

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND  
RATIONAL ENERGY UTILIZATION**

***SHARE OF ENERGY COSTS IN PRODUCTION COSTS***

OPET contract

***BUCHAREST, 2001***

## **1. Introduction**

The final objective of the study is to establish the share of the energy cost by industrial activities. In order to implement this objective it was necessary to gather the following data about the:

- total energy consumption,
- electricity consumption,
- heat consumption,
- values of industrial production,
- average energy tariffs.

The data have been taken over from the “*Romanian Statistic Yearbook*” and the “*Energy Balance Sheet of the Final Energy System*” the latest editions – 2000, edited by the “*National Statistics and Economic Studies Institute*” and do not cover tariffs.

The data refers to the industrial activities carried out in Romania in 1999. The values of the energy cost share within the production cost which have been obtained will improve / update the data base for Renewable Energy Sources and Rational Energy Utilization.

## **2. Reference Terms**

*Industrial production:* the value of manufactured finished products, delivered or which are to be delivered, semifabs delivered from own production, the value of processing raw materials and the customers materials, works (services) of industrials nature rendered to third parties, as well as the difference of unfinished production and semifabs stock.

*Physical production:* includes total manufactured quantities, including those obtained and consumed within the same enterprise.

*Energy balance sheet:* an instrument enabling us to determine the efficiency of utilizing all the energy resources, pointing out the changes in the structure of resources and destinations, providing the elements necessary for calculating the degree of independence and of other quality indicators, in order to perform analyses and comparisons within a given context.

*Final energy consumption:* all energy consumed in various sectors of activity in order to produce material goods and services. There are excluded quantities used for non-energy purpose and quantities used to produce other fuels. The consumption in the energy sector and in transport and distribution losses is not included.

*Final consumer:* any physical or juridical person consuming energy on the basis of a contract and whose energy utilizing installations are connected to the supplier’s installations.

*Industrial consumer:* the consumer utilizing energy to quarry raw materials, manufacture materials or process raw materials, materials or other agricultural products to obtain means of production or consumption goods. They are represented by: shipyards, construction works, pumping stations, including irrigation ones, railway, road, water and air transportation units a.s.o.

*Utilizing installation:* all installations belonging to the consumer located downstream against the point of delimitation.

*Power tax:* a fixed amount of money, established through tariff by contracted or absorbed power unit during a certain period of time – month or year.

*Value of construction work:* all the works in the execution projects fully or partially carried out, that the beneficiary agrees to pay for and established in current estimate prices.

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

*Conventional fuel:* fuel with 29.307 kJ/kg net calorific value.

### ***3. Industrial production by industrial activities in 1999***

The value of the total industrial production represents the value of the physical production manufactured during the analysed period of time – namely 1999 – regardless of its destination. This indicator points out the internal resources of economy on the whole and by industrial activities and the way they are utilized.

By industrial activities, the value of Romanian industrial production was calculated by means of the current prices corresponding to the period of time – 1999 – and is presented in table 1.

Production per total and by main destinations (delivered, productive domestic consumption or stock) was totally based on average prices registered each month, price obtained as ratio between value of delivered production for each positions in the nomenclature of industrial products “PRODIND” by representative series.

The products assure a representatively degree of 78,3 % per total industry.

Table 1.

No.	Activity	Industrial production	Share within
		Year 1999 billion lei current prices	TOTAL %
1.	Metalliferous ores quarrying	1106.0	0.40
2.	Other extractive activities	1717.9	0.63
3.	Food, beverages and tobacco	61413.4	22.36
4.	Textile and textile products	8792.8	3.20
5.	Textile, fur and leather wearing apparel	13855.5	5.04
6.	Leather goods and footwear	5256.8	1.91
7.	Wood processing (excluding furniture)	10046.5	3.66
8.	Pulp, paper and cardboard	4177.2	1.52
9.	Publishing houses, polygraphy and records reproduction on supports	6067.4	2.21
10.	Chemistry and synthetic and man made fibres	22852.2	8.32
11.	Rubber and plastics processing	7003.6	2.55
12.	Other nonmetallic mineral products	13601.6	4.95
13.	Metallurgy	35270.3	12.84
14.	Metallic construction machinery and equipment	25754.5	9.37
15.	Furniture and other nonclassified activities	9320.9	3.39
16.	Waste recovering	1528.5	0.56
17.	Water collection, treatment and distribution	4702.2	1.71
18.	Construction	1528.5	15.36
	<b>TOTAL industry</b>	<b>4702.2</b>	<b>100.00</b>

### ***4. Presentation of the final energy consumption share within the energy balance sheet in 1999***

In industry the activities to be studied are the following:

- extractive, excluding energetic products extraction;
- manufacturing, excluding oil processing, coal coking and nuclear combustible treatment;
- water resources administration, water collection, treatment and distribution;
- construction.

