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Analysis of energy consumption in the Slovak economy

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1. Introduction

The objective of this paper is to analyse the energy consumption in the Slovak economy with the special focus on manufacturing. The attention is to be drawn on the analysis of requirements of different manufacturing branches on the consumption of different kinds of energy as well as on the quantification of the share of energy inputs in the produced final goods.

The use of energy resources currently seems to be an important factor for the sustainability of the stable economic development. It can be seen that the high intensity of economy on energy inputs is related prevailingly to the primary production, within which the raw materials are processed. The economic branches, which are producing goods at higher processing level, require fewer energy inputs. In terms of both, the increasing degree of sophistication of production and the growing share of the tertiary sector, the decrease of energy intensity of production can be expected in the future.

The first part of this paper describes the main methodological characteristics and features, together with tools and approaches, being used for the analysis. For analytical purposes the year 2000 was chosen, for which two main data sources on the energy consumption were available. As a starting point for analysis, the supply and use tables of the Slovak Republic (SR) 2000 supplemented by rows presenting the individual energy commodities [4] were used. The energy balance of the SR, which records the energy consumption in specific physical units and fuel efficiency units, was the second data source. Data from energy balance were adjusted to the form of supply and use tables within the framework of the compilation of Energy Accounts of the SR [5].

The third part of the paper is devoted to the analysis of energy consumption in individual branches. On the basis of data coming from the energy balance and supply and use tables, the specific energy consumption of individual branches was calculated. At the same time the branches are also compared in accordance with their contribution to the value added and to employment. The last part of the paper focuses on the analysis of direct and indirect energy consumption of produced commodities [6] based on the linear input-output modelling approach.

2. Concepts and methods used in the energy consumption analysis

Indicators of energy consumption in the economy of the Slovak Republic are based on two main data sources: the supply and use tables for 2000 and the energy balance for 2000.

The supply and use tables (SUT) comprise in detailed classification flows of goods and services on the supply side (production, imports) as well as on the demand side (final consumption, intermediate consumption, exports, gross capital formation). Simultaneously they describe the cost structure of production and generation of income. The basic version of SUT for the Slovak Republic was constructed in classification of 60 products (commodities) and 60 industries. [7].

For the analytical purposes the more detailed classification of energy commodities was introduced (corresponding to four or five digit level of CPA):

Energy commodities in SUT
CPA 1010: hard coal
CPA 1020: brown coal and lignite
CPA 1030: peat
CPA 11101: mineral oil
CPA 11102: natural gas
CPA 11200: services related to oil and gas extraction

CPA 2310: coke oven products
CPA 2320: refined petroleum products
CPA 2330: nuclear fuel

CPA 4010: production and distribution of electricity
CPA 4020: manufacture of gas, distribution of gaseous fuels through mains
CPA 4030: steam and water supply

The energy consumption in the economy is classified as:
- § intermediate consumption by particular branches (at two digit level of NACE classification)
- § final consumption, represented by households final consumption, changes in inventories and exports.

As the second data source the energy balance of the SR was used. The energy balance constructed annually contains the energy consumption of individual kinds of energy in specific units, as tons, cubic meters, kilowatt-hours and in fuel efficiency units (Terajoules). The energy consumption is split into the following commodities:

Commodities in energy balance:

Solid fuels	***Units***
Coking coal	ton, Terajoules
Steam coal	ton, Terajoules
Brown coal and lignite	ton, Terajoules
Brown coal briquettes	ton, Terajoules
Hard coal coke	ton, Terajoules
Other solid fuels	ton, Terajoules
Liquid fuels	
Crude oil	ton, Terajoules
Gasoline	ton, Terajoules
Diesel oil	ton, Terajoules
Light fuel oil	ton, Terajoules
Heavy fuel oil	ton, Terajoules
Kerosene	ton, Terajoules
Other liquid fuels	ton, Terajoules
Gaseous fuels	
Natural gas	Ths. m^3, Terajoules
Coke oven gas	Ths. m^3, Terajoules
Blast furnace gas	Ths. m^3, Terajoules
Propane-butane	Ths. m^3, Terajoules
Other gaseous fuels	Ths. m^3, Terajoules
Electricity	*GWh, Terajoules*
Heat	*Terajoules*

Data from the energy balance were transformed into the form of Energy Accounts [5], i.e. they were adjusted to correspond with data from supply and use tables. Thereby the value data about energy consumption from SUT were linked with data expressed in physical units from the energy balance.

To be able to harmonise energy consumption expressed in specific or fuel efficiency units and in units of value also differences in methodology for compilation of particular indicators should be considered. It is necessary to take into account these main differences:

- enterprise versus establishment method. Data from the supply and use tables are based on establishments, whereas data from the energy balance are based on enterprises. So, the deliveries between establishments within the same enterprise (intra-enterprise deliveries) are included in indicators of output and intermediate consumption in the SUT. But in the enterprise method, which is based on enterprise, the intra-enterprise deliveries are excluded.
- the establishment units of the same enterprise can be classified in the different industries (NACE), what affects the industrial classification of particular indicators.
- the covering of production units in the SUT is more exhaustive compared to the energy balance.
- the groups of energy commodities classified in SUT do not fully correspond with those commodities observed in energy balance.

In the analysis the following classification of industries was used:

Industry classification:

NACE:	***Industry:***
A,B	Agriculture, hunting and fishing
C	Mining and quarrying
DA	Manufacture of food products, beverages and tobacco
DB	Manufacture of textiles and textile products
DC	Manufacture of leather and leather products
DD	Manufacture of wood and wood products
DE	Manufacture of pulp, paper and paper products, publishing and printing
DF	Manufacture of coke, refined petroleum products and nuclear products
DG	Manufacture of chemicals, chemical products and man-made fibres
DH	Manufacture of rubber and plastic products
DI	Manufacture of other non-metallic mineral products
DJ	Manufacture of basic metals and fabricated metal products
DK	Manufacture of machinery and equipment n.e.c.
DL	Manufacture of electrical and optical equipment
DM	Manufacture of transport equipment
DN	Manufacture n.e.c.
E	Electricity, gas and water supply
F	Construction
I	Transport, storage and communication
G,H,J-P	Services
SUM (A-P)	Total

In the case of value indicators the services are classified according to main industries (NACE).

Analysing the energy consumption in the economy we have considered the level of value added in a given branch as a starting point and we have measured the share of energy inputs in the value added. The indicator "*specific energy consumption"* was calculated as:

specific energy consumption=energy consumption/value added

where energy inputs are measured in fuel efficiency units (*Terajoules - TJ*) and value added is given in mill. Slovak crowns (SKK).

The next part of our analysis is based on data from symmetric Input-output tables and Leontief linear model. We examine what are the energy requirements of the various branches of production and how much energy is involved in final products.
For this purpose the supply and use tables in basic prices were transformed into symmetric product by product Input-Output Table. Taking into account the great heterogeneity of SUT, the industry technology assumption was applied although it is not optimal approach.

On the basis of IOT, the Leontief linear model is defined as:

$X = (E-A)^{-1}. (Y-D)$,
where A is matrix of *input coefficients* defined as follows:

$$a_{ij} = \frac{x_{ij}}{X_j}$$

where x_{ij} - intermediate consumption (input) of *i* commodity needed for production of *j* commodity

X_j - output of *j* commodity

a_{lj} - input coefficient (the direct requirements on intermediate inputs of *i* commodity to produce 1 unit of *j* commodity*).*

$(E-A)^{-1}$ is the inverse Leontief matrix, elements of which (Leontief multipliers) show the direct and indirect requirements of one unit of production delivered to the final use on inputs coming from domestic production as well as from imports in whole economy.

Because the variant "IOT including imports" was used, the final use components (Y) are reduced by imports.

3. The use of energy in the economy of the SR

According to data from the energy balance of the SR (adjusted to the structure of SUT), the energy resources in 2000 amounted in the SR 1 453 188 Terajoules (TJ) in total, including, on the one hand, primary energy resources and, on the other hand, the energy being produced. The consumption of primary energy resources in the SR represented approximately 690 000 TJ from the total. At the same time, it has to be mentioned that the majority of primary resources[1] (except for electricity) is imported.

Table 1
Energy resources of the Slovak Republic, year 2000, (TJ)

	Solid fuels (TJ)	*Liquid fuels (TJ)*	*Gaseous fuels (TJ)*	*Heat (TJ)*	*Electricity (TJ)*	*Total (TJ)*
Primary resources (domestic)	45 600	2 436	5 620	211 523	18 101	283 280
Imports	145 321	231 362	242 613	0	3 424	622 720
Exports	49 167	198 434	42 933	164 289	92 365	547 188
Total	240 088	432 232	291 166	375 812	113 890	1 453 188

When analysing the use of energy in the Slovak economy, not only the use of primary energy resources was traced but also their utilisation within the framework of further processing, e.g. consumption of crude oil for the production of petroleum products, coking coal used for the production of coke etc. The use of fuels and energy within the framework of both, the running of energy processes and the mining, together with refining of fuels, was inquired too. For analytical purposes, the heat produced in the nuclear power plants was excluded, thus the amount of energy being 1 241 665 TJ was in consideration. From the total amount of energy used, the economic branches consumed 80,5%; 9,3% was used in households and approximately 10,0% from the total amount of energy commodities was exported (see table 2).

Table 2
Use of energy in the Slovak Republic, year 2000

	Intermediate consumption	Final consumption of households	Exports	Changes in inventories	Using together
mill. SKK	241 668	55 190	40 532	-3185	334 186
%	72,3	16,5	12,1	-0,9	100,0
Terra Joules	999 480	113 970	123 660	4 555	1 241 665
%	80,5	9,2	10,0	0,3	100,0
(SKK/GJoules)	241,8	484,2	327,8	-	269,1

According to SUT data, the total value of energy commodities being used reached the level of 334 186 million SKK (the amount of imported and exploited natural gas was excluded and its supply and consumption is presented separately on the specific row in SUT). From the above-mentioned amount, the highest share was used as intermediate consumption (72,3%), followed by the consumption of households (around 16,5%) and 12,1% was exported (changes in inventories represented approximately –1%; see table 2).

The interaction linking between the indicators on consumption of energy commodities expressed in fuel efficiency units (TJ) and in units of value (SKK) is only approximate,

[1] Primary resources are inputs of fuels and energy obtained directly, i.e. those, which were not part of further processing.

because the content of the indicator in SUT does not correspond entirely to the content of the relevant indicator presented in the energy balance.

The commodity structure of energy is shown in the following tables (tables 3-4).

