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# **Energy Efficiency Policies and Measures in Croatia**

**Monitoring of Energy Efficiency in EU 27,  
Norway and Croatia (ODYSSEE-MURE)**

Energy Institute Hrvoje Pozar

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## **Contacts:**

**Helena Bozic**  
**Branko Vuk**  
**Dino Novosel**

Energy Institute Hrvoje Pozar, Savska cesta 163, 10000 Zagreb, Croatia

Tel.: +385 1 6326 100 / Fax: +385 1 6040 599

E-Mail: [hbozic@eihp.hr](mailto:hbozic@eihp.hr), [bvuk@eihp.hr](mailto:bvuk@eihp.hr), [dnovosel@eihp.hr](mailto:dnovosel@eihp.hr)

[www.eihp.hr](http://www.eihp.hr)

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# 1 Executive Summary

This report presents an analysis of energy efficiency trends in Croatia on the basis of energy efficiency indicators based on the ODYSSEE methodology. This analysis focuses on the period 1992-2007. Most of data are available for this period; in all calculations where this is not the case, the indicators and comparisons are made with available data.

The main results and conclusions of the report are:

- Over the period 1992-2007, the final energy consumption has grown up by 2.9%/year. The highest growth rate was in tertiary (services) sector of 5.6%/year and in transport sector (5.6%/year) and households (2.5%/year). Industry sector had the smallest growth rate in this period (0.8%/year), while agriculture had negative growth rate (-0.8%/year).
- The primary intensity decreased more than the final intensity: -1.3%/year compared to -0.9%/year.
- In the period 1995-2007 energy efficiency of the whole economy, as measured with the energy efficiency index (ODEX) improved by 12% ,compared to 14% for the EU-27.

## 2 The Background to Energy Efficiency

### 2.1 Overall economic context

Growth of the gross domestic product in Croatia for the period from 1995 to 2007 totalled 4.1% (Table 1). The fastest growth was achieved in the period from 2005 to 2007 (5.1%), while growth in the period from 1995 to 2000 was slowest and totalled 3.3%.

Industrial activities measures in terms of value added (VA) increased at an average annual rate of 4.9%. From 1995 to 2000, VA in industry increased at an average annual rate of 4.7%, while after 2000, this growth was 5%. VA in agriculture and fisheries grew markedly slower, with an average annual growth rate of 1.7%, while the average annual rate in the tertiary sector from 1995 to 2007 was 4.1%. Private consumption increased only slightly slower, with an annual average rate of 4%.

Figure 1 shows the development of the real value for the GDP, VA of industry, VA of agriculture and fisheries, VA of the tertiary sector and private consumption, in millions €2000.

Table 1 Economic growth in Croatia

% per year	1995-2000	2000-2005	2005-2007	1995-2007
GDP	3.3	4.5	5.1	4.1
VA of industry (section C + D + E + F)	4.7	5.0	5.0	4.9
VA of agriculture and fishing	1.6	1.7	1.8	1.7
VA of tertiary sector	3.1	4.6	5.6	4.1
Private consumption	2.5	5.3	4.8	4.0

