ANALYSIS OF THE ENERGY SUPPLY FOR INDUSTRIAL CONSUMPTION IN FRG DURING A SELECTED PERIOD OF TIME

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Abstract

Rising raw material costs and a shortage in non-renewable energy sources lead to rising energy expenses. In order to carry out business plans, budgets and forecasts the Business management planning in companies is to remain especially important due to divergences. If the need arises appropriate measures would have to be introduced to remain competitive.

At times of volatile raw material prices, it has become increasingly difficult for enterprises to carry out forward planning. Gone are the times when a country could depend on its own resources and in fluence the domestic price structures. Because the national resources are currently drying up moderate procurement costs today still appear in the energy sector. This is the result of the financial and economic crisis in 2008 which has led to a global economic collaps thus to a declining demand and lower procurement costs for commodities, in particular well non-renewable energy. Nevertheless well-known scientists, politicians as well as analysts predict rising energy prices, should the economie´s the demand pick up again. The international raw material supply particularly non-renewable energy is becoming increasingly precarious.

This diploma thesis covers the structure of the primary energy supply in Germany from 1990 to 2008. It refers particularly to the non-renewable energy sources. Further, it describes for a specially selected period from 1995 to 2008, how the energy consumption developed within single sectors of the economy. Investigations were conducted on carefully selected topics.

JEL Classification: Q31, Q48

Keywords: energy, cost, planning

1. Initial situation

Now it becomes more visible then before, how much the national economy depends on an economic of save and more environment-friendly energy supply. The global demand leads to rising energy prices and thereby burdens the industry. Germany is dependent on energy imports. Oil and natural gas reach Germany from far distant regions. Presently the worldwide energy consumption in higher than 1970 and the important sources are the non-renewable energies oil and natural gas. It is to be assumed that the global energy consumption will further rise but to what degree? The global energy consumption in particular is also driven by the emerging countries such as India, China and Brazil. They have during the recent years achieved a high economic growth rate. During the last few years Germany, has also experienced an increasing dependency on energy supply imports.

Increasing prices in the energy sector are bothering energy consumers. Other contributing factors are the production and net expenses, as well as the state governed interventions. „Energy related questions in Germany and in the European Union as well as in the emerging economic nations are at the center of political discussions. A fully comprehensive and interdisciplinary approach is therefor essential. In the past, such considerations were normally initiated only by energy crises. Present opinions are calling for a substitution of the non-renewable energy sources before they eventually dry up. But the question is, does the nuclear power era arrive, or has the bioenergy time begun? Could the "energy efficiency"1, perhaps solve, the problem? The scheme of the energy policy will have effects on the industry as well as on the consumers, the growth and the quality of life".2 What does this mean for Germany, with regard to the production of energy to be utilized in different sectors of the industry? What positive impacts could arise out of these deliberations? There are good reasons to deal with this topic.

Aim of the work

The aim of this work is, to show companies residing in Germany how energy consumption presents itself with regard to expenses the gross domestic product and the utilization and how they have developed. The selected period refers in detail to the period from 1999 to 2008. For this period all data required is ascribable.

[1] Energy efficiency is a quotient from a use and the energy used for it.

[2] Cf. Defilla, 2007, p. 10.

Pre- and past investigations are also proportionally introduced. They merely serve to indicate the association with this subject. Throughout the industrie single well-chosen sectors have been singled out and are being examined and outlined.

Approach

Within this work stock levels of the energy of the earth as well as the development of the primary energy consumption of the world are shown. In detail, different economic blocks for example, the United States of America, the European Union and emerging countries are being analyzed and featured. For Germany, the supply structures and the final utilization consumption are shown by means of well-chosen examples from 1990 to 2008. Further representations follow relating to electricity production, energy efficiency of the industry and the energy consumption structure of industrial sectors in Germany.

Detailed information which is being analyzed originates from the syndicates energy balances, the government institution of earth sciences and commodities with its publication in 2009, of the Federal Statistical Office of Germany as well as the Federal Office for environment protection and reactor security and the Federal Ministry for Economy and Technology.

In the following chapter the problem of the restricted raw materials availability is being outlined. Statistical examples referring to the non-renewable energy source, the development of energy consumptions over a period from 1971-2002 in the emerging, development, and industrial countries. The problem of the primary energy supply is outlined. Also the development costs in the area of the heating market should indicate the problems of the rising prices. National as well as international statistics about non-renewable energy sources will indicate the dependence of Germany in this area.

2. Problem of limited resources

„Resources are part of nature and are being exploited by mankind. Among them are the mineral commodities which originate from protracted geologic processes. They play today an important role. The best known commodities are for example, oil, and ores. In the business administration, commodities are in general utilized in the manufacturing process. They are being used as auxiliary materials in intermediate products. Since the beginning of the 20th century the raw material consumption has increased tenfold. This is an exponential development. The natural

resources are in the opinion of the community of states endangered, because the exploitation of this raw material progresses very fast. This situation is still aggravated by conflicts and wars".3

Our world is sustained by limited primary energy sources of fossil origin. The demand of particularly non-renewable energy sources and the race for their possession has begun. Accelerated growth above all, of the Asian states in the near past, the situation in the energy sector and the demand for non-renewable energy sources has strongly intensified. The problem is that these commodities will no longer be available at one point in time. In the past various commissions were instructed by the German Bundestag over and over again to examine the raw material energy availability. These investigations were introduced to the public however they found no resonance neither in the community nor in politics. In 1973 the first energy crisis shocked national economies with full force. Up to 1973 no active energy policy was pursued in Germany. In the German national economy the results were clearly felt. In the following chapter the raw material availability in particular the non-renewable energy sources of the world are being shown.

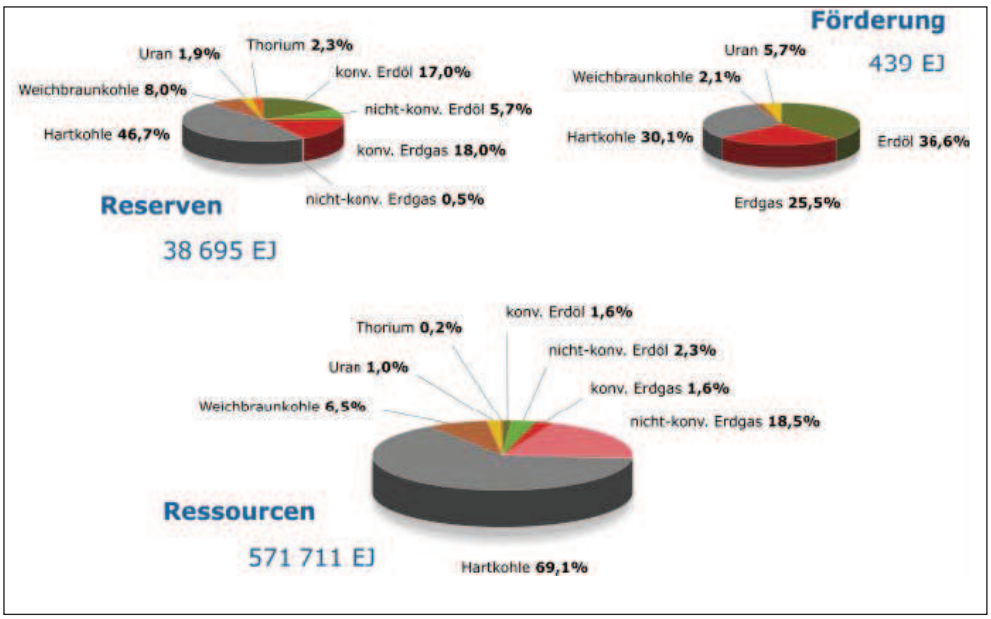
Short overview of the worldwide availability of energy sources

„In 2007 the reserves (Reserven) in non-renewable energy sources totaled of 38.695 Exa joules. Compared to 2001 of 2.200 Exa joules was achieved, particularly due to the soft brown coal, natural gas and oil. Due to a high potential the coal is the dominating energy source. The share amounts to 55%. 22,7% are attributed to oil, and natural gas follows with 18,5%. The nuclear energy has got a share of 4,2%".4 The exploitation lay in the same considered time span at 439 Exa joules. The resources (Ressourcen) in the non-renewable energy sources amount to 571.711 Exa joules. The represents compared to 2007, a share of 1,1%.

[3] Cf. Brockhaus economy, in 2004, p. 498. If the current situation describes in the raw material area and the fact that is fought for commodities also with military means. The security of supply with commodities has become a political security assignment.

4 Cf. Bundesanstalt für Geowissenschaften und Rohstoffe, 2009, p. 11.

Graph number 1: Interests of single non-renewable energy commodities in 2007 in the support, the resources and reserves, source: Bundesanstalt für Geowissenschaften und Rohstoffe (2009), side 11.



Ranking of the reserves in 2007 basis 38.695 Exa joules:

1. Coal 54.7% (21.166 Exa joules)
2. Oil 22.7% (8.784 Exa joules)
3. Natural gas 18.5% (7.159 Exa joules)
4. Nuclear 4.2% (1.625 Exa joules)

Definition: Raw material reserve and raw material resource

The rule does not clearly distinguish between raw material reserves and raw material resources. Because the difference is not entirely known and clearly defined. Both terms are also mistaken in the wide public. Therefore, the terms have to be explained and then be differentiated from one another.

Definition resources (Ressource)

„The resources are all the commodities available in total, in particular including those where locations can be only assumed or are still to be expedited with new technologies where today's available technologies are not economic cally viable ".[5]

[5] Erdmann, 2008, p. 122.

In 2007 the fossil energy commodities have reached about 571.700 Exa joules (graph compares number 1). "In 2007 compared with 2001 this meant an increase of around one and a half time. Decisive for this increase is a higher appraisal of the coal and the additional occurrence in the natural gas area (coal gas and rocks)".[6]

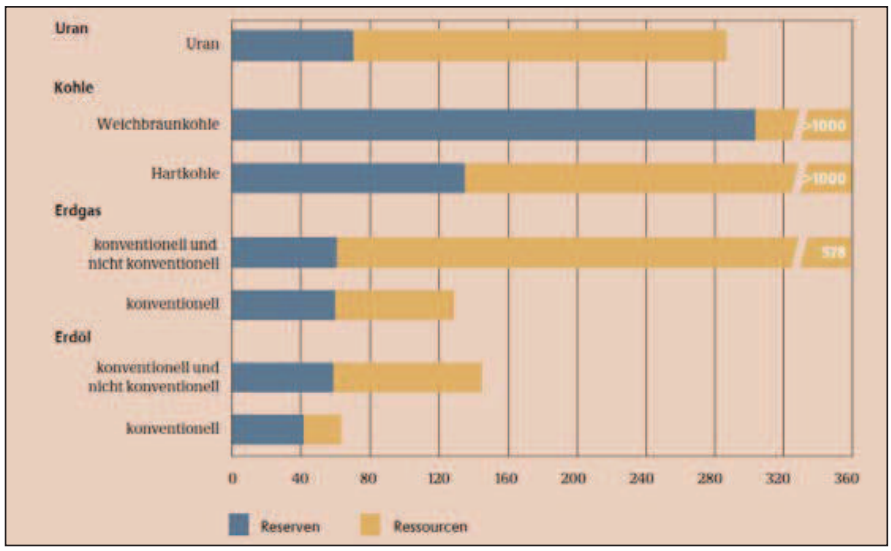
Definition reserves (Reserve)

„Reserves are a share of the resources. This share might in all probability exist and can be placed on the market providet they can be expedited. At reasonably low cost".[7] The share of the reserves within the resources (compares graph number 1) amounts therefore to 6,8%.