Table 3
Commodity structure of energy use, TJ

	Intermediate consumption (TJ)	Final consumption of households (TJ)	Exports (TJ)	Use together (TJ)
CPA 10 (coal, lignite, peat)	178 181	2 010	80	188 051
CPA 11101 (crude petroleum)	225 867	0	609	223 620
CPA 23100 (coke)	79 203	56	1 629	81 325
CPA 23200 (refined petroleum products)	77 946	15 330	118 990	208 612
CPA 40100 (electrical energy)	92 052	19 508	2 329	113 890
CPA 40200 (gas)	198 193	60 814	23	261 879
CPA 40300 (steam and hot water)	148 038	16 251	0	164 289
Together	999 480	113 970	123 660	1 241 666

Table 4
Commodity structure of energy use in %

	Intermediate consumption (TJ)	Final consumption of households (TJ)	Exports (TJ)	Use together (TJ)
CPA 10 (coal, lignite, peat)	94,8	1,1	0,0	100,0
CPA 11101 (crude petroleum)	101,0	0,0	0,3	100,0
CPA 23100 (coke)	97,4	0,1	2,0	100,0
CPA 23200 (refined petroleum products)	37,4	7,3	57,0	100,0
CPA 40100 (electrical energy)	80,8	17,1	2,0	100,0
CPA 40200 (gas)	75,7	23,2	0,0	100,0
CPA 40300 (steam and hot water)	90,1	9,9	0,0	100,0
Together	80,5	9,2	10,0	100,0

Nearly the whole amounts of crude petroleum and coal, together with coke, enter the branches for the purposes of further processing and/or for the operation of manufacturing processes (95-100%). The share of intermediate consumption in the consumption of electricity and gas is also very high (81% and 76% respectively). Almost 57% from the refined petroleum products being produced is intended for exports. The share of final consumption of households is the highest in terms of gas consumption (23,2%), followed by the electricity consumption (17,1%). Its share in the consumption of petroleum products is approximately 7% and in the heat consumption around 10%.

The following parts of this paper will be focused on the analysis of energy consumption in particular economic branches. The analysis is based on both, the data taken over from the energy balance of the SR and the SUT data.

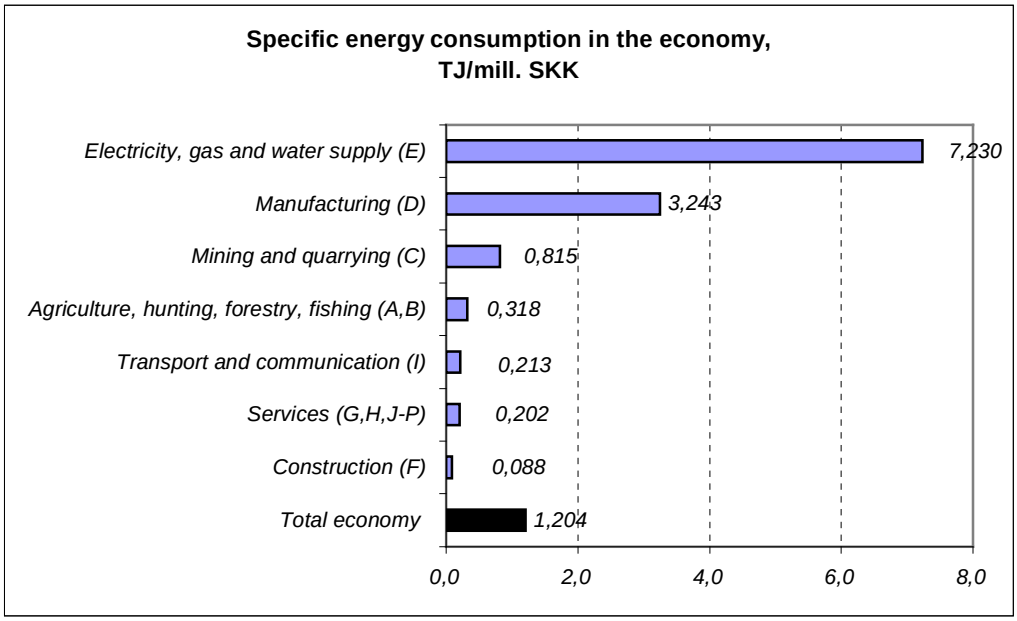
3.1 Consumption of energy by economic branches

The energy consumption by branches was figured out for main economic branches, while at the same time, the manufacturing was traced in more details. The value of energy commodities being consumed was judged on the basis of the calculation of specific consumption, i.e. the consumption in fuel efficiency units falling on the value

added of given branch (in TJ per 1milllion SKK of value added in the given branch; see Figure 1, 2).

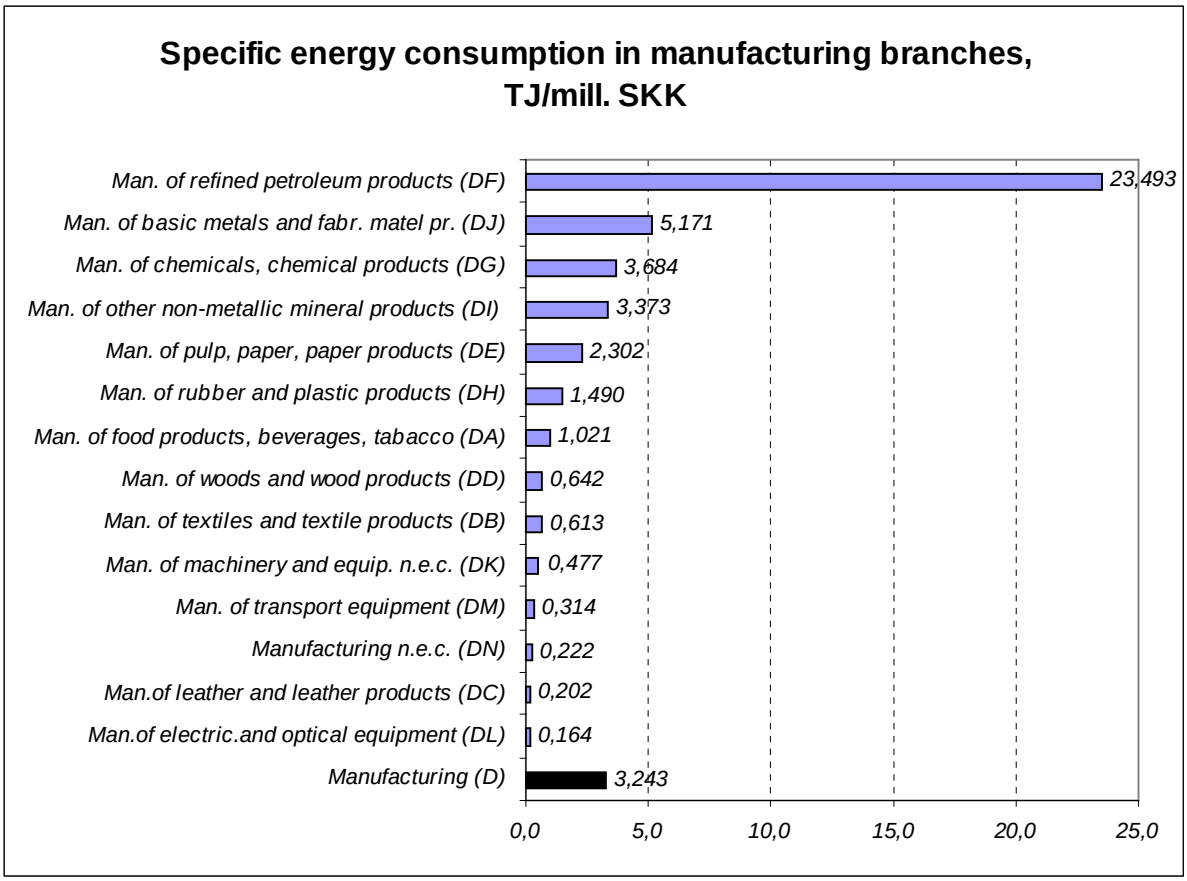
The average specific energy consumption in the Slovak economy represents 1,2 TJ per 1 million SKK of value added; if expressed in units of value, it is 29 SKK per 100 SKK of value added. Higher specific consumption than the average was recorded in Manufacturing (D), with the average consumption being 3,24 TJ/mill. SKK and also in Electricity, gas and water supply (E), 7,23TJ/mill. SKK.

Figure 1



Manufacture of coke, refined petroleum products and nuclear fuel (DF) reports nearly 7 times higher value than the average value of manufacturing; in this branch crude petroleum is firstly processed and consequently used as an intermediate input for the production of petroleum products. Also the consumption recorded in following branches is above the average: Manufacture of basic metals and fabricated metal products (DJ), 5,17 TJ/mill. SKK, Manufacture of chemicals and chemical products (DG) and Manufacture of non-metallic mineral products (DI), with values ranking from 3,4 up to 3,7 TJ/mill. SKK of value added. Regarding the energy consumption, the Manufacture of pulp and paper (DE) belongs also among the branches with high requirements on energy inputs. Among the branches with the lowest energy consumption belong the electrical, machinery and transport equipment industries (DL, DM, DK).

Figure 2



The results indicate that higher specific energy consumption is to be found in those branches which process the original raw materials, primary energy resources, while in branches in which already the intermediate inputs have been processed, the specific energy consumption decreases. For example, if the more detailed breakdown is used, it can be seen that in the textiles production the specific energy consumption is four times higher than in the production of confection and in the production of fabricated metal products, the specific energy consumption is ten times lower than in the production of basic metals. Similar relations can be identified also in other branches, if the more detailed breakdown is taken into consideration.

Thus, it can be said that the higher degrees of processing, the lower specific energy consumption is in question. This confirms the general thesis on the energy intensity of the Slovak economy.

Comparison of consumption, value added and employment by branches

The comparison of branches in terms of their share in the total energy consumption, their contribution to value added of economy and to the total employment, is being done within the following two tables (Table 5 and 6).

Table 5
Energy consumption, value added, employment in the economy (%), year 2000

	Energy cons. in value units (%)	*Energy cons. in TJ (%)*	*Value added (%)*	*Employment (%)*
Agriculture, hunting, forestry, fishing (A,B)	3,11	1,18	4,48	5,60
Mining and quarrying (C)	0,69	0,54	0,79	0,73
Manufacturing (D)	40,54	65,59	24,35	25,29
Electricity, gas and water supply (E)	36,31	22,08	3,68	2,09
Construction (F)	1,47	0,52	7,02	6,59
Transport and communication (I)	6,22	1,76	9,98	7,89
Services (G,H,J-P)	11,66	8,33	49,70	51,81
Total economy	***100,00***	***100,00***	***100,00***	***100,00***

From the comparison of presented indicators results, that the manufacturing, the share of which in the total energy consumption of all branches is 40-60%, contributes to the value added and employment only by one quarter. On the contrary, the contribution of services, the share of which in the energy consumption is 8-11%, to the produced valued added and to employment represents even 50%. As far as the energy intensity is concerned, the construction is effective in the same way; the share of value added and employment in their totals is almost four times higher as compared to its share in the energy consumption. The contributions of agriculture (A,B) and transport (I) to the value added of economy and to employment are only slightly higher than their shares in the energy consumption.

In branches belonging to manufacturing the table was supplemented also by the indicator on labour inputs expressed in relation to the value added, which was compared with the specific energy consumption calculated in the units of value.