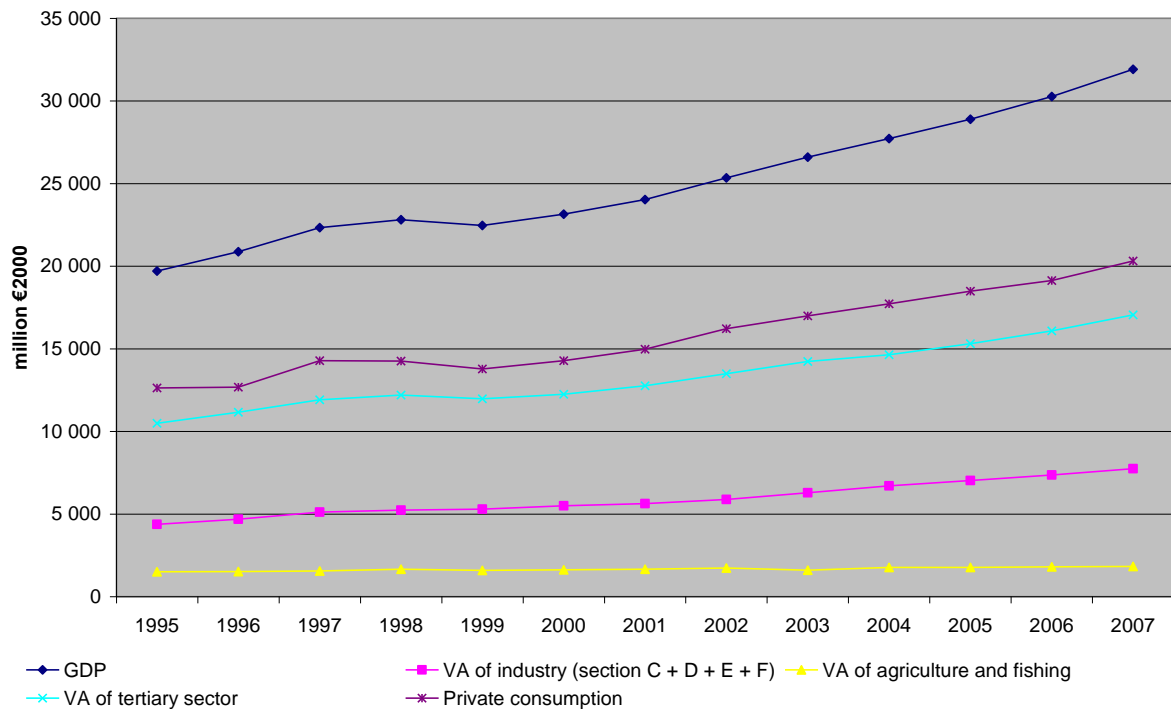


Figure 1 Macro-economic development in Croatia: 1995-2007

## 2.2 Energy consumption trends : by fuel and by sector

Total energy consumption in Croatia (Figure 2) has increased at an average annual rate of 2.7 percent. The fastest growth in consumption was achieved in the period from 2000–2005, when the growth rate of consumption was 3.4 percent. The fastest growth of consumption was seen in coal and coke (11.7% per year), imported electrical energy (5.1% per year) and natural gas (2.8% per year). Hydrological conditions were such that the production of hydroelectric power was reduced at an annual rate of 1.5%. The highest share in total energy consumption is in liquid fuels and natural gas (50.4% and 28.8% in 2007, respectively). The share of other forms of energy were much lower (coal and coke 7.4%, imported electrical energy 5.9%, hydroelectric energy 4.1% and biomass 3.5%).

