Energy Consumption Structure and Development in European Transition Countries

Review

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Abstract *– The structure and development of energy consumption in European transition countries, i.e., 11 former socialistic republics including Croatia, which are now new EU members, are considered. For the last twenty years, transition countries have been in the processes of changing their social, economic and political structures with considerable influence on the energy sector. In these former socialistic countries, due to a planned economy, the energy sector has not been significantly efficient. The structure and development of energy consumption on a national level in transition countries are analyzed and compared with the same indicators of the 12 developed European countries. Furthermore, the structure of energy consumption and its sector utilization in transition countries is presented. Finally, techno-economical solutions are proposed.*

Keywords *– energy consumption, energy intensity, transition countries, structure of energy consumption*

1. INTRODUCTION

In contemporary conditions, energy consumption is rationally organized in technological, ecological and economic efficiency frameworks. Efficiency policies can be applied at different levels, including machine level, business system level, industry branches, economic areas, national economy and the overall state level. On a national level, all technical specifications and scientific-technological solutions in the energy production are summarized. Energy utilization is affected by climate and cultural conditions, economic and policy measures; therefore, energy efficiency policy is manifested at the country level. [1], [2] Efficient energy utilization is an important aspect of all human activities starting from the machine, over a business system and a national economic frame to a global planetary level.

The structure and development on energy consumption in the European transition countries (TEC) have been analyzed separately for the last twenty years. The analyzed transitional countries are in the process of changing their social, economic and political structures with considerable influence on the energy sector. In these former socialistic countries, due to a planned economy, the energy sector has not been significantly efficient. [3]

2. METHODOLOGY

European transition countries (TEC) refer to 11 new EU members including Croatia (Figure 1). The structure and development of energy utilization in TEC are analyzed in terms of: a) primary energy consumption on a total national level and consumption per capita, b) final energy consumption on a national level and on several economic sectors and households, c) distribution losses, d) electricity production efficiency, and e) energy use on the realized GDP. These indicators are compared with the same indicators of 12 developed European countries (DEC), which is represented by 12 developed EU member countries (Table 2). Five EU member countries, i.e., Cyprus, Greece, Luxembourg, Malta and Portugal, are not included in DEC. Thus, the analysis presented here differs from EU-28 indicators.

Data sources are relevant statistical bases worldwide but with different measurement system units due to a possibility of comparison with other global groups of countries, energy consumption world leading countries and the total world consumption. Primary energy consumption refers to the direct use at the source, or supply to users without transformation, of crude energy. [4] Primary energy is found in nature without any conversion or transformation process. It is energy contained in raw fuels as well as other forms of energy received as an input to a system. The concept of primary energy is used especially in energy statistics of energy balances. It includes both non-renewable energy and renewable energy. [5] Any kind of extraction of energy products from natural sources to a usable form is called primary production that takes place when the natural sources are exploited, e.g., in coal mines, crude oil fields, hydropower plants or fabrication of bio-fuels. Energy transformation from one form to another, like electricity or heat generation in thermal power plants is not primary production. [6]

Fig. 1. European transition countries (TEC)

The U.S. Energy Information Administration (EIA) calculated energy consumption in the world in Btu (British thermal unit), i.e., quadrillion Btu (or "quads" for short); a quadrillion is equal to 10^{15} Btu. The metric equivalent of the Btu is the Joule; one quad equals approximately 1.055 exajoules (10^{18} Joules); [7], [8].

World Energy BP Statistical Review has given recent data of primary energy consumption. In these statistics, primary energy consumption comprises commercially traded fuels only. While they are important in many countries, fuels such as wood, peat and animal waste are excluded since they are documented unreliable in terms of consumption statistics.

Final energy consumption includes all energy delivered to the final consumer's door (in industry, transportation, households and other sectors) for all energy uses. It excludes deliveries for transformation and/or self-usage of energy production industries as well as network losses. [6]

3. PRIMARY ENERGY CONSUMPTION

In terms of primary energy consumption in the world, the USA, EU 28, China, Russia and Japan were the main drivers in the period from 1990 to 2011. The USA, EU 28, and China registered an increase from 84.9 to 97.5 quads, from 69.8 to 73.1, and 27 to 104.3 quads, respectively, while Russia registered a decrease from 34.1 to 29.8 quads. Primary energy consumption in the world has grown from 348 to 519.2 quads; Fig. 2.

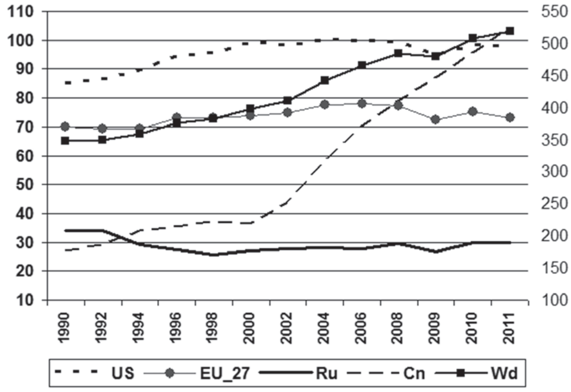

Fig. 2. Primary energy consumption in the period 1990-2011 by leading world economies (left) and in the whole world (right); quads [7]

Figure 3 shows recent primary energy consumption of the first 4 countries in the world (2012); China being the first with 22% of world energy consumption, then the USA with 18%, Russia with 14% and Japan with 6% of world energy consumption. Other countries had consumption of 40% of 12,483 million tons oil equivalent (Mtoe); Fig. 3.