Table 6
Energy consumption, value added, employment in manufacturing branches (%), year 2000

	Energy cons. in value units (%)	*Energy cons. inTJ (%)*	*Value added (%)*	*Employment (%)*	*Coefficients (in 100 SKK)*	
					of spec.energy consumption	*of labour inputs**
Man. of food products, beverages, tabacco (DA)	3,71	3,58	11,38	12,12	15,80	40,02
Man. of textiles and textile products (DB)	1,18	1,13	5,99	11,91	9,56	52,53
Man.of leather and leather products (DC)	0,22	0,15	2,48	3,47	4,27	40,30
Man. of woods and wood products (DD)	0,73	0,67	3,39	5,47	10,39	39,33
Man. of pulp, paper, paper products (DE)	2,69	5,46	7,69	5,58	16,92	32,98
Man. of refined petroleum products (DF)	57,22	42,96	5,93	1,01	467,62	11,19
Man. of chemicals, chemical products (DG)	6,08	8,44	7,43	4,02	39,65	25,79
Man. of rubber and plastic products (DH)	1,34	1,76	3,83	3,26	16,95	41,06
Man. of other non-metallic mineral products (DI)	5,43	6,45	6,20	5,65	42,41	38,30
Man. of basic metals and fabr. matel pr. (DJ)	16,97	26,71	16,75	15,46	49,10	39,27
Man. of machinery and equip. n.e.c. (DK)	2,02	1,19	8,10	11,23	12,07	57,26
Man.of electric.and optical equipment (DL)	0,95	0,48	9,62	11,75	4,78	44,92
Man. of transport equipment (DM)	1,00	0,80	8,27	4,80	5,86	30,30
Manufacturing n.e.c. (DN)	0,48	0,20	2,96	4,27	7,81	43,00
Manufacturing (D)	***100,00***	***100,00***	***100,00***	***100,00***	***48,46***	***38,40***

**Coefficients of labour inputs = wages and salaries/value added, in 100 SKK*

Based on the data from table 6, the manufacturing branches can be divided approximately into three groups:

- branches with the high share in the energy consumption and several times lower contribution to the value added: here belongs mainly the Manufacture of coke, refined petroleum products and nuclear fuel (DF), which, at the same time, contributes to the employment in manufacturing by the lowest ratio. The production of metals could also be classified here if it is separated from the production of fabricated metal products and metal structures;
- branches, the share of which in the energy consumption in manufacturing is nearly the same as their contribution to the value added; those are the following branches: (DG) – Manufacture of chemicals and chemical products, (DI) – Manufacture of non-metallic mineral products, (DE) – Manufacture of pulp, paper and paper products. Their contribution to employment is only a bit lower as their contribution to value added;
- branches, the contribution of which to the valued added is two times higher than their share in the energy consumption: in question are mainly the branches of machinery, electrical and transport equipment (DM), (DK), (DL), light industry branches (manufacture of textiles and confection products (DB), manufacture of leather and leather products (DC), manufacture of food products, beverages and tobacco (DA) and manufacture of rubber and plastic products (DH)). Their contribution to employment is also several times higher than their share in the energy consumption.

Based on the above mentioned indicators, certain tendencies can be identified in manufacturing:

- branches with the high share in the energy consumption contribute relatively less to the value added and employment
- branches with the low share in energy consumption contribute relatively more to the value added and employment
- the high level of specific energy consumption of the given branch tends to be linked to lower coefficients of labour inputs.

The acquired relations are visible also from Figures 3 and 4.

Figure 3

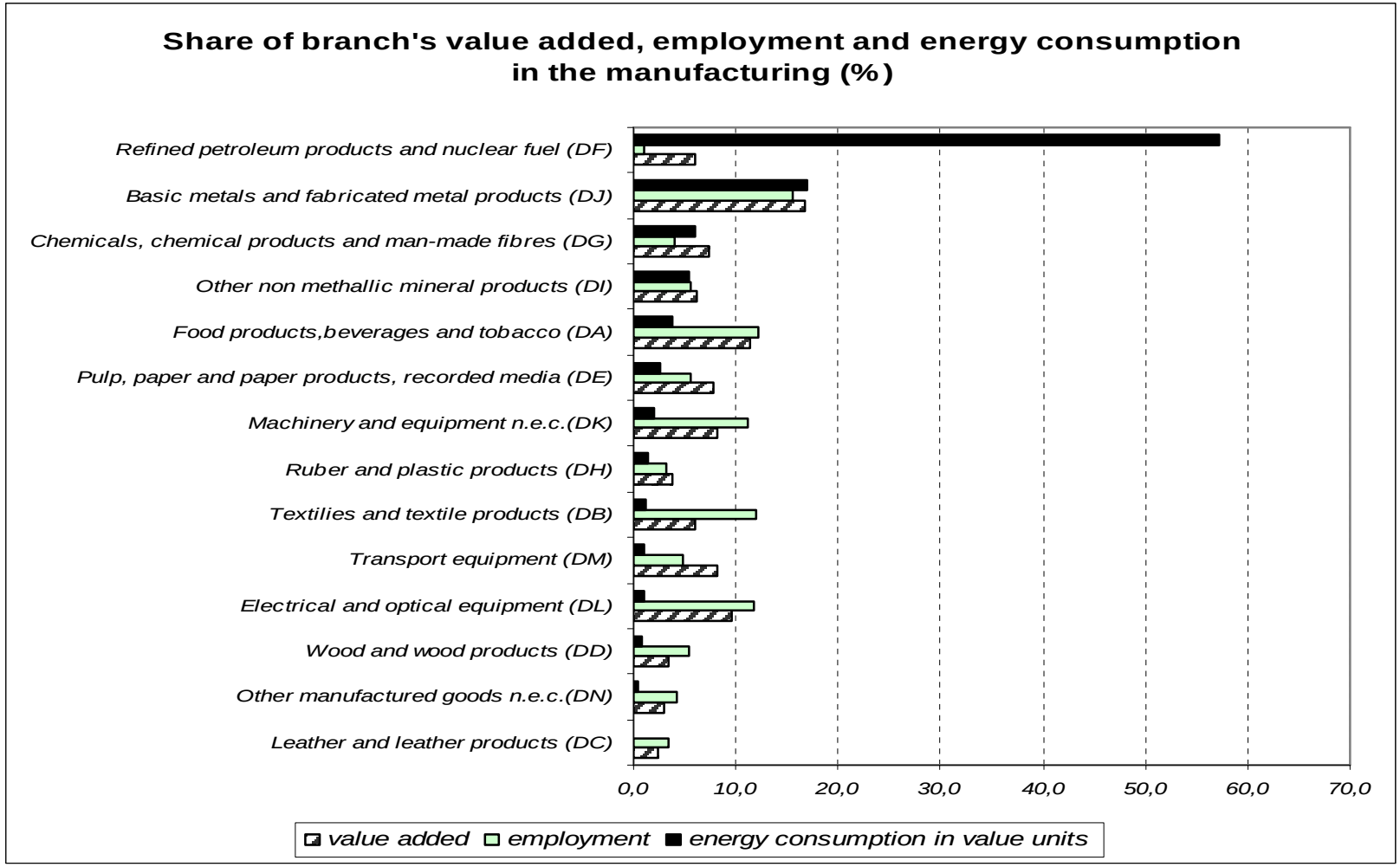
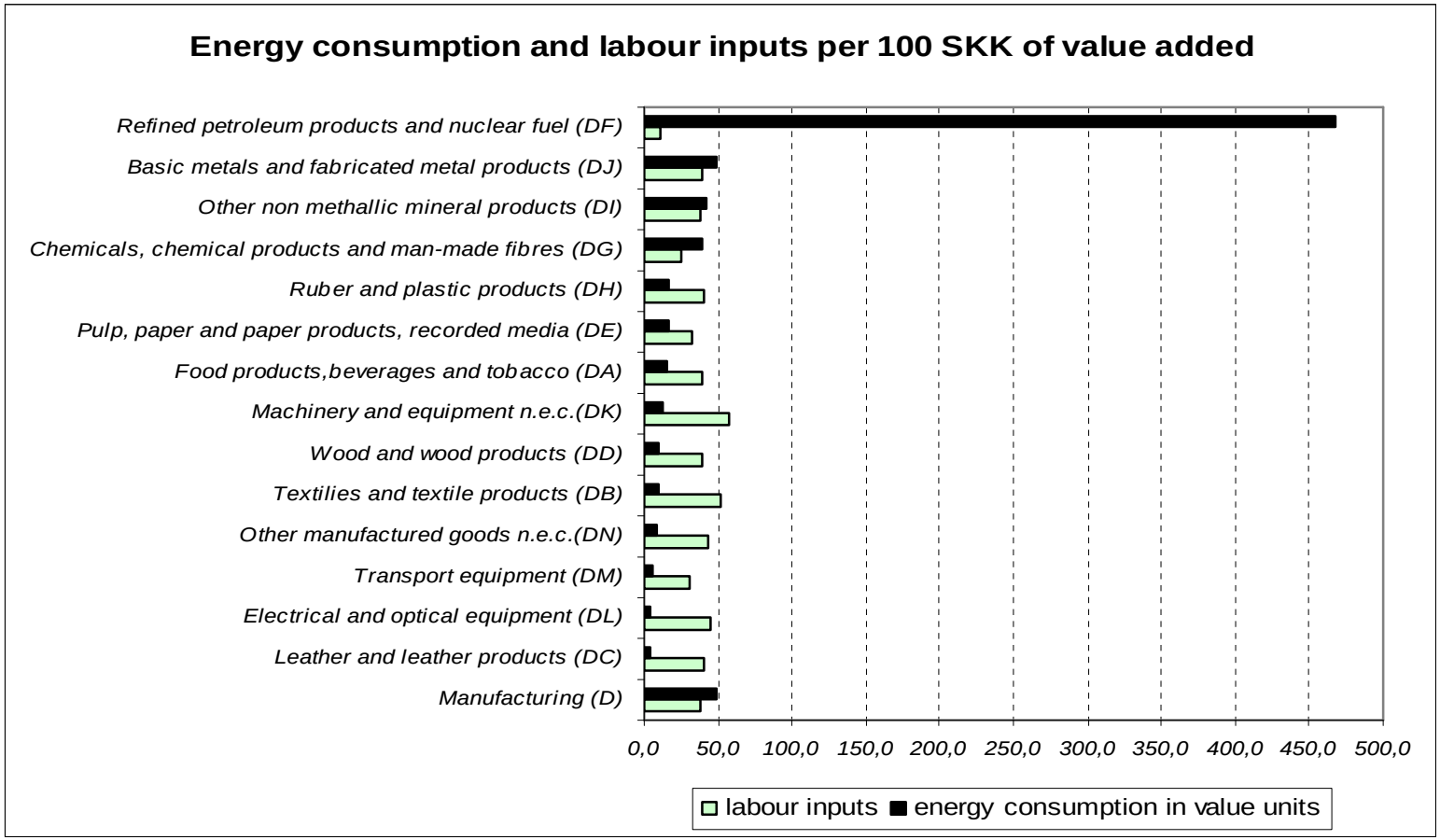

