum industries	Railroads	Exports	General Total
LINEAR EXOGENOUS INPUTS																				
Iron ore	4 492.6	357.0	1 335.0	9.5		49.4	6 243.5													6 24[illegible]
Exogenous scrap				576.6	407.9		984.5	102.3						102.3						[illegible]086.8
Coke	1 414.9	112.4				19.9	1 547.2	4.1						4.1						[illegible]
Limestone	988.3	78.5		25.5		6.0	1 098.3	12.2						12.2						[illegible]10.5
Rolls (100 Kgs)										(986.0)	(758.9)	(27.8)	(956.3)	(2 729.0)						[illegible]
Lime					221.6		221.6													221.6
Manganese ore	126.3	10.1					136.4													136.4
Ferroalloys				19.2	44.3	1.1	64.6	1.5						[illegible]						66.1
Fluorspar				8.1	16.8	0.7	25.6	1.1						1.1						26.7
Graphite electrodes				10.0			10.0													10.0
Soderberg electrodes	27.0	2.2					29.2													29.2
Oxygen				(38.9)	(145.9)		184.8)													[illegible]34.8
Aluminum				1.6	3.6		5.2													[illegible].2
Fuel oil (10^6 lts)					(204.3)		(204.3)			(497.7)	(733.3)	(19.9)	(155.7)	(1 406.[illegible])						(1 6[illegible])
Natural gas (10^6 m^3 N)	(145.9)	(11.6)	(560.7)				(718.2)													7[illegible]
Electric energy (10^6 Kwh)	(3 356.6)	(266.7)	(89.0)	(831.2)	(59.9)		(4 603.4)	(5.7)		(303.1)	(218.3)	(5.5)	(81.9)	(614.5)						[illegible]
TOTAL EXOGENOUS MATERIAL	7 049.1	560.2	1 335.0	650.5	694.2	77.1	10 366.1	121.2						121.2						10 [illegible]7.3
LINEAR ENDOGENOUS INPUTS																				
Pig iron for steel making					2 807.9		2 807.9													2 807.9
Pig iron for foundries						115.1	115.1	108.0						108.0						223.1
Sponge iron				890.0			890.0													390.0
Return scrap				354.5	827.3	19.9	1 201.7	59.9						59.9						1 26[illegible].6
Electric furnace steel									48.9	462.6	524.1		493.4	1 529.0						1 529.0
Other types of steel										1 666.4	1 978.9	126.0		3 771.3						3 771.3
Ingot moulds				40.2	92.3		132.5													132.5
TOTAL ENDOGENOUS MATERIAL				1 284.7	3 727.5	135.0	5 147.2	167.9	48.9	2 129.0	2 503.0	126.0	493.4	5 468.[illegible]						10 615.4
FINISHED PRODUCTS																				
Flat rolled products															1 350.7	19[illegible].0	24.[illegible]	40.2		1 608.0
Rolled sections, bars and wire															394.4	1 271.6	12.0	13.9		1 991.9
Rails																		102.1		102.1
Seamless pipes																	347.0			347.0
Gray iron castings															190.1					190.1
Steel castings															32.6					32.6
TOTAL FINISHED PRODUCTS															2 467.8	1 264.6	383.1	156.2		4 271.7
TOTAL INPUTS	7 049.1	560.2	1 335.0	1 935.2	4 421.7	212.1	15 513.3	289.1	48.9	2 129.0	2 503.0	126.0	493.4	5 589.4						21 102.7
-Return scrap				35.4	137.2	19.9	192.5	59.9	16.3	443.8	394.0	21.2	133.9	1 069.1						1 26[illegible].6
-Wastes and others	4 241.2	337.1	445.0	370.8	513.2	59.7	5 967.0	39.1		77.2	117.1	2.7	12.5	248.6						6 215.6
=National production	2 807.9	223.1	890.0	1 529.0	3 771.3	132.5	9 353.8	190.1	32.6	1 608.0	1 991.9	102.1	347.0	4 271.7						13 625.5
+Imports																				
=Total supply	2 807.9	223.1	890.0	1 529.0	3 771.3	132.5	9 353.8	190.1	32.6	1 608.0	1 991.9	102.1	347.0	4 271.7						13 625.5
-Exports																				
=Apparent consumption	2 807.9	223.1	890.0	1 529.0	3 771.3	132.5	9 353.8	190.1	32.6	1 608.0	1 991.9	102.1	347.0	4 271.7						13 625.5

Source: Industrial Programming Division, Nacional Financiera, S.A. (Mexico)

Table 10

Production cost indexes of steel ingots with virtual and shadow prices, for different locations.

(Lowest value - (100)

Plant sites	With virtual prices of inputs		With shadow prices of inputs	
	Cost index	Ranking	Cost index	Ranking
1	112	12	111	4
2	113	11	113	7
3	106	6	109	3
4	107	8	111	5
6	108	9	119	11
7	105	4	121	13
8	103	2	120	12
9	100	1	100	1
10	105	5	112	6
11	107	7	117	9
12a	119	13	120	11
12b	104	3	105	2

Table 11

Hypotheses of geographical distribution of the market for non-flat rolled steel products

(percentages of total market)

Market \ Hypotheses	1	2	3	4	5	6	7	8
A	51.0	60.0	40.0	45.0	54.0	45.3	45.0	40.0
B	4.0	3.3	4.9	3.5	4.2	3.6	4.0	4.0
C	5.0	4.1	6.1	4.4	5.3	4.4	5.0	5.0
D	8.0	6.5	9.8	7.1	8.5	7.1	8.0	8.0
E	15.0	12.2	18.4	25.0	10.0	13.4	15.0	20.0
F	5.0	4.1	6.1	4.4	5.3	4.4	5.0	5.0
G	10.0	8.2	12.3	8.8	10.6	20.0	16.0	16.0
H	2.0	1.6	2.4	1.8	2.1	1.8	2.0	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 12

Total national virtual and shadow cost indexes for the production and distribution of non-flat rolled steel products

(Lowest value = 100)