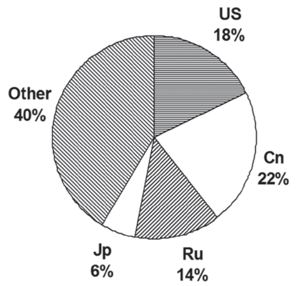

Fig. 3. Primary energy consumption in the first four countries of the world [10]

Primary energy consumption per capita in the world registered a slight increase from 1,665 (1990) to 6,794 kgoe (2012). The largest consumption per capita was recorded in the USA, i.e., 7,672 kgoe in 1990, and 6,794 kgoe in 2012. With respect to other leading economies in the year 2012, Russia 5,113 kgoe, France 3,832, Germany 3,822, Japan 3,539, Great Britain 3,020 and China 2,029 kgoe per capita. The EU average is 3,338 and the average in the world is 1,899 kgoe; Fig. 4.

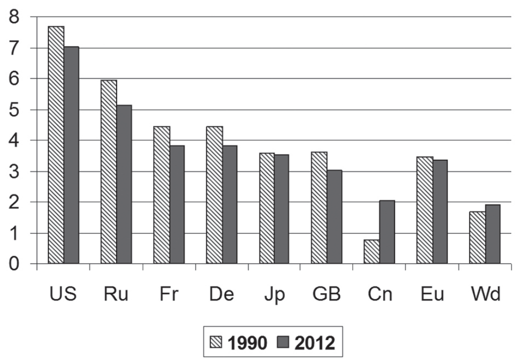

Fig. 4. Primary energy consumption per capita in the world leading countries (1,000 kgoe) [7]

3.1. PRIMARY ENERGY CONSUMPTION IN TEC AND DEC

A fall in primary energy consumption was recorded in the period 1990–2011 in TEC countries from 13.74 to 10.94 quads. In 1990, the largest consumption of 3.95 quads was recorded in Poland, while the lowest consumption was recorded in Latvia = 0.26 and Slovenia = 0.27 quads; Table 1.

Table 1. Primary energy consumption in TEC (quads)

	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2009	2010	2011
Bg	1.18	0.90	0.84	0.95	0.85	0.87	0.87	0.87	0.94	0.83	0.72	0.77	0.82
Cz	1.94	1.66	1.54	1.65	1.42	1.40	1.44	1.50	1.59	1.61	1.53	1.6	1.58
Ee	0.34	0.29	0.19	0.23	0.23	0.20	0.20	0.23	0.23	0.24	0.08	0.08	0.08
HR	0.36	0.31	0.34	0.35	0.37	0.38	0.37	0.41	0.42	0.41	0.38	0.39	0.37
Hu	1.18	1.06	1.03	1.07	1.05	1.02	1.06	1.09	1.15	1.11	1.04	1.05	1.02
Lt	0.56	0.48	0.35	0.36	0.39	0.30	0.34	0.35	0.35	0.39	0.32	0.26	0.28
Lv	0.26	0.22	0.16	0.17	0.16	0.15	0.15	0.18	0.18	0.16	0.16	0.16	0.16
Pl	3.95	3.83	3.82	4.14	3.85	3.62	3.44	3.70	3.85	3.89	3.79	4.05	4.07
Ro	2.81	2.05	1.87	2.05	1.74	1.59	1.68	1.69	1.72	1.68	1.41	1.42	1.51
Sk	0.89	0.73	0.75	0.79	0.77	0.78	0.84	0.80	0.82	0.80	0.72	0.77	0.74
Sl	0.27	0.23	0.25	0.30	0.29	0.29	0.30	0.31	0.32	0.33	0.31	0.31	0.31
TEC	13.75	11.77	11.14	12.06	11.13	10.60	10.71	11.14	11.57	11.46	10.46	10.86	10.94

Source [7]

Table 1. Total primary energy consumption in DEC (quads)

	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2009	2010	2011
At	1.16	1.20	1.23	1.34	1.38	1.39	1.46	1.51	1.53	1.52	1.47	1.53	1.47
Be	2.19	2.24	2.38	2.59	2.70	2.73	2.68	2.81	2.75	2.91	2.66	2.82	2.68
De	14.86	14.04	14.01	14.39	14.33	14.26	14.33	14.70	14.65	14.36	13.25	14.03	13.48
Dk	0.77	0.79	0.88	0.98	0.92	0.87	0.85	0.86	0.90	0.84	0.79	0.83	0.79
Es	3.92	4.12	4.18	4.41	4.92	5.53	5.87	6.39	6.56	6.50	6.11	6.24	6.11
Fi	1.06	1.13	1.18	1.14	1.22	1.21	1.25	1.34	1.32	1.29	1.21	1.30	1.23
Fr	9.13	9.79	9.78	10.42	10.59	10.85	11.00	11.30	11.38	11.29	10.76	11.02	10.83
GB	9.29	9.29	9.56	10.07	9.75	9.74	9.74	9.92	9.80	9.27	8.74	8.92	8.44
Ir	0.37	0.39	0.42	0.46	0.53	0.60	0.62	0.64	0.70	0.69	0.62	0.64	0.59
It	6.76	6.88	6.78	7.12	7.44	7.63	7.70	8.08	8.07	7.90	7.35	7.66	7.50
Ne	3.31	3.47	3.51	3.73	3.69	3.79	3.94	4.11	4.14	4.33	4.06	4.27	4.07
Se	2.22	2.24	2.26	2.27	2.40	2.27	2.27	2.30	2.21	2.22	2.06	2.20	2.16
DEC	55.04	55.59	56.16	58.92	59.87	60.89	61.71	63.98	64.01	63.11	59.08	61.46	59.35

Source [7]

The largest primary energy consumption growths from 1990 to 2011 were registered in Slovakia with the index 114.8 (1990=100) and Poland 103.0; the average in TEC was 79.6. A fall in primary energy consumption was experienced in Estonia (index 23.5) and Lithuania (index 50); Fig. 5(a).