The energy balance sheet is performed annually based on data gathered through statistic research studies (production, consumption at the economy level) and of the data provided by C.N. Transelectrica.

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

Each energy carriers transformation into conventional units requires setting up some equivalence coefficients. These coefficients are set up based on their net calorific value (NCV).

Therefore, electricity and heat were expressed by means of equivalent conventional units based on the energy potential by each energy type.

The conventional unit utilized in this study is *tce* = tonne of coal equivalent.

The formulae utilized for establishing the equivalence were:

➤ 1 MWh = 0.123 tcc = 0.086 tep = 3.6 GJ

➤ 1 Gcal = 0.143 tcc = 0.1 tep = 4.187 GJ

where *tep* = tonne of oil equivalent.

### a) Energy consumption

Energy consumption by industrial activities is presented in table 2.

At the same time, the table presents its share within the total energy consumption.

The energy consumption given below includes:

- electricity;
- heat;
- other energy resources: coals, coke, gases, oil products by different types, other energy sources than the conventional ones. (see chapter 5, p.c ).

Table 2.

No.	Activity	Energy consumption		Share within TOTAL
		thousand tce	TJ	%
1.	Metalliferous ores quarrying	77	2243	0.62
2.	Other extractive activities	68	2005	0.55
3.	Food, beverages and tabacco	881	25831	7.14
4.	Textile and textile products	236	6927	1.91
5.	Textile, fur and leather wearing apparel	142	4165	1.15
6.	Leather goods and footwear	51	1490	0.41
7.	Wood processing (excluding furniture)	231	6740	1.87
8.	Pulp, paper and cardboard	373	10921	3.02
9.	Publishing houses, polygraphy and records reproduction on supports	6	203	0.05
10.	Chemistry and synthetic and man made fibres	2156	63189	17.47
11.	Rubber and plastics processing	182	5313	1.47
12.	Other nonmetallic mineral products	1592	46640	12.89
13.	Metallurgy	3898	114180	31.57
14.	Metallic construction machinery and equipment	1600	46899	12.96
15.	Furniture and other nonclassified activities	233	6810	1.89
16.	Waste recovering	3	83	0.02
17.	Water collection, treatment and distribution	212	6229	1.72
18.	Construction	403	11843	3.26
	<b>TOTAL industry</b>	<b>12344</b>	<b>361711</b>	<b>100.00</b>

The results in table 2 are more suggestively presented in figure 1.

### b) Electricity consumption

Electricity consumption by industrial activities is presented in table 3. The table also presents the share of electricity consumption within the energy consumption by activities.

Table 3.

No.	Activity	Energy consumption	Electricity consumption			Share within energy consumption by activity
		thousand tce	GWh	TJ	thousand tce	%
1.	Metalliferous ores quarrying	77	462	1665	57	74.03
2.	Other extractive activities	68	119	428	14	20.59

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

3.	Food, beverages and tobacco	881	1192	4297	146	16.57
4.	Textile and textile products	236	298	1072	37	15.68
5.	Textile, fur and leather wearing apparel	142	134	482	16	11.27
6.	Leather goods and footwear	51	55	197	7	13.73
7.	Wood processing (excluding furniture)	231	184	662	23	9.96
8.	Pulp, paper and cardboard	373	536	1933	66	17.69
9.	Publishing houses, polygraphy and records reproduction on supports	6	13	46	1	16.66
10.	Chemistry and synthetic and man made fibres	2156	2884	10394	355	16.47
11.	Rubber and plastics processing	182	257	926	32	17.58
12.	Other nonmetallic mineral products	1592	1811	6527	223	14.00
13.	Metallurgy	3898	7346	26475	903	23,17
14.	Metallic construction machinery and equipment	1600	2875	10366	354	22.13
15.	Furniture and other nonclassified activities	233	339	1222	42	18.03
16.	Waste recovering	3	6	23	1	33.33
17.	Water collection, treatment and distribution	212	1250	4504	154	72.64
18.	Construction	403	586	2112	72	17.87
	<b>TOTAL industry</b>	<b>12344</b>	<b>20348</b>	<b>73332</b>	<b>2503</b>	<b>20.28</b>

### c) Heat consumption

Heat consumption by industrial activities is presented in table 4. The table also presents the share of heat consumption within the energy consumption by activities.