Hypotheses of the geographical structure of the market \ Plant sites	1	2	3	4	5	6	7	8	9	10	11	12a	12b
A. National total with virtual prices													
1	108	107	105	102	102	101	105	105	102	101	100	107	102
2	108	108	105	103	102	101	106	106	102	101	100	107	102
3	108	107	104	101	102	101	105	105	102	100	101	108	101
4	108	107	104	102	101	101	104	104	102	100	101	107	102
5	109	108	104	102	103	101	106	106	103	101	101	108	102
6	109	108	104	101	102	101	106	105	103	101	102	108	103
7	109	108	104	101	102	101	105	105	102	101	101	108	103
8	108	107	104	101	101	101	105	104	102	100	101	108	103
B. National total with shadow prices													
1	107	108	105	105	106	106	110	110	101	104	105	108	102
6	108	108	104	104	106	106	110	110	101	104	105	108	103
7	108	108	104	104	105	106	110	109	100	103	105	108	103
8	108	108	104	104	106	106	111	110	101	104	105	109	103

Annex I

Relative steel costs, according to manufacturing processes and input prices

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Siemens Martin (60-40) with oxygen															
									Blast furnace									Electric furnace						E.F.P.R.
									100% S			50% S			100% M			100% S		50% S		100% M		100% M
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
		WC	A			F	G		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
0a	+	+	+	+	+	+	+	+	86	89	91	84	87	89	81	83	85	97	91	93	88	91	86	76	76
0b	m	m	m	m	m	m	m	m	70	72	74	68	70	72	65	67	68	77	71	74	69	73	67	60	60
0c	-	-	-	-	-	-	-	-	56	57	59	54	56	57	52	53	54	59	53	56	52	56	50	45	46
1a	m	m	m	-	-	-	-	-	63	64	67	61	63	65	59	60	62	65	59	62	57	61	55	50	51
1b	-	-	-	m	m	m	m	m	63	65	66	61	63	64	59	60	61	71	65	68	64	68	63	54	55
1c	-	-	-	+	+	+	+	+	73	75	76	71	73	74	68	69	70	84	79	82	78	81	76	65	67
2a	■	-	-	■	m	-	-	-	60	61	63	58	60	61	56	57	58	67	62	65	61	64	59	51	52
2b	-	■	■	-	-	m	m	m	66	68	70	64	66	68	61	63	65	68	63	65	60	64	59	53	54
2c	-	◆	◆	-	-	+	+	+	78	81	83	76	79	81	73	76	77	89	83	86	81	83	78	69	69
3a	■	-	-	-	-	m	m	-	60	62	63	58	60	61	56	57	58	63	57	60	56	60	54	49	50
3b	-	■	m	m	m	-	-	m	65	67	70	64	66	68	61	63	64	72	67	70	65	68	63	56	56
3c	-	+	+	+	+	-	-	+	78	80	83	76	78	81	73	75	77	88	83	86	80	83	78	68	69
4a	m	-	-	-	-	-	-	m	63	64	66	61	63	64	59	60	61	66	60	63	59	62	57	51	53
4b	-	m	m	m	m	m	m	-	63	65	67	61	63	65	59	60	62	70	65	67	63	66	61	53	54
4c	-	+	+	+	+	+	+	-	70	72	74	68	70	72	65	67	69	80	74	77	72	75	70	60	60
5a	+	+	+	-	-	-	-	-	69	71	74	68	70	73	65	67	69	71	65	67	62	66	60	56	56
5b	+	+	++	m	m	m	m	m	76	79	81	74	77	79	72	74	76	83	77	80	74	78	72	65	65
5c	m	m	m	+	+	+	+	+	80	82	84	77	80	81	75	77	78	91	85	88	83	86	81	71	71
6a	+	-	-	+	+	-	-	-	64	65	67	62	64	65	59	61	62	75	70	73	69	72	67	57	58
6b	+	m	m	+	+	m	m	m	74	76	78	72	74	76	69	71	72	84	79	82	77	80	75	65	66
6c	m	+	+	m	m	+	+	+	82	85	87	80	83	85	75	79	81	93	87	90	84	87	82	72	75
7a	+	-	-	-	-	+	+	-	64	66	67	63	65	65	60	62	62	67	61	64	60	64	58	53	54
7b	+	m	m	m	m	+	+	m	74	76	78	72	75	76	69	71	72	81	75	78	73	77	71	63	64
7c	m	+	+	+	+	m	m	+	82	85	87	80	83	85	77	79	81	93	87	90	84	87	82	72	73

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Siemens Martin (40–40) with oxygen															
									Blast furnace									Electric furnace						E.F.P.k.	
									100% S			50% S			100% M			100% S		50% S		100% M		100% M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
		WC	A			F	G		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
8a	+	-	-	-	-	-	-	+	72	74	76	71	72	74	68	69	70	75	70	72	68	72	67	61	62
8b	+	m	m	m	m	m	m	+	80	82	84	78	80	80	75	77	78	87	81	84	79	82	77	69	70
8c	m	+	+	+	+	+	+	m	76	79	81	74	77	79	71	74	75	87	81	84	78	81	76	67	67
9a	m	+	+	-	-	-	-	-	66	68	71	65	67	69	62	64	65	69	63	65	60	64	59	54	55
9b	-	+	+	m	m	m	m	m	69	71	74	67	70	72	64	66	68	75	70	72	67	70	65	58	58
9c	-	m	m	+	+	+	+	+	76	78	80	74	76	78	71	73	74	87	81	84	80	82	77	67	68
10a	m	-	-	+	+	-	-	-	66	68	70	65	67	68	62	63	64	69	64	66	62	66	61	55	56
10b	-	m	m	+	+	m	m	m	66	68	70	64	67	68	62	63	65	77	72	74	70	72	68	58	58
10c	-	+	+	m	m	+	+	+	78	81	83	76	79	81	74	76	78	85	80	82	77	80	75	67	67
11a	m	-	-	-	-	+	+	-	60	63	63	59	61	62	56	58	58	63	57	60	56	60	55	49	50
11b	-	m	m	m	m	+	+	m	66	68	70	64	67	68	62	64	65	73	68	71	66	69	64	56	57
11c	-	+	+	+	+	m	m	+	78	81	83	76	79	81	73	75	77	89	83	86	81	83	78	69	69
12a	m	-	-	-	-	-	-	+	69	70	72	67	69	70	65	66	67	72	66	69	65	68	63	57	59
12b	-	m	m	m	m	m	m	+	72	74	76	70	72	74	68	69	71	79	74	76	72	75	70	62	63
12c	-	+	+	+	+	+	+	m	73	75	77	71	73	75	68	70	72	83	77	80	75	77	73	63	63
13a	+	m	m	-	-	-	-	-	65	68	70	64	66	69	61	63	66	67	61	63	58	62	56	52	52
13b	+	-	-	m	m	m	m	m	71	72	74	69	71	72	66	67	68	78	73	76	72	75	70	61	62
13c	m	-	-	+	+	+	+	+	77	79	80	75	77	77	72	73	74	83	83	86	82	85	80	69	70
14a	+	-	-	m	m	-	-	-	64	65	67	62	63	65	59	60	62	71	66	69	65	68	63	55	56
14b	+	m	m	-	-	m	m	m	73	76	77	71	74	75	69	70	72	77	70	72	67	72	66	61	61
14c	m	+	+	-	-	+	+	+	82	85	87	80	83	85	77	79	81	85	78	80	75	79	73	68	68
15a	+	-	-	-	-	m	m	-	60	61	63	58	60	61	56	57	58	71	66	69	65	68	63	53	54
15b	+	m	m	m	m	-	-	m	73	75	77	71	73	75	68	70	72	81	75	77	73	76	71	63	63
15c	m	+	+	+	+	-	-	+	82	84	87	79	82	84	77	78	81	92	87	89	81	87	82	72	72

