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Helena Božić (1968) obtained BS, MS and PhD degrees from the Faculty of Electrical Engineering and Computing, University of Zagreb in 1992, 1996 and 2005 respectively. At 2007 Ms. Božić finished the Study of Executive MBA at Cotrugli Business School in Zagreb. She also attented various regional and international training courses related with the models for the long term energy system planning.

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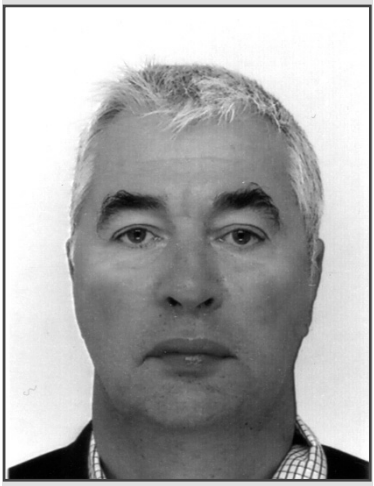

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MONITORING ENERGY EFFICIENCY IN THE EU-27 THE ODYSSEE - MURE PROJECT

Abstract

Since more than a decade, the European Commission through the Intelligent Energy for Europe programme and 29 partners, mainly European national energy efficiency agencies, have developed common methodologies on energy efficiency monitoring. This relies on two complementary tools:

- ODYSSEE, an internet database on energy efficiency indicators. Around 200 indicators comparable and harmonised across countries are developed at sectoral or end uses levels, over the period 1980-2006 for the EU-15 countries and from 1990 for EU-10 countries + Croatia and Norway.
- MURE, an interactive internet data base on energy efficiency policies. More than 1300 policies descriptions are stored. When available, ex-post evaluations are reported.

Based on this material provided by each of partners representing all the EU-Members and Croatia, a cross countries analysis is carried by sector on the recent trends for the EU as a whole and by countries. This diagnosis of benchmark shows that countries which have performed the best differ according to the end uses. The contribution of the manufacturing sector in the energy savings seems slowing down compared to the late nineties. Inversely, results in transport seem now encouraging. The building sector has performed disappointingly despites numerous policies. Analysis of the policy mix across countries and its dynamic shows divergences between the EU-15 countries and the EU-10. Innovative measures can be found everywhere and are discussed extensively.

These results become more and more widely used by member state to assess and interpret the target and the National Energy Efficiency Action Plan of the plan of the Energy Service directive recently launched.

This report presents an analysis of energy efficiency trends in Croatian on the basis of energy efficiency indicators based on the ODYSSEE methodology. This analysis focuses on the period 1992-2004[1], in the energy consumption and energy efficiency in total and in sectors (industry, transport, households and services).

[1] The choice of 1992 for the starting year is because of war situation and relating energy consumption in 1990-1991.

PRAĆENJE ENERGETSKE UČINKOVITOSTI U ZEMLJAMA EU-27 PROJEKT ODYSSEE - MURE

Sažetak

U proteklih deset i više godina Europska komisija je, kroz program Inteligentna energija za Europu, zajedno s 29 partnera, uglavnom europskih nacionalnih agencija za energiju, razradila zajedničku metodologiju praćenja energetske učinkovitosti. Metodologija se zasniva na dva komplementarna alata:

- ODYSSEE, internetska baza podataka o pokazateljima energetske učinkovitosti. Tijekom perioda između 1980. – 2006 definirano je oko 200 usporedivih i usklađenih pokazatelja na sektorskoj razini i razini krajnjih korisnika u različitim zemljama, za EU-15 i od 1990. godine za EU-10 plus Hrvatska i Norveška.
- MURE, interaktivna internetska baza podataka o mjerama energetske učinkovitosti. Pohranjeni su opisi više od 1300 mjera. Baze sadrže i ex-post evaluacije, ukoliko su one načinjenje.

Na temelju ovog materijala kojeg su priložili svi partneri koji predstavljaju članice EU-a i Hrvatsku provedena je usporedna analiza sektora nedavnih trendova među zemljama i to na razini EU-a kao cjeline i po pojedinačnim zemljama. Benchmarking analiza pokazuje da među zemljama koje su imale najbolje rezultate postoje razlike na razini krajnih korisnika. Doprinos prerađivačkog sektora u štednji energije se usporava u odnosu na razdoblje krajem devedesetih godina, a za razliku od njega, rezultati u transportu sada se pokazuju povoljnijim. Sektor zgradarstva, međutim, pokazao je razočaravajuće učinke unatoč brojnim politikama. Usporedna analiza kombinacije različitih mjera i njihove dinamike pokazuje razlike između zemalja EU-15 i EU-10. Sve zemlje primjenjuju inovativne mjere i o ovim mjerama se vodi široka rasprava.

Zemlje članice sve više koriste ove rezultate u ocjeni i tumačenju ciljeva Nacionalnog plana za energetsku učinkovitost i plana nedavno usvojene Direktive o energetskim uslugama.

Ovo izvješće prikazuje analizu trendova energetske učinkovitosti u Republici Hrvatskoj na osnovi indikatora energetske učinkovitosti i ODYSSEE metodologije. Analiza potrošnje energije i energetske učinkovitosti prikazana je ukupno i po sektorima potrošnje (industrija, promet, kućanstva i usluge) u periodu od 1992. do 2004. godine (gdje je polazna 1992. godina odabrana kao prva godina nakon energetske potrošnje u periodu ratnih zbivanja).

1. EXECUTIVE SUMMARY

The report starts with a review of general context of energy efficiency, i.e. economic and energy consumption development, the policy background on energy efficiency, policy instruments, international obligations on environmental protection. The energy consumption and trends in energy intensity are also presented, in total and at sectoral level, including the energy efficiency by sector.

The main results and conclusions of the report are:

- Over the period 1992-2004, the final energy consumption grew at a rate of 3,3% per year. The highest growth rate was in the tertiary (services) sector, of 6,8%

per year, followed by the transport sector (5,7%/year) and households (3,9%/year). The industry sector had the smallest growth rate in this period (0,5%/year), while agriculture had a negative growth rate (-1,3%/year).

- The primary intensity decreased more than the final intensity: -0,6% annually compared to -0,3% annually.
- In the period 1995-2004 energy efficiency of the whole economy, as measured with the energy efficiency index (ODEX) improved by 11%, compared to 8% for the EU-25. Especially the industrial sector (cement and paper) and transport sector (rail and trucks & light vehicles) contributed to this development.
- Direct CO_2 emissions (emissions from final consumers) in Croatia have increased by 54% since 1992. The highest increase was in transport sector (99%), followed by households, services and agriculture sectors (60%). The emissions increase in industry sector was 12%.

2. THE BACKGROUND OF ENERGY EFFICIENCY

The economic growth in the period from 1992 to 2004 in Croatia was 3,4% per year (Table 1); the highest economic growth was recorded during the period 2001-2004 (5,1%).

The industrial activity (as measured by the value added at constant price) increased by 3,1% per year, with the highest growth in the period 2001-2004 (6,4%). Data for private consumption (households' expenditures) are available from 1995; average growth rate for the period 1995-2004 was 3,9% per year, with the highest growth in the period 2001-2004 (5,7%). Because the data for private consumption are available from 1995, Figure 1 presents relative values for GDP, value added of the industry and private consumption of households relative to 1995.

Table 1. Economic and industrial growth in Croatia

%/year	**1992-1996**	**1996-2001**	**2001-2004**	**1992-2004**
GDP	2,4%	3,1%	5,1%	3,4%
Industry	0,4%	3,3%	6,4%	3,1%
Private consumption	na	3,5%	5,7%	3,9%[1]

[2] For the period 1995-2004.