Share of branch's value added, employment and energy consumption in the manufacturing (%)
Refined petroleum products and nuclear fuel (DF)
Basic metals and fabricated metal products (DJ)
Chemicals, chemical products and man-made fibres (DG)
Other non methallic mineral products (DI)
Food products,beverages and tobacco (DA)
Pulp, paper and paper products, recorded media (DE)
Machinery and equipment n.e.c.(DK)
Ruber and plastic products (DH)
Textilies and textile products (DB)
Transport equipment (DM)
Electrical and optical equipment (DL)
Wood and wood products (DD)
Other manufactured goods n.e.c.(DN)
Leather and leather products (DC)
0,0
10,0
20,0
30,0
40,0
50,0
60,0
70,0
value added
employment
energy consumption in value units

Figure 4


Energy consumption and labour inputs per 100 SKK of value added
Refined petroleum products and nuclear fuel (DF)
Basic metals and fabricated metal products (DJ)
Other non methallic mineral products (DI)
Chemicals, chemical products and man-made fibres (DG)
Ruber and plastic products (DH)
Pulp, paper and paper products, recorded media (DE)
Food products,beverages and tobacco (DA)
Machinery and equipment n.e.c.(DK)
Wood and wood products (DD)
Textilies and textile products (DB)
Other manufactured goods n.e.c.(DN)
Transport equipment (DM)
Electrical and optical equipment (DL)
Leather and leather products (DC)
Manufacturing (D)
0,0
50,0
100,0
150,0
200,0
250,0
300,0
350,0
400,0
450,0
500,0
labour inputs
energy consumption in value units

3.2 Consumption of selected energy commodities in branches

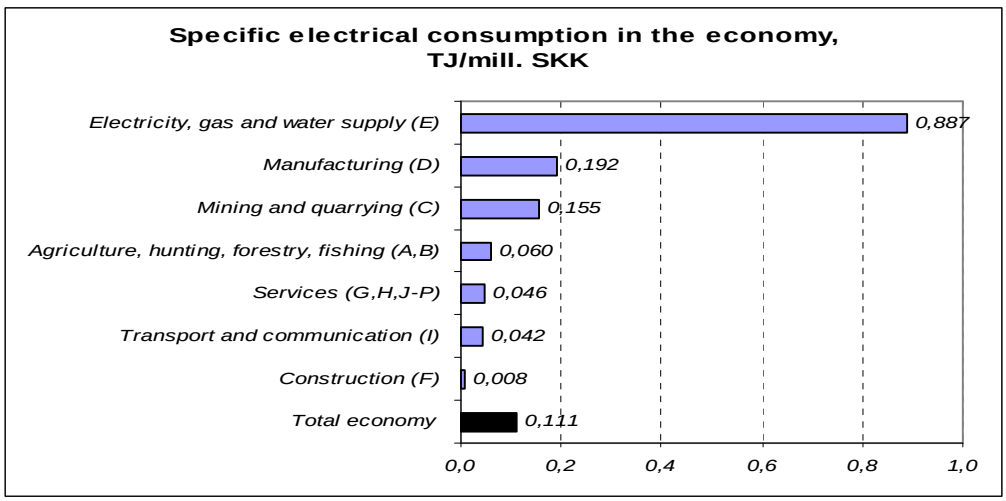
The energy consumption was traced also separately, i.e. for electricity, gas and petroleum products in the main economic branches and in manufacturing branches. For analytical purposes, again the specific energy consumption indicator, expressed in fuel efficiency units, was used.

Consumption of electricity by branches

The calculated indicators of specific consumption of electricity by economic branches are presented in the Figures 5 and 6.
The total amount of electricity consumption in economic branches reported in 2000 was 73 369 mill. SKK; in fuel efficiency units 92 052 TJ. The average specific electricity consumption represented 0,111 Terajoules (TJ) per 1 million SKK of value added and in value units it was 8,84 SKK per 100 SKK of value added.

The specific electricity consumption in the Manufacturing (D) as well as in Mining and Quarrying (C) is at the level above the average of the whole economy, i.e. 0,192, respectively 0,155 TJ/mill. SKK. Other branches as agriculture, service sector and construction is below the average.
The branch (E) -Electricity, gas and water supply, in which the electricity is produced but also processed in the production process, has the specific electrical consumption 7 times higher as the average.

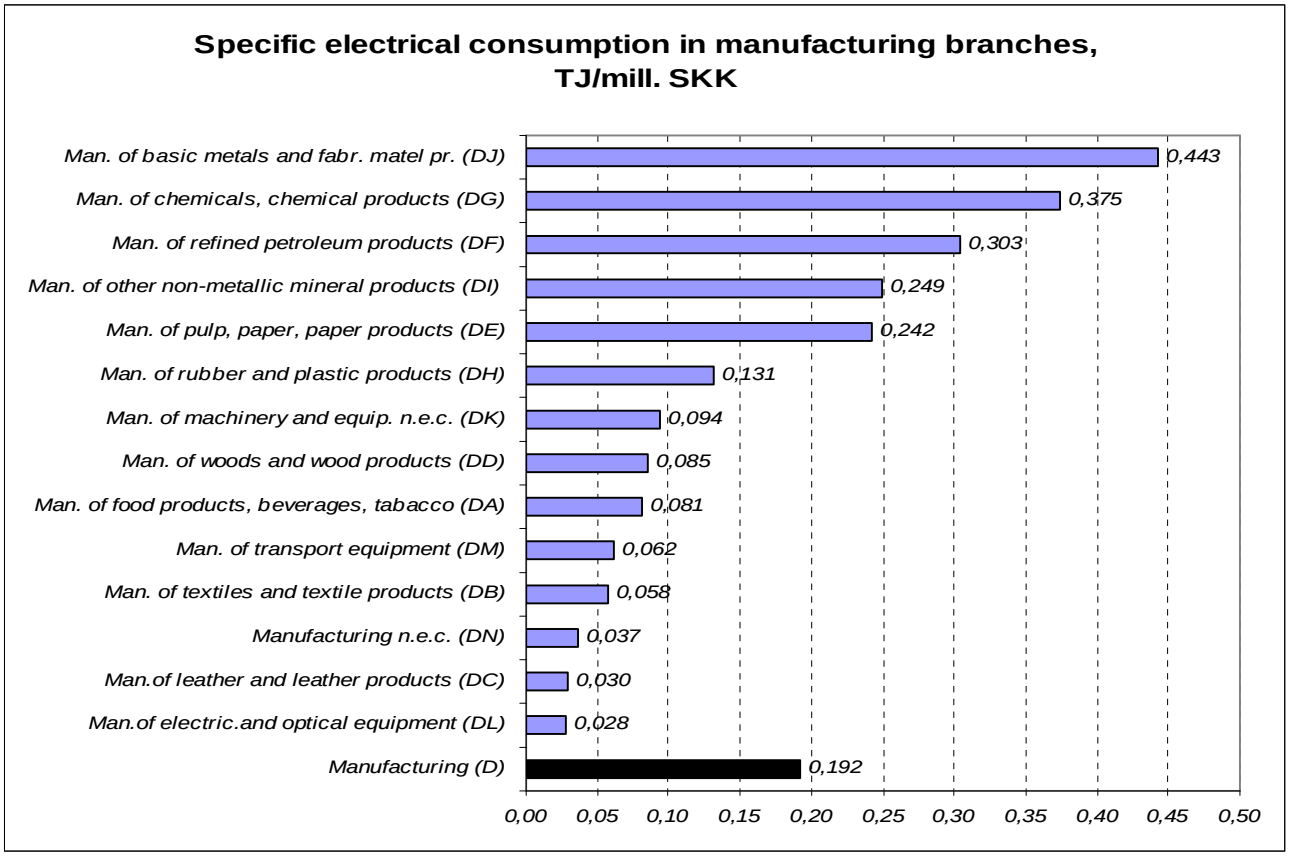
Figure 5



The average specific electricity consumption in manufacturing represented 0,192 TJ/mill. SKK of VA, while three branches reported 1,5-2 times higher electricity consumption than this average; those are: (DJ) - Manufacture of basic metals and fabricated metal products, (DG) – Manufacture of chemicals and chemical products and (DF) – Manufacture of coke, refined petroleum products and nuclear fuel. Also two other branches (DI) – Manufacture of non-metallic mineral products and (DE) – Manufacturing of pulp, paper and paper products belong among branches with the

above-average specific electricity consumption (0,240-0,250 TJ/mill. SKK). The lowest consumption of electricity is recorded in light industry branches (DC, DB, DA) and in electrical and optical equipment (DL).

Figure 6



Consumption of gas and gas fuels by branches

The reported gas consumption in economic branches in 2000 was 49 537 million SKK; if expressed in fuel efficiency units it was 198 193 TJ. The indicators of specific gas consumption by economic branches are presented in Figures 7 and 8.
In the branch (E) itself the highest amount of gas is processed, i.e. for the production of heat and for the electricity production. According to data from energy balance, the gas consumption in the branch (E) – Electricity, gas and water supply represents approximately 40% from the total intermediate consumption of gas in economic branches.

Data expressed in fuel efficiency unit evidence that the average specific consumption of gas in economy is 0,239 TJ/mill.SKK. This indicator is two times higher in the Manufacturing (D) and Mining and quarrying (C) (0,469 TJ/mill. SKK, respectively 0,455 TJ/mill. SKK), while in other main economic branches is four times lower than the average.

The consumption of the following branches is two-three times higher as compared to the average of the Manufacture: (DG) – Manufacture of chemicals and chemical

products, (DI) – Manufacture of non-metallic mineral products, (DF) – Manufacture of coke, refined petroleum products and nuclear fuel; the consumption of these branches moves approximately in scope of 0,600-1,500 TJ/mill. SKK. Also in the branch (DJ) – Manufacture of basic metals and fabricated metal products, the consumption of gas is above the average. The consumption of gas in (DA) – Manufacture of food products, beverages and tobacco is close to the average. The lowest gas consumption is recorded in machinery, electrical and transport equipment (DL, DM, DK).