Price combination	Mineral	Washed Coal	Anthracite	Oxygen	Electricity	Fueloil	Natural gas	Scrap	Siemens Martin (60-40) with oxygen															
									Blast furnace									Electric furnace						E.F.P.R.
									100% S			50% S			100% M			100% S		50% S		100% M		100% M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
		WC	A			F	G		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
16a	+	-	-	-	-	-	-	m	66	68	70	65	66	68	62	63	64	69	64	66	62	66	61	55	56
16b	+	m	m	m	m	m	m	-	71	73	75	69	71	73	66	68	69	78	72	75	70	73	68	60	61
16c	m	+	+	+	+	+	+	-	73	76	78	71	74	76	68	71	72	84	78	81	75	78	73	64	63
17a	m	-	-	-	-	-	-	-	60	61	63	58	60	61	56	57	58	63	57	60	56	59	54	49	50
17b	-	m	m	m	m	m	m	m	66	68	70	64	66	68	62	63	65	73	68	70	66	69	64	56	57
17c	-	+	+	+	+	+	+	+	79	81	83	76	79	81	74	76	78	89	83	86	81	83	79	69	69
18a	+	-	-	-	-	-	-	-	63	65	67	62	63	65	59	60	61	66	61	63	59	63	58	52	53
18b	+	m	m	m	m	m	m	m	74	76	78	72	74	76	69	71	72	81	75	78	73	76	71	63	64
18c	m	+	+	+	+	+	+	+	82	85	87	80	83	85	77	80	81	93	87	90	84	87	82	73	73

Relative steel costs, according to manufacturing processes and input prices

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Siemens Martin (65-35) with oxygen															
									Blast furnace									Electric furnace						E.F.P.R.
									100% S			50% S			100% M			100% S		50% S		100% M		100% M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
		WC	A			F	G		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
0a	+	+	+	+	+	+	+	+	88	91	94	86	89	91	82	85	87	100	94	96	89	93	87	77	77
0b	m	m	m	m	m	m	m	m	71	74	76	69	71	73	66	68	70	79	73	75	70	73	68	60	60
0c	-	-	-	-	-	-	-	-	56	58	60	54	56	58	52	53	55	59	53	56	51	55	49	44	44
1a	m	m	m	-	-	-	-	-	64	66	69	62	64	66	59	61	63	67	60	63	57	61	55	50	50
1b	-	-	-	m	m	m	m	m	63	65	67	61	63	64	58	60	61	72	66	69	64	67	62	53	54
1c	-	-	-	+	+	+	+	+	73	75	76	70	73	74	68	69	70	86	80	83	78	81	76	65	65
2a	m	-	-	m	m	-	-	-	61	63	64	59	60	62	56	57	59	69	63	66	61	65	59	51	52
2b	-	m	m	-	-	m	m	m	66	69	71	64	67	69	61	63	65	69	63	65	59	64	58	52	53
2c	-	+	+	-	-	+	+	+	79	82	84	76	80	82	73	76	78	82	84	87	80	84	78	68	68
3a	m	-	-	-	-	m	m	-	61	63	65	59	61	62	56	58	59	64	58	61	56	60	54	49	49
3b	-	m	m	m	m	-	-	m	66	68	71	64	66	68	61	62	65	74	68	71	65	68	63	55	55
3c	-	+	+	+	+	-	-	+	78	81	84	76	78	82	73	75	78	90	84	87	80	83	78	68	68
4a	m	-	-	-	-	-	-	m	64	65	67	61	63	65	59	60	62	67	61	63	58	62	57	51	52
4b	-	m	m	m	m	m	m	-	64	66	68	61	64	66	59	60	63	72	66	68	62	66	60	52	52
4c	-	+	+	+	+	+	+	-	71	74	76	68	71	73	65	67	70	82	76	79	72	75	70	60	59
5a	+	+	+	-	-	-	-	-	71	74	77	69	72	75	67	68	72	74	67	69	62	67	61	56	56
5b	+	+	+	m	m	m	m	m	79	81	84	76	79	82	73	75	78	86	80	82	75	79	73	66	65
5c	m	m	m	+	+	+	+	+	81	83	85	78	81	83	75	77	79	93	87	90	84	87	82	71	71
6a	+	-	-	+	+	-	-	-	66	67	69	63	65	67	61	62	63	78	72	75	70	73	68	57	58
6b	+	m	m	+	+	m	m	m	76	78	80	73	76	78	70	72	74	88	82	84	78	82	76	66	66
6c	m	+	+	m	m	+	+	+	84	87	89	81	84	86	78	80	83	93	89	90	85	88	83	73	72
7a	+	-	-	-	-	+	+	-	66	68	69	64	66	67	61	63	64	69	63	65	60	65	59	53	54
7b	+	m	m	m	m	+	+	m	76	79	80	73	76	78	70	72	74	84	78	80	74	78	72	64	64
7c	m	+	+	+	+	m	m	+	83	86	89	81	84	86	78	80	83	95	89	91	85	88	83	73	72