## 7 Energy Efficiency Policies and Measures in Croatia in 2007

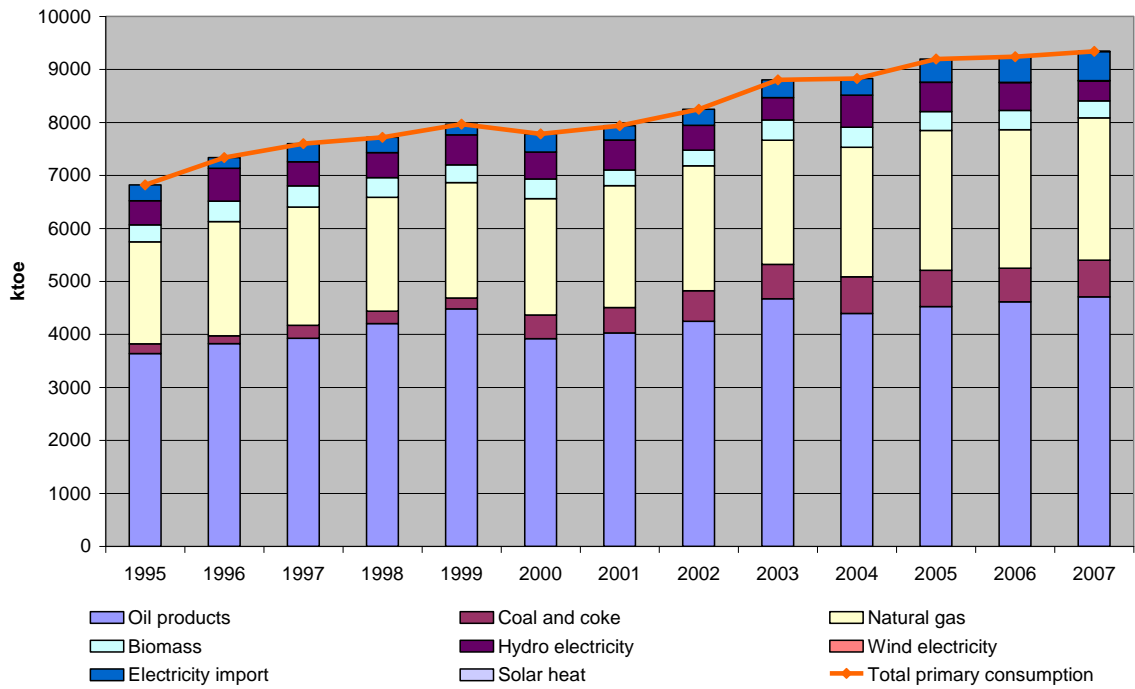


Figure 2 Total primary energy supply in Croatia

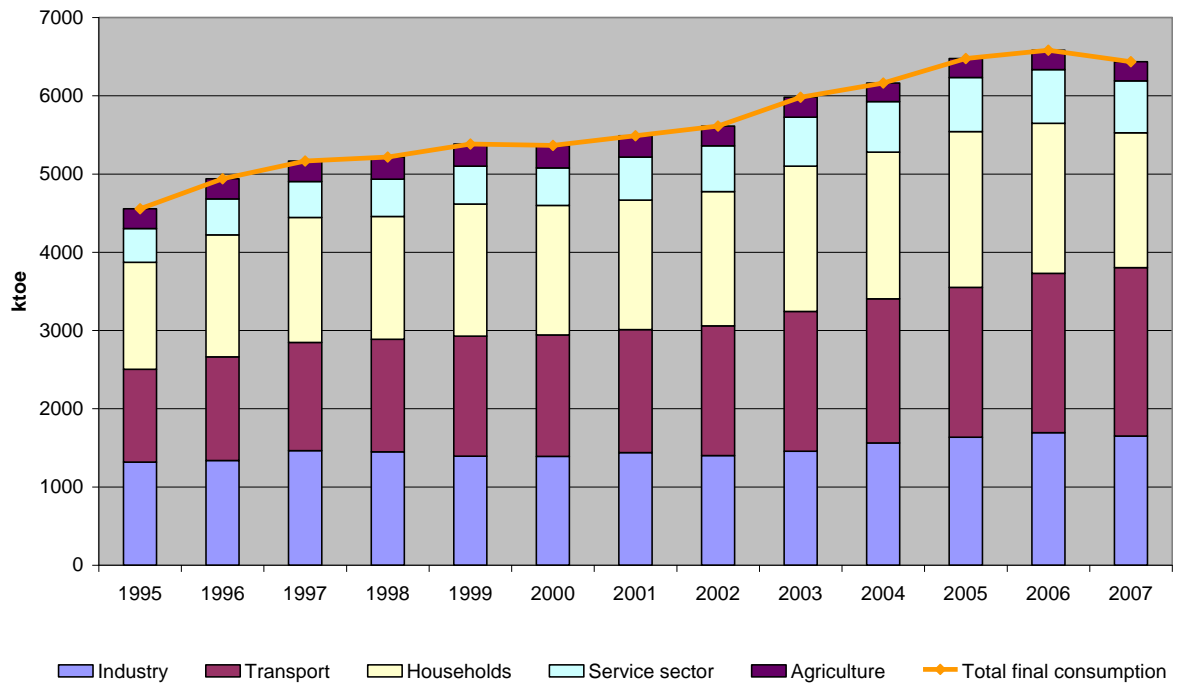


Figure 3 Final energy demand in Croatia by sector

Final energy demand (Figure 3) in the period from 1995 to 2007 increased at an average annual rate of 2.9 percent. The fastest growth of demand was seen in the period from 2000 to 2005, while a slight reduction in demand was seen in the period to 2007. The fastest trend in demand occurred in transport (5.1% per year) and in the services sector (3.7% per year). Final energy demand in industry and households was increased with an average annual rate of 1.9%, while energy demand in agriculture dropped at an average annual rate of 0.3%.