The largest consumption growth in DEC from 1990 to 2011 was registered in Ireland with index 159.8 (1990=100) and Spain (155.7); the average in DEC was 107.8. A fall in total primary energy consumption was registered in Germany and Great Britain; Fig. 5(b).

Primary energy consumption per capita in TEC in the period from 1990 to 2011 varied; i.e., in 2011, six countries registered consumption of energy per capita under the TEC average of 2,628 kgoil equivalent (kgoil); these are Romania = 1,778 kgoil, Croatia = 1971, Latvia = 2,122, Lithuania = 2,406, Hungary = 2,503, and Bulgaria = 2,615 kgoil. The largest consumption was experienced in Poland = 2,629, Slovakia = 3,214, Slovenia = 3,531, Czech Republic = 4,138 and Estonia = 4,221 kgoil. In comparison to 1990, a growth in this consumption was registered only in Slovenia and Croatia; Fig. 6(a). With 3,020 kgoil, DEC have on average larger primary energy consumption per capita than TEC. Finland 6,183, Sweden 5,134, Belgium 5,148, Germany 3,822, the Netherlands 4,668 and France 3,832 kgoe have higher consumption per capita than the DEC average. In the period between 1990 and 2011, energy consumption per capita declined only in Sweden, Germany, Great Britain and Denmark; Fig. 6(b).

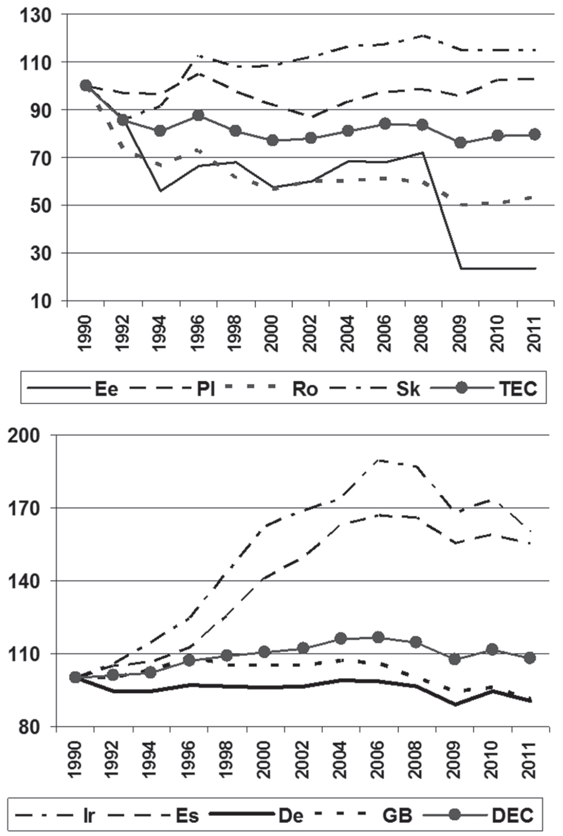

Fig. 5. Indices (1990=100) of primary energy consumption 1990-2011 in TEC and DEC; [7]

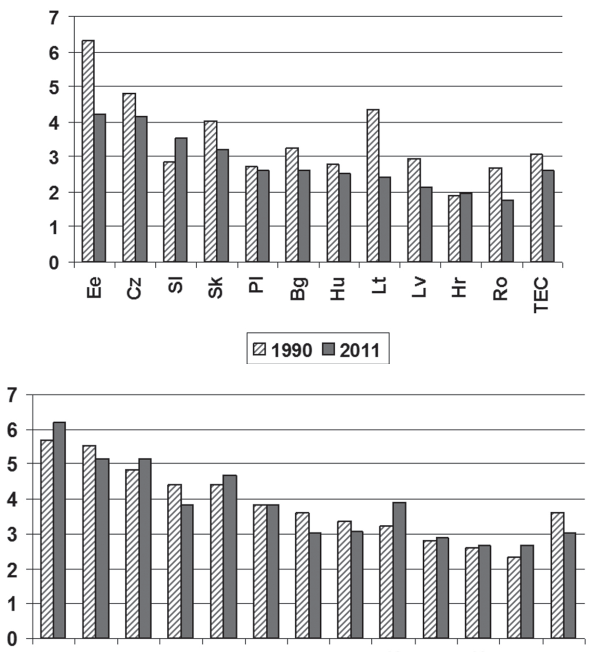

Fig. 6. Primary energy consumption per capita in 1990 and in 2011 in TEC and DEC (1,000 kgoe); [7]

Recent data of primary energy consumption [9] [10] shows a change in the period from 1990 to 2011 on a global level. The whole world registered primary energy consumption growths from 346.9 to 519.2 quads (index 149.6 based on 1990=100), EU 28 registered a small growth from 69.4 to 73.1 quads (index 105.3), while TEC registered a decline from 13.7 to 10.9 quads (index 79.1) and DEC registered a growth from 55.1 to 59.4 quads; Fig. 6. Fig 7. shows primary energy consumption per capita (a) in the world, and (b) in the EU, TEC and DEC in the period 1990–2011.