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Siemens Martin (65-35) with oxygen													
									Blast furnace									Electric furnace				E.F.P.R.
									100% S			50% S			100% M			100% S	50% S	100% M		100% M
									G	F	-	G	F	-	G	F	-	WC A	WC A	WC A		A WC
		WC	A			F	G		18	19	20	21	22	23	24	25	26	27 28	29 30	31 32		33 34
8a	+	-	-	-	-	-	-	+	74	76	78	72	73	75	69	70	72	77 71	73 68	73 67		61 62
8b	+	m	m	m	m	m	m	+	81	84	86	79	81	83	76	78	80	89 83	86 80	84 78		70 70
8c	m	+	+	+	+	+	+	m	78	81	83	75	78	81	72	75	77	90 83	86 79	83 77		67 67
9a	m	+	+	-	-	-	-	-	67	69	73	65	[illegible]	70	62	64	67	69 63	64 61	62 56		54 52
9b	-	+	+	m	m	m	m	m	69	72	75	67	[illegible]	73	64	67	69	77 71	73 67	70 64		57 57
9c	-	m	m	+	+	+	+	+	76	79	81	74	76	78	71	73	75	88 82	85 79	83 77		67 67
10a	m	-	-	+	+	-	-	-	68	70	72	66	68	69	63	64	66	71 65	67 63	67 61		55 56
10b	-	m	m	+	+	m	m	m	67	69	71	64	67	69	62	63	65	78 73	76 70	73 67		57 57
10c	-	+	+	m	m	+	+	+	79	82	85	77	80	82	74	76	78	87 81	83 76	80 74		66 66
11a	m	-	-	-	-	+	+	-	62	64	65	59	62	63	57	58	59	65 58	61 56	60 54		49 49
11b	-	m	m	m	m	+	+	m	67	69	71	64	67	69	62	64	66	75 69	71 65	69 63		55 56
11c	-	+	+	+	+	m	m	+	79	82	85	76	79	82	73	76	78	91 85	87 81	84 78		68 68
12a	m	-	-	-	-	-	-	+	69	71	73	67	69	71	65	66	68	73 67	69 64	68 62		57 58
12b	-	m	m	m	m	m	m	+	72	75	77	70	73	75	67	69	71	80 74	77 71	75 69		61 61
12c	-	+	+	+	+	+	+	m	74	76	79	71	74	76	68	70	73	85 79	81 75	78 73		63 62
13a	+	m	m	-	-	-	-	-	67	69	73	65	67	70	62	64	67	69 63	64 58	62 56		52 52
13b	+	-	-	m	m	m	m	m	72	74	76	70	72	73	67	68	70	81 75	78 73	76 71		62 62
13c	m	-	-	+	+	+	+	+	78	80	81	75	77	78	72	73	74	90 84	87 82	86 80		69 70
14a	+	-	-	m	m	-	-	-	65	67	69	63	65	67	60	61	63	74 68	71 66	69 64		55 56
14b	+	m	m	-	-	m	m	m	75	78	80	73	75	77	70	72	74	79 72	74 68	73 66		61 61
14c	m	+	+	-	-	+	+	+	84	87	89	81	84	86	78	80	83	86 79	81 74	79 73		68 68
15a	+	-	-	-	-	m	m	-	61	63	65	59	61	62	56	57	59	73 68	71 66	69 63		53 54
15b	+	m	m	m	m	-	-	m	75	77	80	72	75	77	70	71	74	83 77	79 74	77 72		63 64
15c	m	+	+	+	+	-	-	+	83	85	89	80	83	86	77	79	82	95 87	91 85	88 82		72 72

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Siemens Martin (65-35) with oxygen															
									Blast furnace									Electric furnace						E.F.P.R.
									100% S			50% S			100% M			100% S		50% S		100% M		100% M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
		WC	A			F	G		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
16a	◆	-	-	-	-	-	-	■	68	70	72	66	68	69	63	64	66	71	65	67	63	67	61	55	56
16b	◆	■	■	■	■	■	■	-	73	75	77	70	73	75	67	69	71	81	74	77	71	75	69	61	61
16c	■	◆	◆	◆	◆	◆	◆	-	75	78	81	72	75	78	69	72	74	87	80	83	76	80	74	64	64
17a	■	-	-	-	-	-	-	-	61	62	64	58	60	62	56	57	59	64	58	60	55	60	54	48	49
17b	-	■	■	■	■	■	■	■	66	69	71	64	67	69	61	63	65	75	69	71	65	69	63	55	55
17c	-	◆	◆	◆	◆	◆	◆	◆	79	82	85	77	80	82	74	76	79	91	85	87	81	84	78	69	68
18a	◆	-	-	-	-	-	-	-	65	67	69	63	65	66	60	61	63	69	62	65	60	64	58	52	53
18b	◆	■	■	■	■	■	■	■	76	78	80	73	76	78	70	72	74	84	77	80	74	78	72	64	64
18c	■	◆	◆	◆	◆	◆	◆	◆	84	87	89	81	84	87	78	80	83	95	89	92	85	88	83	73	73