Statistical reserves of the non-renewable energy sources

As already described, the non-renewable energy sources are finite therefore only available within limits. In the graph number 2 shows the static reach of the non-

Graph number 2: Static reach of non-renewable energy sources, source: Bundesministerium für Wirtschaft und Industrie, Energie in Deutschland April 2009, side 9.



renewable energy sources is. „The static reach is an approximation and is calculated on the bases of present annual productions. For example the oil which is shown with a period of 40 years. The oil reserves will be exhausted in 40 years if the exploi-

[6] Cf. Bundesanstalt für Geowissenschaften und Rohstoffe, 2009, p. 11.

[7] Cf. Erdmann, 2008, p. 122.

tation rate remains unchanged every year and no new sources are being tapped".[8] Below the statistical reserves of some commodities have been listed.

The static reach is for oil is 60 years as well as, for natural gas for the coal (hard coal) 139 years, for the brown coal 300 years and for the uranium are 70 years.

The biggest non-renewable energy source potential exist in the form of the coal, followed by natural gas. The core fuel uranium books rank three with 290 years of reach. As the last follows the energy source oil with a reach of 140 years. Comparisons the following overview.

Order of rank list of the reserves (static reach stood in 2009):

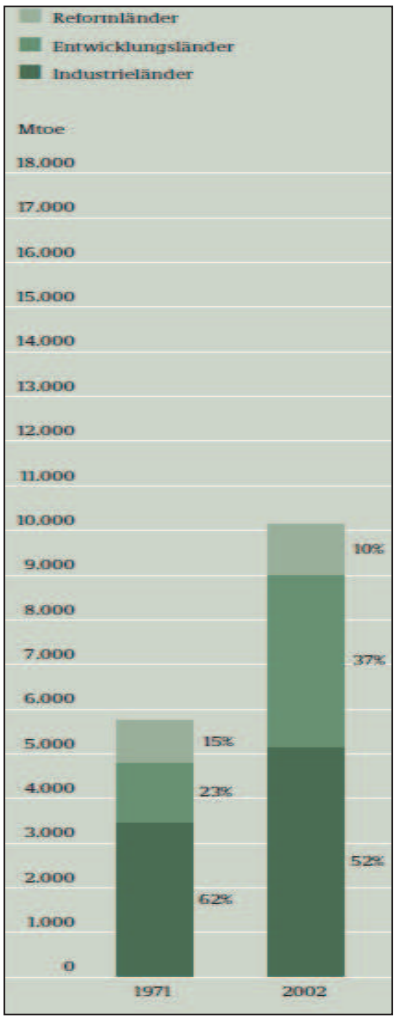
1. Brown coal 300 years
2. Hard coal 139 years
3. Uranium 290 years
4. Natural gas 60 years
5. Oil 60 years

Overview of the worldwide primary energy consumption

In graph number 3 the worldwide energy consumption is shown divided into world regions comparins the years 1971 to 2002. In 1971 a share of the world energy consumption of 62% was attributed mounted to the industrial countries. In 2002 it was 52%, only a difference about 10%. The developing countries used in 1971 only 23% of the world energy but their share increased to 37% in 2002. The share of the reform countries was in 1971 at 15% and decreased until 2002 to 10%. Overall in total there has been an substantial increase in the energy consumption since 1971 from 5.800 million tons of oil equivalent to 10.200 million tons of oil equivalent. The world primary energy consumption has clearly increased from 1971 up to 2002. The big increase of the worldwide energy consumption is partly due to the backlog demand of the developing countries. In particular the people's republic of China had an ever increasing demand. The attitude of the Chinese at the climate-summit in Copenhagen from December indicated that the worldwide primary energy situation will in future be intensified and more aggravated.

[8] Cf. Bundesanstalt für Geowissenschaften und Rohstoffe, 2009, p. 235.

Graph number 3: World energy consumption after regions in 1971 and 2002, source: Energiewirtschaftliche Institut / Prognose Studie 545, side 14.



The power demand in 2002 of main energy consumers is shown in graph number 3. The following ranking shows the world energy consumption divided in groups of consumers.

Ranking of the energy consumption after land markings (2002):

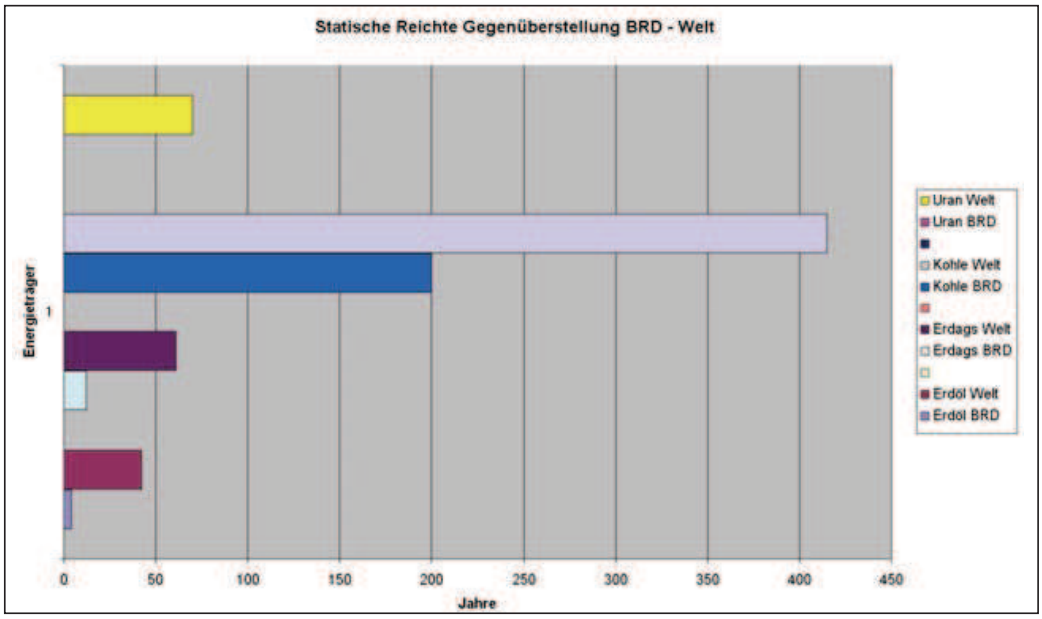
1. Industrial countries 52% (in 1971 = 62% correspond -10%)
2. Developing countries 37% (in 1971 = 23% correspond +14%)
3. Reform countries 10% (in 1971 = 15% correspond + 5%)

In the following chapter the German static reach of the primary energy sources is analyzed and shown.

National statistic reach of non-renewable energy sources

The reserves in non-renewable energy corresponded at the end of 2007 in Germany to: Oil 37 million tones, (47 million tones, in 2001), natural gas 218 million tones (343 million tones, in 2001), and coal 40.936 million tones. The national Statistical reserves

Graph number 4: Statistic reach comparison the non-renewable energy sources in Germany and the world, source: Own representation.



in non-renewable energy sources amount to 4 years for oil, for natural gas to 12 years and for the coal to 200 years. Since 1998 Germany does no longer produce its, own uranium. Since 1990 there is no exploration activity in Germany in this field either. The graph number 4 illustrates clearly the critical situation of the non-renewable energy sources in Germany. Considering coal Germany owns very good reserves. No realistic availability for Oil is given at a forecast of four years only. The overall static reserves were at 216 years for the year 2007.

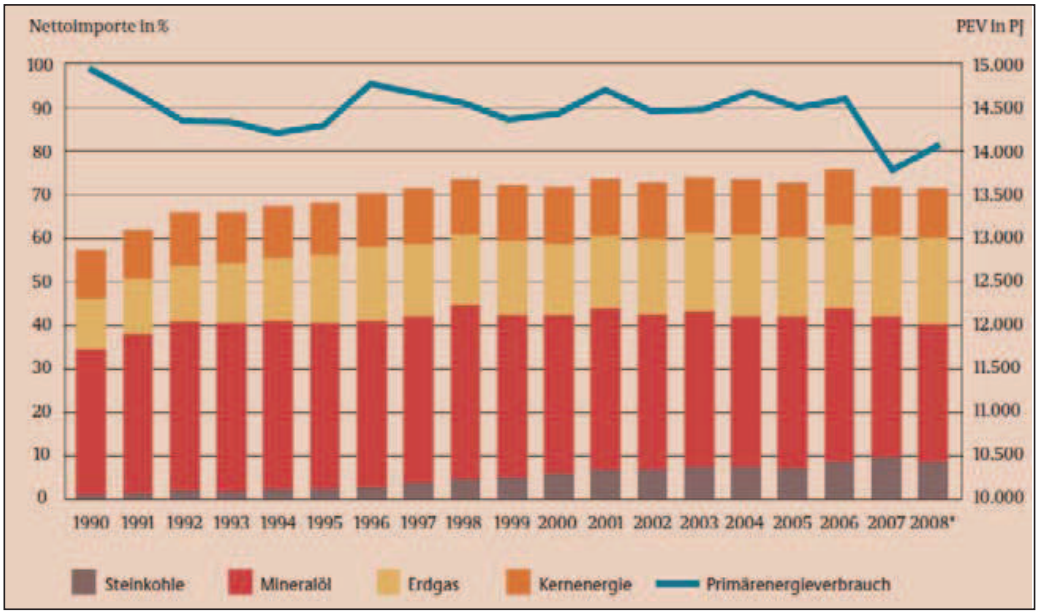
Order of rank of the static reserves in Germany (2007):

1.	Coal	200 years	(92.6% of share)
2.	Natural gas	12 years	(5.6% of share)
3.	Oil	4 years	(1.8% of share)
4.	Total	216 years	

The national contribution of our domestic non-renewable energy sources has clearly declined by 2008. At the beginning of the nineties (1990) still nearly 44% of the primary energy consumption was covered by the national sources. Currently this share still reaches 3,5%. 96,5% are being imported. This is shown in the graph number 5 (net imports). The blue line shows the primary energy consumption in Germany which is limited to 100% at 15.000 Peta joules. Only in 2007 the net imports could roughly cover the primary energy consumption.

The diminishing of the currently most important non-renewable energy source oil is clearly shown. It is virtually no longer available in. This has an effect that the dependence on imports will clearly increase in the following years and will also negatively affect the development of the purchase prices and the national economy in Germany.

Graph number 5: Netimport and primary energy consumption development from 1990 to 2008 in Peta joules and in percent, source: Bundesministerium für Wirtschaft und Technologie, Energie in Deutschland 2009, side 15.