The diagramme in fig.4 presents the data of table 4 in the form of shares within the total heat consumption by activities

Table 4.

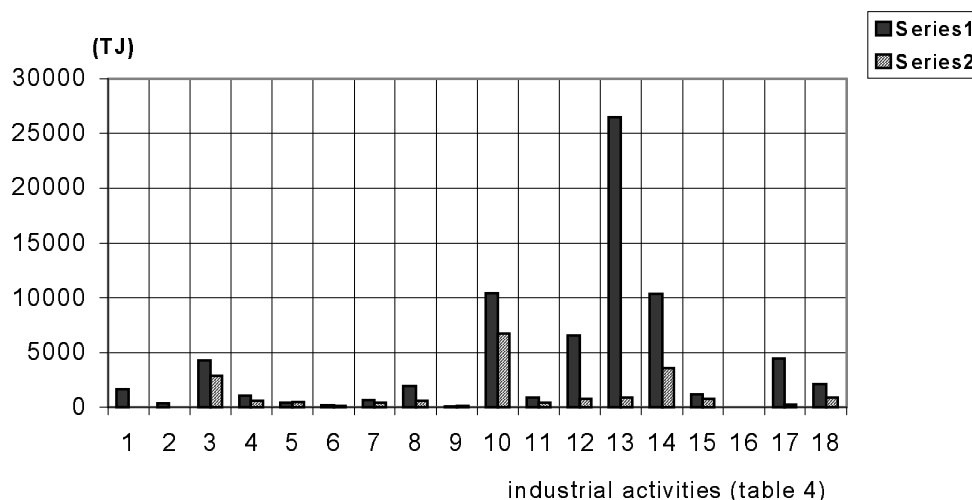
No.	Activity	Energy consumption	Heat consumption			Share within the energy consumption by activity
		TJ	thousand Gcal	thousand tce	TJ	%
1.	Metalliferous ores quarrying	2243	1	0	5	0.22
2.	Other extractive activities	2005	2	0	10	0.49
3.	Food, beverages and tobacco	25831	682	97	2856	11.06
4.	Textile and textile products	6927	157	22	656	2.54
5.	Textile, fur and leather wearing apparel	4165	120	17	502	12.05
6.	Leather goods and footwear	1490	33	5	138	9.26
7.	Wood processing (excluding furniture)	6740	109	16	459	6.81
8.	Pulp, paper and cardboard	10921	151	22	633	5.79
9.	Publishing houses, polygraphy and records reproduction on supports	203	22	3	91	44.83
10.	Chemistry and synthetic and man made fibres	63189	1606	230	6730	10.65
11.	Rubber and plastics processing	5313	116	16	485	9.13
12.	Other nonmetallic mineral products	46640	193	28	810	0.71
13.	Metallurgy	114180	214	31	897	0.79
14.	Metallic construction machinery and equipment	46899	845	121	3540	7.55
15.	Furniture and other nonclassified activities	6810	195	28	819	12.03
16.	Waste recovering	83	2	0	6	7.23

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

17.	Water collection, treatment and distribution	6229	56	8	234	3.76
18.	Construction	11843	224	32	940	7.94
	<b>TOTAL industry</b>	<b>361711</b>	<b>4728</b>	<b>676</b>	<b>19811</b>	<b>5.48</b>

A comparison between electricity (series 1) and heat consumption (series 2) by industrial activities resulting from tables 3 and 4 is presented in figure 5.

**Fig.5**



### 5. The share of energy costs within production costs - tables

#### Source of data:

- Government Decision No. 417/01.10.1998;
- Romanian Official Papers No. 227/21.05.1999, No. 470/30.09.1999;
- S.C.Electrica S.A. – for the average electricity cost supplied to economic agents;
- statistical reports relating to:
  - production and utilization of electricity, heat, fuels and
  - energy equipment structure
- developed by manufacturing, distributing and consuming units within economy;
- papers developed by the specialized offices within the National Statistics Commission for the statistical data relating to: primary and transformed energy generation, imports and exports.