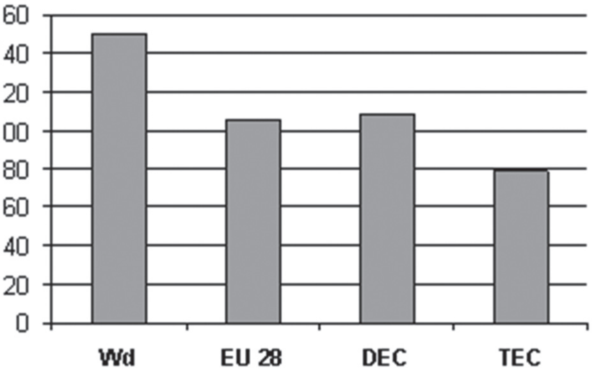

Fig. 7. Indices of primary energy consumption in the period 1990–2011 in the world, EU28, DEC and TEC; [7]

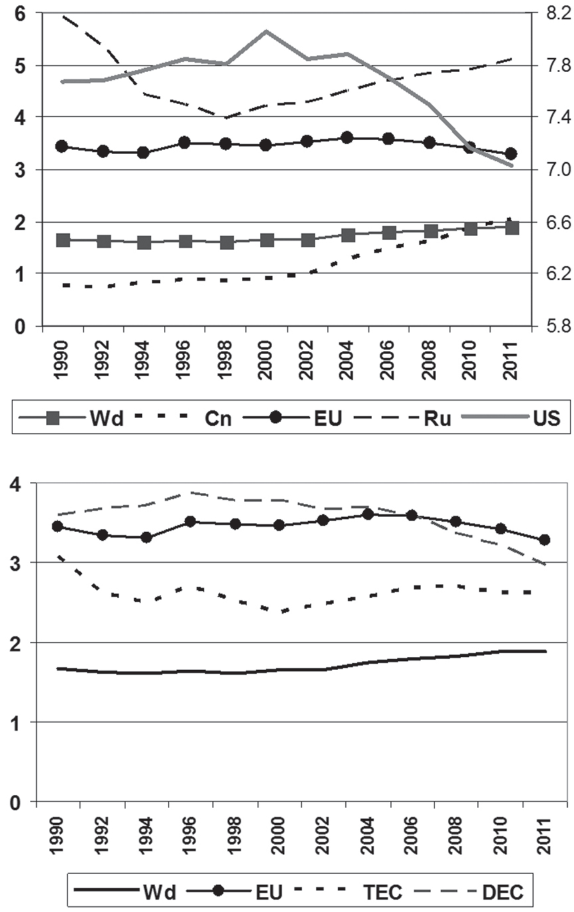

Fig. 8. Primary energy consumption per capita (a) in the world and (b) in the EU, TEC and DEC, in the period 1990–2011 (1,000 kgoe); Source: calculated from [10].

4. FINAL ENERGY CONSUMPTION

In the period 2001–2012, TEC registered a small growth of total final energy consumption from 162.4 to 167.3 Mtoe, index 103 (2001=100). Poland had the largest final energy consumption in 2012 (63.8 Mtoe); it was followed by the Czech Republic (24.1 Mtoe) and Romania (22.7 Mtoe). In the same period, DEC registered a decrease from 949 to 898 Mtoe, index 94.6. In 2012, the largest consumption was registered in Germany (213), France (151) and Great Britain (134 Mtoe). The structure and development of final energy consumption in TEC and DEC are shown in Figures 9 and 10.

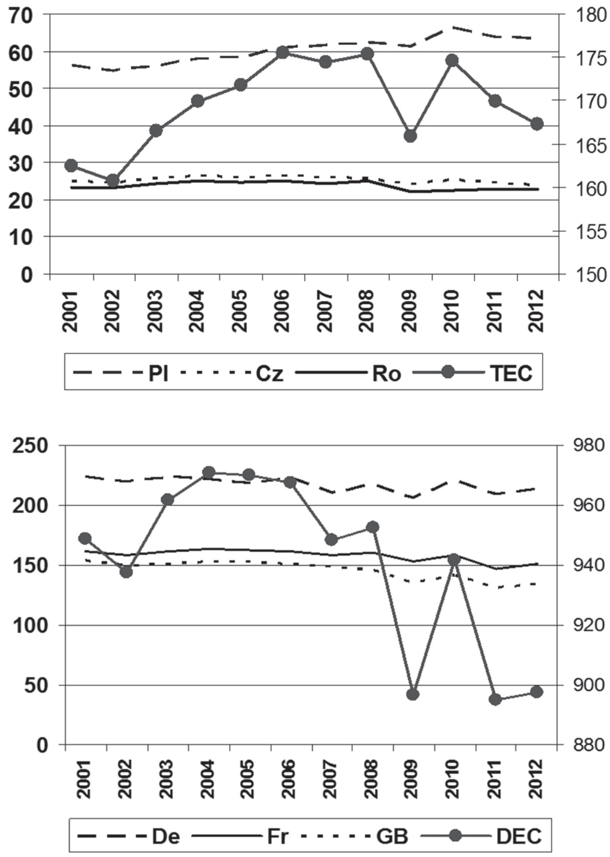

Fig. 9. Final energy consumption in TEC (a) and in DEC (b); (Mtoe); [6]
(TEC (DEC) average ranking is given in the bottom figure)

The structure of final energy consumption in TEC and DEC is analyzed by sectors and shown in Fig. 10. Industry was the largest final energy consumer in TEC with a decline of 100 Mtoe (1990) to 44 Mtoe (2012), index = 42.9. In 2012, ranking and consumption of other sectors were as follows: households = 50.2 Mtoe, transportation = 45.4 Mtoe, and services = 21 Mtoe.