If we look now at the following segment of the sectorial energy use in Germany in this context.

Sectorial energy use in Germany

In the picture number 5 indicates the primary energy consumption by power stations to generate electric power. They make available to the consumers the so-called end energy as in table number 1 enumerated.

The development of the primary energy consumption with regard to non-renewable energy sources appears as follows. In 1990 14.905 Peta joules were required. In 2008 these were still 13.607 Peta joules. This corresponds to a decline of 8,7%. The development of the final energy consumption has decreased from 1990 at 9.472 Peta joules to 9.027 Peta joules in 2008. This corresponds to a decline of 4,7%. The final energy consumption in 1990 in the sector industry amounted to 2.977 Peta joules. This corresponds to an interest of 31,4%. In 2008 the final energy consumption amounted to 2.589 Peta joules which corresponds to an interest of 28,7%. The decline of the final energy consumption from 1990 to 2008 amounts therefore to 2,7%.

Table number 1 shows an overview of the development of the primary energy input and the end energy consumption.

in Petajoule (PJ)

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Primärenergieverbrauch	**14.905**	**14.236**	**14.401**	**14.679**	**14.427**	**14.600**	**14.591**	**14.537**	**14.786**	**14.128**	**13.607**
Verbrauch und Verluste im Energiesektor, statistische Differenzen	4.475	3.950	4.098	4.192	4.155	4.218	4.263	4.248	4.452	4.306	3.568
Nichtenergetischer Verbrauch	958	963	1.068	1.031	1.046	1.025	1.033	1.046	1.038	1.008	1.012
Endenergieverbrauch	**9.472**	**9.322**	**9.235**	**9.455**	**9.226**	**9.356**	**9.295**	**9.242**	**9.296**	**8.815**	**9.027**
Industrie [1)]	2.977	2.474	2.421	2.365	2.322	2.545	2.581	2.610	2.604	2.653	2.589
Verkehr	2.379	2.614	2.751	2.698	2.672	2.601	2.616	2.589	2.615	2.599	2.573
Haushalte	2.367	2.655	2.584	2.822	2.689	2.750	2.634	2.591	2.622	2.259	2.466
Gewerbe, Handel, Dienstleistung (GHD)	1.749	1.579	1.478	1.571	1.544	1.461	1.464	1.452	1.454	1.304	1.399

Anteile am Primärenergieverbrauch in %

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Verbrauch und Verluste im Energiesektor, Statistische Differenzen	30,0	27,7	28,5	28,6	28,8	28,9	29,2	29,2	30,1	30,5	26,2
Nichtenergetischer Verbrauch	6,4	6,8	7,4	7,0	7,2	7,0	7,1	7,2	7,0	7,1	7,4
Endenergieverbrauch	63,5	65,5	64,1	64,4	64,0	64,1	63,7	63,6	62,9	62,4	66,3

Anteil der Verbrauchsbereiche am Endenergieverbrauch in %

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrie [1)]	31,4	26,5	26,2	25,0	25,2	27,2	27,8	28,2	28,0	30,1	28,7
Verkehr	25,1	28,0	29,8	28,5	29,0	27,8	28,1	28,0	28,1	29,5	28,5
Haushalte	25,0	28,5	28,0	29,8	29,1	29,4	28,3	28,0	28,2	25,6	27,3
Gewerbe, Handel, Dienstleistungen (GHD)	18,5	16,9	16,0	16,6	16,7	15,6	15,7	15,7	15,6	14,8	15,5

Table number 1: Development and structure of the German primary energy consumption, source: Bundesministerium für Wirtschaft und Technologie, Zahlen und Fakten Energiedaten Internationale und nationale Entwicklung.

The share of the industrial sector decreased from 1990 at 31,4% to 28,7% in 2008.

Order of rank of the proportional interests of the sectors stood in 2008:

1. Industry	28,7%
2. Transport	28,5%
3. Households	27,3%
4. Trade, Industry, services	15,5%

The detailed analysis for branches in the industrial sector is shown in the following chapter. At the same time the structural analysis of branches with a particularly high energy demand is in indicated. They are therefore also susceptible for high energy expenses.

The use of non-renewable energy in the industrial sector

For the manufacturing of products and services commodities are being used. The problem of the dependence on of the non-renewable energy natural gas for example can be clearly indicated. In graph number 5 one can recognize that the primary end energy consumption lies at 13.500 Peta joules for 2008. The German static reserves of the non-renewable energy source accumulate to 12 years. The industrial sector consumed natural gas in 2008 at the rate of 796 Peta joules (compares table number 2). This corresponds to a share of 8%. The industrial consumers of natural gas are: recovery of minerals, food / tobacco, paper trade, chemistry, rubber and plastics, glass and ceramics, metal production, nonferric metals, mechanical engineering and automotive industry. In 2008 the energy consumption of the chemistry sector was at 197.3 Peta joules the highest. Followed by the food and tobacco with 98,3 Peta joule as well as the metal production with 90 Peta joules and the area of the paper+pulp industry with 76.8 Peta joules (table number 2).

Table number 2: Amount and final energy consumption of natural gas Germany, source: Bundesministerium für Wirtschaft und Technologie, Zahlen und Fakten. Energiedaten nationale und internationale Entwicklung.

in PJ

	1991	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AUFKOMMEN												
Inlandsgewinnung	**621,4**	**679,7**	**706,6**	**713,3**	**711,5**	**740,6**	**685,3**	**661,7**	**653,7**	**598,8**	**545,4**	**509,9**
Einfuhr	**2.063,5**	**2.574,0**	**2.841,7**	**2.951,4**	**3.063,7**	**3.187,3**	**3.389,9**	**3.420,7**	**3.519,1**	**3.323,7**	**3.480,5**	**3.551,3**
davon:												
Niederlande	789,5	841,0	628,5	703,0	683,1	644,4	748,8	735,2	824,8	737,6	665,1	726,2
Norwegen	340,9	469,4	758,0	831,3	964,7	987,8	1.038,3	1.097,8	1.069,2	1.040,9	1.137,0	1.299,1
Russland [1)]	899,3	1.205,3	1.299,9	1.235,4	1.249,7	1.398,3	1.466,7	1.425,9	1.475,5	1.436,1	1.527,6	1.343,5
Sonstige	33,8	58,3	155,3	181,7	166,3	156,9	136,1	161,7	149,6	109,1	150,8	182,4
Aufkommen insgesamt [2)]	**2.684,9**	**3.253,7**	**3.548,3**	**3.664,8**	**3.775,2**	**3.927,9**	**4.075,2**	**4.082,4**	**4.172,8**	**3.922,5**	**4.025,9**	**4.061,1**
Endenergieverbrauch [3)]												
Inlandsabgabe Endabnehmer	**1.687,7**	**2.024,6**	**2.204,0**	**2.324,4**	**2.290,2**	**2.232,0**	**2.216,7**	**2.198,8**	**2.173,7**	**2.107,8**	**2.068,1**	
davon:												
Industrie	709,4	747,5	811,7	794,1	781,5	809,3	821,4	837,9	842,9	835,8	796,0	
- Gewinnung von Steine Erden	46,1	63,9	59,9	52,9	46,6	49,8	54,8	54,1	55,1	56,1	55,0	
- Ernährung Tabak	68,9	71,1	84,0	82,3	87,2	97,0	99,2	98,5	94,8	99,3	98,3	
- Papiergewerbe	35,3	66,1	78,7	77,7	69,5	76,8	65,0	85,4	76,6	94,4	76,8	
- Chemie	188,1	202,1	223,2	215,3	219,2	193,0	207,6	197,0	169,4	199,7	197,3	
- Gummi und Kunststoffwaren	20,7	21,5	21,8	20,4	18,7	20,9	20,8	21,0	21,5	20,1	20,9	
- Glas und Keramik	48,0	62,6	64,8	62,3	63,5	62,9	64,0	64,4	67,1	63,1	63,6	
- Metallerzeugung	102,2	68,2	80,3	80,5	80,7	93,0	92,8	73,5	89,8	90,0	90,0	
- NE-Metalle	26,3	30,8	38,6	39,8	40,1	38,6	39,5	41,2	41,4	39,7	39,6	
- Maschinenbau	32,3	27,5	22,6	23,1	22,3	28,9	29,2	29,4	29,8	29,5	29,4	
- Fahrzeugbau	36,0	37,9	38,1	39,7	39,4	42,4	43,7	42,7	40,4	39,6	42,1	
Gewerbe, Handel, Dienstleistungen	305,3	397,6	444,5	505,4	506,1	379,8	377,8	370,1	365,8	374,1	374,1	
private Haushalte	673,0	879,5	947,7	1.024,9	1.002,6	1.042,9	1.017,5	985,2	959,8	893,8	893,8	
Verkehr	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,7	5,2	4,1	4,1	

1) bis 1997 frühere SU

2) oberer Heizwert brutto (einschließlich Abfackelungen und Verarbeitungsverluste)

3) unterer Heizwert

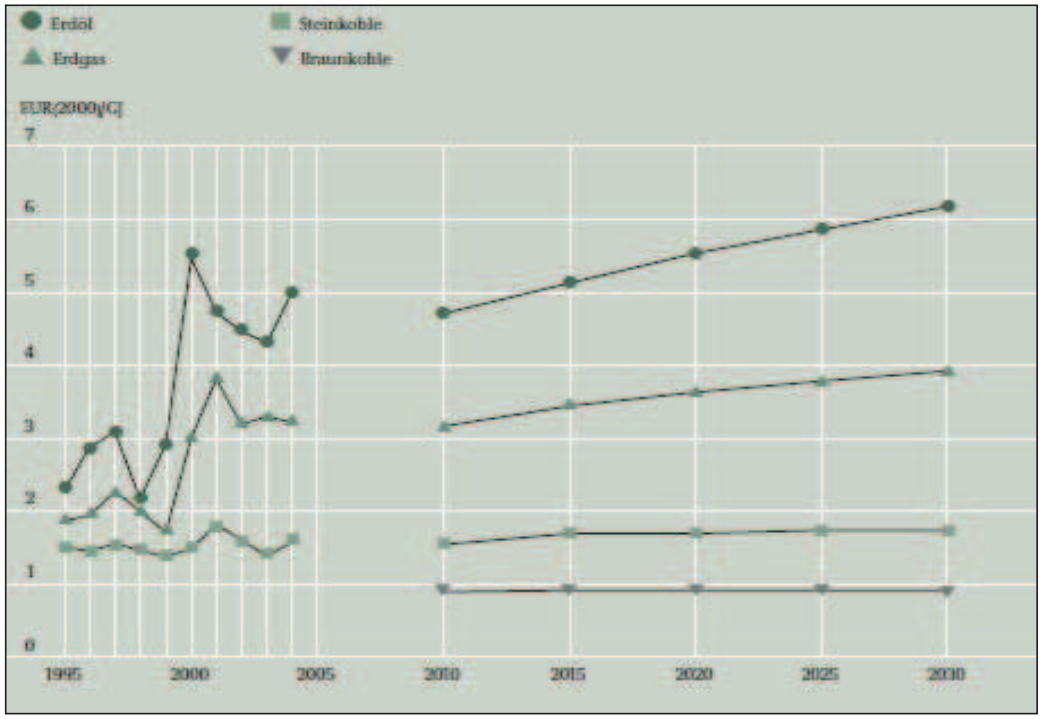
Order of rank overview of the sectors engaged with natural gas consumption in 2008:

1. Chemistry 197.3 Peta joules (share 24,8%)
2. Food, tobacco 98.3 Peta joules (share 12,3%)
3. Metal production 90.0 Peta joules (share 11,3%)
4. Paper + Pulp 76.8 Peta joules (share 9,6%)
5. Glass and ceramics 63.6 Peta joules (share 7,9%)
6. Recovery of minerals 55.0 Peta joules (share 6,9%)
7. Automotive industry 42.1 Peta joules (share 5,2%)
8. Metals 39.6 Peta joules (share 5,0%)

9. Mechanical engineering	29.4 Peta joules (share 3,7%)
10. Rubber and plastics	20.9 Peta joules (share 2,6%)

Price development of the energy commodities

According to calculations done by the Federal Ministry for Economy and work in 2008, the prices of energy commodities would in future clearly increase, in particular for oil and natural gas. In graph number 6 the developments are retrospectively shown for the period from 1995 to 2004 as well as a graph of the future price development (inflation-adjusted). It is to be noted that oil as well as natural gas are still going to be more expensive and that prices have escalated. According to graph number 6 the costs for the oil at 2,30 euros in 1995 rose to 5,00 euros compared to 2004. This corresponds to an increase of 2,70 euros (+117,4%). In the natural gas area the expenses rose from 1,80 euros in 1995 to 3,20 euros in 2004. This corresponds to an increase of 1,40 euros (+77,8%). Coal shows a more moderate increase of approximately 0,10 euros (+6,7%). An overview of the cost development from 1995 at 1,50 euros up to 2005 at 1,60 euros follows.



Graph number 6: Real prices of oil, natural gas, coal, brown coal in 1995 to 2030, source: Bundesministerium für Wirtschaft und Arbeit, Dokumentation Nummer 545.

Order of rank overview of the real cost development in 1995 - 2004:

1. Oil 2,70 euros (+117,4%)
2. Natural gas 1,40 euros (+ 77,8%)
3. Coal 0,10 euros (+ 6,7%)

The Federal Ministry for Economy and Work had in 2008 forecast further developments for above described energy commodities. Correspondingly oil will sell in 2010 at, 4,80 euros and develop until 2030 to 6,20 euros. This corresponds to an increase of 1,40 euros (+29,2%). Natural gas offered in 2010 at 3,20 euros could reach 3,90 euros in 2030. This increase corresponds to 0,70 euros (+21,9%). A more moderate increase can be expected for coal and brown coal. Coal could rise from a praising of 1,65 euros in 2010 to a max of 1.80 euro in 2030 equivalent to 0,15 euros (+9,1%). The brown coal area are can be calculated 0,90 euros in 2010 without any further increase following an order of rank overview forecast for the delivery costs, for the described energy sources is shown.

Summary of the cost forecasts from 2010 to 2030:

1. Oil 1,40 euros (+29,2%)
2. Natural gas 0,70 euros (+21,9%)
3. Coal 0,15 euros (+9,1%)
4. Brown coal 0,00 euros (0.0%)

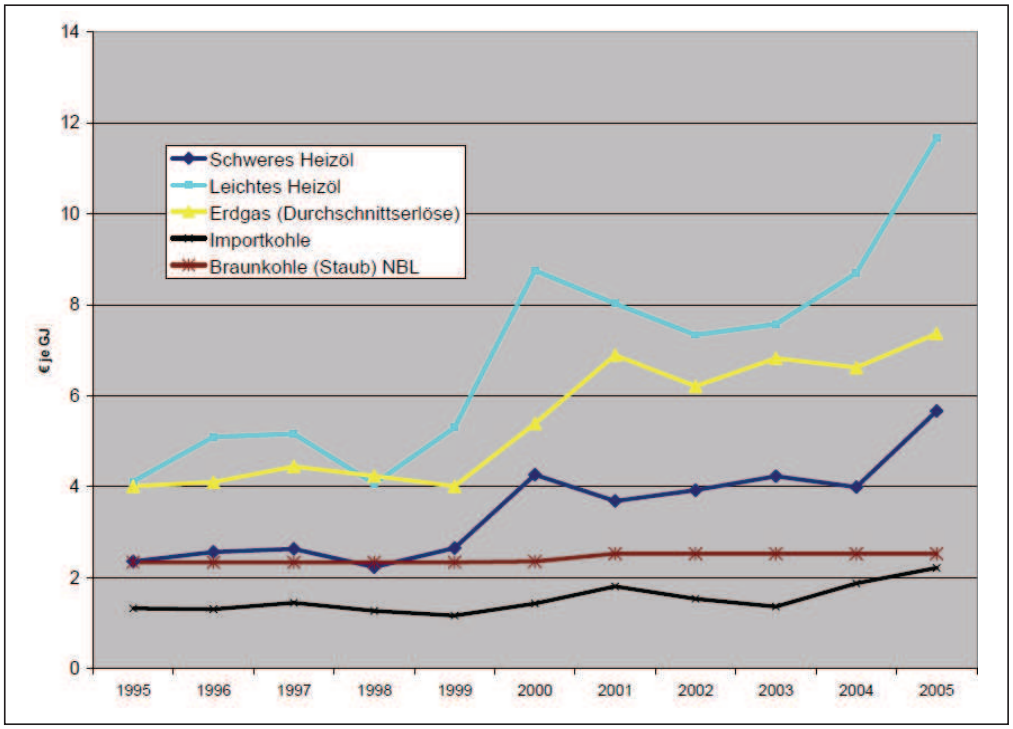
The risks for further price increases after 2008 rose, because of the dependence of the Germany on economically and politically unstable mining and transit regions. „Another negative aspect is the future increase in demand and the fact that there are not enough mining exploitation facilities available. This was triggered off by absent investments in new plants or in investigations where additional resources could be detected. The effect on the purchase prices due to a general supply shortage leads therefore in total to higher purchase prices“.[9] If we look next at the development of the raw material prices for example of the heating market.

[9] Cf. Campel, 2007, p. 7. Colin J. Campbell acted for decades in leading positions at oil companies, and knows the circumstances like no one else. He is a respectable expert in this area. In this connection he describes this situation in 2002 as a Peak Oil.

Development of the raw material cost for example of the heating market

Primary energy prices are an important factor for the economic performance and development of the German national economy. The relative height of competitive energy prices can be determining factor for the business management planning. It is furthermore also important for any financial economic planning. Domestic energy prices are being influenced by the prize pattern and the development on the world market. Other influential factors are the expenses for the procurement, energy commoditie it self, energy taxes and various extra charges (for example, service remuneration) as well as the delivery and conversion expenses. Availability, expectations of the market participants and politically caused risks play an important role regarding the prize development. Excluded from this development is the mining of the national reserves which do not sufficiently exist in Germany. Graph number 7 shows the development in the past using the example of the industrial heating market in 1995 up to 2005. Here, increases are visible, above all in the areas of Natural gas, heavy fuel oil and the purchases of import coal. Clear increases are to be recognized as from 1999.

Referring to light fuel oil an increase is to be seen between 1999 at 5,20 euros and 2005 at 11.80 euros. This corresponds to an increase within six years of 126,9%. A similar course can be recognized in the area of Natural gas. In 1999 at 4,00 euros it rose to 7,40 euros in 2005. This corresponds to an increase of 3,40 euros (85%). In the area of the heavy fuel oil a price of 2,60 euros was paid in 1999, in 2005 the costs were at 5,80 euros. This corresponds to an increase of about 3,20 euros or 123,1%. The imported brown coal the registers are more moderate increase. The price for imported coal was in 1999, at 1,20 euros and in 2005 at 2,20 euros. This corresponds to an increase of 1,00 euro or 83,3%. The price for brown coal was 2,20 euros in 1999. In 2005 the expenses lay at 2,40 euros. This corresponds to an increase of 9,1% or 0,20 euros. The costs are to pay for Giga joules. The indicated costs are per Giga joule.



Graph number 7: Energy price development in the warm market of the industry from 1995 to 2005, source: Bundesministerium für Wirtschaft und Technologie und Bundes-ministerium für Umwelt, Naturschutz und Reaktorsicherheit, side 23.

Following is an overview of the cost development from 1999 till 2005.

Ranking overview of the real proportional cost development between 1999 and 2005:

1. Light fuel oil + 126.9% (in 2030 = 6,60 euros / Giga joules)
2. Heavy fuel oil + 123,1% (in 2030 = 3,20 euros / Giga joules)
3. Natural gas + 85,0% (in 2030 = 3,40 euros / Giga joules)
4. Import coal + 83,3% (in 2030 = 1,00 euros / Giga joules)
5. Brown coal + 9,1% (in 2030 = 0,20 euros / Giga joules)

The graph shows that the light as well as heavy fuel oil register the biggest increases. These are followed by natural gas and the imported coal which also developed rapidly. The brown coal remains at a moderate cost increase.

Summary:

The introduction shows that worldwide there are sufficient energy sources in the medium term. The same picture also appears for the energy resources which means that there is a good availability. This fact is supported by a good worldwide statistic reach on non-renewable energy sources. They are sufficiently availabl. The statistics reaches from oil at 40 years and the coal in excesses of 1.000 years availability. At the same time a trend develops to substantially higher energy consumption rates. From 1971 to 2002 the developing countries had a higher power demand in comparison to the industrial nations. The worldwide energy consumption has increased within 31 years by 75,9%. The driving fore these are the developing countries and industrialized nations.

In Germany is in a bad position regarding the national statistic range of the non-renewable energy sources. At the end of 2007 the statistic range for oil in particular was at only 4 years. The same picture appears in the area of Natural gas. Only the coal can demonstrate a good availability at 200 years. The uranium production was stopped in Germany and does not exist any longer. The nuclear energy has to be inevitably imported. The primary energy consumption in Germany continuously improved from 1990 at 14.905 Peta joules to 13.607 Peta joules in 2007. This corresponds to a decline of 1.298 Peta joules which corresponds to decline within 18 years to 8,7% equivalent to 0,48% per year. The German primary energy consumption must be covered by imports. Therefore Germany is dependent on imports of non-renewable energy sources.

With 28,7% the industry is the most affected sector as far as by these energy imports are concerned. The final demand on utilized power was in 1990 at 2.977 Peta joules and improved by 2008 by 388 Peta joules to 2.589 Peta joules. This corresponds to an improvement 13% in 18 years or 0,72% per year. Nevertheless, the dependence on imports still remains. The sector chemistry within the industrial sector is looking at the energy source natural gas for instance at 197.3 Peta joules relying on stable energy supply to maintain its production rate. For example the heating transfer marked showed real price increases during years from 1995 to 2005 (10 years) for the non-renewable energy sources like oil, natural gas and coal. These increases lay inflation-adjusted for oil at 117,4%, followed by natural gas at 77,8%. The coal lies with a moderate increase 6,7% in the lower vicinity. In future a more moderate forecast appears compared with the near past however there is a rising cost development to be expected.