In the observed period, the share of transport was increased, from 26% to 33.5%, thus making transport the largest share of final energy demand. The share of the services sector was also increased, to 10.3% in 2007. The share of households, industry and agriculture was reduced, and at the end of the observed period totalled 26.8%, 25.6% and 3.8%, respectively.

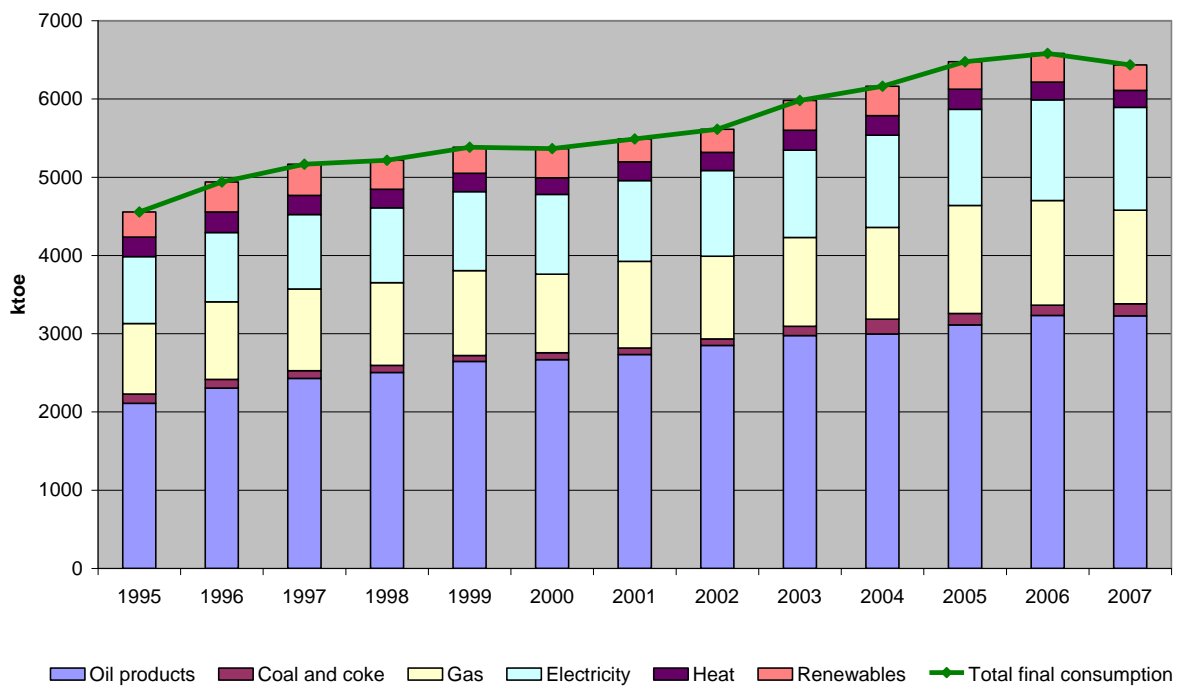


Figure 4 Final energy demand in Croatia by energy forms

With regard to the final demand of individual energy forms (Figure 4), it can be observed that the fastest growth of consumption was in petroleum derivatives and electrical energy (3.6% per year). The final demand of natural gas and coal grew at an average

age annual rate of 2.4% and 2.3% respectively, while the demand of renewable energy sources saw minimal growth, with an average annual rate of only 0.1%. Demand of remote heat declined at an average rate of -1.1%.