DEC transportation was the largest final energy consumer recording an increase from 246 Mtoe (1990) to 290 Mtoe (2012). DEC industry registered a decline from 263 Mtoe (1990) to 238 Mtoe (2012), index = 90.3. Other sectors that followed in 2012 were households = 208 and services = 127 Mtoe; Fig. 10.

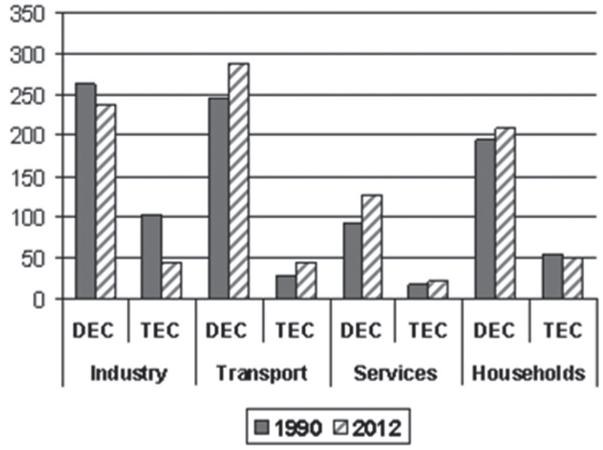

Fig. 10. Final energy consumption in TEC and DEC by sectors; Mtoe [6]

5. DISTRIBUTION LOSSES AND ENERGY EFFICIENCY

Distribution losses are an inevitable consequence of energy transfer across distribution networks; losses are undesirable and costly. While there are many similarities in the distribution networks operated by each distribution company, important differences exist including geographical size of the network location area; the number of customers connected to the network; quantity of distributed electricity; a dispersion degree of customers across the network; proportion of different types of customers connected to the network and the amount of underground cables compared to overhead lines. [13]

The recorded losses can be broken down into three main categories: variable losses, fixed losses and non-technical losses. Variable losses vary with the amount of electricity distributed and, more precisely, they are proportional to the square of the current (utilization of capacity, higher voltages, shorter or more direct lines, demand management and balancing the three-phase loads). Fixed losses do not vary according to current. These losses take the form of heat and noise. Fixed losses are between 25% and 33% of all technical losses in the distribution network (quality of transformer core material, eliminating transformation levels, switching off transformers). Non-technical losses comprise commodities that are delivered and consumed, but not recorded as sales (meter errors, measurement errors in the settlement system, unmetered supply). Other sources of non-technical losses include illegal electricity/energy abstraction that consists of tampering with meters and illegal connections. Currently it is impossible to gauge the exact extent of illegal abstraction because it is likely to be undetected. [13], [14], [15]

Distribution losses of all energy distribution in TEC increased in the first five years during the period 1990-2012 from 2.61% to 4.86% (1995) and decreased to 3.76% (2012) of total final energy consumption. With minimal variation, these losses are stable in DEC = 2.01% (1990) and 2.24% (2012) of total final energy consumption. Distribution losses of electricity of total final electricity consumption in TEC increased in the first five years during the period 1990-2012 from 10.98% to 17.34% 1990 and decreased to 10.20% (2012). With minimal variation, these losses in DEC are stable decreasing from 7.46% (1990) to 7.21% (2012) of total final energy consumption; Fig. 11

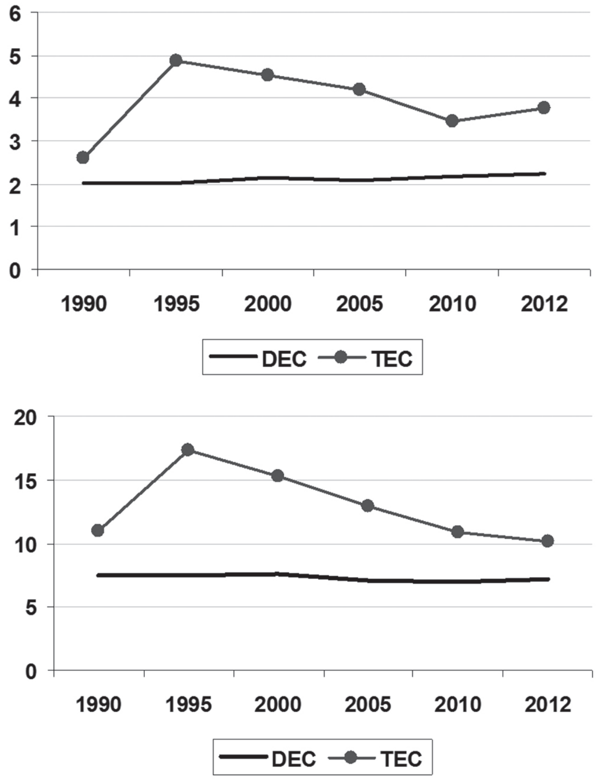

Fig. 11. Distribution losses of all energy (left) and electricity (right) in final energy consumption in TEC and DEC (given in percentage); [6], [11], [12], [13]