Up to 2030 an increase for oil of 29,2%, for natural gas of 21,9% and for the coal of 9,1% is forecast. Merely for the brown coal there is no reason to fear any appreciable increase.

For the German industry a clear cost increase was recognized since 1999 for the heating transfer media market. The increase will reach in 6 years for the light fuel oil 126,9% and for the heavy fuel oil 123,1%. They are the biggest cost driving forces, followed in the centerfield by natural gas with 85% and the import coal with 83,3%. The tail ender is the brown coal with 9,1%.

Resümee:

Germany is very strongly dependent on energy imports of non-renewable energy sources. The reason for this is a lack of own resources in Germany itself. The primary power demand is covered in Germany by imports. The expenses for the non-renewable energy imports show for the period of observation of from 1999 to 2008 dramatic cost developments. The biggest consumer of the non-renewable energy sources is the industrial industry with its biggest consumer, the chemical industry.

The energy prices have not only an upwards trend, but at the same time they show a manner of high volatility.

2. Analysis and investigation

The problems of the rising expenses and of the absence of domestic availability of non-renewable energy sources asper 2007, have been shown. The investigation on single sectors of the industry, the further subdivision of the primary energy development, the import structure of the energy imports, the German primary power production, the energy consumption in relation to energy sources, the German electricity production and finally the development of the German energy efficiency will be shown in this chapter. The period of observation entails a wide range from 1991 to 2008. Situatively some analyses are conducted for shorter time intervals.

Industry analysis of the industrial sectors

The table number 3 shows a summary of the final energy consumptions in Germany from 1999 to 2007.

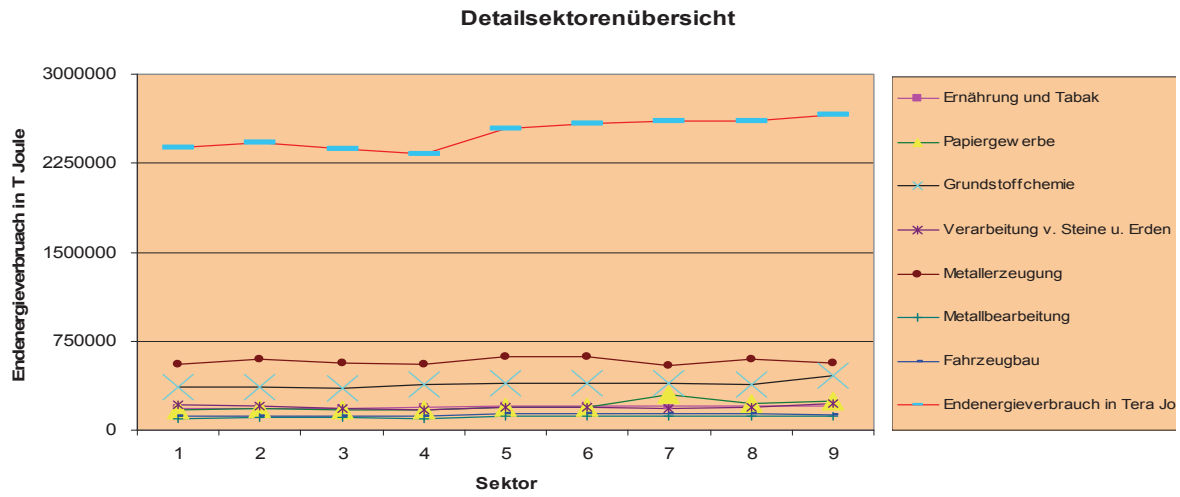
Struktur des Energieverbrauchs für den Sektor Industrie von 1999 - 2007

Deutschland

Tera Joule	1999	2000	2001	2002	2003	2004	2005	2006	2007
Gewinnung von Steinen und Erden, sonst. Bergbau	20379	18877	19471	18697	18 509	26 011	18 691	16 679	17 777
Ernährung und Tabak	185429	184025	185641	190113	204 635	202 706	203 503	202 444	204 328
Papiergewerbe	172948	178344	174598	168533	196 418	197 504	303 737	224 167	242 634
Grundstoffchemie	364345	368018	357417	388894	392 576	393 114	393 784	382 483	460 104
Sonstige chemische Industrie	110649	107363	111677	83065	81 196	100 290	89 782	98 633	91 138
Gummi- u. Kunststoffwaren	70169	70516	69719	67608	77 590	80 469	79 435	81 200	81 298
Glas u. Keramik	97957	98374	96010	95208	96 344	92 583	92 262	97 480	92 501
Verarbeitung v. Steine u. Erden	216316	208030	181286	166052	189 871	196 728	184 589	187 499	221 802
Metallerzeugung	552514	593921	561985	552788	621 721	617 675	539 247	594 086	561 846
NE-Metalle, -gießereien	132345	133762	136098	135310	132 908	136 724	140 578	133 009	133 674
Metallbearbeitung	100904	103089	102191	100972	120 069	117 111	112 470	114 001	114 476
Maschinenbau	73357	71085	72574	69146	80 272	78 333	79 870	81 666	84 435
Fahrzeugbau	115640	113396	117096	118308	135 851	140 039	139 141	134 013	131 117
Sonstige Wirtschaftszweige	170962	172586	179634	167433	196 694	201 910	233 193	256 601	215 970
Endenergieverbrauch	2383914	2421386	2365397	2322127	2544655	2581199	2610282	2603960	2653101

Table number 3: Single sectors energy consumption structure from 1999 to 2007, source: Own representation.

Detailed industrial sectors are shown in table number 3, and the sequences of the energy consumption of single branches are illustrated in graph number 8.



Graph number 8: Detailed sector overview of the sector industry from 1990 to 2007, source: Own representation.

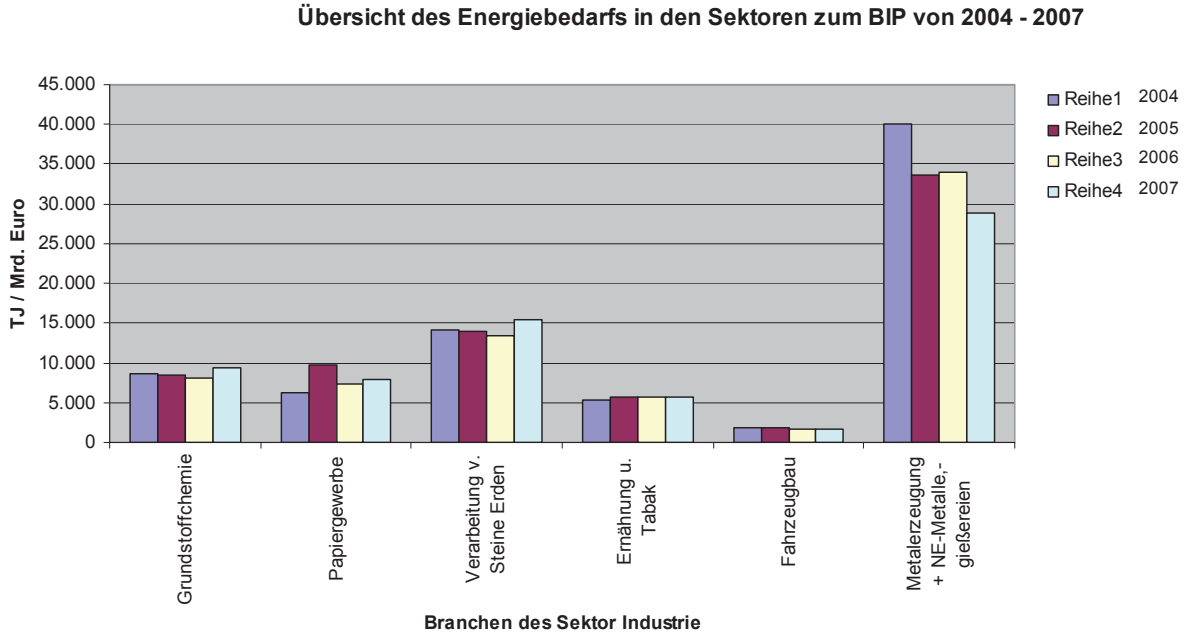
Order of rank of the structural energy consumption of the sector industry (2007):

1. Metal production 561.846 Tera Joule (share 21,2%)
2. Raw material chemistry 460.104 Tera Joule (share 17,3%)
3. Paper and pulp 242.634 Tera Joule (share 9,2%)
4. Processing stones earth ware 221.802 Tera Joule (share 8,5%)

5. Other industrial branches	215.970 Tera Joule	(share	8,2%)
6. Food and tobacco	204.328 Tera Joule	(share	7,8%)
7. Metals, - foundries	133.674 Tera Joule	(share	5,1%)
8. Automotive industry	131.117 Tera Joule	(share	4,9%)
9. Metal handling	114.476 Tera Joule	(share	4,3%)
10. Glass and ceramics	92.501 Tera Joule	(share	3,5%)
11. Other chemical industries	91.138 Tera Joule	(share	3,4%)
12. Mechanical engineering	84.435 Tera Joule	(share	3,2%)
13. Rubber and plastics	81.298 Tera Joule	(share	3,1%)
14. Mining stones earth ware	17.777 Tera Joule	(share	0,7%)
15. Total sum	2.653.101 Tera Joule		

The sector metal production and the raw material chemistry amounted to an energy consumption in 2007 of 1.021.950 Tera joules. This corresponds to a share of 38,5% and more than one third of the whole sector's needs. These sectors are followed by the paper trade, processing stones and earthware, food + tobacco and the automotive industry. The industries metal production and foundries need a total of 695.520 Tera joules. This corresponds to a share of 26,2%. This is more than one quarter of the whole sector power demand. The utilized power demand has risen from 1999 at 2.383.914 Tera joules to 2.653.101 Tera joules in 2007. This corresponds to an increase of 269.187 Tera joules, or 11,3%.

In the following step industrial branches which are especially energy-intensive, are being put into relation to the gross domestic product. These are the raw material chemistry, the paper trade, the processing of stone and earthware, the food and tobacco as well as the metal production and metals and foundries. The basis for the calculation is the year 2003 (base 100). The analyzed period encomparses the years from 2004 to 2007.



Graph number 9: Energy application (in Tera joules) to well-chosen industries, gross domestic product from jump in 2004 to in 2007: source: Own representation.

Graph number 9 shows the relation of the gross domestic product of the branches to their energy input. From the diagram one a recognize the sectors metal production and metals, - foundries as well as the processing of stone and earth have a high share in energy input in relation to the GDP, followed by the raw material chemistry and the paper trade. The automotive industry shows the smallest part. For the period from 2004 to 2007, all industries remain nearly the same values. Merely the industry metal production +Non ferrous– metals, foundries have registered an increase.