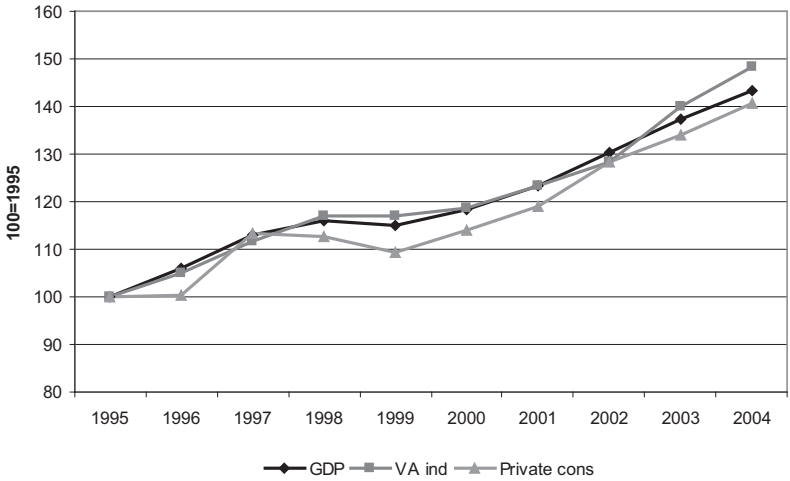

Figure 1: Macro-economic development in Croatia: 1995-2004

2.1. Efficiency measures in the transport sector - LPG & CNG Incentives

At the moment, in Croatia there is lack of support by local or national policy as for the CNG market development. Public transport companies favor diesel (or biodiesel as possible alternative fuel) and there is a strong LPG competition from focused LPG companies, primary daughter company of the Croatian national oil and gas company, which is interested to increase LPG demand in domestic market and reduce export (Croatia exports 70% of its LPG and imports 40% of needed natural gas).

Key drivers that might push the LPG & CNG market forward are: proximity of developed markets like Italy and the fact that CNG and LPG vehicles are exempt from, so called, “Eco-test” during annual technical vehicle inspection, which makes it interesting for older, more polluting vehicles, but on the other hand, this influences more the increase in the number of LPG vehicles then CNG vehicles. The international standards are accepted by national legislation and there are no obstacles for import of OEM vehicles.

In 2005, new Fund for Environmental Protection and Energy Efficiency, which is financed mostly from fees paid by the automotive sector, announced strategy to return part of the Fund revenues back to the automotive sector (probably in form of grants) instead of using them entirely for stabilization of landfills, which is case today. The Fund recently introduced favorable loans for projects aiming to decrease air pollution: loans up to (226 500 EUR) with 5 years repayment period + 2 years grace period or subsidy of interest rate of commercial loans up to 2%.

2.2. Energy efficiency improvements in buildings

With the adoption of Technical regulation concerning heat energy savings and thermal protection in buildings (OG 79/05) in Croatia the level of thermal protection is enlarged and the annual heat energy consumption is limited depending on the form factor of the building and is between 51,31 kWh/m^2 and 95,01 kWh/m^2 for residential buildings and between

16,42 kWh/m^3 and 30,40 kWh/m^3 for non residential buildings. This is the first step of implementing the 2002/91 EC Directive on the energy performance of buildings.

Energy Institute Hrvoje Požar conducted a large number of energy audits of family houses and residential buildings. For each house, according to specific location, infrastructure availability and specific demands, measures for efficient use of energy are calculated with preview of total investment and simple pay-back period.

3. OVERALL ASSESSMENT OF ENERGY EFFICIENCY TRENDS

3.1. Energy consumption

Over the period 1992-2004, the final consumption grew by 3.3% per year (at normal climate). The growth in the final consumption was the most dynamic for the services sector (6,8% per year). The transport sector and the households had lower growth rates (5,7%/ year and 3,9%/year), while the growth rate for the industry was the lowest (0,5%/year). The only sector with negative average growth rate was agriculture (-1,3%/year). The evolution of the final consumption by sector in Croatia is shown in Table 2. Figure 2 presents the final energy consumption by sectors in Croatia.

Table 2. Evolution of the final consumption by sectors (normal climate)

	1992-1996	**1996-2001**	**2001-2004**	**1992-2004**
Industry	-2,2%	1,5%	2,8%	0,5%
Transport	8,6%	3,5%	5,5%	5,7%
Households	7,1%	1,2%	4,2%	3,9%
Services	11,7%	3,7%	5,6%	6,8%
Agriculture	-2,1%	1,2%	-4,3%	-1,3%
Total	4,3%	2,1%	3,9%	3,3%

The industry sector had the highest share in total final energy consumption in 1992 (35%) and in 2004 its share decreased to 24%, because of the dominance of the transport sector (23% in 1992 to 30% in 2004). Share of the households and tertiary consumption increased from 28% to 30% and from 7% to 11% respectively. Final energy consumption of the agriculture sector decreased from 7% in 1992 to 4% in 2004.

Final energy consumption of oil increased from 43% in 1992 to 49% in 2004 (Figure 3). The market share of electricity in the final consumption remains stable (around 20%) together with coal (around 4%) and gas (19%). Share of heat consumption decreased from 6% in 1992 to 4% in 2004 and biomass from 8% to 6% in 2004.

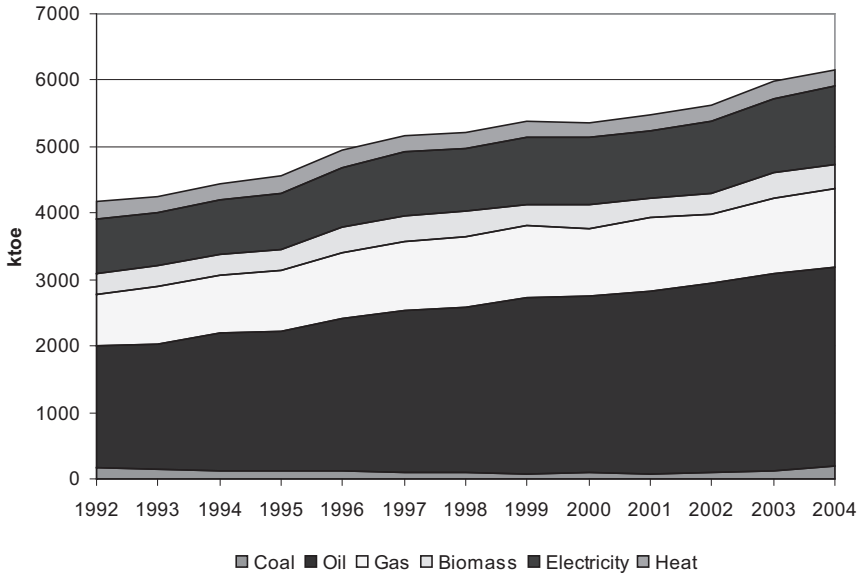

Figure 2. Final energy consumption by sector in Croatia

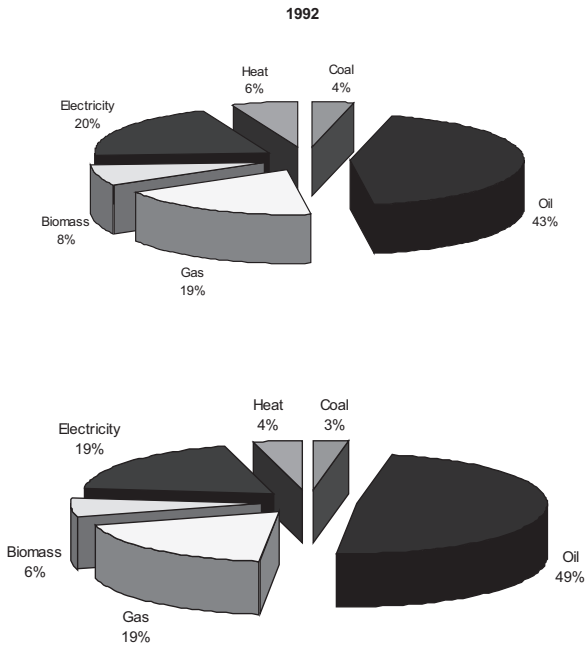

Figure 3. Final energy consumption by energy in Croatia in 1992 and 2004

3.2. Energy intensity

3.2.1. Overall trends

In Croatia, the primary energy consumption developed from 6,61 Mtoe in 1992 to 8,83 Mtoe in 2004, i.e. by 34%. From 1990 to 1992 primary energy consumption increased (because of the war situation in Croatia) and after that it remained relatively stable at the level of 6,82 Mtoe until 1996. Up to 1999 primary energy consumption was increased at the level of 7,97 Mtoe, and in the following year it decreased to be increased again from 2000 to 2003 (8,80 Mtoe) and 2004 (8,83 Mtoe).