The largest growth of distribution losses of all energy in total final energy consumption between TEC in the period from 1990 to 2012 was registered in Romania (from 1.99% in 1990 to 5.88% in 2012) followed by Bulgaria (from 4.29% in 1990 to 5.63% in 2012) and Estonia (from 3.72% in 1990 to 5.58% in 2012). The lowest loss was registered by Slovenia (2.25%) and Poland (2.73%). A decline was also registered in Latvia, i.e., from 7.30% (1990) to 3.56% (2012). An index of average losses for TEC (1990-2012) was 112. Among DEC countries, the lowest loss was registered in Finland and the Netherlands, whereas the largest loss was registered in Spain and Great Britain; Fig. 12.

The largest growth of electricity distribution losses among TEC in the period from 1990 to 2008 was registered in Romania (10.93% in 1990, 16.66% in 2012), and Bulgaria (12.6% in 1990, 15.2% in 2012). A decrease in these losses was registered in Latvia (14.26% in 1990, 8.17% in 2012), and Slovakia (8.36% in 1990, 5.32% in 2012). An index of average losses for TEC (1990-2012) was 98. Electricity distribution losses in DEC countries are significantly lower than in TEC countries; Fig. 13.

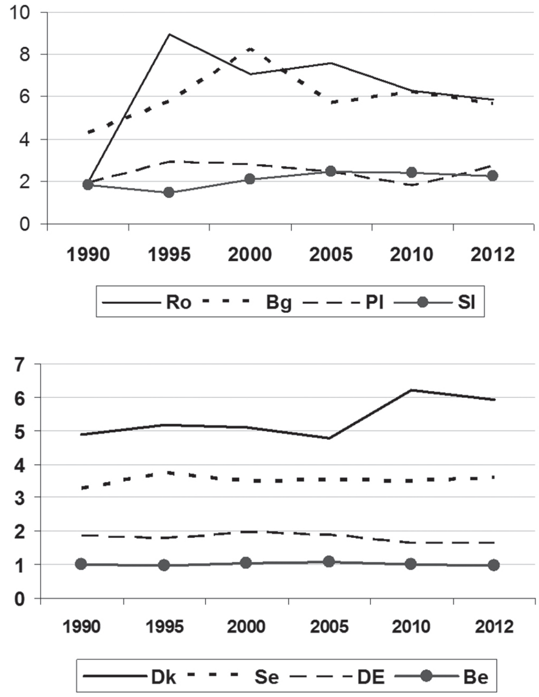

Fig. 12. Distribution losses of all energy uses in final energy consumption in (a) TEC and (b) DEC (given in percentage) – the first two best and two worst countries; [6], [11], [12], [13]

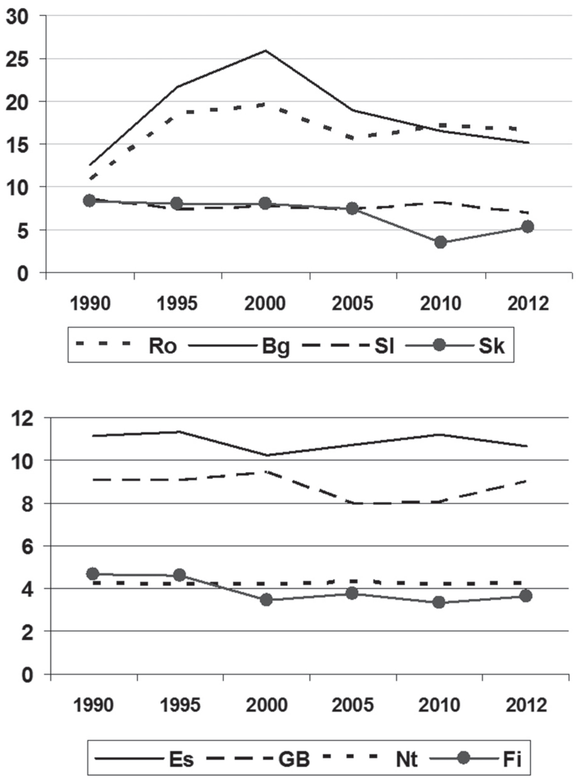

Fig. 13. Distribution losses of electricity in final energy consumption in TEC and DEC; the first two best and two worst countries (given in percentage); [6], [11], [12], [13]

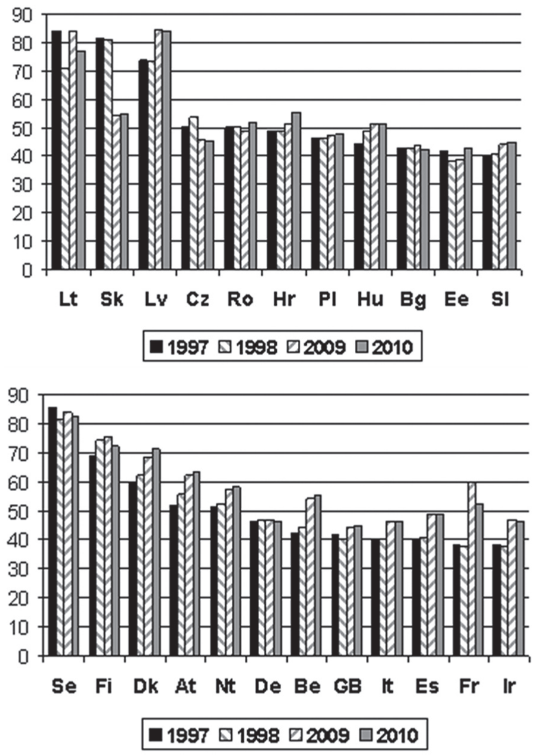

Fig. 14. Efficiency of thermal power plants in TEC and DEC; [6], [16]