Order of rank of the power demand to the GDP to 2007:

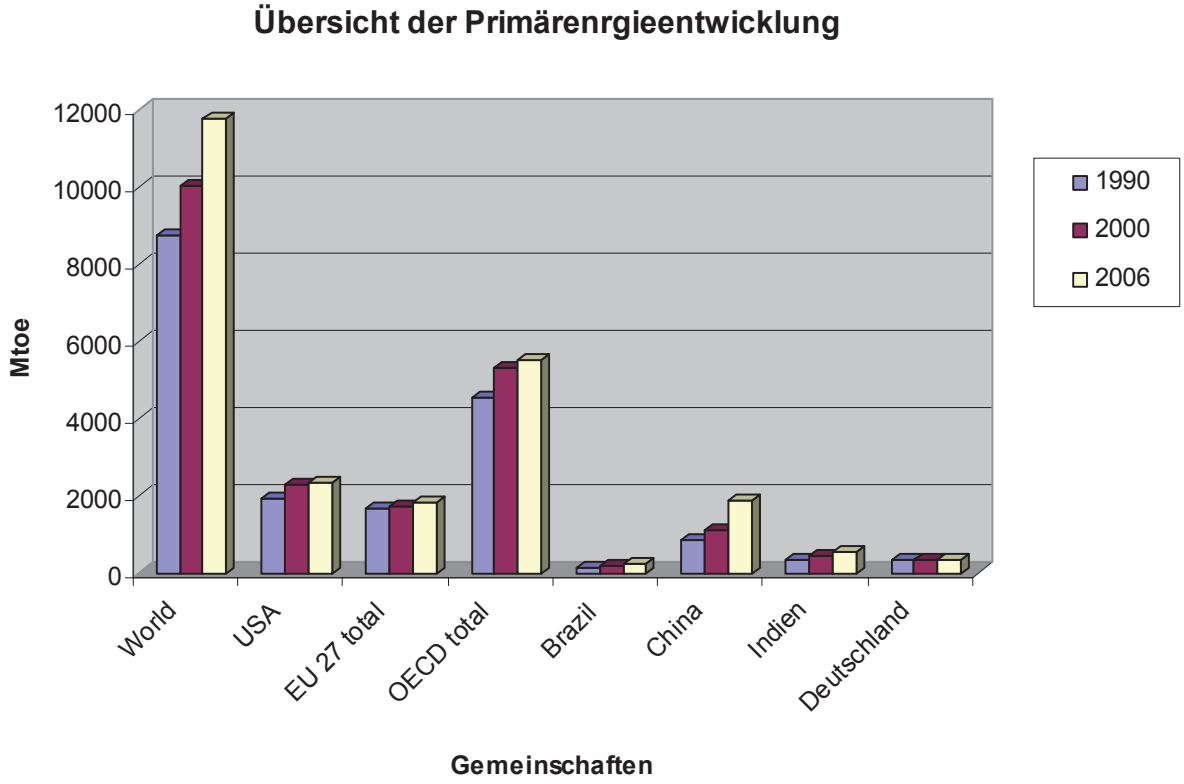
(Unit Tera Joule/Milliarde euros)

1. Metal production and one metal foundries 29.000
2. Stone + earthware 15.500
3. Raw material chemistry 9.000
4. Paper + Pulp 7.500
5. Food tobacco 6.000
6. Automotive industry 2.000

Global economic development

At the beginning the rapid development of the energy consumption of the union of states was shown between 1971 and 2002. While the energy consumption went down in the industrial countries within this period by about 10% of from 62% to 52%, the developing countries in the same period registered an increase of about 14% of from 23% to 37%. Graph number 10 shows the development of the energy consumption of the most important states and communities in 1990, in 2000 and 2006. The Organization for Economic co-operation and Development has not been included here.

The world energy consumption rose from 1990 at 8.758.8 million tons of Oil equivalent to 11,740 million tons of Oil equivalent in 2006. This corresponds to an increase of 34% in 16 years or 2,1% per annum.



Graph number 10: Overview of the primary energy development from 1990 to 2006, source: Own representation.

In the European Union as well as in Germany the energy consumption at 1.700 million tons of oil equivalent and 340 million tons of oil equivalent remains for the same period in each case nearly at a steady level.

The USA had an increase of 1.926,3 million tons of oil equivalent from (1990) to 2,320.7 million tons of oil equivalent in 2006. The energy increase amounts to 394,4 million tons of Oil equivalent or 20,5%. This corresponds to an increase of 1,3% per annum.

During the same period China had increase from 863.2 million tons of oil equivalent to 1.878,7 million tons of oil equivalent (2006). The increase amounts to 1.015,5 million tons of Oil equivalent or 117,6%. This corresponds to 7,4% per annum.

Brazil had forceded its power demand of 140 million tons of oil equivalent in 1990 to 224,1 million tons of oil equivalent in 2006, and used 84,1 million tons of oil equivalent more. This corresponds to an increase of 60% or 3,8% per annum.

The Indian energy consumption rose from 1990 at 319,9 million tons of oil equivalent to 265,8 million tons of oil equivalent in 2006. This increase amounts to 245,9 million tons of Oil equivalent and amounts to 76,9% or to 4,8% per annum.

Order of rank overview of the primary energy development of selected regions:

1.	China	117,6%	(7,4% per annum)
2.	India	76,9%	(4,8% per annum)
3.	Brazil	60,0%	(3,8% per annum)
4.	World	34,0%	(2,1% per annum)
5.	USA	20,5%	(1,3% per annum)
6.	European Union	2,9%	(0,2% per annum)
7.	Germany	0%	

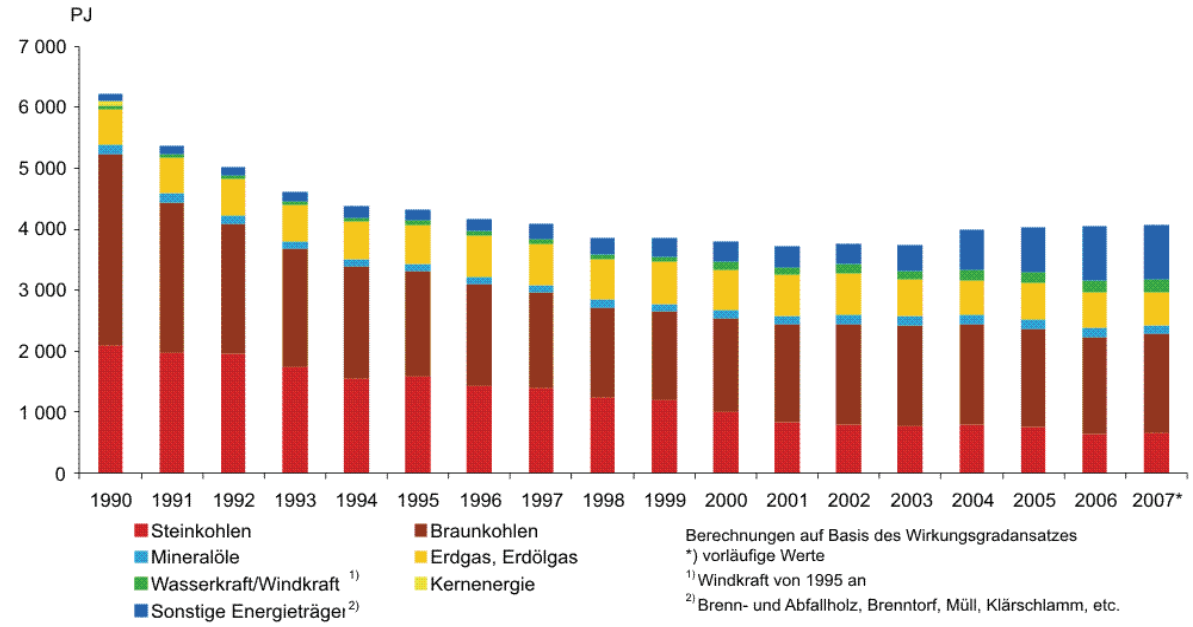
In the following segment the German primary power production is shown and being evaluated from 1990 to 2007.

Primary power production in Germany From 1990 to 2007:

The primary power production in Germany was decreasing during to the period of 1990 to 2007, according to the publication of the federal environment office from February, 2009. “Between 1990 and 2007 the production of local energy commodities decreased in Germany by about 35%, from 6.224 Peta joules to 4.077 Peta joules. The brown coal in 2007 represented a share of 39,9% (in 1990: 51%)

and was the most utilized domestic energy source. The coal mining industry´s contribution to the domestic energy provision is ranked second. The share amounts to 16% in 2007 (in 1990: 34%). During the last 15 years the coal has registered a decline of 68,7%. Oil and gas had a light increase of 11% for the same period. And contributed 2007 a share of 13,3% (in 1990: 9,1%) towards the primary power production. The production of the mineral oil is not relevant because of reserves being absent. In 2007 only a share of 3,7% was reached.

The contribution of wind energy and water power in the past contributed a minimal share to the primary power production in Germany. The amount of both these primary energies has still almost quadrupled to 217 Peta joules in 2007 from 59 Peta joules in 1990. This corresponds to an increase of 267,8% or 15,8% per annum.



Graph number 11: German primary power production after energy sources from 1990 to 2007, source: Arbeitsgemeinschaft Energiebilanzen, Energiebilanz Auswertungstabelle Deutschland 1990 bis 2007 Stand 09 / 2008.

The remaining primary energy sources which contain mainly renewable energy sources like solar energy, biomass, Geothermal, but also, for example, waste incineration have risen in this period since 1990 by six fold from 153 Peta joules to 890

Peta joules and (737 Peta joules +481,7% or 23,3% per annum) represented in 2007 a share of 21,8% in the primary energy sources".[10]

Overview of the German primary power production from 1990 to 2007:

Coal	- 68,7%	(-4,0%)
Overall development in Germany	- 35,0%	(-0,5%)
Brown coal	- 11,1%	(-0,7%)
Oil gas and oil	+ 11,0%	(+0,6%)
Wind and water power	+ 267,8%	(+15,8%)
Rest (Biomass, Geothermal, Solar)	+ 481,7%	(+23,3%)

In the following segment the relation structure of the energy imports for Germany as well as the utilization of the energy source is being depicted. A trend is visible here towards the use the renewable energy sources.

Supply structure of the Germany energy imports

The time considered runs from 1991 up to 2008. Table number 4 depicts the energy sources coal, crude oil, natural gas and uranium for said period with the respective imports. The change in the area of the coal is remarkable. In 1990 approx. 90% had been covered by the domestic production. In 2008 the demand was covered two thirds by the imports. In 1991 16,9 million tons of coal were imported. Then in 2008 the amount rose to 39,1 million tons. The increase amounts to 22,2 million ton corresponding to an increase of about 131,4%. In 1991 573,2 Tera watt hours of natural gas were imported. In 2008 the imports rose to 981.4 Tera Watt hours. This corresponds to an increase of 408,2 Tera to Watt hours or 71,2%. The natural gas imports emanated mainly from countries like the Netherlands, Russia and from Norway. It can be recognized that the import structure has shifted in this field in favor of the Norwegian and Russian natural gas deliveries. In 1991 the Imports amounted to 94,7 Tera watt hours and in 2008 they lay at 291,4 Tera watt hours. This corresponds to an increase of 207,7% within the last 17 years. Russia supplied the biggest share at 40% of the entire natural gas imports.