Figure 7

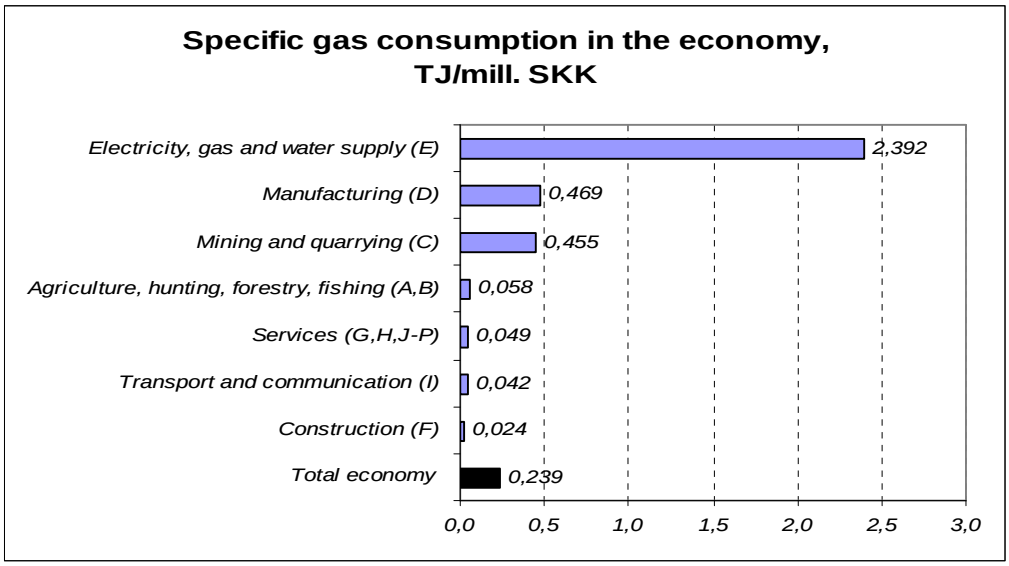
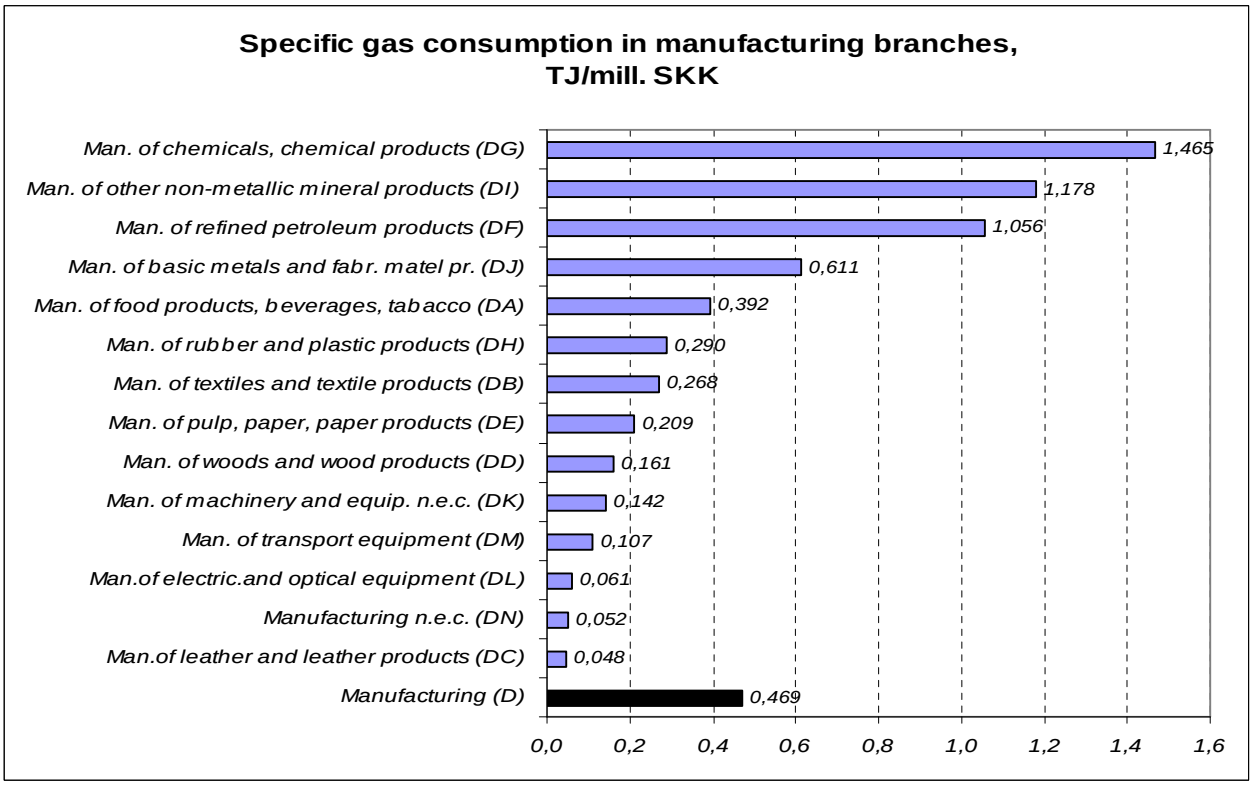


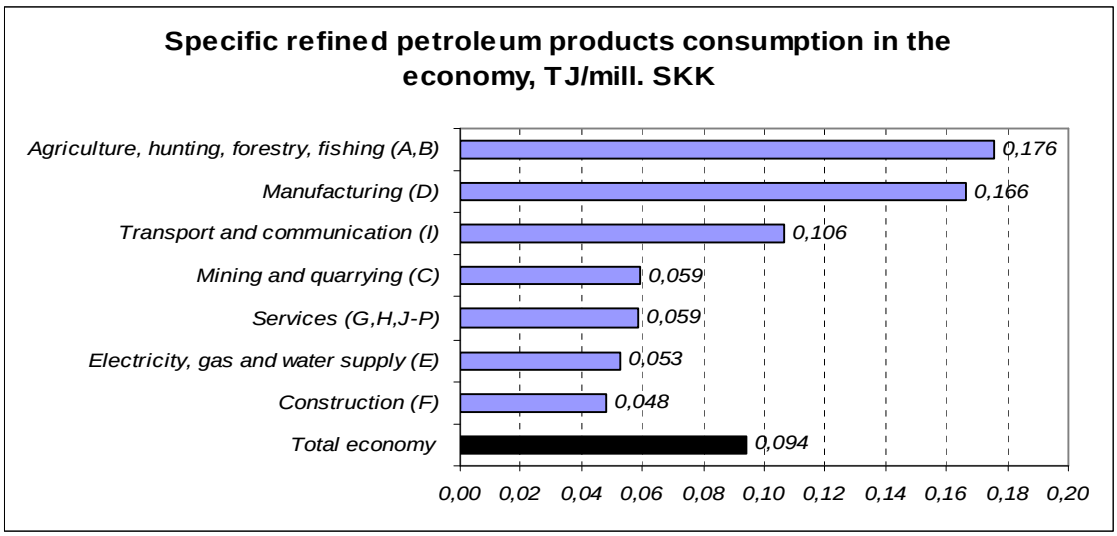
Figure 8



Consumption of refined petroleum products by branches

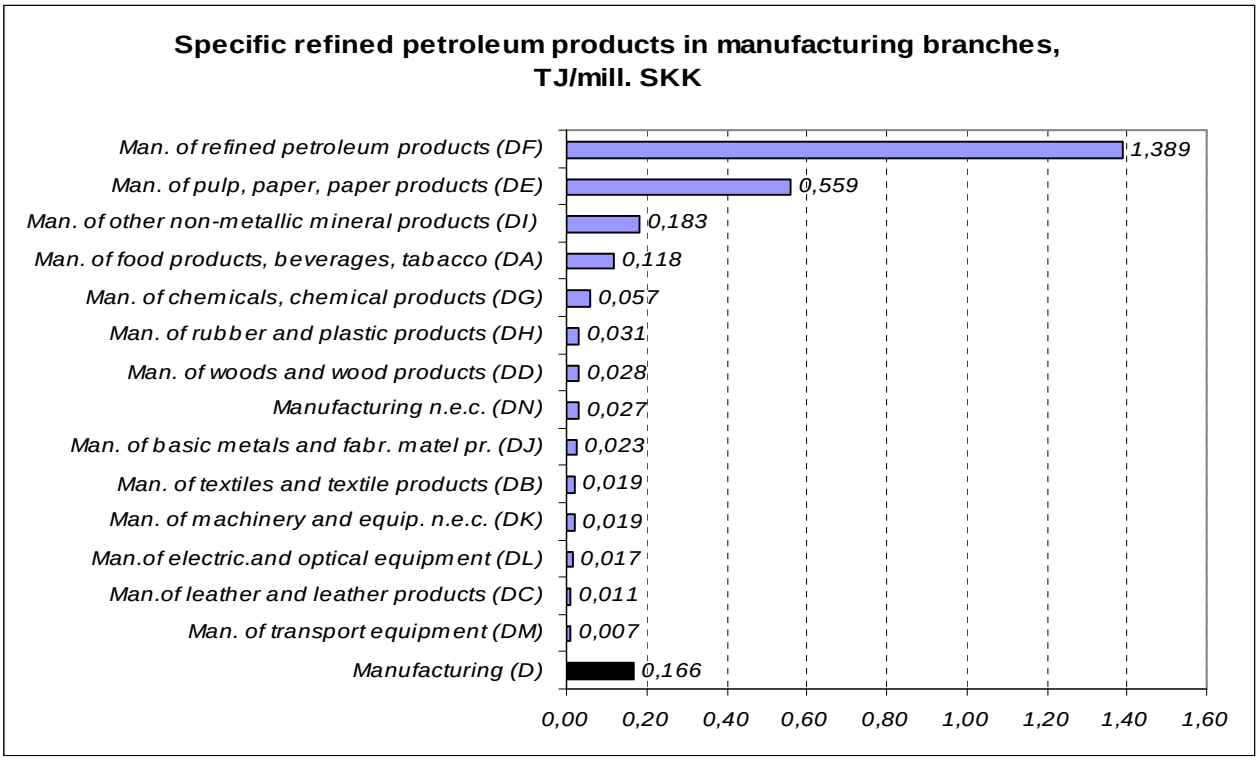
The consumption of petroleum products in the Slovak economy represents 77 946 TJ (Figures 9 and 10).
Data on the specific consumption of petroleum products in fuel efficiency units by main economic branches show that the highest specific consumption of petroleum products is to be found in the branch (A,B) - Agriculture, hunting, forestry and fishing i.e. 0,176 TJ per 1million SKK of value added. The average consumption of petroleum products is the second highest in Manufacturing (D) being 0,166 TJ/mill. SKK. The branch (I) – Transport reports also the above-average consumption of petroleum products (0,106 TJ/mill. SKK). In other main branches the average specific petroleum products consumption moves within the range of 0,040-0,060 TJ/mill. SKK.

Figure 9



Within the manufacturing, the very branch, in which the petroleum products are produced, belongs among the branches with the highest specific consumption, i.e. (DF) – Manufacture of coke, refined petroleum products and nuclear fuel, where 1,389 TJ per 1 mill. SKK of value added are consumed at the average. Based on the energy balance data, also the branch (DE) – Manufacture of pulp, paper and paper products ranks among the branches with the above-average specific consumption, i.e. 0,559 TJ per 1 mill. SKK of VA. The branch (DI) – Manufacture of non-metallic mineral products is above the average too (0,183 TJ/mill. SKK). The machinery and electrical equipment, together with light industry, report the lowest specific consumption.