There are two general indicators which are often used to characterise the overall energy efficiency of an economy: the primary energy intensity (i.e. the ratio primary consumption over GDP) and the final energy intensity (i.e. ratio final consumption over GDP).

Between 1992 and 2004, the primary energy intensity decreased much more than the final intensity (Table 3): -0,6% per year on average compared to -0,3% per year. The strongest reduction in primary intensity was in the period from 2001 to 2004 (-1,6%/year), and for the final intensity in the same period (-1,1%/year). Energy intensity is the indicator of energy productivity (energy efficiency from an economic view point). The reason for the strongest reduction (fastest decrease) of the primary intensity in the period 1992-2004 lies in an improvement in the efficiency of thermal power generation (higher efficiency).

The development of primary (or final) energy intensity over time is often used as an indicator for the overall energy efficiency of all final consumers. These indicators can be distorted by climatic variations from year to year. The influence of climatic variations on the development of final energy intensity in Croatia is shown in Figure 4 and 5. In years with warmer winters than the long-term average year (in terms of degree days), the climate-corrected final energy intensity is above the real intensity (e.g. 1992, 1994, 1999-2002). The coldest year was 1996 (13% colder than average) so the climate-corrected final intensity is below the real intensity.

Table 3. Variations in primary and final energy intensities in Croatia (normal climate)

	1992-1996	**1996-2001**	**2001-2004**	**1992-2004**
Primary	0,3%	-1,1%	-1,6%	-0,6%
Final	0.7%	-1,0%	-1,1%	-0,3%

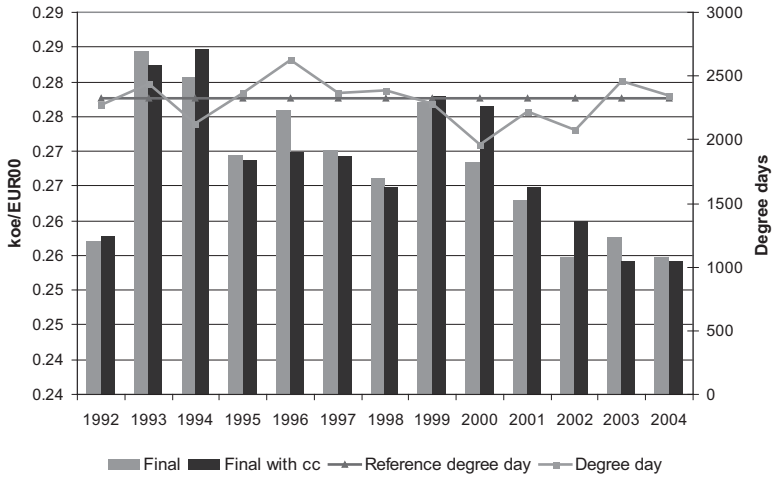

Figure 4. Final energy intensity: actual, with climate corrections and degree-days

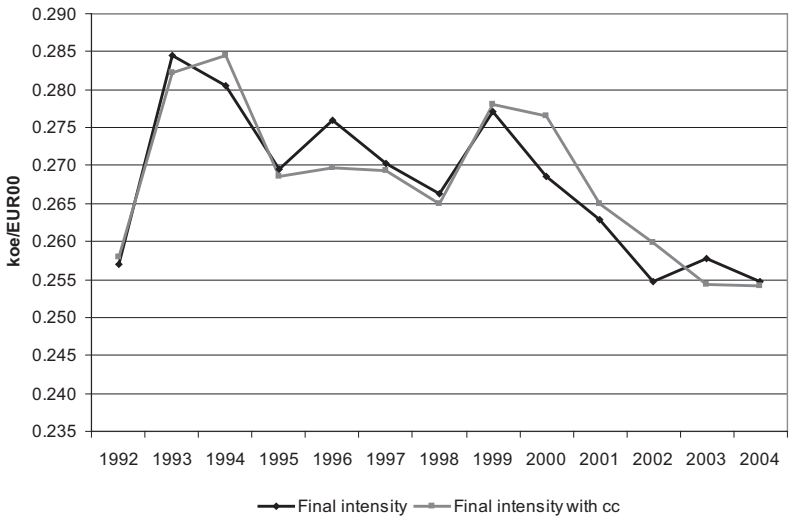

Figure 5. Final energy intensity in Croatia, role of climate variations

The different variations between primary and final intensities are captured by the ratio final to primary intensity (Figure 6). This ratio has increased for Croatia from 63% in 1992 and 1993 to the value of 67% in 1994. This ratio was stable in the period from 1994 to 1996 and after that it increased to 68% from 1997 and remained stable until 2004. The decrease in the final to primary intensity ratio in Croatia in 1992 and 1993 was due not to an increased share of primary energy consumption of consumers themsleves (final energy consumption), but to a growing consumption in the energy sector – losses in energy transformations and energy sector own use.

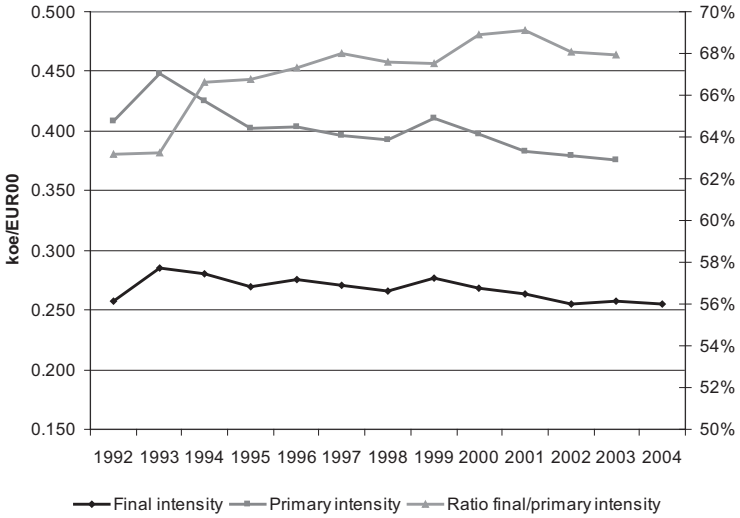

Figure 6: Primary and final energy intensity in Croatia (normal climate)

3.2.2. Industry

The energy intensity (actual intensity) in manufacturing has decreased by -2,2% per year from 1995 to 2004, with the highest decrease in period 1995-2001 (-2,6%/year). The energy intensity at constant 2000 structure (energy intensity without structural changes) for the period 1995-2004 has a negative value is of -2,7% per year. For both energy intensities data, for 1992-1994 period are not available so the results are presented for the most recent period, from 1995 to 2004. The energy intensity in manufacturing is shown in Figure 7.

Table 4. Energy intensity in manufacturing

	1995-2001	2001-2004	1995-2004
Energy intensity	-2,6%	-1,3%	-2,2%
Energy intensity at constant 2000 structure	-3,4%	-1,2%	-2,7%

A part of the reduction in energy intensity in manufacturing may be linked to changes in the structure of the industrial activity, with a reduction of the share of energy intensive branches (primary metals or non metallic minerals that require 29 and 15 times more energy to produce one unit of value added than equipment). In the case of Croatia, there was an increase in energy consumption for non metallic minerals, but the energy consumption for iron and steel branch decreased. The changes in iron and steel occurred due to closing of capacities, not because of energy efficiency improvements.