The second techno-economical indicator of efficient energy utilization is the efficiency of thermal power plants. The level of this efficiency depends on different kinds of primary energy sources (coal, oil, gas, renewable energy sources or nuclear). Table 3 and Figure 14 show the efficiency of thermal power plants in TEC and DEC during the period 1997–2010. They indicate that TEC countries are less efficient in electrical production than DEC.

Table 3. Efficiency of thermal power plants in TEC and DEC (given in percentage)

Country	1997	1998	2009	2010
Lt	84.2	71.1	84.0	77.3
Sk	81.4	81.0	54.2	55.2
Lv	74.0	73.5	84.9	84.3
Cz	50.7	53.9	45.9	45.6
Ro	50.2*	50.2*	49,0	51.7
Hr	49.0*	49.0*	51.3	55.5
Pl	46.3	46.8	47.5	47.9
Hu	44.4	49.1	51.6	51.3
Bg	42.8*	42.9*	43.8	42.7
Ee	41.6	38.5	38.8	43.0
Sl	40.7	41.0	44.3	45.1
Se	85.4	81.7	83.9	82.9
Fi	69.3	74.5	75.5	72.2
Dk	59.6	62.1	68.9	71.5
At	51.9	55.9	62.1	63.4
Nt	51.4	52.5	57.6	58.2
De	46.3	47.2	47.2	46.5
Be	42.5	44.4	54.2	55.4
GB	41.8	40.6	44.6	45.2
It	40.2	40.1	46.6	46.7
Es	39.7	41.1	48.9	49.0
Fr	38.7	37.6	59.7	52.6
Ir	38.1	37.8	47.0	46.8

*/ Estimation | Sources: [6], [16]

The third indicator of energy use is an economic frame; its energy consumption per unit of GDP realized. In this paper, we used the GDP per unit of energy use, i.e., the constant 2011 PPP $ per kilogram of oil equivalent. GDP per unit of energy use is the PPP GDP per kgoe. "*PPP GDP is a gross domestic product converted to 2011 constant international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as a U.S. dollar has in the United States*". [17]

On a global level, the energy efficiency growth process is shown in Figure 15; the EU and Japan are leaders with 10.2 and 9.5$ of realized GDP per 1 kg oil equivalent energy (kgoe). Among TEC countries (2011), Croatia was a leading country with 10.3 $ GDP per 1 kgoe; TEC average is 8.2$/kgoe; Fig. 15.

Among DEC countries, Ireland (14.7$/kgoe) and Denmark (13.6$/kgoe) were the leading countries, DEC average is 10.8 $/kgoe and with this result these countries are the world leaders; Fig 16.

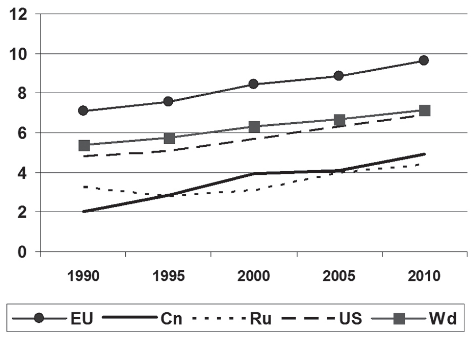

Fig. 15. Realized GDP ($) per kg oil equivalent energy (kgoe) on a global level; [17]

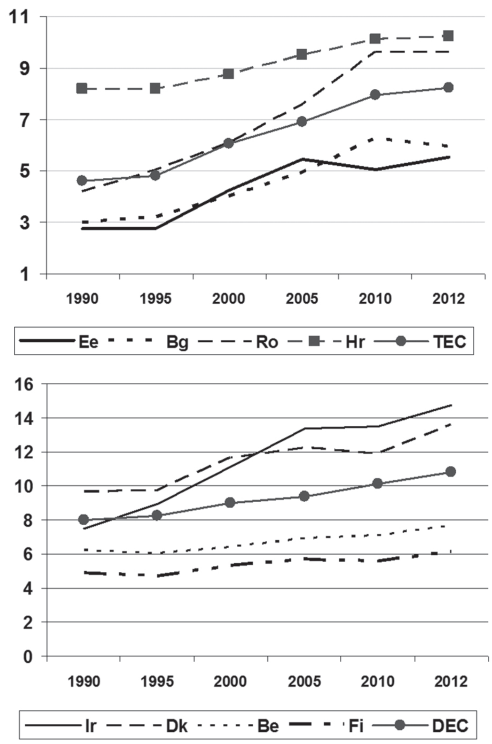

Fig. 16. Realized GDP ($) per kgoe in TEC and DEC; [17]