#### a) Share of electricity costs within production cost

The average electricity tariff during 1999 was utilized to calculate the amount of electricity supplied by the National Electricity Company S.A. to its final consumers, the economic agents, respectively. The value taken over by Electrica S.A. and utilized in calculations for the average tariff of electricity supplied to the economic agents was of 606,524 lei/MWh.

The value of electricity consumption and the share of electricity costs within the production value are given below – table 5 - by industrial activities.

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

Table 5.

No.	Activity	Industrial production year 1999	Value of electricity consumption	Share of electricity costs within industrial production
		billion lei current prices	billion lei current prices	%
1.	Metalliferous ores quarrying	1106.0	280.21	25.34
2.	Other extractive activities	1717.9	72.18	4.2
3.	Food, beverages and tobacco	61413.4	722.98	1.18
4.	Textile and textile products	8792.8	180.74	2.06
5.	Textile, fur and leather wearing apparel	13855.5	81.27	0.59
6.	Leather goods and footwear	5256.8	33.36	0.63
7.	Wood processing (excluding furniture)	10046.5	111.6	1.11
8.	Pulp, paper and cardboard	4177.2	325.1	7.78
9.	Publishing houses, polygraphy and records reproduction on supports	6067.4	7.89	0.13
10.	Chemistry and synthetic and man made fibres	22852.2	1749.22	7.65
11.	Rubber and plastics processing	7003.6	155.88	2.23
12.	Other nonmetallic mineral products	13601.6	1098.41	8.08
13.	Metallurgy	35270.3	4455.53	12.63
14.	Metallic construction machinery and equipment	25754.5	1743.76	6.77
15.	Furniture and other nonclassified activities	9320.9	205.61	2.21
16.	Waste recovering	1528.5	3.64	0.24
17.	Water collection, treatment and distribution	4702.2	758.16	16.12
18.	Construction	42184.1	355.42	0.84
	<b>TOTAL industry</b>	<b>274651.4</b>	<b>12340.96</b>	<b>4.49</b>

The results in the table are graphically presented in figure 6.

### ***b) The share of heat costs within the production cost***

The value of the average tariffs for the heat supplied to the economic agents in 1999 was calculated as a weighted average of the four values over 1999. The following average values of the heat prices were considered:

- hot water: 182,457.45 lei/Gcal, for the activities mentioned at points 1, 2, 9, 16, due to the specific activity they develop – considering that the majority of these economic agents are connected to the transmission networks;
- a steam up 19 ata: 197,888.08 lei/Gcal for the rest of activities – considering that most of the economic agents are connected to the cogeneration plant or to the thermal power station.
- for 1 Gcal/h maximum yearly contracted thermal power: 100,338127.8 lei/year.

Graphically, the results in table 6 are also presented in figure 7.

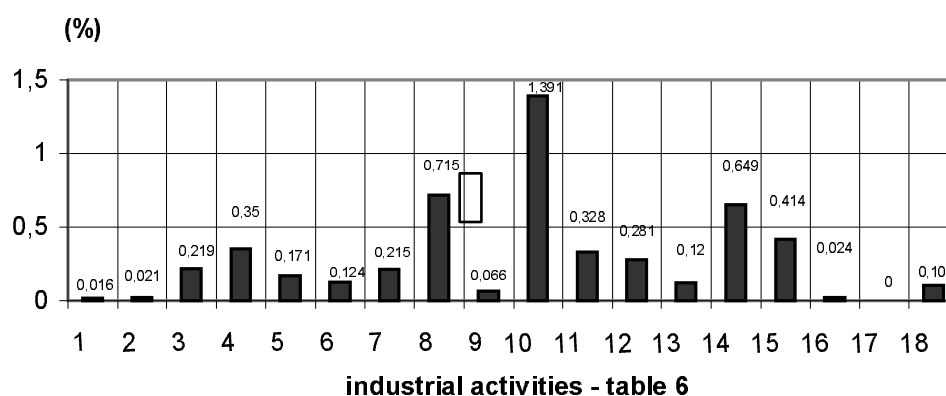
The very low values of the heat costs share within the production value is to be underlined.