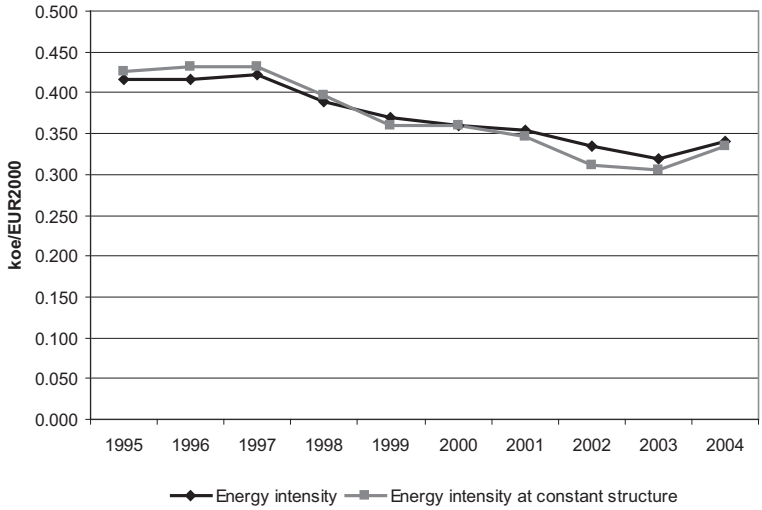

Figure 7. Energy intensity in manufacturing

A steep decrease of energy consumption in the Croatian industry after 1990 can be observed. This is a clear consequence of the war and transition situations. This decline lasted approximately until 1996, after which the consumption took a stable path. It is evident that the electricity consumption practically went down to half of its pre-'90 level and remains constant after 1996.

The consumption for thermal uses – regarded as the sum of consumed gaseous, liquid and solid fuels, and steam and hot water – after drop of more than 35% is slowly increasing.

The biggest change in the energy consumption by branches was for non metallic industry, with increasing share from 26% in 1992 to 35% in 2004 and steel industry with changes from 12% to 2%. The next one is food industry with increasing share from 14% in 1992 to 18% in 2004. Because of the rapid energy decrease in the period from 1990 to 1992, the structure of shares for industrial branches are given starting from 1992.

The only increasing energy intensity is the one in the chemical industry, rating 25%. All other energy intensities of manufacturing branches decreased, for primary metals (-43%), non metallic minerals (-29%), paper (-12%), equipment (-19%), food (-27%) and textile (-42).

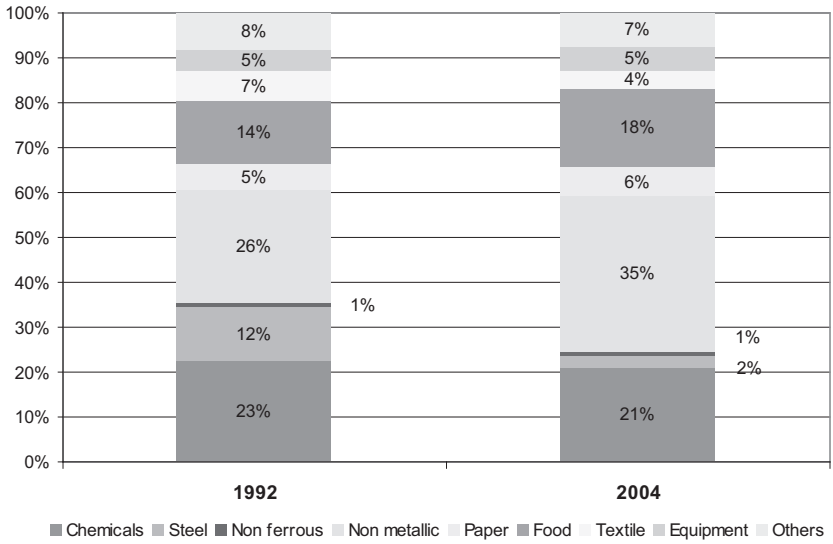

Figure 8. Energy consumption of industry by branch

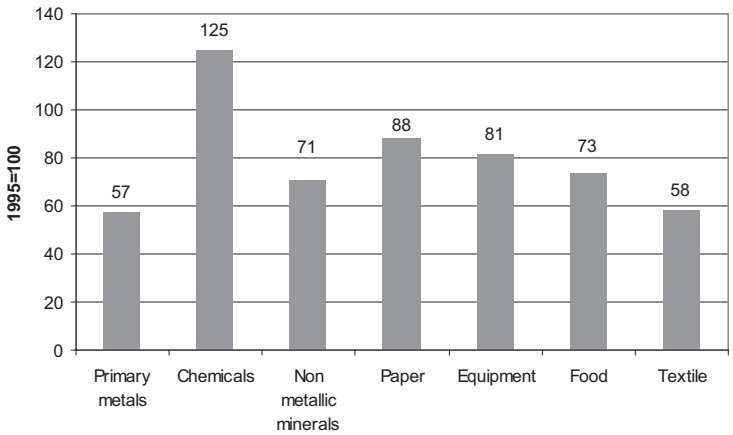

Figure 9. Energy intensities of manufacturing branches (2004, index 100 in 1995)

The unit consumption for all energy intensive products that decreased in 1992-2004, dropped; steel -9,4%/year, cement -2,9%/year, paper -0,7%/year and glass -1,7%/year.

In the 1995-1999 period, the final energy consumption (actual change) increased by 0,3% per year with the growth of added value by 2,3% per year (activity effect), as is shown in Figure 10. In the 1999-2004 period the share of energy intensive branches (chemical industry) was higher. Energy intensity effect (intensity with constant structure and without structural changes) decreased by - 2,7% per year in the period 1995-2004 while the actual intensity (intensity with structural changes) increased by 1,6% peryear in same period (Table 5). Structural effect is calculated as the difference between the regarded energy intensity and the energy intensity at constant structure.

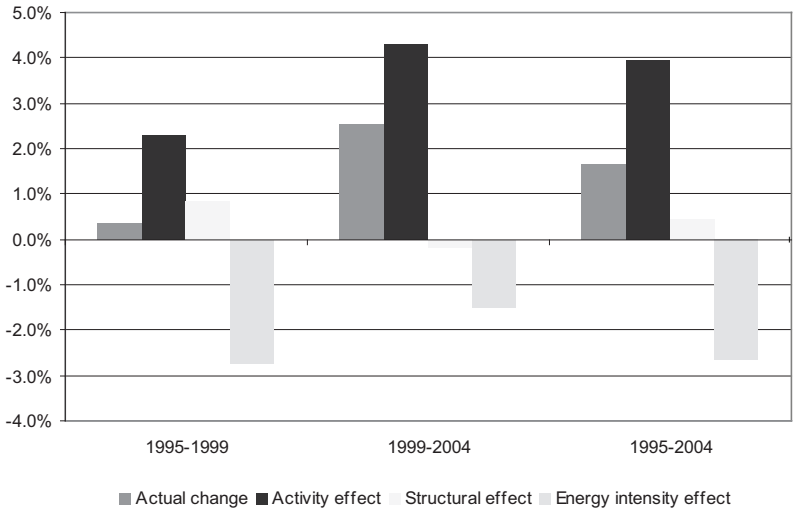

Figure 10. Explanatory factors of the energy consumption of industry

Table 5. Explanatory factors of the energy consumption of industry

	1995-1999	**1999-2004**	**1995-2004**
Actual change	0.3%	2.5%	1.6%
Activity effect	2.3%	4.3%	3.9%
Structural effect	0.8%	-0.2%	0.5%
Energy intensity effect	-2.7%	-1.5%	-2.7%

3.2.3. Transport

Energy Intensity in transport

The stock of cars recorded almost a continous and high growth since 1996 with an average yearly increase of 7,4%. The stock of cars doubled over the period, from 669 760 to 1 337 537.

Also, as in the rest of Europe, there is a large increase, with further upward trend, in a number of new diesel personal cars (overall increased 303%). The share of gasoline cars decreased from 85% in 1992 to 69% in 2004, while share of gasoline cars increased from 14% up to 28% in 2004. The share of CNG and LPG cars doubled, from 2% up to 3%, as it is shown in the following Figure.