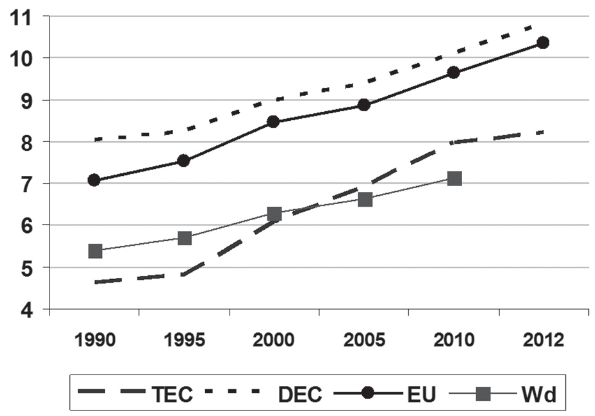

Fig. 17. Realized GDP ($) per kgoe; comparison: world, EU, TEC and DEC [17]

6. CONCLUSION

Based on the presented analysis one can draw a conclusion on several different levels; the first is the basic analytical frame:

1) TEC registered the decline of (a) primary energy, and (b) final energy consumption in the period 1990–2012 (a) from 13.75 to 10.94 quads, or (b) in oil equivalent energy from 216 to 167 Mtoe, index 77.4 (1990=100), respectively. In the same period, DEC registered an increase from (a) 55 to 58.8 quads, and (b) 823 to 897 Mtoe (index 107.8).

2) Industry, as an area of economy, is the largest energy consumer in TEC; consumption by industry in the period 1990–2012 registered a sharp large fall from 102.3 to 43.9 Mtoe (index 42.9 based on 1990=100). During the analyzed period, the process of a large change in the structure of final energy consumption has been realized in TEC; industry registered the decline in their share in total consumption from 47.3 to 26.2%; services, transportation and households recorded growth from 8.4 to 12.6%, from 12.4 to 27.1%, and 24.9 to 30%, respectively.

3) The structure of final energy consumption in DEC during the same period registered minor changes in the structure; transportation increased from 29.5 to 32.3%; industry decreased from 31.6 to 26.5%; services increased from 10.9 to 14.1%; households decreased from 23.4 to 23.2% and the sector of other consumption decreased from 4.5 to 3.9%. Transportation started as an area of economy with largest energy use in DEC; energy consumption by transportation in the period 1990–2012 registered growth from 245.8 to 289.7 Mtoe (index 117.9).

4) Distributions losses as all energy distribution share of total final energy (end-use) consumption and losses of electricity of total final electricity consumption in TEC are larger than in DEC; the mentioned processes are a result of different causes and will have influence on economic, environmental and technical effects. Distributions losses of all energy distribution in TEC have increased from 2.61% to 3.76% (2012); in DEC, these losses are stable from 2.01% (1990) to 2.24% (2012). Distribution losses of electricity in TEC have decreased from 10.98% to 10.20% (2012), DEC registered the decline; 7.46% (1990) and 7.21% (2012).

5) Efficiency of thermal power plants during the period 1997-2010 varied; but, generally, during the analyzed period this efficiency was on the rise; e.g., per largest countries: in TEC, Poland = 46.3 (1997) to 47.9% (2010) and the Czech Republic 50.7 (1997) to 45.6% (2010); in DEC, Germany = 46.3 (1997) and 46.5% (2010) and Great Britain = 41.8 (1997) to 45.2% (2010).

Technical (energy) context

1) Variations in consumption cause disabilities in the domestic energy system management, increase the possibility of malfunctions, make maintenance planning difficult and reduce the energy system efficiency. On the other hand, stable consumption in DEC makes the system management easy, reduces the possibility of malfunctions, enables plant exploitation planning and increases the energy system efficiency.

2) A change in the economic structure strongly influences the structure and regime of energy and electricity consumption; TEC have larger consumption and a larger increase in the service sector (small-scale industry), i.e., power supply from low voltage that carries larger distribution losses. DEC have a larger percentage of large industrial consumers, i.e., supply on the high voltage threshold as well as smaller electricity distribution losses.

3) Large distribution losses in TEC are a result of the undeveloped structure of the energy/electricity system and insufficient investments in distribution network maintenance and quality.

4) Emerging technologies in the industry, services and households in energy/electricity consumption have large positive effects on all sectors of consumption; in DEC, these positive effects are greater than in TEC.

Economic context

1) The industrial sector significantly changes through restructuring industrial productions abandoning labor-intensive and energy/electricity intense industries in both groups of countries. These processes influence the structure and the mode of the energy/electricity system in TEC and DEC groups of countries.

2) Large distribution losses in TEC are on the one hand results of no technical causes, i.e., illegal consumptions that cause economical and administrative problems.

3) Significantly larger distribution losses in TEC reduce economic sector competitiveness and public-household consumption costs increase.

4) Questions on large energy and special electricity

consumption in TEC's households are related to economic justification in realized GDP, especially for the electricity-based heating and cooking system. Special projects on gas and renewable energy use are necessary for resolving such problems. [18], [19], [20], [21]

5) DEC countries are world leaders in realized GDP per kgoil equivalent energy.

Environmental context

1) Irrational and unnecessary consumption of electrical power in European countries, especially in TEC, has specific consequences for environmental protection; i.e., use of electricity for sanitary water heating in the sector of household and services reduces the efficiency of primary energy forms (fossil fuels) usage and contributes to larger air pollution and a larger greenhouse effect.

Policy context

1) Numerous EU projects that achieved favorable effects in the area of energy supply in DEC can be adopted for profiling energy policies in TEC. [22], [23]

2) Besides the EU directives, TEC countries need special projects for increasing the energy efficiency for easier fitting into the EU electricity efficiency framework.

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