[10] Cf. Umweltbundesamt, 2007, Energieverbrauch nach Energieträgern. http://www.umweltbundesamt-daten-zur-umwelt.de/um welt daten/public/theme.do;jsessionid=7F068C3E4542E6C9B53DA8DE7F043C36?nodeIdent=2326 (Datum 26.07.2010).

Steinkohlen', in Mio. t	1991	1995	2000	2005	2008
Europa	6,9	7,1	12,6	10,7	10,2
Nordamerika	1,9	2,8	1,8	3,0	7,3
Südafrika	5,5	4,2	4,7	8,2	8,2
Russland	0,2	0,3	1,3	6,8	8,0
Pazifik	1,8	1,6	5,4	5,0	6,7
Übrige	0,6	1,6	8,5	7,5	6,0
Rohöl, in Mio. t					
Europa	22,7	39,1	31,6	33,8	30,1
Russland	14,0	20,6	29,8	38,2	33,6
Naher Osten	18,2	12,9	13,5	20,5	16,0
Afrika	27,1	23,6	21,3	7,7	8,8
Übrige	6,8	4,4	7,4	12,0	16,8
Erdgas, in TWh					
Niederlande	219,3	233,6	174,4	204,2	224,8
Norwegen	94,7	130,4	215,7	305,0	291,4
Russland	249,8	334,8	376,0	396,1	424,4
Übrige	9,4	16,2	57,5	44,9	40,8
Uran, in kt					2007
Frankreich	0,40	0,30	0,43	0,25	0,91
Kanada	0,06	0,10	0,30	1,34	0,80
Großbritannien	0,52	0,93	0,77	0,63	0,78
USA			0,33	0,79	0,36
Übrige	0,06	0,20		0,17	0,34

Table number 4: The relation structure of the energy imports from 1991 to 2008. source: BMWI 2009, side 16.

In 1991 crude oil stand at 88.8 million tons and rose until 2008, to 105,3 million tons. This corresponds to an increase of 16,5 million tons or 18,6%. The crude oil import from Africa since 1991 at 27,1 million tons went down to 8.8 million tons in 2008. This corresponds to a decline of 67,5%. Russia however has also played an important role in the area of Crude oil. With imports in 1991 at 14.0 million tons, to a total of 33,6 million tons of oil in 2008. This corresponds to an increase of 140%. The imports from the Middle East remained almost consistent.

In the uranium field the imported amounts from the listed supply countries reached 3.09kt by 2007. This corresponds to an increase of 2.05 kt or an incline of 197,1% correspondingly.

Order of rank list of the energy sources with imports from 1991 to 2008:

1. Uranium + 197,1%
2. Crude oil + 140,0%
3. Coal + 131,4%
4. Natural gas + 71,2%

In the following chapter the utilization of the energy sources is being analyzed. The main focus lies on the industrial sector. Table number 5 shows the development of the utilized energy consumptions by the sectors.

1990–2008, in PJ					
Mineralölprodukte	**1990**	**1995**	**2000**	**2005**	**2008***
Industrie	308	299	199	161	160
Verkehr	2.329	2.556	2.681	2.448	2.390
Handel, Gewerbe	603	550	406	364	269
Haushalte	740	901	779	689	440
Endenergieverbrauch (gesamt)	3.980	4.306	4.065	3.662	3.259
Gase					
Industrie	936	929	972	921	800
Verkehr	0	0	0	0	8
Handel, Gewerbe	301	406	454	529	499
Haushalte	633	925	984	1.052	978
Endenergieverbrauch (gesamt)	1.870	2.260	2.410	2.502	2.285
Kohle[1]					
Industrie	884	490	459	524	577
Verkehr	1	0	0	0	0
Handel, Gewerbe	289	51	23	19	30
Haushalte	428	200	220	228	244
Endenergieverbrauch (gesamt)	1.602	741	702	771	851
Strom					
Industrie	748	685	748	823	818
Verkehr	49	58	57	58	59
Handel, Gewerbe	434	447	504	474	519
Haushalte	422	458	470	509	511
Endenergieverbrauch (gesamt)	1.653	1.648	1.779	1.864	1.907
Übrige[2]					
Industrie	101	70	43	45	44
Verkehr	0	0	12	77	166
Handel, Gewerbe	122	125	91	88	90
Haushalte	160	171	131	131	128
Endenergieverbrauch (gesamt)	383	366	278	341	428

Table number 5: Final energy consumption after sectors from 1990 to 2008 in PJ,source: BMWI 2009, side 23.

In the area of mineral oil products the consumption of 308 Peta joules in 1990 decreased to 160 Peta joules in 2008. This corresponds to a decline of 48,1%.

In the area of gases a decline is to be registered by 136 Peta joules or 14,5%. If in 1991, 936 Peta joules had been used, these were in 2008 only 800 Peta joules.

In the area of Coal the final energy consumption could be lowered from 884 Peta joules to 577 Peta joules. This corresponds to a reduction of 307 Peta joules equivalent 34,7% by 2008.

In the electricity field a growth rate of 70 Peta joules was reached. In 1990 the final energy consumption lay at 748 Peta joules and had increased to 818 Peta joules. This corresponds to an increase of 9.4%. It has to be recorded that the industry is the biggest final energy consumer concerning coal (interest 66%) and electricity (42,9%). It takes up 2nd place regarding gas consumption at an interest of 35%. With the mineral oil products the industry occupies place 4 with a share of 4,9%. This is only very small part. Within the remaining sources a decline has to be registered. 101 Peta joules used in 1990, decreased to 44 Peta joules. This corresponds to a reduction of 57 Peta to joule which corresponds to decrease of approx 56,4%.

Ranking of the final energy consumption of the industry from 1990 to 2008:

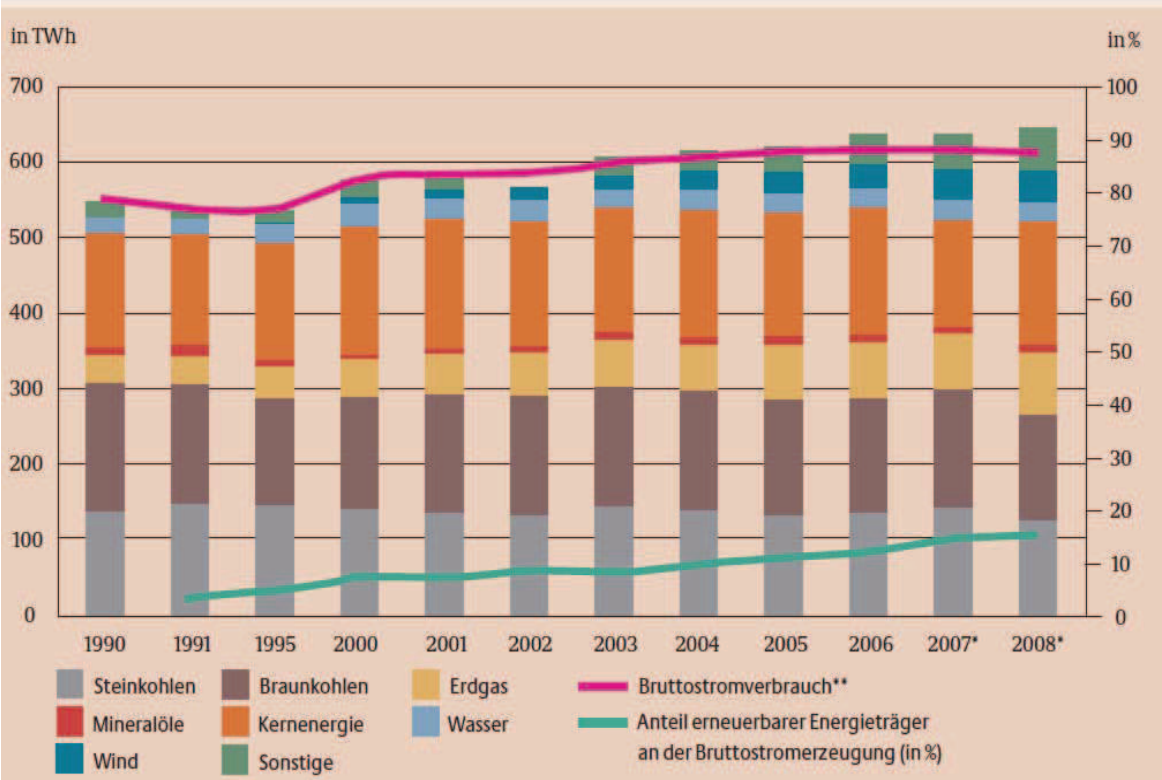
1. Remaining one - 56,4%
2. Mineral oil products - 48,1%
3. Coal - 34,7 %
4. Gas - 14,5 %
5. Electricity + 9,4 %

It has got to be recognized that all sources except electricity show a decline. Merely the electricity consumption registers a growth of 9,4%. This is being examined in the following chapter. The gross electricity production for the whole of Germany as well as the structural development are being depicted and described.

Electricity production in Germany from 1990 to 2008:

The imported as well as the domestically produced primary energy sources are not utilized immediately. They usually through different processes of transformation. Thereafter they are being used in purified form to operate vehicles, machines, production plants or are used as process energy and serve as a source for heating of buildings. The biggest share of the conversion is being used for the electricity production. Beforehand it has to be mentioned, that the power generation structure in

Germany, is the result of long-term investment decisions. „Because of an expected life span of the plants of 35 years and more, the design of the power station park can at a certain times be the result of economic, ecological, regional-economic-political and energy-political factors of influence, which can partly be backdated for".[11]



Graph number 12: German gross electricity production of the power stations after energy sources from 1990 to 2008, source: BMWI, side 19.

Thus it can be explained, that approx. half of the presently running plants have been constructed 20 years ago or longer. At that time other basic conditions for the power generation by coal applied than those valid today. In the graph number 12 the gross electricity production for Germany together with the primary energy source input is shown. In 2008, 639 milliard kilos of watt of hour's of electric power were produced. This corresponds to a primary power demand of 5.494 Peta joules. Compared to the whole primary energy consumption this represent approx

[11] Bundesministerium für Wirtschaft und Technologie, 2009, p. 18. Books been getting on in years power stations in Germany and how the decisions were made in the past.