Figure 10



To conclude we can summarise:

- § mainly the following branches belong among the branches being highly specific energy-intensive nearly in terms of all energy commodities: (DF) – Manufacture of coke, refined petroleum products and nuclear fuel, (DJ) – Manufacture of basic metals and fabricated metal products, (DI) – Manufacture of non-metallic mineral products, (DG) – Manufacture of chemicals and chemical products;
- § branch (DE) – Manufacture of pulp, paper and paper products ranks among the branches with the above-average specific consumption of some energy commodities
- § the following branches belong among the branches with the average specific consumption of some energy commodities: (DA) – Manufacture of food products, beverages and tobacco, (DH) – Manufacture of rubber and plastic products;
- § manufacture of electrical equipment, transport equipment, textiles, textile products and leather rank among the branches with the lowest specific consumption.

4. Analysis of the produced commodities' requirements on energy inputs

The objective of this part of analysis is to show the share of energy in the commodities being produced, i.e. to point out the amount of energy consumed directly as well as indirectly in the whole economy. The analysis is based solely on data from commodity by commodity Input-output table of the SR for the year 2000.

4.1 Coefficients of direct and indirect energy consumption of produced commodities

The analysis is based on the calculation of input coefficients as well as Leontief multipliers. The input energy coefficients record the value of consumed energy per one unit of production in the given branch. Besides, another energy was consumed within the preceding productive processes in terms of producing materials, semi-finished products and services, which were consumed as inputs for the purposes of production of the given commodity. This is to be considered as indirect energy requirements, which should also be included in the final product costs. The direct and indirect energy consumption jointly represents the *total energy requirements* of the commodity being produced. They are represented by the Leontief multipliers. Thus, the "total energy consumption coefficient" indicates the sum of SKK incurred on energy commodities consumed in the whole economy to produce one unit of output intended for final use.

Having said that, it is obvious that *coefficients of total energy consumption* can be broken down into two components:
- *coefficients of direct energy consumption*
- *coefficients of indirect energy consumption*

of commodities being produced.

For the calculation of coefficients of direct and indirect energy consumption we used the aggregated symmetric IOT broken down into 28 x 28 commodities.
The calculated coefficients of energy consumption are presented in tables 7-9.

Data in the first column of table 7 show the direct requirements of produced commodities on the inputs. In the whole economy for the production of one unit of the total gross output (1 SKK) the direct inputs of goods and services in the amount of 0,61 SKK are required.

The coefficient of direct energy consumption itself represents 0,1011. The highest share in direct energy inputs is recorded in case of electricity (33%), followed by consumed petroleum (23%), gas (22%), petroleum products (11 %), coal and coke (8%), heat and hot water (4%).

The total Leontief multipliers (table 8) show that for the production of one unit of gross output (1 SKK) intended for final use it is necessary in the whole economy to consume both, directly and indirectly, 1,54 SKK of material and service inputs.
The coefficient of total energy consumption is 0,2876, of which again the highest share has the electricity consumption (34%), gas (24%), petroleum (21%), petroleum products (10%), coal and coke (8%), heat and hot water (4%).

The difference between the coefficients of total consumption and direct consumption represents the coefficient of indirect consumption (see table 9).
When we consider only energy consumption, we see that *the coefficient of indirect consumption is about 0,1865*, what means 64,8%, in the total energy consumption.

Table 7
Coefficients of direct consumption, year 2000
(inputs coefficients)

CPA classification	*goods and services together*	*energy commodities together*	*of which (%)*					
			coal, coke uranium	*crude petroleum*	*refined petroleum prod.*	*electrical energy*	*gas*	*steam and hot water*
A,B - Products of agriculture, hunting, forestry ar	0,5926	0,0548	4,04	0,00	52,03	32,22	7,04	4,67
CA - Coal and lignit, peat, crude petroleum and r	0,4487	0,0823	4,99	5,83	14,93	41,64	26,37	6,25
CB - Metal ores and other mining and quarrying p	0,6326	0,1574	2,62	0,00	14,69	48,28	33,16	1,25
DA - Food products,beverages and tobacco	0,7269	0,0339	2,04	0,01	23,27	38,83	31,97	3,88
DB - Textilies and textile products	0,5241	0,0419	1,59	0,00	7,90	45,46	38,25	6,80
DC - Leather and leather products	0,4857	0,0206	0,61	0,00	8,56	52,19	14,42	24,22
DD - Wood and wood products	0,6173	0,0318	1,36	0,00	22,09	60,57	10,46	5,52
DE - Pulp, paper and paper products, recorded r	0,6671	0,0504	19,65	0,00	6,98	48,32	10,53	14,52
DF - Coke, refined petroleum products and nucle	0,8118	0,6935	1,07	90,19	6,47	2,07	0,18	0,02
DG - Chemicals, chemical products and man-ma	0,7045	0,2518	4,24	57,07	5,17	15,17	15,68	2,67
DH - Ruber and plastic products	0,6935	0,0418	0,19	0,26	11,89	52,65	22,88	12,12
DI - Other non methallic mineral products	0,6504	0,1244	12,58	0,00	9,61	34,17	40,88	2,76
DJ - Basic metals and fabricated metal products	0,7457	0,1012	57,40	0,02	3,69	30,51	6,91	1,47
DK - Machinery and equipment n.e.c.	0,6828	0,0338	8,97	0,13	12,13	50,52	18,53	9,72
DL - Electrical and optical equipment	0,6614	0,0187	3,69	0,00	18,57	50,61	18,89	8,24
DM - Transport equipment	0,8172	0,0100	4,32	0,00	10,42	57,79	21,05	6,43
DN - Other manufactured goods n.e.c.	0,6852	0,0201	1,76	2,32	20,09	57,05	10,99	7,80
D - Manufactured products together	0,7178	0,1190	11,42	53,72	7,20	16,76	8,84	2,06
E - Electrical energy, gas, steam and hot water	0,7322	0,4954	6,27	0,19	2,45	48,51	39,35	3,23
F - Construction work	0,6235	0,0262	3,54	0,05	30,45	36,75	25,05	4,16
G - Wholesale and retail trade services	0,5696	0,0288	1,52	0,02	43,10	39,39	12,41	3,57
H - Hotel and restaurant services	0,6439	0,0578	0,76	0,00	20,72	58,55	13,93	6,05
I - Transport, storage and communication service	0,6070	0,0448	1,58	3,77	50,02	25,99	8,86	9,77
J - Financial intermediation services	0,4408	0,0121	2,41	0,00	22,62	59,46	9,42	6,09
K - Real estate, renting and business services	0,4537	0,0278	2,11	1,30	19,56	34,79	32,03	10,22
L - Public administration and defence services	0,3462	0,0382	12,01	0,00	38,03	29,32	2,11	18,53
M - Education services	0,1762	0,0277	3,15	0,00	19,46	38,60	23,90	14,89
N - Health and social services	0,3591	0,0450	0,96	0,00	11,52	38,77	34,30	14,45
OPQ - Other services	0,5573	0,0502	5,99	0,00	21,73	45,74	18,27	8,26
Total	0,6075	0,1011	7,78	22,46	11,04	32,78	22,15	3,78

Table 8

Leontief multipliers, year 2000

(Total consumption coefficients)

CPA classification	*goods and services together*	*energy commodities together*	*of which (%)*						*Share in total energy consumptin coef.*	
			coal, coke uranium	*crude petroleum*	*refined petroleum prod.*	*electrical energy*	*gas*	*steam and hot water*	*direct coef. %*	*indirect coef. %*
A,B - Products of agriculture, hunting, forestry ar	1,5422	0,2417	5,47	20,10	22,26	31,11	17,47	3,58	22,7	77,3
CA - Coal and lignit, peat, crude petroleum and r	1,0875	0,2451	6,80	11,27	10,01	39,73	27,65	4,55	33,6	66,4
CB - Metal ores and other mining and quarrying p	1,7026	0,4520	5,99	9,25	9,69	41,97	30,52	2,57	34,8	65,2
DA - Food products,beverages and tobacco	1,8978	0,2249	5,89	15,19	15,53	35,20	24,38	3,81	15,1	84,9
DB - Textilies and textile products	1,2738	0,1892	5,70	11,36	8,13	39,68	30,59	4,53	22,1	77,9
DC - Leather and leather products	1,1336	0,1261	5,78	13,87	9,29	39,40	23,54	8,12	16,3	83,7
DD - Wood and wood products	1,5803	0,1947	6,10	14,77	14,40	39,75	20,95	4,02	16,3	83,7
DE - Pulp, paper and paper products, recorded n	1,7356	0,2403	10,50	11,74	8,82	40,08	21,95	6,90	21,0	79,0
DF - Coke, refined petroleum products and nucle	1,8163	0,9467	2,80	72,11	7,12	10,59	6,40	0,98	73,3	26,7
DG - Chemicals, chemical products and man-ma	1,8518	0,6009	5,53	38,70	5,85	25,42	21,47	3,04	41,9	58,1
DH - Ruber and plastic products	1,8610	0,2963	6,84	19,61	8,31	36,08	24,29	4,87	14,1	85,9
DI - Other non methallic mineral products	1,7541	0,4105	9,86	9,31	8,00	37,02	32,69	3,12	30,3	69,7
DJ - Basic metals and fabricated metal products	2,1008	0,3935	26,90	13,29	6,43	32,94	17,95	2,48	25,7	74,3
DK - Machinery and equipment n.e.c.	1,9224	0,2389	14,26	12,27	8,78	37,99	22,31	4,39	14,1	85,9
DL - Electrical and optical equipment	1,7791	0,1895	12,92	13,90	9,96	36,80	22,37	4,05	9,9	90,1
DM - Transport equipment	2,5939	0,1823	11,97	12,79	10,01	38,31	22,74	4,19	5,5	94,5
DN - Other manufactured goods n.e.c.	1,8045	0,1956	11,08	14,13	11,06	38,22	21,42	4,09	10,3	89,7
D - Manufactured products together	1,7932	0,3164	8,96	29,36	8,50	29,90	19,90	3,39	37,6	62,4
E - Electrical energy, gas, steam and hot water	2,0559	1,0506	6,44	3,75	3,46	46,19	36,88	3,28	47,2	52,8
F - Construction work	1,6282	0,1972	9,44	12,85	12,56	35,91	25,66	3,58	13,3	86,7
G - Wholesale and retail trade services	1,3940	0,1635	6,44	15,87	17,34	35,00	21,34	4,01	17,6	82,4
H - Hotel and restaurant services	1,6150	0,2347	4,95	11,76	13,65	42,16	22,97	4,50	24,6	75,4
I - Transport, storage and communication service	1,4610	0,2045	5,62	16,84	20,15	32,23	19,82	5,36	21,9	78,1
J - Financial intermediation services	0,9563	0,0815	6,05	12,02	13,70	40,64	22,60	4,99	14,9	85,1
K - Real estate, renting and business services	1,0575	0,1301	6,60	11,80	12,08	36,43	27,60	5,50	21,4	78,6
L - Public administration and defence services	0,8426	0,1329	8,13	14,87	18,39	32,99	17,50	8,13	28,7	71,3
M - Education services	0,4500	0,0874	5,51	10,66	12,03	38,19	26,39	7,22	31,7	68,3
N - Health and social services	0,9389	0,1988	5,00	17,04	8,08	35,53	28,41	5,94	22,7	77,3
OPQ - Other services	1,3605	0,2046	6,49	11,35	12,84	39,85	24,35	5,12	24,5	75,5
Total	1,5428	0,2876	7,77	20,89	9,50	34,45	23,64	3,75	35,2	64,8