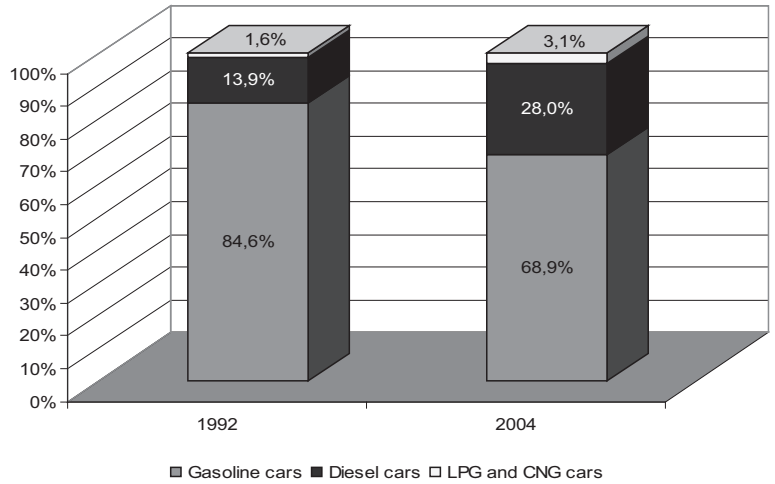

Figure 11. Structure of the cars by fuel type

CNG is at the moment used mainly by the fleet (LDVs) of main gas distribution company of the City of Zagreb, which is also the owner of the only fuelling station in Croatia. Price difference is very favorable, but potential customers consider the price of CNG equipment still too high. Total number of CNG cars in 2004 amounted around 75, while total LPG number was around 41 000.

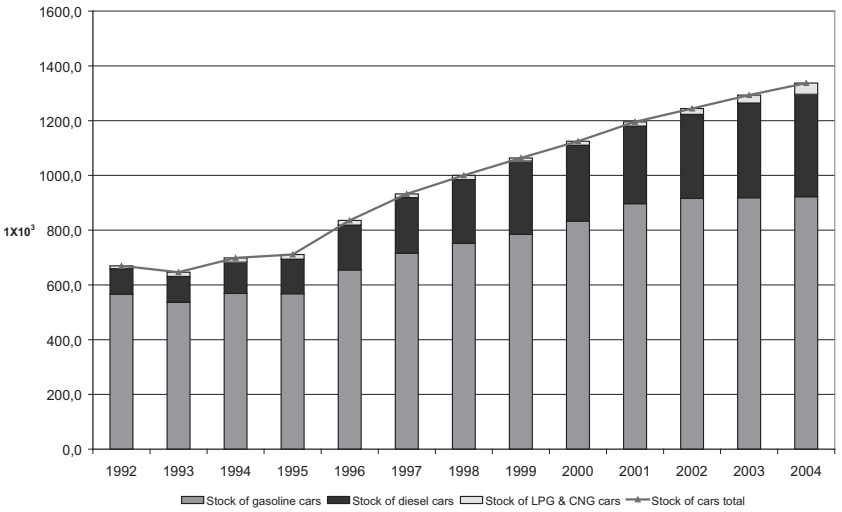

Figure 12. Stock of cars

The registration of new cars increased rapidly since 1996 from 20 000 new cars per year to 70 000 in 2001. It is almost stable since 2001.

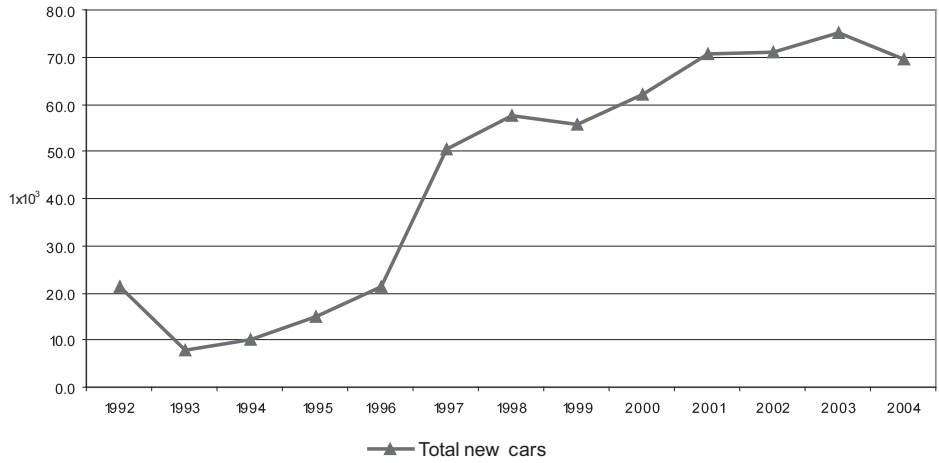

Figure 13. Stock of new cars

The stock of buses slightly increased within 1995 and 1996 (for about 18%) and than remained almost stable.

The stock of trucks and light duty vehicles increased rapidly (211%).

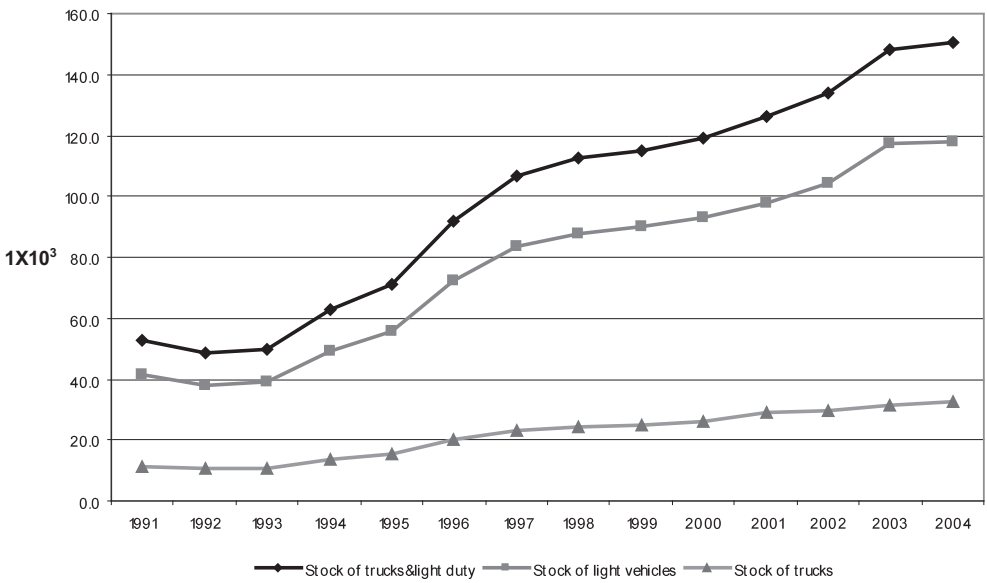

Figure 14. Stock of trucks & light duty vehicles

In the Republic of Croatia, between 1992 and 2004, total energy consumption in the transport sector increased by about 91%, from 0,95 Mtoe up to 1,81 Mtoe with an average yearly growth of 5,6 %. The consumption increased quite linearly over the period.

Road transport represents 87% of total consumption in 1992, while its share increased up to 93% in 2004. Share of rail transport decreased from 5% in 1992 to 3% in 2004, while the

share of the domestic air transport remains stable at 3%.

The share of cars in the road transport consumption slightly inreased over the period, from 62% in 1992 up to 65% in 2004. The biggest change occurred in the share of trucks which increased from 10% in 1992 up to almost 20% in 2004. The share of light vehicles and buses respectively from 19% to 10,5% and for buses from 9% to 4%.

Since 1992, the consumption in road transport increased by more than 100%, with an average annual growth of 6,2%, where such a trend is reasonable due to almost double increase of vehicle stock as well as number of annual passed kilometers.