Relative steel costs, according to manufacturing processes and input prices

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	L-D Oxygen converter												E.F.P.R.	
									Blast furnace								Electric furnace					
									100% S			50% S			100% M			100% S		50% S		100% M		100%M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
		WC	A			F	G		35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
0a	+	+	+	+	+	+	+	+	81	84	87	79	82	85	76	78	81	94	88	90	84	88	82	71	71
0b	m	m	m	m	m	m	m	m	66	68	71	64	66	69	61	63	65	75	69	72	66	69	64	55	55
0c	-	-	-	-	-	-	-	-	52	54	56	50	52	54	48	49	51	56	50	53	48	52	46	40	41
1a	m	m	m	-	-	-	-	-	60	62	65	58	61	63	56	57	60	63	57	59	54	58	52	47	47
1b	-	-	-	m	m	m	m	m	58	60	61	56	58	59	53	54	56	68	62	65	60	63	58	49	49
1c	-	-	-	+	+	+	+	+	66	67	69	63	65	66	60	61	63	80	74	77	72	75	70	58	59
2a	m	-	-	m	m	-	-	-	57	58	61	55	57	59	52	53	55	66	61	64	59	62	57	48	49
2b	-	m	m	-	-	m	m	m	61	63	66	59	62	64	56	58	60	65	58	61	55	59	53	48	48
2c	-	+	+	-	-	+	+	+	72	75	78	70	73	75	67	69	72	85	79	81	75	78	73	62	62
3a	m	-	-	-	-	m	m	-	57	59	60	55	57	58	52	54	55	61	54	57	52	56	51	45	45
3b	-	m	m	m	m	-	-	m	61	63	66	59	61	64	56	58	61	70	65	67	61	65	60	51	51
3c	-	+	+	+	+	-	-	+	72	74	78	70	72	76	67	68	72	85	79	82	75	78	73	62	62
4a	m	-	-	-	-	-	-	m	59	60	62	57	58	60	54	55	57	62	56	59	54	58	52	47	47
4b	-	m	m	m	m	m	m	-	60	62	64	58	60	62	55	56	59	69	63	65	60	63	58	49	49
4c	-	+	+	+	+	+	+	-	67	70	72	65	67	70	61	64	66	80	74	76	70	73	68	57	56
5a	+	+	+	-	-	-	-	-	68	70	74	66	69	72	63	65	69	71	64	66	59	64	58	53	53
5b	+	+	+	m	m	m	m	m	74	77	80	72	75	77	69	71	74	82	76	78	71	76	70	62	61
5c	m	m	m	+	+	+	+	+	74	76	78	71	74	76	68	70	72	87	81	84	78	81	76	65	65
6a	+	-	-	+	+	-	-	-	62	63	65	60	61	63	57	58	60	75	70	73	68	71	66	54	55
6b	+	m	m	+	+	m	m	m	71	73	75	69	71	73	65	67	69	84	78	81	75	78	73	62	62
6c	m	+	+	m	m	+	+	+	77	80	82	75	77	80	71	73	76	90	84	86	79	83	78	66	66
7a	+	-	-	-	-	+	+	-	62	63	65	60	62	63	57	58	59	65	59	61	56	61	55	49	50
7b	+	m	m	m	m	+	+	m	71	73	75	69	71	73	65	67	69	80	73	76	70	74	69	59	60
7c	m	+	+	+	+	m	m	+	77	79	83	74	77	80	71	73	76	90	84	86	79	83	78	67	66

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	L-D Oxygen converter												E.F.P.R.	
									Blast furnace									Electric furnace						
									100% S			50% S			100% M			100% S		50% S		100% M		100% M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
		WC	A			F	G		35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
8a	+	-	-	-	-	-	-	+	67	68	70	65	67	68	62	63	65	71	64	67	62	67	61	55	55
8b	+	m	m	m	m	m	m	+	74	77	79	72	75	77	69	71	73	83	77	80	74	78	72	63	63
8c	m	+	+	+	+	+	+	m	73	76	79	71	74	76	68	70	73	86	80	82	76	79	74	63	63
9a	m	+	+	-	-	-	-	-	63	66	69	62	64	68	59	61	64	66	60	62	58	59	54	51	49
9b	-	+	+	m	m	m	m	m	65	67	70	63	66	69	60	62	65	73	67	69	63	66	61	52	53
9c	-	m	m	+	+	+	+	+	69	71	74	67	69	71	64	65	68	82	77	80	74	77	72	60	60
10a	m	-	-	+	+	-	-	-	63	65	67	61	63	65	58	59	61	67	61	63	58	63	57	51	52
10b	-	m	m	+	+	m	m	m	62	64	66	60	62	64	57	58	61	75	69	72	66	69	64	53	53
10c	-	+	+	m	m	+	+	+	72	75	78	70	73	75	67	69	72	81	75	77	70	74	69	60	60
11a	m	-	-	-	-	+	+	-	57	59	60	56	57	58	52	54	55	61	54	57	52	56	51	45	45
11b	-	m	m	m	m	+	+	m	62	64	66	60	62	64	57	59	61	70	65	67	61	65	60	51	51
11c	-	+	+	+	+	m	m	+	72	75	78	70	73	76	67	69	72	85	79	82	75	78	73	62	62
12a	m	-	-	-	-	-	-	+	62	64	66	60	62	64	58	59	61	66	60	63	58	62	56	50	51
12b	-	m	m	m	m	m	m	+	65	67	70	63	66	68	60	62	64	74	68	71	65	69	63	55	55
12c	-	+	+	+	+	+	+	m	69	71	74	67	69	72	63	65	68	81	75	78	71	75	69	59	58
13a	+	m	m	-	-	-	-	-	63	66	69	62	64	68	59	61	64	66	60	62	55	59	54	49	49
13b	+	-	-	m	m	m	m	m	67	69	71	65	67	68	62	63	64	77	71	73	69	73	67	57	58
13c	m	-	-	+	+	+	+	+	70	72	73	68	70	71	64	66	67	84	79	81	77	80	75	62	63
14a	+	-	-	m	m	-	-	-	62	61	65	60	61	63	57	58	60	71	65	68	63	67	61	52	53
14b	+	m	m	-	-	m	m	m	70	73	75	68	71	73	65	67	69	74	67	69	63	68	62	56	56
14c	m	+	+	-	-	+	+	+	76	79	82	74	77	80	71	73	76	80	73	74	68	73	67	61	61
15a	m	-	-	-	-	m	m	-	57	59	61	55	57	59	52	53	56	70	65	69	64	66	61	50	51
15b	+	m	m	m	m	-	-	m	70	72	75	68	70	73	65	66	69	80	73	76	70	74	69	59	60
15c	m	+	+	+	+	-	-	+	77	79	82	74	77	80	71	73	76	90	84	86	79	83	78	67	66

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	L-D Oxygen converter													
									Blast furnace									Electric furnace				E.F.P.R.
									100% S			50% S			100% M			100% S	50% S	100% M		100% M
									G	F	-	G	F	-	G	F	-	WC A	WC A	WC A		A WC
		WC	A			F	G		35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
16a	◆	-	-	-	-	-	-	■	63	65	67	61	63	65	58	59	61	67	61	63	58	63	57	51	52
16b	◆	■	■	■	■	■	■	-	69	71	73	67	69	71	63	65	67	78	72	74	68	72	67	58	58
16c	■	◆	◆	◆	◆	◆	◆	-	71	74	77	69	72	75	66	68	71	84	78	81	74	77	72	61	61
17a	■	-	-	-	-	-	-	-	57	58	60	55	57	58	52	53	55	60	54	57	52	56	51	45	45
17b	-	■	■	■	■	■	■	■	61	64	66	60	62	64	57	58	61	70	65	67	61	65	60	51	51
17c	-	◆	◆	◆	◆	◆	◆	◆	72	75	78	70	73	76	67	69	72	85	79	82	75	78	73	62	62
18a	◆	-	-	-	-	-	-	-	61	63	65	59	61	63	56	57	59	65	59	61	56	61	55	49	50
18b	◆	■	■	■	■	■	■	■	71	73	75	68	71	73	65	67	69	80	73	76	70	74	69	59	60
18c	■	◆	◆	◆	◆	◆	◆	◆	77	80	83	75	77	80	71	73	76	90	84	86	79	83	78	67	66