Table 6.

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

No.	Activity	Industrial production year 1999	Value of heat consumption	Share of value within industrial production
		billion lei current prices	Billion lei current prices	%
1.	Metalliferous ores quarrying	1106.0	0,182	0.016
2.	Other extractive activities	1717.9	0,365	0.021
3.	Food, beverages and tobacco	61413.4	135,002	0.219
4.	Textile and textile products	8792.8	31,078	0.350
5.	Textile, fur and leather wearing apparel	13855.5	23,754	0.171
6.	Leather goods and footwear	5256.8	6,531	0.124
7.	Wood processing (excluding furniture)	10046.5	21,573	0.215
8.	Pulp, paper and cardboard	4177.2	29,885	0.715
9.	Publishing houses, polygraphy and records reproduction on supports	6067.4	4,014	0.066
10.	Chemistry and synthetic and man made fibres	22852.2	317,850	1.391
11.	Rubber and plastics processing	7003.6	22,958	0.328
12.	Other nonmetallic mineral products	13601.6	38,198	0.281
13.	Metallurgy	35270.3	42,353	0.120
14.	Metallic construction machinery and equipment	25754.5	167,240	0.649
15.	Furniture and other nonclassified activities	9320.9	38,593	0.414
16.	Waste recovering	1528.5	0.365	0.024
17.	Water collection, treatment and distribution	4702.2	11.083	0.2357
18.	Construction	42184.1	44.333	0.105
	<b>TOTAL industry</b>	<b>274651.4</b>	<b>935.357</b>	<b>0.340</b>

Fig.7



**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

**c. Other energy resources**

Besides electricity and heat a total amount of 10,181 thousand tce. from the following energy resources: hard coal, coke and semicoke, lignite, brown coal, firewood (including wood waste), gasoline, kerosene (including white spirit), diesel oil, fuel oil, refinery gas, LPG, other oil products, natural gas, coke oven gas, ballast furnace gas, energy from unconventional sources are used during the production processes of the analyzed industrial activities..

Within the energy balance of 1999, the total values in conventional units, that the above mentioned energy resources add, as well as their share in the total energy consumption are presented in table 6.

As there is no information relating to their average price in 1999, we could not determine the energy cost shares added by them to the production value by industrial activities.

Table 6.

No.	Other energy resources	Energy input	Percentage within total energy consumption
		thousand tce	%
1.	Hard coal	860	6.97
2.	Coke	853	6.91
3.	Steam coal	6	0.05
4.	Other coal	163	1.30
5.	Lignite	161	1.29
6.	Brown coal	2	0.02
7.	Firewood (including wood waste)	319	2.55
8.	Gasoline	79	0.63
9.	Kerosene (including white spirit)	31	0.25
10.	Diesel oil	236	1.89
11.	Fuel oil	866	6.93
12.	Refinery gas	24	0.19
13.	LPG	13	0.11
14.	Other oil products	475	3.80
15.	Natural gas	5376	43.01
16.	Coke oven gas	255	2.04
17.	Blast furnace gas	404	3.23
18.	Other fuel	55	0.44
19.	Energy from unconventional sources	3	0.03
20.	<b>TOTAL</b>	10181	<b>100.00</b>

## 6. Conclusions

a) The paper aims at determining the share of the energy cost within the production cost, by industrial activities.

b) The sources of the data utilized in this paper are:

- the government Decision no. 417/01.10.1998;
- the Romanian Official Papers (Bulletins) no. 227/21.05.1999, no. 470/30.09.1999;
- S.C.Electrica S.A. – for the average tariffs of electricity supplied to the economic agents;
- The Statistical Yearbook of Romania – 2000 – the latest edition;
- The Energy Balance sheet within the Final Energy System – 2000 – the latest edition.

c) The industrial activities covered in this study are:

- extractive, excluding energetic products extraction;
- manufacturing, excluding oil processing, coal coking and nuclear combustible treatment;
- water resources administration, water collection, treatment and distribution;
- construction.

The data from the above mentioned sources cover **78.3 %** of the entire Romanian industry.

d) Chapter 3 presents the annual value of the industrial production by activities; the values were calculated at the current prices during that period of time, 1999 respectively.