## **2.3 The policy background to energy efficiency**

Overall energy policy framework in Croatia is determined by the signed international agreements and political determination to join the European Union as soon as possible<sup>1</sup>.

In the international context, important documents are Energy Charter Treaty, Energy Community, UNFCCC and Kyoto Protocol as well as energy legislation of the European Union (EU).

Croatia has signed Energy Charter Treaty in 1994, ratified it in 1997 (OG 15/97) and in 1998 the Government has confirmed the Protocol on Energy Efficiency and Related Environmental Aspects - PEEREA (OG 7/98). PEEREA requires its Signatories to formulate energy efficiency strategies and policy aims, to establish appropriate regulatory frameworks and to develop specific programmes for the promotion of efficient energy use. It also requires developing programmes for reduction of adverse environmental effects from energy sector.

Treaty establishing Energy Community was concluded on 25 October 2005 and it established an integrated market in electricity and natural gas in 33 European countries. The tasks of the Energy community are to enhance the security of supply of the single regulatory space by providing a stable investment climate in which connections to Caspian, North African and Middle East gas reserves can be developed, to improve environmental situation and energy efficiency of the energy sector, to foster the use of renewable energy sources and to develop network energy market competition on a broader geographic scale.

Croatia ratified UNFCCC in 1996, while Kyoto Protocol was ratified in 27 April 2007. Croatia is now obliged to reduce its emissions 5% in relation to the base year over the commitment period 2008-2012 and energy efficiency measures are expected to play crucial role in fulfilment of these obligations.

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<sup>1</sup> Source: Energy Efficiency Master Plan for Croatia 2008-2016, [www.energetska-efikasnost.undp.hr](http://www.energetska-efikasnost.undp.hr)

One of the basic political objectives of the Republic of Croatia is accession to the EU. Currently, Croatia has a status of candidate country and is undergoing the process of screening and harmonisation with EU's policy framework. Therefore, it is important that Croatian policy framework is consistent with legislation of EU.

In the field of energy efficiency this EU policy framework covers following areas:

- End-use efficiency and energy services
- Buildings
- Minimum efficiency in energy using products – Eco design
- Domestic Appliances – Labelling
- Office Equipment – Energy Star Programme
- Combined Heat and Power

There are also requirements for implementation of environmental management systems such as Eco Management and Audit Scheme (EMAS) and ISO-14000 standards. In addition, the EU requires each Member State to have active policies for the promotion of energy efficiency and renewable energy although the design and implementation is mainly the responsibility of the individual member states.

Within this international context Croatia is required to have energy policy that should also include energy efficiency policy.

Croatian overall energy policy is formulated in Energy Sector Development Strategy of the Republic of Croatia (OG 38/02). The Strategy has the following objectives:

- energy efficiency increase
- security of energy supply
- diversification of energy sources
- utilisation of renewable resources
- realistic energy prices, energy market and private entrepreneurship development
- environmental protection

However, it has to be emphasised that Strategy is covering the time period until 2030 and there are many uncertainties related to the development scenarios. Even predictions until 2010 are not considered to be correct any more. The conclusion is that Strategy is outdated. Thus, it is strongly recommended to update the Strategy.

Legal framework for energy sector in Croatia is defined through package of energy laws that consist of the following primary legislation: Energy Act, Act on Electricity Market, Act on Gas Market, Act on Oil and Oil Products, Act on Production, Distribution

and Supply of Heat and Act on Regulation of Energy Activities. The main issues regarding energy efficiency covered and prescribed within these acts are described hereafter.