Relative steel costs, according to manufacturing processes and input prices

Price combination	Mineral	Washed coal WC	Anthracite A	Oxygen	Electricity	Fuel oil F	Natural gas G	Scrap	Kaldo oxygen converter														E.F.P.R.	
									Blast furnace									Electric furnace						
									100% S			50% S			100% M			100% M		50% S		100% M		100% M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
									52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
0a	◆	◆	◆	◆	◆	◆	◆	◆	81	84	87	79	82	84	76	78	80	93	87	90	83	87	81	71	71
0b	m	m	m	m	m	m	m	m	66	68	71	64	66	69	61	63	65	75	69	71	66	69	64	56	56
0c	-	-	-	-	-	-	-	-	52	54	56	51	52	54	48	49	51	56	50	53	48	52	47	41	42
1a	m	m	m	-	-	-	-	-	61	62	65	59	61	63	56	57	60	63	57	60	54	58	52	48	48
1b	-	-	-	m	m	m	m	m	58	60	61	56	58	59	53	55	56	67	62	65	60	63	58	49	50
1c	-	-	-	◆	◆	◆	◆	◆	66	67	69	63	65	66	60	61	63	79	73	77	72	75	70	58	59
2a	m	-	-	m	m	-	-	-	57	59	61	56	57	59	53	54	56	66	61	64	59	62	57	48	49
2b	-	m	m	-	-	m	m	m	61	63	66	59	62	64	57	58	61	64	58	61	55	59	54	48	48
2c	-	◆	◆	-	-	◆	◆	◆	72	74	77	59	72	75	66	68	71	84	78	81	74	77	72	62	62
3a	m	-	-	-	-	m	m	-	57	59	61	55	57	59	53	54	56	60	55	57	53	57	51	45	46
3b	-	m	m	m	m	-	-	m	61	63	66	59	61	64	57	58	61	70	64	67	61	65	59	51	51
3c	-	◆	◆	◆	◆	-	-	◆	72	74	77	69	72	75	66	68	72	84	78	81	75	77	72	62	62
4a	m	-	-	-	-	-	-	m	59	60	62	57	59	61	54	55	57	62	56	59	54	58	53	47	48
4b	-	m	m	m	m	m	m	-	60	62	64	58	60	62	55	57	59	68	62	65	60	63	58	49	50
4c	-	◆	◆	◆	◆	◆	◆	-	67	69	72	65	67	70	62	64	66	79	73	76	69	72	67	57	57
5a	◆	◆	◆	-	-	-	-	-	68	71	74	66	69	72	64	65	69	71	64	66	60	64	58	54	54
5b	◆	◆	◆	m	m	m	m	m	74	76	79	72	74	77	69	71	74	82	76	79	71	75	70	62	62
5c	m	m	m	◆	◆	◆	◆	◆	74	76	78	71	74	75	68	70	72	86	80	83	78	81	76	65	65
6a	◆	-	-	◆	◆	-	-	-	62	64	66	60	62	64	57	58	60	75	69	73	68	71	66	55	56
6b	◆	m	m	◆	◆	m	m	m	71	73	75	69	71	73	66	67	70	83	78	81	75	78	73	62	62
6c	m	◆	◆	m	m	◆	◆	◆	77	79	82	74	77	80	71	73	76	89	83	85	79	82	77	66	66
7a	◆	-	-	-	-	◆	◆	-	62	64	65	60	62	63	57	59	60	65	59	62	57	61	56	50	50
7b	◆	m	m	m	m	◆	◆	m	71	73	75	69	71	73	66	67	69	79	73	76	70	74	69	60	60
7c	m	◆	◆	◆	◆	m	m	◆	76	79	82	74	77	80	71	73	76	89	83	85	79	82	77	67	66

Price combination	Mineral	Washed coal WC	Anthracite A	Oxygen	Electricity	Fuel oil F	Natural gas G	Scrap	Kaldo oxygen converter														E.F.P.R.	
									Blast furnace									Electric furnace						
									100% S			50 % S			100% M			100% M		50% S		100% M		100% M	
									G	F	-	G	F	-	G	F	-	WC	A	WC	A	WC	A	A	WC
									52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
8a	♦	-	-	-	-	-	-	♦	67	69	70	65	67	69	62	63	65	70	64	67	62	67	61	55	56
8b	♦	m	m	m	m	m	m	♦	74	76	79	72	74	77	69	71	73	83	77	79	74	77	72	63	64
8c	m	♦	♦	♦	♦	♦	♦	m	73	76	79	71	74	76	68	70	72	85	79	82	75	79	74	63	63
9a	m	♦	♦	-	-	-	-	-	65	67	70	63	65	68	61	62	65	68	62	64	58	63	57	52	52
9b	-	♦	♦	m	m	m	m	m	65	67	70	63	65	68	60	62	65	73	67	69	63	66	61	53	53
9c	-	m	m	♦	♦	♦	♦	♦	69	71	73	67	69	71	64	65	67	81	76	79	73	76	71	60	60
10a	m	-	-	♦	♦	-	-	-	64	65	67	62	63	65	59	60	62	67	61	63	59	63	57	52	52
10b	-	m	m	♦	♦	m	m	m	62	64	66	60	62	64	57	59	61	74	69	72	66	69	64	53	54
10c	-	♦	♦	m	m	♦	♦	♦	72	74	77	70	72	75	67	69	71	80	74	76	70	73	68	60	60
11a	m	-	-	-	-	♦	♦	-	55	59	61	56	58	59	53	54	56	61	55	57	53	57	51	45	46
11b	-	m	m	m	m	♦	♦	m	62	64	66	60	62	64	57	59	61	70	64	67	61	65	59	51	51
11c	-	♦	♦	♦	♦	m	m	♦	72	74	77	70	72	75	67	69	72	84	78	81	75	77	72	62	62
12a	m	-	-	-	-	-	-	♦	62	64	66	61	62	64	58	59	61	66	60	63	58	62	56	51	51
12b	-	m	m	m	m	m	m	♦	65	67	69	63	65	68	60	62	64	73	68	70	65	68	63	55	55
12c	-	♦	♦	♦	♦	♦	♦	m	69	71	74	66	69	72	63	65	68	81	75	77	71	74	69	59	58
13a	♦	m	m	-	-	-	-	-	64	66	69	62	64	68	59	61	64	66	60	62	55	59	54	50	49
13b	♦	-	-	m	m	m	m	m	67	69	71	65	67	69	62	63	65	76	71	73	69	73	67	58	59
13c	m	-	-	♦	♦	♦	♦	♦	70	72	73	68	70	71	65	66	67	83	78	81	76	79	74	63	63
14a	♦	-	-	m	m	-	-	-	62	63	65	60	62	63	57	58	60	71	65	68	63	67	62	53	53
14b	♦	m	m	-	-	m	m	m	71	73	75	68	71	73	65	67	69	74	67	69	64	68	63	57	57
14c	m	♦	♦	-	-	♦	♦	♦	76	79	82	74	77	79	71	73	76	79	72	74	68	77	67	61	61
15a	♦	-	-	-	-	m	m	-	58	59	61	56	57	59	53	54	56	70	65	69	64	66	61	51	51
15b	♦	m	m	m	m	-	-	m	71	73	75	68	70	73	65	67	69	79	73	76	70	74	68	60	60
15c	m	♦	♦	♦	♦	-	-	♦	76	79	82	74	76	79	71	73	76	89	83	85	79	82	77	67	66