Table 9
Indirect consumption coefficients, year 2000

CPA classification	goods and services together	energy commodities together	of which (%)					
			coal, coke uranium	crude petroleum	refined petroleum prod	electrical energy	gas	steam and hot water
A,B - Products of agriculture, hunting, forestry and fishing	0,9496	0,1869	5,89	25,99	13,54	30,79	20,52	3,26
CA - Coal and lignit, peat, crude petroleum and natural gas	0,6389	0,1627	7,72	14,02	7,52	38,76	28,30	3,68
CB - Metal ores and other mining and quarrying products	1,0700	0,2945	7,80	14,20	7,02	38,60	29,10	3,28
DA - Food products,beverages and tobacco	1,1710	0,1910	6,58	17,88	14,15	34,56	23,03	3,80
DB - Textilies and textile products	0,7497	0,1474	6,87	14,59	8,20	38,03	28,42	3,89
DC - Leather and leather products	0,6479	0,1056	6,78	16,57	9,43	36,91	25,32	4,98
DD - Wood and wood products	0,9630	0,1629	7,03	17,65	12,90	35,69	23,00	3,72
DE - Pulp, paper and paper products, recorded media	1,0685	0,1899	8,08	14,86	9,31	37,89	24,98	4,88
DF - Coke, refined petroleum products and nuclear fuel	1,0045	0,2532	7,55	22,57	8,89	33,93	23,43	3,62
DG - Chemicals, chemical products and man-made fibres	1,1473	0,3492	6,46	25,45	6,34	32,81	25,65	3,30
DH - Ruber and plastic products	1,1675	0,2545	7,92	22,78	7,72	33,37	24,52	3,68
DI - Other non methallic mineral products	1,1038	0,2861	8,68	13,35	7,30	38,25	29,13	3,28
DJ - Basic metals and fabricated metal products	1,3552	0,2923	16,35	17,89	7,38	33,79	21,78	2,82
DK - Machinery and equipment n.e.c.	1,2396	0,2052	15,13	14,27	8,23	35,93	22,93	3,51
DL - Electrical and optical equipment	1,1177	0,1708	13,93	15,42	9,02	35,29	22,75	3,59
DM - Transport equipment	1,7767	0,1723	12,41	13,53	9,98	37,18	22,84	4,06
DN - Other manufactured goods n.e.c.	1,1193	0,1755	12,14	15,49	10,02	36,07	22,62	3,67
D - Manufactured products together	1,0754	0,1974	7,48	14,68	9,28	37,81	26,56	4,19
E - Electrical energy, gas, steam and hot water	1,3237	0,5552	6,59	6,93	4,36	44,12	34,68	3,31
F - Construction work	1,0047	0,1710	10,34	14,81	9,82	35,78	25,76	3,49
G - Wholesale and retail trade services	0,8244	0,1347	7,50	19,26	11,84	34,06	23,25	4,10
H - Hotel and restaurant services	0,9710	0,1769	6,32	15,60	11,34	36,81	25,93	4,00
I - Transport, storage and communication services	0,8539	0,1597	6,75	20,50	11,76	33,98	22,89	4,12
J - Financial intermediation services	0,5154	0,0693	6,69	14,12	12,14	37,34	24,91	4,79
K - Real estate, renting and business services	0,6038	0,1023	7,82	14,65	10,05	36,87	26,39	4,21
L - Public administration and defence services	0,4964	0,0948	6,56	20,86	10,48	34,46	23,70	3,93
M - Education services	0,2738	0,0597	6,60	15,61	8,57	38,01	27,55	3,66
N - Health and social services	0,5798	0,1537	6,19	22,03	7,07	34,58	26,69	3,45
OPQ - Other services	0,8031	0,1544	6,65	15,04	9,95	37,94	26,32	4,10
Total	0,9352	0,1865	7,77	20,04	8,67	35,36	24,44	3,73

4.2 Coefficients of energy consumption of selected products

The direct and indirect energy consumption of produced commodities will be analysed now in more details.

The output produced by manufacturing is especially material-intensive. The share of intermediate consumption in output represents even 72% and the share of value added forms only 28%. The direct energy inputs contribute to the output by 11,9%. The highest share in the direct energy inputs is recorded in case of consumption of petroleum (53,7%), followed by the electricity consumption (16,8%), and the consumption of coal and coke (11,4%). The indirect consumption contributes to the total energy intensity of manufacturing by 62,4%, what is less than the average for the whole.

Mainly the following items belong among the products with ***the above-average energy*** intensity: petroleum products, chemical products and man-made fibres, non-metallic products, metal products, with ***the coefficient of total energy consumption higher than 0,30***, i.e. for the production of 1 SKK of output intended for final use of these commodities, in the entire economy it is necessary to consume more than 0,30 SKK of energy inputs at the average (table 8).

From the products of manufacturing the most energy intensive is the production of *petroleum products,* with the *coefficient of total energy consumption* being 0,9467, to which the direct energy consumption contributes by as much as 73% and indirect energy consumption 27%.
The direct energy inputs represent almost 69% from the value of output. The highest share in this consumption (90%) has crude petroleum, which is entirely imported.

Other products of manufacturing marked by a high energy intensity are *chemical products and man-made fibres.* Coefficient of total energy consumption is at the level of 0,6009, to which the direct energy inputs contribute by 42% and indirect by 58%.
The highest share in the direct energy inputs is recorded in case of crude petroleum consumption and consumption of petroleum products (62%), which are the main materials for the production of man-made fibres and other chemical products. The consumption of both, electricity and gas represents 15-16%.
The highest share in indirect energy inputs has been inquired in case of electricity (33%), together with the consumption of petroleum and petroleum products (31,8%), followed by the gas consumption (25,6%).

The production of *non-metallic products* ranks as the third one among the highest energy-intensive productions with the total coefficient being 0,4105, to which the direct energy inputs contribute by 30% and indirect 70%.
The direct energy inputs represent 0,1244 SKK from the 1 SKK of gross output. In the direct energy consumption the highest share has the gas consumption (40,9%) and electricity consumption (34,2%).
The highest share in the indirect energy consumption was generated by electricity (38%), gas (29%), petroleum and petroleum products (20,6%).

The above-average energy intensity is recorded also in case of *production of basic metals and fabricated metal products*, with the total coefficient of 0,3935, to which the direct energy inputs contribute by 25,7%, indirect 74,3%.
The production of metal and metal products is dependent mainly on the import of black coal being used for the production of coke, which is furthermore used for the production of metals. Therefore the direct energy consumption in this production is formed by the consumption of black coal and coke amounting to 57%. The electricity consumption amounts to another 31% and the consumption of gas represents 7%. The direct energy inputs together represents approximately 10% from the value of output.

The indirect energy consumption is created mainly by the electricity (33,8%), gas (21,8%), petroleum and petroleum products (25,2%), and coal and coke (16%), which were consumed in previous production processes.

The second group includes products, the coefficient of total energy consumption of which is lower than the average, however, is ***higher than the level of 0,20***. The following products belong here: rubber and plastic products, pulp and paper products, machinery and equipment, and food, beverage and tobacco products. Those are products with relatively low direct energy intensity (in scope of 3-6% from the value of production) and with the high share of indirect consumption representing in the total energy intensity 80-86%.

The coefficient of total energy consumption in the production of *rubber and plastic products* is 0,2963, in which direct consumption represents 14% and indirect consumption 86%. This production uses from direct energy inputs mainly the electric power (52,7%) and gas (22,9%). The consumption of petroleum products, which are inevitable for the production of rubber and plastics, is also significant (11,9%). The direct energy consumption represents in total 4,2% from the gross value of production.

As the production of *pulp and paper products* is concerned, the total energy consumption is characterised by the coefficient of 0,2403. The direct consumption contributes to the total energy intensity by 21% and indirect consumption by 79%. The highest share in the direct energy inputs is formed by the electric power (48,3%), followed by consumption of coal (19,7%), heat consumption (14,5%) and the consumption of petroleum products (7%). The direct energy inputs represent approximately 5% from the value of gross output.

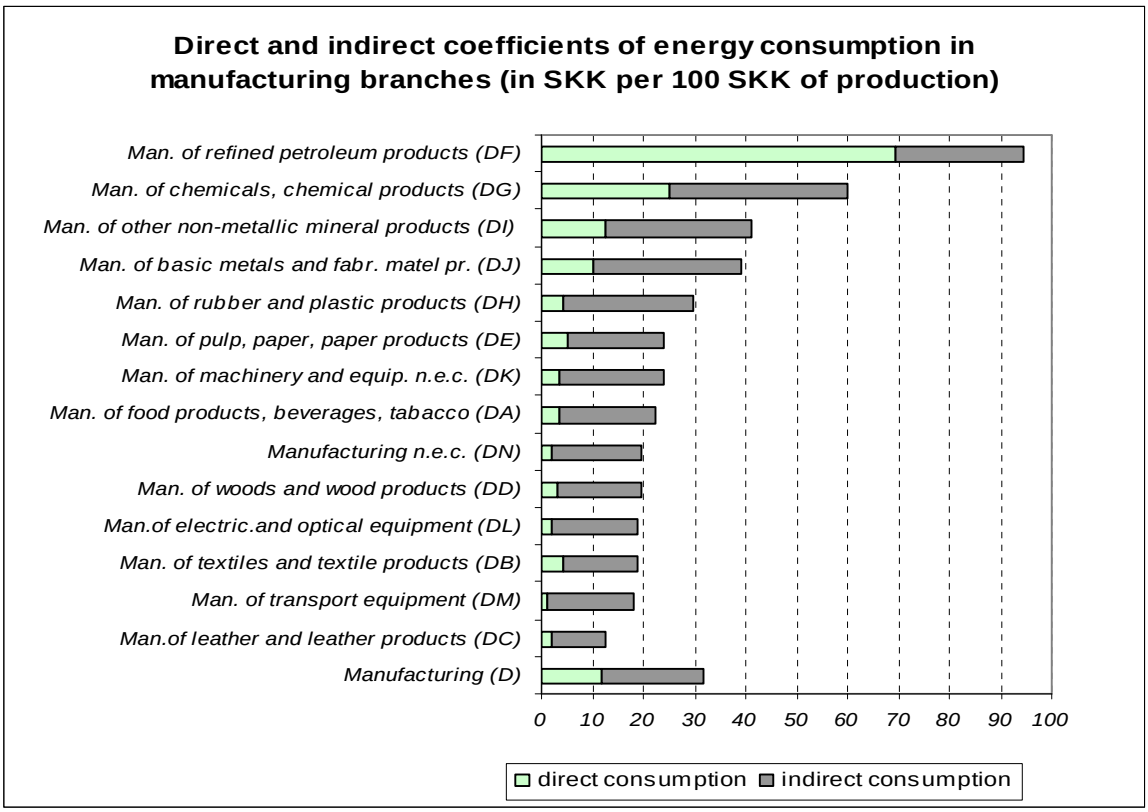
Regarding the total energy inputs in production, *machineries and equipments* are ranked among the products with under average energy consumption (0,2389), in which direct consumption represents 14% and indirect 86%. About 50,5% of direct consumption is represented by electricity. Indirect energy consumption depends on the energy intensity of other products necessary for production of machineries, mainly on the consumption of electricity (35,9%), gas (22,9%), but it depends also on the consumption of coal and coke (15%) and of petroleum and petroleum products (22,5%).