The key legal document for Croatian energy sector is Energy Act (OG 68/01, 177/04, 76/07). It names the Strategy as the basic energy policy document and defines the role of national energy programmes. It also provides the basis for establishment of Environmental Protection and Energy Efficiency Fund, which will participate in the financing of national energy programmes. Important is that this law leaves the possibility for establishment of agency for energy efficiency and renewable energy sources. Furthermore, in the Energy Act it is explicitly stated that efficient use of energy is in the interest of the Republic of Croatia.

Programmes for rational use of energy should be developed by the Government for the national level and by local authorities for regional and local level. Energy subjects are obliged to inform their customers at least once a year about trend of their energy consumption and are obliged to stimulate customers to use energy in the most efficient manner. This Act also prescribes a legal obligation for energy efficiency labelling of appliances. It also provides the regulatory basis for the promotion of renewable energy sources and cogeneration and prescribes that Minister of economy is responsible for set out the Rulebook on the use of renewable energy sources and cogeneration. Furthermore it regulated the energy prices, which can be free or regulated. Regulated price is determined in tariff systems, which have to be based on reasonable costs of operation and environmental protection and they have to stimulate mechanisms for energy efficiency improvements and demand management including the usage of renewable energy sources. Tariff system for electricity produced from renewable energy sources and cogeneration determines the right of the producer to the incentive price, which market operator pays for the delivered electricity.

The Act on Electricity Market (OG 177/04, 76/07) defines the organisation of the electricity market, including tariffs and eligible customers. It defines the status of eligible producers and sets the legal obligation to purchase electricity produced by eligible producers. Conditions for gaining the status of eligible producer should be defined by special by-law prescribed by the Minister. It also states that eligible producers are entitled to the incentive price defined in Tariff system for electricity produced from renewable energy sources and cogeneration. The compensation for promotion of renewable energy sources and cogeneration paid by all customers collects the Market Operator and distributes it to the eligible producers according to Tariff system. Transmission and distribution systems operators are obliged to take over all electricity produced from eligible producer. The minimum obligatory share of renewable energy sources and cogenera-

tion in electricity production is determined by special Government ordinance. Furthermore, electricity supplier has a legal obligation to inform its customers at least once a year about the share of energy sources in the mix they use for satisfying customers' needs and to direct them to existing information sources where there is publicly available information on environmental influences in sense of CO<sub>2</sub> emissions and radioactive waste that are consequences of electricity production.

The Act on Gas Market (OG 40/07) defines the status of eligible customer. In this category belong the customers that use gas for simultaneous production of electricity and heat, with no regard to the annual consumption of gas.

The Act on Production, Distribution and Supply of Thermal Energy (OG 42/05) states that cogeneration plants have the priority in selection of solutions for new production objects. Energy subject that uses cogeneration and waste, bio-waste or renewable energy sources for heat production can gain the status of eligible heat producer. The Minister is prescribing the Rulebook which determines the conditions for gaining the status of eligible producer. Still, in Croatia is the major problem metering and billing of heat consumption from district heating systems. The Act gives the right to the owner of the flat in the building that is built before this law and has the common heat meter to install own heat meter. For that, the owner has to have the approval of heat distributor. If the approval is denied, the complaint can be referred to the HERA and its decision is final. The costs of the installation of individual metering and billing will be prescribed by the special Regulation to be set up by the Minister. Also it is important to adopt the Ordinance on attaining the status of an eligible heat producer, which will trigger the use of renewables (solar, biomass and geothermal) in the heating systems.

The Act on Regulation of Energy Agency (OG 177/04, 76/07) establishes the Croatian Energy Regulatory Agency (HERA) as an independent legal entity and defines its roles and responsibilities. Among others, HERA's responsibility is to collect and analyse data from energy subjects, publishing information and data on energy efficiency and energy use and to participate in definition of energy policy.