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Kaldo oxygen converter													
									Blast furnace								Electric furnace					E.F.P.R.
									100% S			50% S			100% M		100% S		50% S		100% M	100% M
									G	F	-	G	F	-	G	F -	WC	A	WC	A	WC A	A WC
		WC	A			F	G		52	53	54	55	56	57	58	59 60	61	62	63	64	65 66	67 68
16a	+	-	-	-	-	-	-	m	64	65	67	62	63	65	59	60 62	67	61	63	59	63 57	52 52
16b	+	m	m	m	m	m	m	-	69	71	74	67	69	71	64	65 68	77	71	74	68	72 67	58 58
16c	m	+	+	+	+	+	+	-	71	74	77	69	72	74	66	68 71	83	78	80	74	77 72	61 61
17a	m	-	-	-	-	-	-	-	57	59	61	55	57	59	53	54 56	61	55	57	53	57 51	45 46
17b	-	m	m	m	m	m	m	m	62	64	66	60	62	64	57	58 61	70	64	67	61	65 59	51 51
17c	-	+	+	+	+	+	+	+	72	75	77	70	72	75	67	69 72	84	78	81	75	77 73	62 62
18a	+	-	-	-	-	-	-	-	62	63	65	60	61	63	57	58 60	65	59	62	57	61 56	50 50
18b	+	m	m	m	m	m	m	m	71	73	75	69	71	73	66	67 69	79	73	76	70	74 69	60 60
18c	m	+	+	+	+	+	+	+	77	79	82	74	77	80	71	73 76	89	83	85	79	82 77	67 66

Relative steel costs, according to manufacturing processes and input prices

Price combination	Mineral	Washed al	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Electric steel furnace							
									100% S		Scrap		50% S 50% M		100% M	
									69	70	71	72	73	74	75	76
0a	+	+	+	+	+	+	+	+	79	78	90	89	77	76	74	73
0b	m	m	m	m	m	m	m	m	64	64	69	69	62	62	59	59
0c	-	-	-	-	-	-	-	-	51	51	56	56	50	49	47	47
1a	m	m	m	-	-	-	-	-	56	56	56	56	54	54	51	51
1b	-	-	-	m	m	m	m	m	59	59	69	68	58	57	55	54
1c	-	-	-	+	+	+	+	+	69	68	90	89	68	67	65	64
2a	m	-	-	m	m	-	-	-	58	57	57	57	56	56	53	53
2b	-	m	m	-	-	m	m	m	57	57	67	67	56	56	53	52
2c	-	+	+	-	-	+	+	+	66	66	90	89	64	64	61	61
3a	m	-	-	-	-	m	m	-	56	56	56	56	55	55	52	52
3b	-	m	m	m	m	-	-	m	59	58	69	69	57	56	54	53
3c	-	+	+	+	+	-	-	+	68	67	90	89	66	65	63	62
4a	m	-	-	-	-	-	-	m	58	57	64	64	57	56	53	53
4b	-	m	m	m	m	m	m	-	58	57	60	60	56	55	53	52
4c	-	+	+	+	+	+	+	-	64	63	64	64	62	61	59	58
5a	+	+	+	-	-	-	-	-	61	61	56	56	59	55	56	56
5b	+	+	+	m	m	m	m	m	69	69	69	69	67	67	64	63
5c	m	m	m	+	+	+	+	+	74	73	90	89	72	71	69	68
6a	+	-	-	+	+	-	-	-	64	63	59	58	62	62	60	59
6b	+	m	m	+	+	m	m	m	70	69	70	69	68	68	65	65
6c	m	+	+	m	m	+	+	+	73	72	90	89	71	70	68	67
7a	+	-	-	-	-	+	+	-	62	62	56	56	61	61	58	58
7b	+	m	m	m	m	+	+	m	70	70	69	69	68	68	65	65
7c	m	+	+	+	+	m	m	+	73	72	90	89	71	70	68	67