From the point of view this indicator, the activities worthy of remark due to their high percentage within the total production were:

- food and food processing, beverages and tobacco: 22.36 %;
- construction: 15.34 %;
- metallurgy / metal processing: 12.84 %.

e) The energy consumption presented in chapter 4 was analysed by its components:

- electricity;
- heat;
- other energy resources.

The following activities required a high energy consumption:

- Metallurgy: 31.57 %,
- Metallic construction, machinery and equipment: 12.96 % and
- Other products made of nonmetallic minerals: 12.90 %.

The results are more suggestively presented in the diagram of fig.1.

From the point of view of electricity consumption by activities – fig.2, the following activities are to be mentioned:

- Metalliferous ores quarrying: 74.03 %;
- Water collection, treatment and distribution: 72.64%.

The diagram in fig.3 presents the data representing their share within the total energy consumption at the level of the entire industry.

The data point out that “Metallurgy” – **36.10 %** - represents an electricity energy intensive consumer.

While waste and recyclable materials recovery is at the opposite pole with a **0.03 %** share.

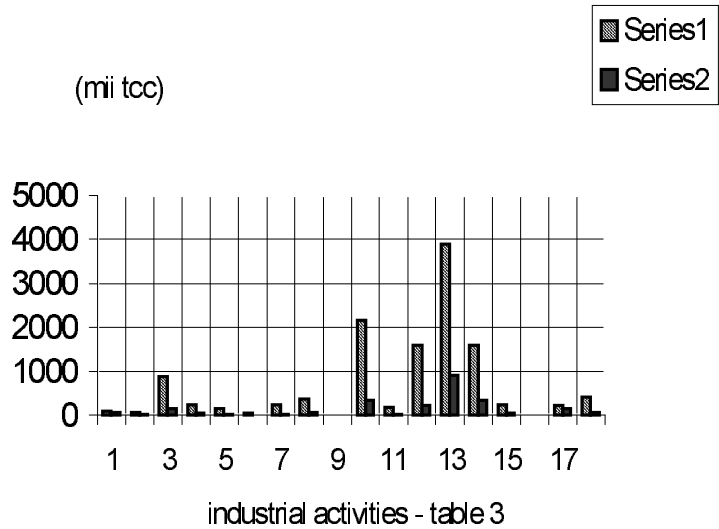
By industrial activities, heat consumption and its share within the total energy consumption are given in table 4.

**Fig.2**

E

noiembrie 2001

**ENERGY UTILIZATION  
TS**



The industrial activities with high percentages are:

- Publishing houses, polygraphs and records reproduction on supports: 44.83%,
- Textile, fur and leather wearing: 12.05 %.

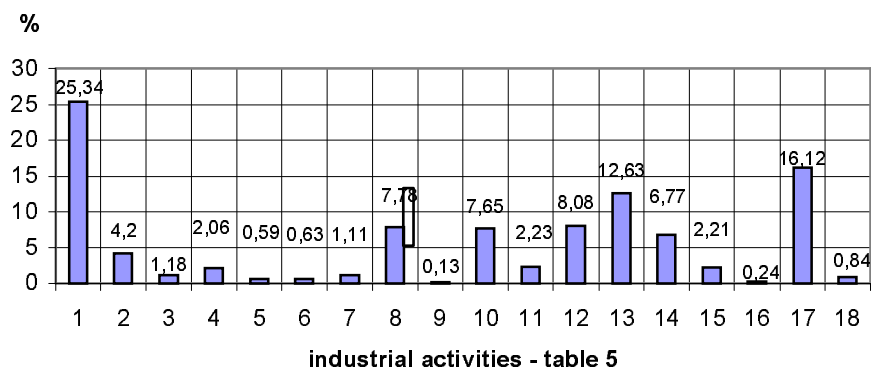
With a low percentage of **0.22 %** the “Metalliferous minerals quarrying“.

f) In determining the energy costs we utilized the average tariff of electricity supplied to the final consumers by the National Electricity Company S.A. to the economic agents, respectively in 1999 which was of 606,524 lei/MWh.

The diagram in figure 6 presents the results obtained. The share of electricity costs within the value of production registered high values in the following sectors:

- Metalliferous ores quarrying: **25.34 %**;
- Water catching, treatment and distribution: **16.12 %**;
- Metallurgy: **12.63 %**.