There are also a number of secondary legislation (by-laws) that regulates energy efficiency (including cogeneration and renewables). All of them are implementing legislation that arose from the above described primary legislation acts. Furthermore, through this secondary legislation actual but still only partial harmonisation with EU legal framework for energy efficiency is accomplished.

### 3 Overall Assessment of Energy Efficiency Trends

#### 3.1 Overall trends in energy intensity

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 energy consumption over GDP) and the final energy intensity (i.e. ratio final energy consumption over GDP).

Between 1995 and 2007, the primary energy intensity decreased much more than the final intensity (Table 2): -1.4%/year on average compared to -1.1%/year. The strongest reduction in primary intensity was in the period from 2005 to 2007 (-4.1%/year), and for the final intensity in the same period (-5.2%/year). Energy intensity is the indicator of energy productivity (energy efficiency from an economic view point). The reason for strongest reduction (faster decrease) of primary intensity in the period 1995-2007 comes from an improvement in the efficiency of energy transformation sector (higher efficiency), from lower share of energy sector own use, from lower share of transport and distribution losses and from lower share of non energy demand.

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 5 and 6. 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 (eg 1999, 2000, 2001, 2002, 2006 and 2007). The coldest year was 1996 (13.6% colder than average) so the climate corrected final intensity is below the real intensity.

Table 2 Variations in primary and final energy intensities in Croatia (normal climate)

	<b>1995- 2000</b>	<b>2000- 2005</b>	<b>2005- 2007</b>	<b>1995- 2007</b>
Primary intensity	-0.6%	-1.1%	-4.1%	-1.4%
Final intensity	0.1%	-0.7%	-5.2%	-1.1%

Energy Efficiency Policies and Measures in Croatia in 2007

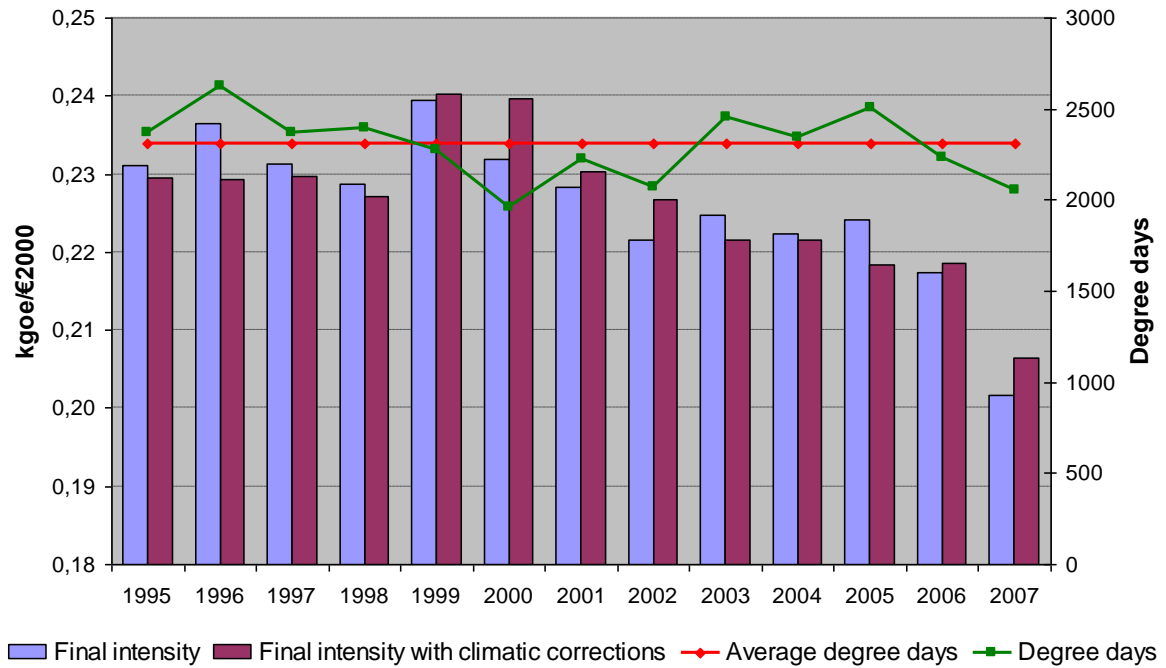


Figure 5 Final energy intensity: actual, with climate corrections and degree-days