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Electric steel furnace							
									100% S		Scrap		50% S 50% M		100% M	
									69	70	71	72	73	74	75	76
8a	+	-	-	-	-	-	-	+	66	66	81	82	65	65	62	62
8b	+	m	m	m	m	m	m	+	73	72	86	86	71	70	68	67
8c	m	+	+	+	+	+	+	m	70	70	73	72	69	68	65	64
9a	m	+	+	-	-	-	-	-	57	56	56	56	55	54	51	51
9b	-	+	+	m	m	m	m	m	60	60	69	69	58	57	55	54
9c	-	m	m	+	+	+	+	+	70	69	90	89	68	67	65	64
10a	m	-	-	+	+	-	-	-	59	59	64	64	58	57	55	54
10b	-	m	m	+	+	m	m	m	61	60	70	69	60	59	57	56
10c	-	+	+	m	m	+	+	+	69	68	90	89	67	66	63	63
11a	m	-	-	-	-	+	+	-	58	58	56	56	56	56	54	53
11b	-	m	m	m	m	+	+	m	61	61	69	69	59	59	56	56
11c	-	+	+	+	+	m	m	+	69	68	90	89	67	66	64	62
12a	m	-	-	-	-	-	-	+	62	62	81	82	60	60	57	57
12b	-	m	m	m	m	m	m	+	64	64	86	86	62	62	59	59
12c	-	+	+	+	+	+	+	m	66	65	73	72	64	63	61	60
13a	+	m	m	-	-	-	-	-	60	61	56	56	59	59	56	56
13b	+	-	-	m	m	m	m	m	68	68	69	68	67	66	64	63
13c	m	-	-	+	+	+	+	+	74	73	90	89	72	71	69	68
14a	+	-	-	m	m	-	-	-	62	62	57	57	61	60	58	57
14b	+	m	m	-	-	m	m	m	66	66	67	67	65	64	62	61
14c	m	+	+	-	-	+	+	+	71	71	87	87	69	69	65	65
15a	+	-	-	-	-	m	m	-	61	61	59	58	59	59	57	57
15b	+	m	m	m	m	-	-	m	68	67	69	69	66	65	63	62
15c	m	+	+	+	+	-	-	+	72	71	90	89	70	69	67	66

Price combination	Mineral	Washed coal	Anthracite	Oxygen	Electricity	Fuel oil	Natural gas	Scrap	Electric steel furnace							
									100% S		Scrap		50% S 50% M		100% M	
									69	70	71	72	73	74	75	76
16a	+	-	-	-	-	-	-	m	62	62	64	64	61	60	58	58
16b	+	m	m	m	m	m	m	-	66	66	60	60	65	64	62	61
16c	m	+	+	+	+	+	+	-	69	68	64	64	67	65	63	62
17a	m	-	-	-	-	-	-	-	56	55	56	56	54	54	51	51
17b	-	m	m	m	m	m	m	m	60	59	69	69	58	57	55	54
17c	-	+	+	+	+	+	+	+	70	69	90	89	68	67	65	64
18a	+	-	-	-	-	-	-	-	60	60	56	56	58	58	56	56
18b	+	m	m	m	m	m	m	m	69	68	69	69	67	66	64	63
18c	m	+	+	+	+	+	+	+	75	74	90	89	73	72	69	68

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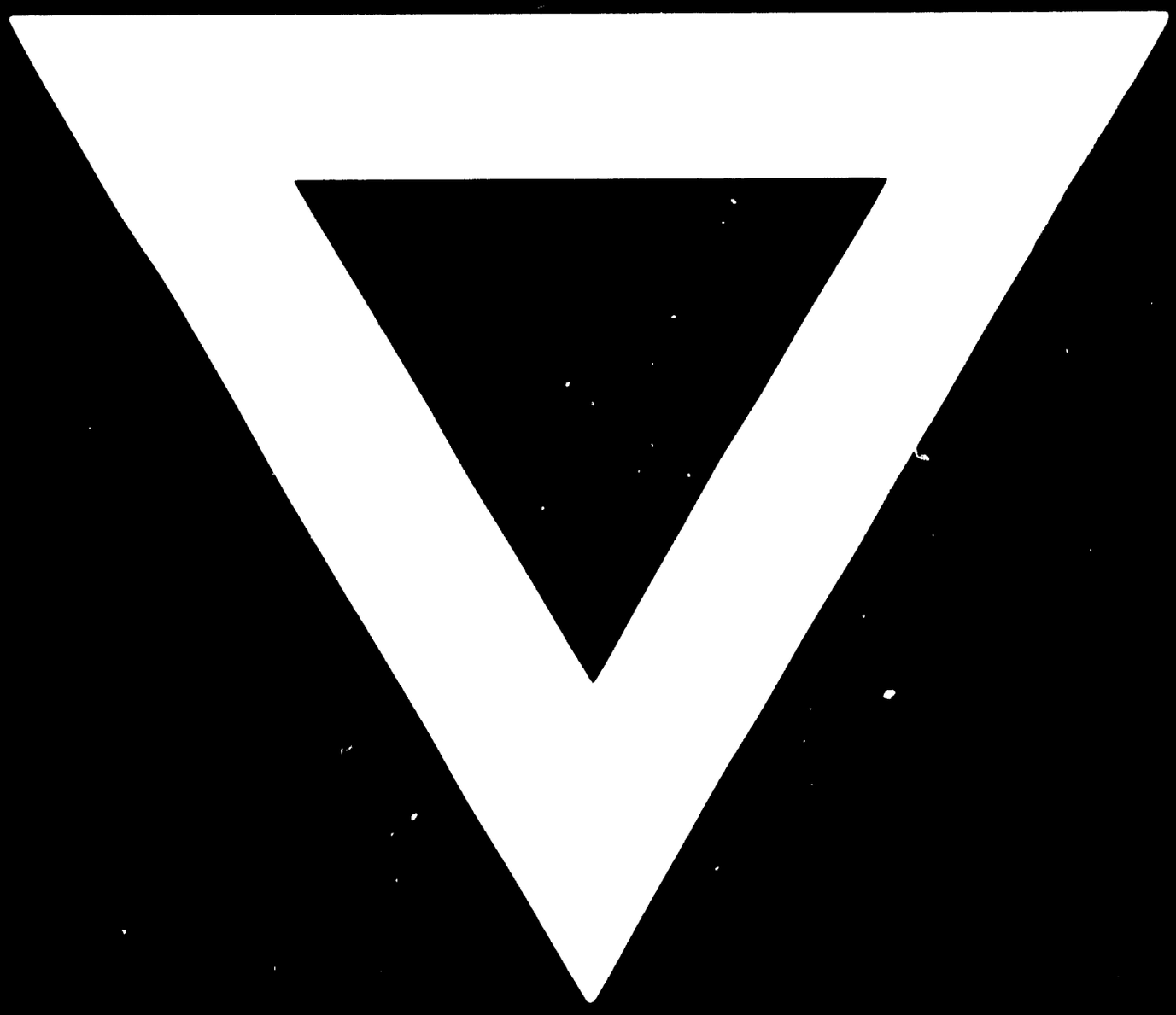

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