The mean value of the electricity costs share within production value by the total industrial activity in 1999 amounted to **4.49 %**.

**Fig.6**

**g)** The value of the average tariff of the heat supplied to the economic agents in 1999 was calculated as a weight mean of the four values in 1999 (see chapter 5.b).

We should underline the extremely low values of the heat costs share within the value of production.

Among the activities considered, the following sectors registered the highest values for the heat costs share within the production value:

- Chemistry and synthetic and man made fibres: **1.39 %**;
- Pulp, paper and cardboard: **0.715 %**.

The activity having the least value is Metalliferous minerals quarrying – amounting to 0.016 %.

The average share by total industrial activities is low, representing **0.34 %**.

**h)** In the processes of production of industrial activities analysed in this study, a total of **10,181 thousand tce** representing the energy from the following resources: hard coal, coke and semicoke, lignite, brown coal, firewood (including wood waste), gasoline, kerosene (including white spirit), diesel oil, fuel oil, refinery gas, LPG, other oil products, natural gas, coke oven gas, ballast furnace gas, energy from unconventional sources are also used besides electricity and heat.

The total values in conventional units of the above mentioned energy sources within the energy balance in 1999, as well as the share within the total energy consumption are presented in table 6, chapter 5.c.

We have to underline the high values of:

- natural gases consumption: 43.01 %;
- bituminous coal consumption: 6.97 %.

**i)** As we had no information relating to the average price of the energy resources mentioned in the paragraph h) in 1999, we could not determine the shares of the energy cost they had within the value of production by industrial activities.

**DATA BASE FOR RENEWABLE ENERGY SOURCES AND RATIONAL ENERGY UTILIZATION**  
**SHARE OF ENERGY COSTS IN PRODUCTION COSTS**

Fig.1

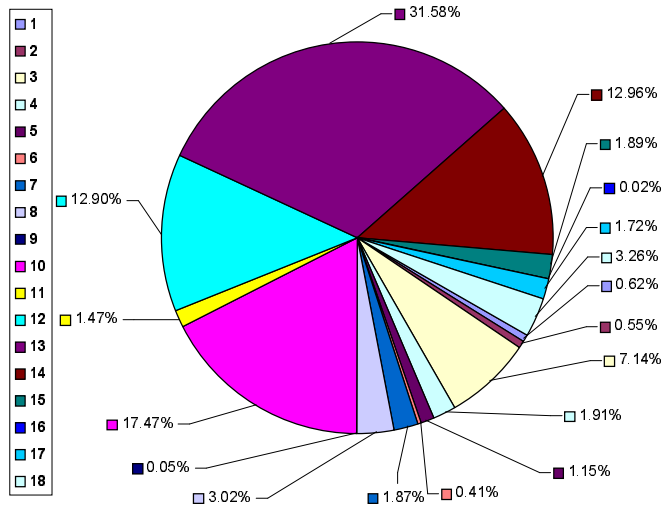


Fig.3

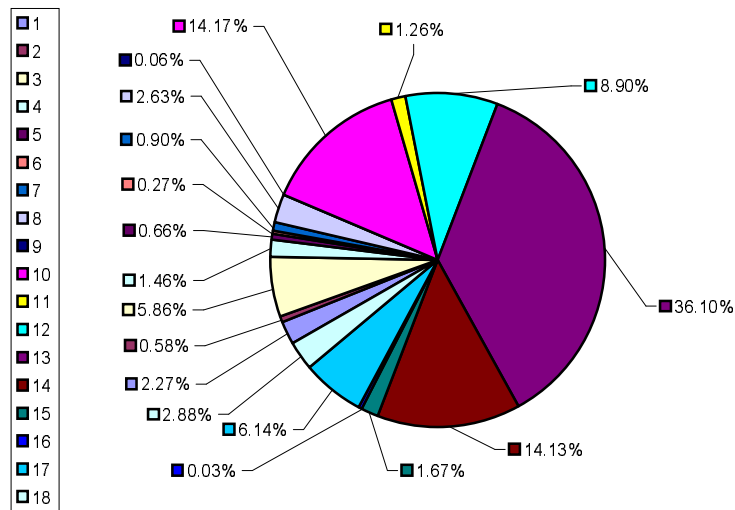


Fig.4