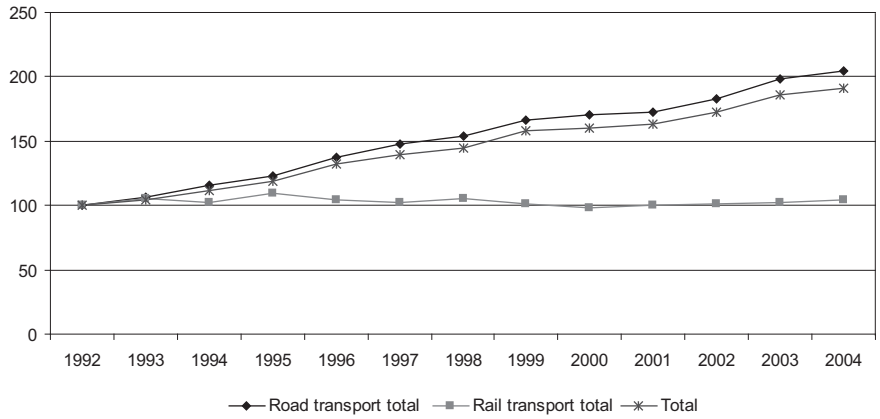

Figure 15. Evolution of the transport consumption by mode

The biggest growth of road traffic in vehicle kilometers can be seen for trucks, diesel cars and light vehicles: trucks by 393%, diesel cars by 389% and light vehicles by 323%. Major reason for such development lies in enormous increase of freight traffic on road in the post war period, since the Republic of Croatia has been passing through the “economy booming”. Buses seem to remain a stable mode of transport all over the period.

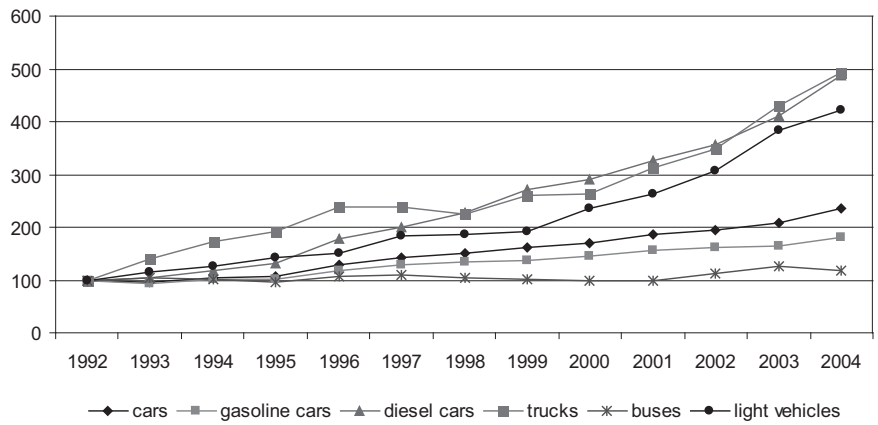

Figure 16. Traffic of road vehicles (in vehicle kilometres)

Final intensity of the transport sector (ratio of the energy consumption to the GDP in constant prices) has increased by 2,4% per year over the period. On the other hand, unit consumption per passenger - km almost remains stable, while unit consumption per tonne - km decreased by 31%.

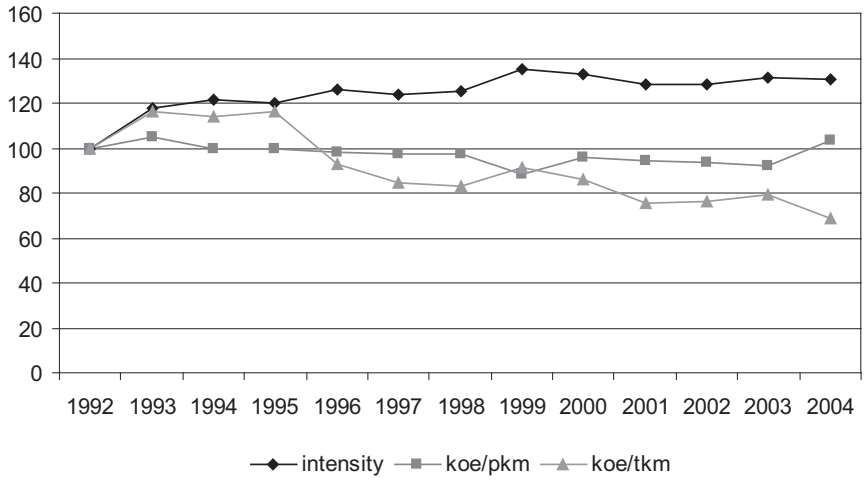

Figure 17. Energy intensity, unit consumption per passenger-km and tone-km

Specific consumption of cars decreased approximately by 9,5% overall, from 9 litres in 1992 to 8,2 litres in 2004. Accordingly, the specific consumption of gasoline cars decreased by 5%, from 9,2 litres to 8,8 litres and diesel cars consumption decreased by 11%, from 7,6 litres to 6,8 litres per 100 km. This trend is explained by increased availability of commercial loans for vehicles to the wider population which led to the huge substitution of old vehicles with new ones (consequently, enhanced vehicles has boosted on the market).

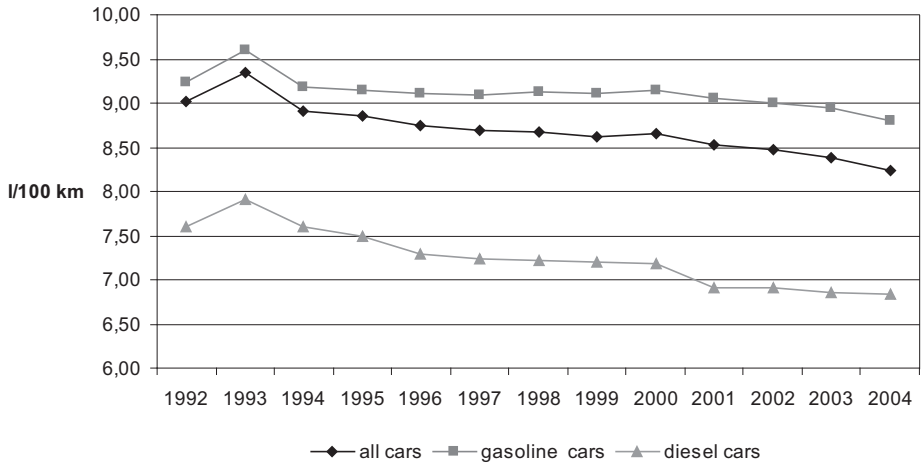

Figure 18. Specific consumption of cars

As for the other types of vehicles, biggest reduction in the specific consumption was obtained by diesel light vehicles (15%).

3.3.1. Households

Between 1992 and 2004, final energy consumption of the Croatian households grew from 1,57 Mtoe to 1,87 Mtoe (not climate-corrected). The increase of energy consumption in 1996 was mainly due to colder weather but also with the increasing living standard, since the population size, the number of households and dwellings did not change much in Croatia during the period.

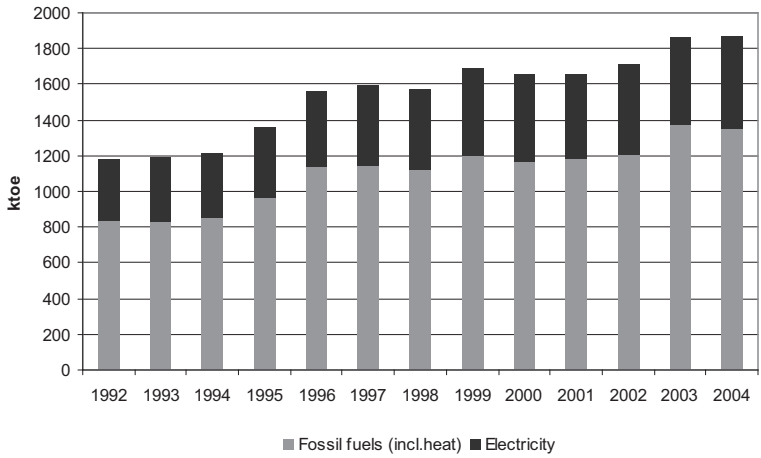

Figure 19. Development of household energy consumption between 1992-2002 (not-climate corrected)

The highest market share in final consumption of households 1992 was for electricity and oil products (29%), and in 2004 the share of electricity increased to 32% and share of oil decreased (27%) (Figure 21). The share of gas increased from 17% in 1992 to 23% in 2004. Biomass consumption decreased from 15% to 11% so the share of heat (from 9% to 7%). Consumption of coal in households is very low (around 1%).

The share of space heating in total energy consumption of households increased from 57% in 1992 to 62% in 2004, as more dwellings have central heating, which requires on average twice as much energy than with room heating. The share of electric appliances and lighting and water heating remained stable (11% and around 12% resepctively) in the period, while the share of cooking decreased from 16% to 12%.