For the production of *food, beverage and tobacco products* the coefficient of total energy consumption is 0,2249. The direct consumption contributes to the total energy intensity by 15% and indirect consumption by 85%.
In this production several petroleum products are used (such as furnace oils), which represent even 23% from the direct energy consumption. However, electricity and gas record the highest shares in direct energy consumption (38,8% and 32% respectively). The direct energy consumption represents 3,4% from the value of production of these commodities.

The third group is represented by products with the lowest energy intensity, i.e. ***up to 0,20 SKK*** for the production of one unit of output intended for final use. Those are: other manufacturing products, wood and products made from wood, electrical and optical equipments, textiles and textile products, transport equipment, leather and leather products; of which the highest direct energy consumption is recorded in case of textiles and textile products (4,2% from the value of production), followed by wood and products made from wood (3,2%). The direct energy consumption of other products is lower than 2% from the value of gross output. The highest indirect energy consumption is evidenced in transport equipments, electrical and optical equipments and manufacturing n.e.c (90-95% from the total energy intensity of the relevant production).

Relations between the direct and indirect energy consumption of products being produced within manufacturing can be illustrated also by the Figure 11.

Figure 11



As far as products out of the manufacturing boundary are concerned, let's have a more detailed look now on the energy intensity of agricultural goods, production of electricity, gas and water supply, transport services and construction works.

The total energy consumption coefficient of *agricultural products* is 0,2417, what is under the average of the economy. The share of direct consumption is 23% and the ratio related to indirect consumption is 77%.
The direct energy consumption, which is by more than a half generated by the consumption of petroleum products, represents approximately 5,5% from the value of gross output.
As compared to other goods and services, the indirect energy consumption in agriculture is at the average level. The ratio of petroleum and petroleum products is the highest (39,5%), electricity and gas represent together 51%.

Transport services (including storage and communication services) are less energy intensive than the agricultural products, as the coefficient of total energy consumption represents the value of 0,2045. The share of direct energy consumption in total consumption is about 22% and indirect consumption 78%.
The direct energy consumption, which is generated mainly by the consumption of crude petroleum and petroleum products (54%), represents approximately 4,5% from the value of gross output. The highest share in the indirect consumption has electricity, petroleum and petroleum products (34% and 32% respectively).

The coefficient of total energy consumption in the *construction works* is similar as that in the transport services, but the share of direct energy consumption is lower, about

13%. In addition to the consumption of electricity and gas, it is formed mainly by the consumption of petroleum products (30,4% from the direct consumption), such as petroleum and diesel. The indirect consumption contributes to the total energy intensity of production by 87% and is prevailingly formed by the consumption of electricity (35,8%), gas (25,8%) and by the consumption of petroleum and petroleum products (24,6%).

The *production of electricity, gas and water* itself is highly intensive mainly on direct energy inputs, which represent nearly 50% from the value of production. This production is mostly intensive on the electricity (48,5%), followed by the gas (39,3%) and coal (6,3%). The total energy intensity of this commodity group represents the value of 1,0506, what means that for the supply of 1 unit production of electricity, gas and water intended for final use, the amount of 1,0506 SKK of energy inputs has to be produced and/or incurred in the entire economy.

In conclusion it can be said that:

- with the decreasing total energy intensity of output in manufacturing, the share of indirect consumption is increasing in case of particular products,
- the share of direct energy consumption is higher in case of products, within the production of which the non-processed raw stocks and materials are used,
- the share of direct energy consumption is lower in case of products, within production of which the already processed goods and semi-finished goods are used,
- high energy intensity of primary production essentially influences the total energy intensity of particular products.

5. Conclusion

The paper has focused on the analysis of energy consumption in the Slovak economy by using value indicators as well as physical indicators. However, the results obtained are to a high extent influenced by the imprecision of data used and/or methodological differences, which have to be solved in the future. For a deeper analysis the more detailed breakdown of economic branches, mainly branches of manufacturing, should be used.

Despite all the above-mentioned facts the analysis has pointed out the basic relations and links in the economic branches in connection to consumption of energy commodities. To summarise, once again the main conclusions from particular parts of this paper will be reiterated below.

From the analysis of branch energy consumption of the Slovak economy resulted that the specific energy consumption is at the average higher in the branches of manufacturing as compared to other economic branches (except for the branch (E)-electricity, gas and water supply). The production of manufacturing, the share of which in the total energy consumption of all branches is 40-60%, contributes to the value added approximately only by one quarter. On the contrary, services, the share of which in the total energy consumption is 8-11%, contribute to the produced value added and to employment by 50%. From the energy intensity standpoint, construction seems to be similarly effective, i.e. it contributes to the value added and

to employment four times more as compared to its share in the energy consumption. Both, agriculture (A,B) and transport (I) contribute to the value added of the economy, and to employment, only slightly higher as compared to their share in the energy consumption.

The manufacturing branches can be broken down into approximately three groups:

- branches with the high share in the energy consumption and several times lower contribution to the value added: here belongs mainly the manufacture of coke, refined petroleum products and nuclear fuel (DF), which, at the same time, contributes to the employment in industrial production by the lowest ratio. If the only production of basic metals is taken into account, it can also be classified here;
- branches, the share of which in the energy consumption in manufacturing is nearly the same as their contribution to the value added; those are the following branches: (DG) – manufacture of chemicals and chemical products, (DI) – manufacture of non-metallic mineral products, (DE) – manufacture of pulp, paper and paper products. Their contribution to employment is only a bit lower as their contribution to value added;
- branches, the contribution of which to the value added is two times higher than their share in the energy consumption: in question are mainly the branches of machinery, electrical and transport equipment (DM), (DK), (DL), light industry branches (production of textiles and textile products (DB), leather production (DC), food, beverage and tobacco production (DA) and production of rubber and plastic products (DH). Their contribution to employment is also several times higher than their share in the energy consumption.

The higher specific energy consumption is recorded in those branches, which process the original raw materials. While in branches where already processed semi-finished products are used, the specific energy consumption is decreasing.

Based on the analysis of several indicators, certain tendencies can be identified in industrial production:

- branches with the high share in the energy consumption contribute relatively less to the value added and employment
- branches with the low share in energy consumption contribute relatively more to the value added and employment
- the high level of specific energy consumption of the given branch tends to be linked to lower coefficients of labour inputs.

The analysis of total energy intensity of production has pointed out the amount of energy inputs being bounded within the production of particular products. Although the results haven't been compared with other countries, it can be said that:

- the high total energy consumption of goods within the production of which the non-processed materials are used is caused mainly by the high direct energy consumption
- in case of products with the average and lower total energy consumption the indirect energy consumption is high, what is influenced by a high energy intensity of primary production.

In conclusion the comparison of consumption of primary energy resources in the SR with the consumption in EU 15 member countries and with selected countries will be presented. Data from Eurostat have been used.[2] According to the consumption intensity of primary resources (i.e. consumption of coal, electricity, oil, natural gas and renewable energy resources), which was calculated as the share of energy consumption in GDP at constant prices of 1995 in EURO, the energy consumption in the SR is nearly 5 times higher than in the EU15 countries; the similar situation holds also for the Czech Republic (see table 10).

Table 10
Comparison of consumption of primary energy resources with EU15 and other countries

	EU15	Slovak Republic	Czech Republic	Poland	Hungary	Finland
Consumption of primary energy resources, 1000 TOE	1 455 295	16 463	40 103	90 194	24 941	32 508
Consumption/GDP* (v KGOE/1000 EURO)	193	934	948	647	600	261
Comparison with EU15 (%)	1,0	4,8	4,9	3,4	3,1	1,4
GDP, current prices, mill. EURO	8 571 003,3	21 925,7	60 396,5	180 601,3	50 654,9	130 145,0
GDP in mill. PPS	8 204 408,4	51 114,2	131 597,3	349 704,9	107 881,5	116 878,3
Consumption/GDP in PPS (v KGOE/1000 EURO)	177,4	322,1	304,7	257,9	231,2	278,1
Comparison with EU15 (%)	1,0	1,8	1,7	1,5	1,3	1,6

**GDP in constant prices of year 1995*
TOE: tons of oil equivalent
Purchasing Power Standard

However, this indicator is not entirely suitable for the comparison of energy consumption in the EU countries. On the one hand, the total level of GDP in the SR (in 2000) was lower than in the EU countries, while in export still less sophisticated goods prevailed, i.e. with the lower share of value added (although the situation has recently been changed) and the share of services also did not reach the parameters of western countries. On the other hand the purchasing power of population is higher than the level of final consumption of households involved in the GDP, thus, it is more realistic to compare consumption of energy calculated in relation to GDP at current prices and in purchasing power parities.

Based on this indicator the energy consumption in the SR is approximately 1,8 times higher than the average of EU 15 countries. For illustration***,*** in Finland it is 1,6 times higher, in the Czech Republic 1,7 times, in Poland 1,5 times and in Hungary 1,3 times higher than the average of EU 15 countries.

[2] Presented on Eurostat web pages.

References:

[1] Mäenpää,I.: The Economy, Energy and Air Emissions. Working paper No. 2/1998/B/2. Copyright European Commission 1998

[2] Energetics 2000. Publication of SOSR . No: 510-0718/2001. Bratislava 2001.

[3] Integrated Environmental and Economic Accounting. Handbook of National Accounting. United Nations New York 1993.

[4] Hajnovicova,V.: Construction of social accounting matrix in the Slovak Republic. Working paper 26-2004-A/5. INFOSTAT. Bratislava 2004.

[5] Hajnovicova, V.: Construction of Energy accounts in the Slovak Republic. Working paper 27-2004-A/6. INFOSTAT. Bratislava 2004.

[6] Hajnovicova, V.: The analysis of the energy consumption in the economy of the SR. Working papers. Institute for Forecasting SAS. Bratislava 2004.

[7] The supply and use tables by commodities and industries in the SR for the year 2000. SOSR. Bratislava 2004.

[8] Hajnovicova,V., Lapisakova,J.: Input-output and SAM multipliers analysis: The Slovak case. In: XIV. Conference on input-output techniques. Montreal. Canada, 2002

[9] Hajnovicova,V., Lapisakova,J.: The impact of internal and external disparities on structural changes in the Slovak economy. In: XIII. International Conference on input/output techniques, Macerata. Italy 2000.