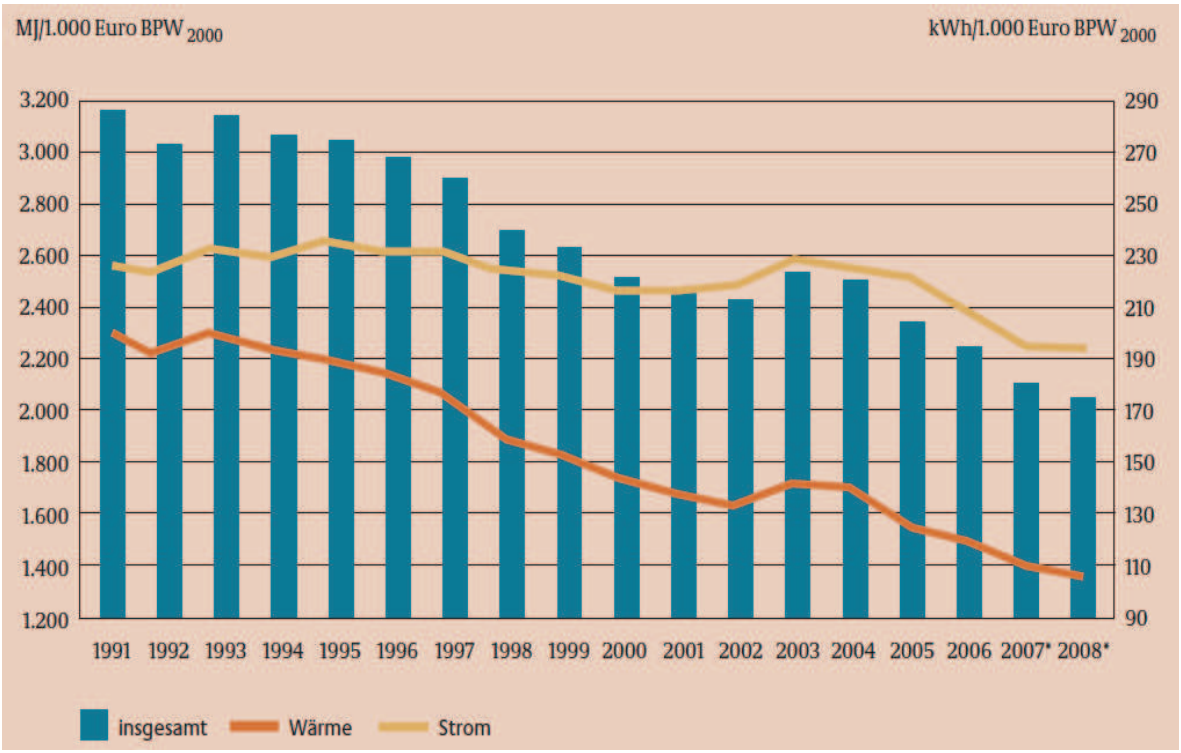
to 39%. 29% can be allocated to nuclear sources, 26% to brown coal, 22% to coal, 14% to gas and 8,4% to remaining energy sources.

As it can recognized in the graph number 12, the share in renewable energy has increased. In 2008 an interest of 93 Tera watts of hours of electric energy was produced from renewable energy sources. This corresponds to an interest of 14,6%. In 1990 550 Tera watt of hours electricity were generated. This corresponds to an increase of about 89 Tera watt of hours compared to 2008 to an increase of 16,2% in 18 years. Representing a moderate increase of 0,9% per annum. What are now the reasons of this moderate increase in the gross electricity production. Why does it not rise as strongly as for example the world energy consumption? Let's therefore look, next at the energy efficiency in Germany.

Analysis of the energy efficiency of the industry

„Due to the improvement of the energy efficiency the energy consumption has gone down in the industrial sector and has decoupled itself from the gross output value. The industry could reduce the energy intensity for the production processes by about approx. 35% from 1991 to 2008. This corresponds to 2.054 Mega joules per 1.000 euros of gross output in prices compared to 2000. This was achieved by high savings in the fuel sector as well as by small declines in the specific electricity application. From 1991 up to 2008 the electricity application sank at an annual average of 2,05%. The fact that the electricity utilization did not go down considerably more, is due to an increased automation as well as replacement of fuels by the electricity. The consumption of the fuel went down by 3,2% at an annual average. The modern rotary furnaces in the cement industry have contributed to energy savings as well as the ongoing change of energy-intensive production processes. In the cement industry the thermal demand of fuels has gone down by about 6% since 1991, and lies at 2.896 kJ / kilogram of cement produced. In the steel production energy savings due to higher efficiencies have also been possible in all production processes. In 1990 an energy input equivalent to 18,3 Giga joules was required to produce 1 ton of raw steel. Presently the energy input lies at 15.5 Giga joules and corresponds to a decline of 15,3%“.[12]

[12] Cf. Bundesministerium für Wirtschaft und Technologie, 2009, p. 27f.



Graph number 13: Development of the energy efficiency of the German industry in unit gross output value in prices of 2000, source: Bundesministerium für Wirtschaft und Technologie 2009, side 27.

The moderate increase in the power generation can also be attributed to new investments by the industry for improved energy efficiency. Less energy being is required for the gross output production.

„In a survey by the credit institute for the reconstruction (kfW) banking group in 2005, 521 companies in Germany were questioned on the subject of energy efficiency in their own plants. 60% of the interviewees stated to have attached an high relevance to the questions of energy efficiency. 29% had already introduced concrete energy efficiency measures. The measures were carried out in the areas of Process head requirements, space heating as well as hot-water consumption (58%). 43% were invested for improved Building insulation and advanced lighting technologies. The main motive for 94% of the companies was lowering of energy expenses. 55% explained to have introduced energy efficiency measures in order to be able to react adequately to rising energy prices“.[13]

[13] Cf. KFW-Befragung, 2005. Belegt wie sich die Einstellung und die Haltung zu steigenden Energiekosten sich im Sektor Industrie am Beispiel der Stahl-, und Zementindustrie geändert hat.

3. Results

Global results:

The global energy consumption from 1971 to 2002 developed rapidly, substantially more energy was needed. In 1971 the oil equivalent energy consumption amounted to 5,800 million tons. In 2002 additional 4,400 million tons were required . The increase in this period amounts to 75,9% and lies at the level of 10,200 million tons of oil equivalent in 2002. This corresponds to an increase of 2,4% per year. The driving force behind this development are the industrialized countries and the reform countries. In the period from 1990 to 2006 the world energy consumption rose from 8.759 million tons of oil equivalent to 11.749 million tons of oil equivalent. This corresponds to an increase of 2.981 million tons of Oil Equivalent or 34% which is an increase of nearly 2,1%. Compared to the first annual increase at 2.4% the second increase of the recent past at 2.1% is slightly lower by -0,3%. However this is still at a very high level. Respnsible for this development since 1990 are in particular countries like India, China, Brazil and the USA. Worldwide indications are the sufficient energy sources are available. The worldwide static range on non- renewable energy sources is good and indicates sufficient supplies. Worldwide enough non-renewable energy sources exist. The worldwide exploitation lays at 1,1% compared to the reserves. This means that there are enough resources of non-renewable energy source. The reserves compared to the resources amount to 6,8%.

National results:

The problem portrayed and at the same time the challenges for the German economy and its industry are as follows. The German energy exploitation is extremely precarious in the areas of Oil and natural gas. The static range is only four and twelve years. Germany depends in all primary energy sectors on imports. The primary energy consumption in Germany cannot be covered by own energy resources. The biggest energy consumer in Germany is the industry, with a share of 28.7%. Between 1990 and 2008, the end energy consumption has fallen by about 4,7% in Germany. The industry could achive a decrease of the final energy consumption of 2,7% in the same period. The most intensive energy industries are the chemistry, food and tobacco and the metal production. A worrying factor are the volatile energy prices. They manifest themselves clearly in the period from 1995 to 2004. Increased expenses for oil at 117.4%, for natural gas at 77,8% and for coal

at 6,7% are disturbing. Also the energy expenses forecast indicated in 2005 all-clearance either. According to the forecast up to 2030 increases can be expected for oil at 29,2%, for natural gas at 21,0% and for coal at 9,1%. Merely the brown coal can get by well. If this investigation is more refined, other volatile energy expense developments appear, For example, in the period from 1999 to 2005 increases in the area of the light fuel oil of 126,9%, of heavy fuel oil of 123,1% and of the import coal of 83,3% were to be registered.

In 2007 especially energy-intensive industries such as the metal production with an interest of 21,2%, the raw material chemistry with an interest of 17,3%, the paper industry with an interest of 9,2%, the processing of stones and earth ware with an interest of 8,5%, food and tobacco with 7,8%, the one metal foundries with 5,1% and the construction of vehicles with 4,9% have been susceptible. If one looks at the above the gross domestic product of the industries referred to above the same period in 2007 then the following energy input amounts had to by invested by the sector raw material chemistry, at 9000 Tera joules per 1 milliard euro turnover, the paper industry with 7.500 Tera joules per 1 milliard turnover, the stone and earthware with 15.500 Tera joules per 1 milliard euros turnover, the food and tobacco with 6.000 Tera joules per 1 milliard euros turnover, the automotive industry with 2.000 Tera joules per 1 milliard euros turnover and in the metal production and one metal foundries with 29.000 Tera joules per 1 milliard euros turnover therefore they are the most susceptible sectors in the industry. Here the metal production and non-ferrets metal foundries are the most susceptible sector in place 1, followed by stones and earth ware place 2, the raw material chemistry in place 3, as well as the paper trade in place 4 and food and tobacco in place 5. Place 6 is occupied by the automotive industry.

For the primary power production in Germany a trend can be not iced away from various non-renewable energy sources. In the period from 1990 to 2007 the coal with -68,7% and the brown coal with -11,1% lost impact on an overall consideration of the primary power production in Germany, a decline of -35,0% was registered. Merely the oil gas and oil production were able to improve by about 11,0%. At the same time the imports of non-renewable energy sources rose. In the period, increasing imports of uranium of 197,1%, of crude oil at 140%, of the coal at 131,4% and of the natural gas at an increase of 71,2% had be registered. At the same time the imports structure for natural gas had moved towards Norwegian, Dutch and Russian suppliers.

The final energy consumption in the industrial sector is falling. There will 48,1% less mineral oil products, 34,7% less coal, and 14,5% gas used. The remaining will decline significantly with 56,4%. Only with electricity there is an opposite direction to be recognized. Here a growth of 9,4% was registered in the same period. In particular the renewable energy sources like wind and water power have achieved an increase of 267.8% from 1990 to 2007. If one examines the gross electricity production in Germany from 1990 to 2008 an increase of 16,2% can be registered. This corresponds to a year by increase of 0,9%. This is also not an exceptionally high average due to an a reason for this improved contribution of the energy efficiency of the German industry. In the period considered from 1991 to 2008 the energy intensity could be reduced by 35%. The energy efficiency of the German industry has clearly improved over the last years. On a average of 2,05% per year. Less energy is being used per gross output value.

In the following sectors of the industry the industries metal production, raw material chemistry, the paper trade as well as the processing of stone+earthware in particular must the subject energy seriously be locked into. They deliver a big economical contribution to the prosperity and social well fare. Nevertheless, they still have to remain internationally competitive at levels of high energy consumptions. Thereby volatil energy prices with a rising tendency are a disadvantage, in a competitive market. This fact was confirmed with a survey by the loan corporation for reconstruction in 2005.

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List of abbreviation

BIP -	Bruttoinlandsprodukt
Exa -	10^{18}
Giga -	10^{9}
Kfw -	Kreditanstallt für Wiederaufbau
Kt -	Kilo tonnen
Tera -	10^{12}
USA -	United States of America
NE-Metall -	Nichteisen-Metall