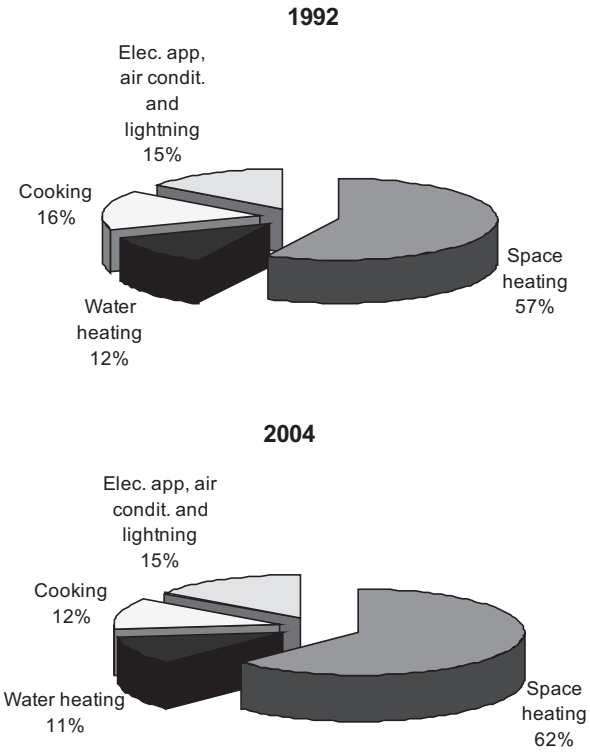

Figure 20. Households energy consumption by end-uses

Figure 21 shows the trends in the average energy consumption per dwelling for all end-uses and space heating (both climate corrected, in toe/dwelling) and for specific uses of electricity (for electrical appliances, air conditioning and lighting, in kWh/dwelling). The average growth rate of the unit consumption per dwelling for all end-uses in the period 1992-2004 was 3,2% peryear, 3,7% per year for space heating and 3,6% per year for specific uses of electricity. The rapid growth of the electricity consumption for electrical appliances, air conditioning and lighting is explained by a larger diffusion of large household appliances and the rapid penetration of air conditioning)[3]. The reason for growth in specific energy consumption for space heating in households was better living standard and increase in share of centrally heated apartments[4].

[3] The share of air conditioned households changed from 2% in 1990 to 24% in 2004 (result from the model). The second influence comes from the increase in number of TV, computers and similar appliances with the average growth rate of 1,6%/year from 1994-2004 (result from the model). The similar growth rate was for refrigerators and freezers.

[4] The share of central heated dwellings changed from 25% in 1994 to 40% in 2004 (results from the model).

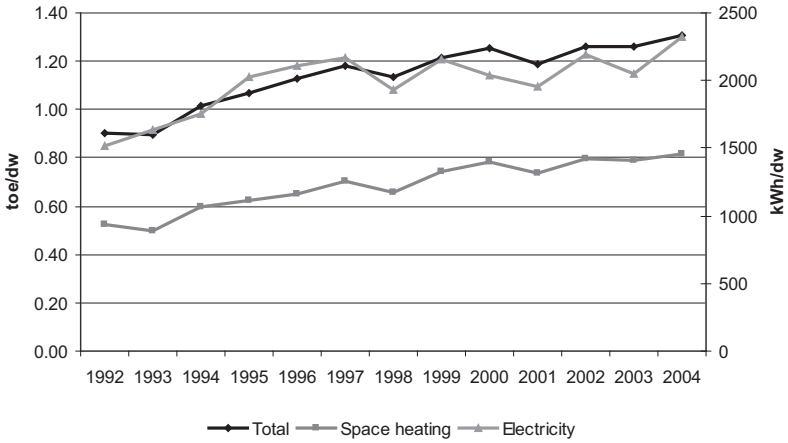

Figure 21. Unit consumption of households in toe/dwelling (total and space heating climate corrected and electrical appliances, air conditioning and lightning)

3.3.2. Services

Electricity has the highest share in energy consumption in service sector with a stable value of 51% during the whole period. The most important changes in the services consumption concern oil and heat; oil increased its market share from 18% to 25% from 1992 to 2004, while there was a decrease for heat from 11% to 6%. The share of gas remained stable at around 18%, while the share of coal is very small (under 1%), as shown in Figure 23.
There are no data available on total energy consumption by sub-sector for the service sector in Croatia, except for electricity consumption. There was almost no changes in share of electricity consumption by sub-sectors. Hotels represents the largest share of the electricity consumpion of the sector (around one third).
Because of statistical disruptions in available data the unit consumption per employee in the service sector is presented for the period 1998-2004, with growth rate of 0,8% per year. The unit consumption for electricity increased with growth rate of 2,4%per year.

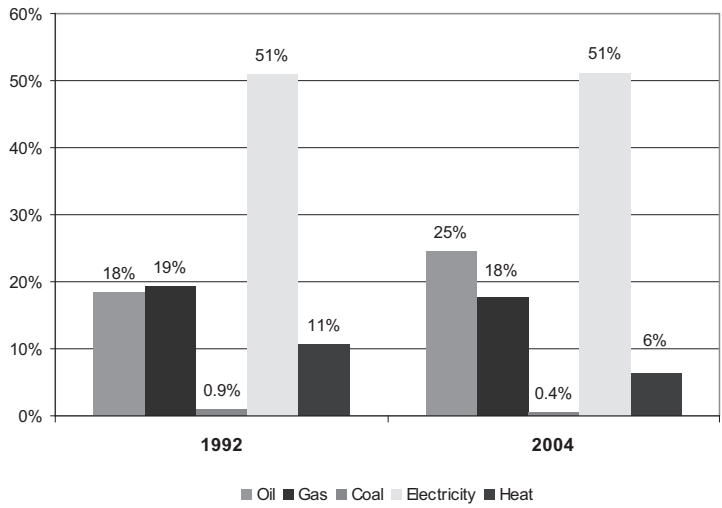

Figure 22. Final energy consumption of services by energy carrier

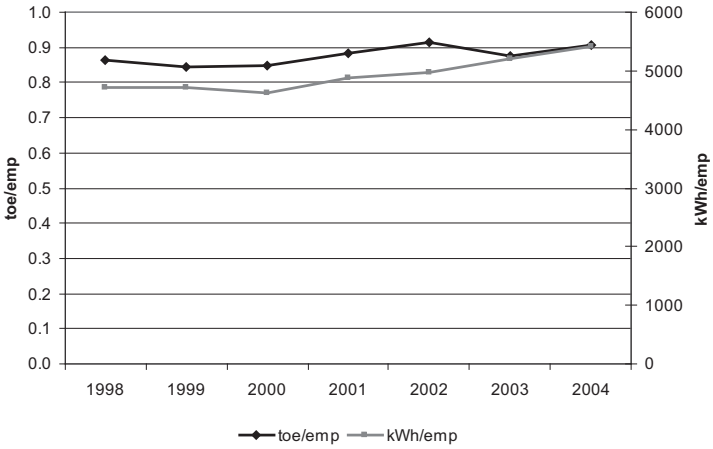

Figure 23. Energy consumption per employee in services (with climate corrections)

The energy intensity of services had different growth rates in the period; 8,2%/year in 1992-1996, 0,0%/year in 1996-2001, 0,6%/year in 2001-2004 and 2,8%/year in 1992-2004. Electricity intensity in services had growth rate of 2,9%/year in 1992-2004.

3.4. Energy efficiency by sector

The improvement in energy efficiency could be observed in all sectors based on the ODEX which calculates technical efficiency improvements. There were energy efficiency improvements for all sectors in Croatia, except in the chemicals and households sectors.

3.4.1. Overall energy efficiency

In the period 1995-2004 the energy efficiency index for the whole economy (ODEX) decreased by 11%, compared to 8% decrease for the EU-25. The industrial sector (cement and paper) and transport sector (rail and trucks & light vehicles) contributed the most to this development.

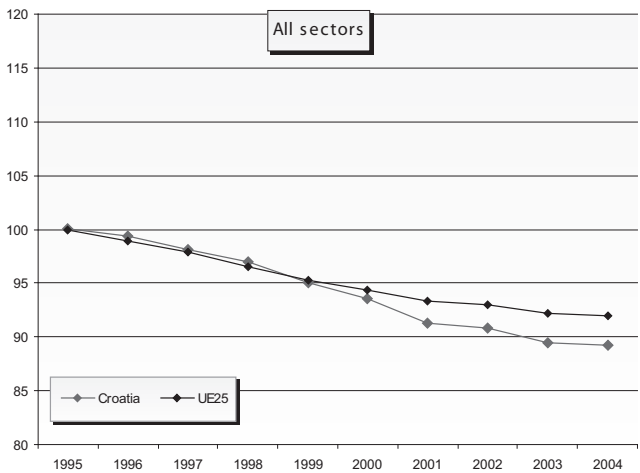

Figure 24. Energy efficiency index for all sectors

3.4.2. Industry

The efficiency in the industrial sector progressed by about 18% in 2004 compared to 1995. The paper and cement branches contributed to decrease the overall industrial efficiency index, because of decrease in specific energy consumption, while chemicals contributed to increase of the efficiency index. The values for Croatia is above the EU-25 value (11%) for energy efficiency improvement in the industry. This index could only be calculated from 1995 because there are not available data for the industrial sector from 1990.

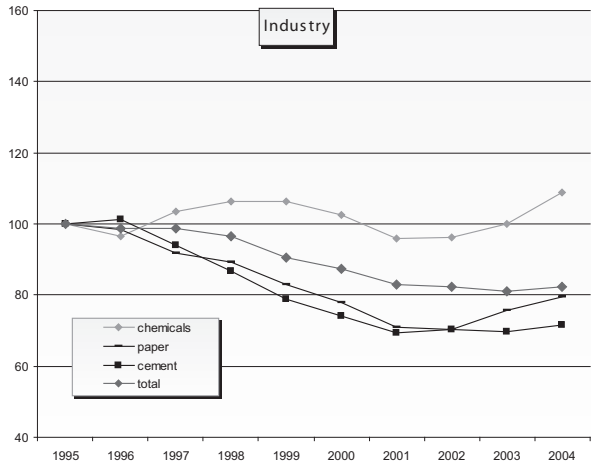

Figure 25. Energy efficiency index for industry

3.4.3. Transport

The energy efficiency index for transport sector improved by 15% in 2004 compared to the base year 1995, which is above the EU-25 level of 8%. The highest efficiency improvements was for trucks and light vehicles (25%), while cars had smaller improvement (6%).

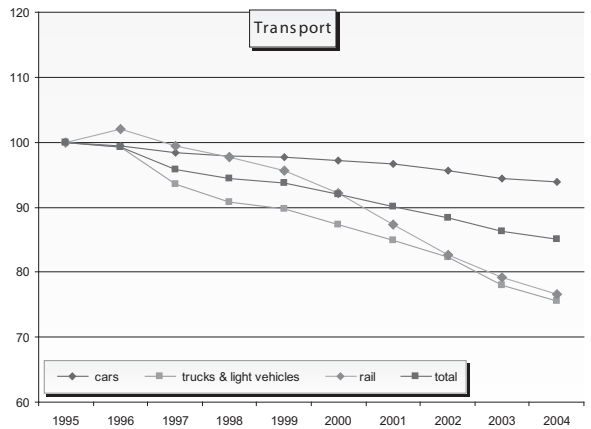

Figure 26. Energy efficiency index for transport

3.4.4. Households

Between 1995 and 2004 the technical energy efficiency index in the households sector was constant, while the trend in the EU-25 showed energy efficiency index improvement for 7%; households sector in Croatia has no improvement of energy efficiency. The reason for this is increased specific energy consumption for heating per dwelling in the period 1995-2004 (with the exception for years 1998 and 2001 with decreased energy consumption due to climate conditions). In the period 1995-2004 energy for heating increased, while the number of households first increased (until 2000) and after that remained stable.

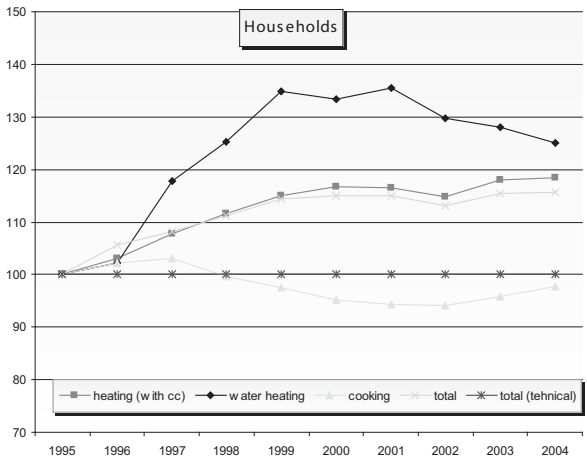

Figure 27. Energy efficiency index for households

4. CO_2 EMISSIONS

The ODYSSEE programme considers two types of emissions: direct emissions and total emissions. Direct CO_2 emissions correspond to emissions generated at level of the consumers by the combustion of oil, gas and coal. Total CO_2 emissions includes in addition to the direct emissions, the indirect emissions generated at the level of power plants by the production of electricity consumed in each of the end-use sectors; total emissions show the responsibility of each end-use sector in the total emissions of the country.

Direct CO_2 emissions

Direct CO_2 emissions (emissions from final consumers) in Croatia have increased by 54% since 1992. The highest increase was in transport sectors (99%) and after that in households, services and agriculture sectors (60%). The emissions increase in the industry sector was 12%.

Total CO_2 emissions

Total CO_2 emissions in Croatia have increased by 44% since 1992. This change differs from the change in direct CO_2 emissions because of emissions impact from electricity generation mix.

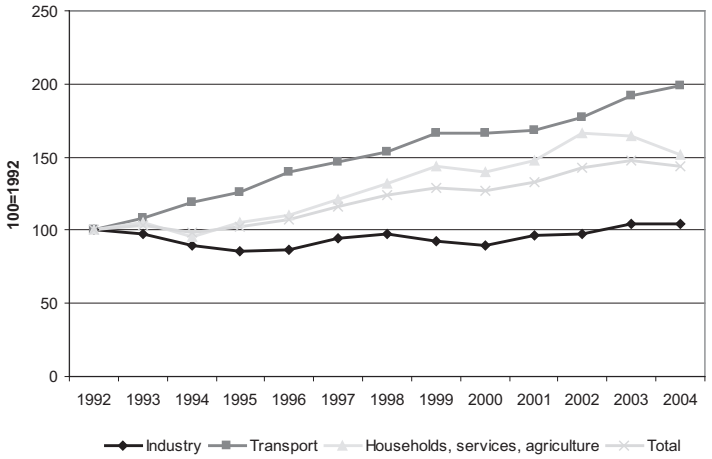

Figure 28. Total CO_2 emissions by sector (1992=100)

5. CONCLUSION

Between 1992 and 2004, the primary energy intensity decreased much more than the final intensity:

-0,6% per year on average compared to -0,3% per year. The strongest reduction in primary intensity was in the period from 2001 to 2004 (-1,6%/year), and for the final intensity in the same period (-1,1%/year).

The energy intensity (actual intensity) in manufacturing has decreased by -2,2%/year from 1995 to 2004, with the highest decrease in period 1995-2001 (-2,6%/year). The reason for the intensity decrease were the changes in structural components.

Final intensity of the transport sector (ratio of the energy consumption to the GDP in constant prices) increased by 2,4% per year over the period. On the other hand, the unit consumption per passenger - km almost remained stable, while unit consumption per tonne - km decreased by 31%.

In the households sector, the average growth rate of the unit consumption per dwelling for all end-uses in the period 1992-2004 was 3,2% per year, and 3,7%epr year for space heating and 3,6% per year for specific uses of electricity.

The unit consumption per employee in the services sector fluctuated in the period 1998-2004, with growth rate of 0,8% per year. For electricity, the unit consumption increased with growth rate of 2,4% per year.

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