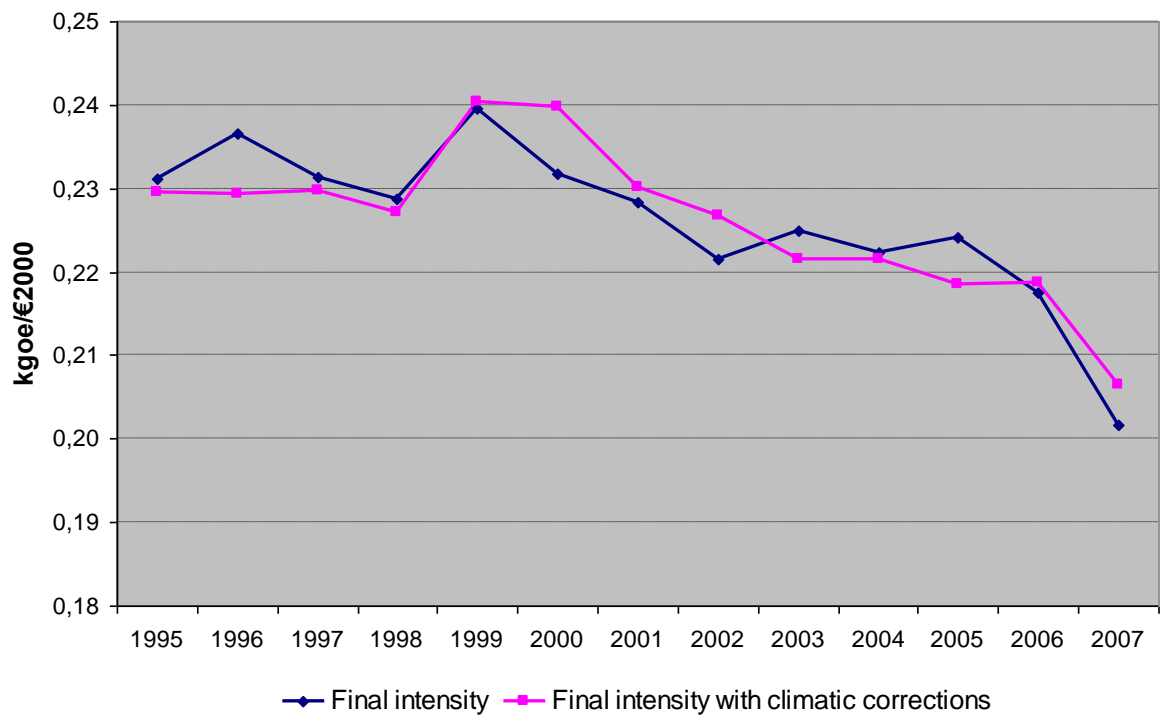


Figure 6 Final energy intensity in Croatia, role of climate variations

The different variations between primary and final intensities are captured by the ratio final to primary intensity (Figure 7). This ratio has increased for Croatia from 66.8% in 1995 to the value of 68.9% in 2007 with an average annual growth rate of 0.3%. The fastest growth was achieved between 1995 to 2000, 0.6% per year. In some years reduction of this ratio was achieved (1998, 1999, 2002, 2003, 2007). The reason for increasing of the ratio final to primary intensity in Croatia was because the decreased share of losses in energy transformations, energy sector own use, losses in transport and distribution of energy and non energy use.

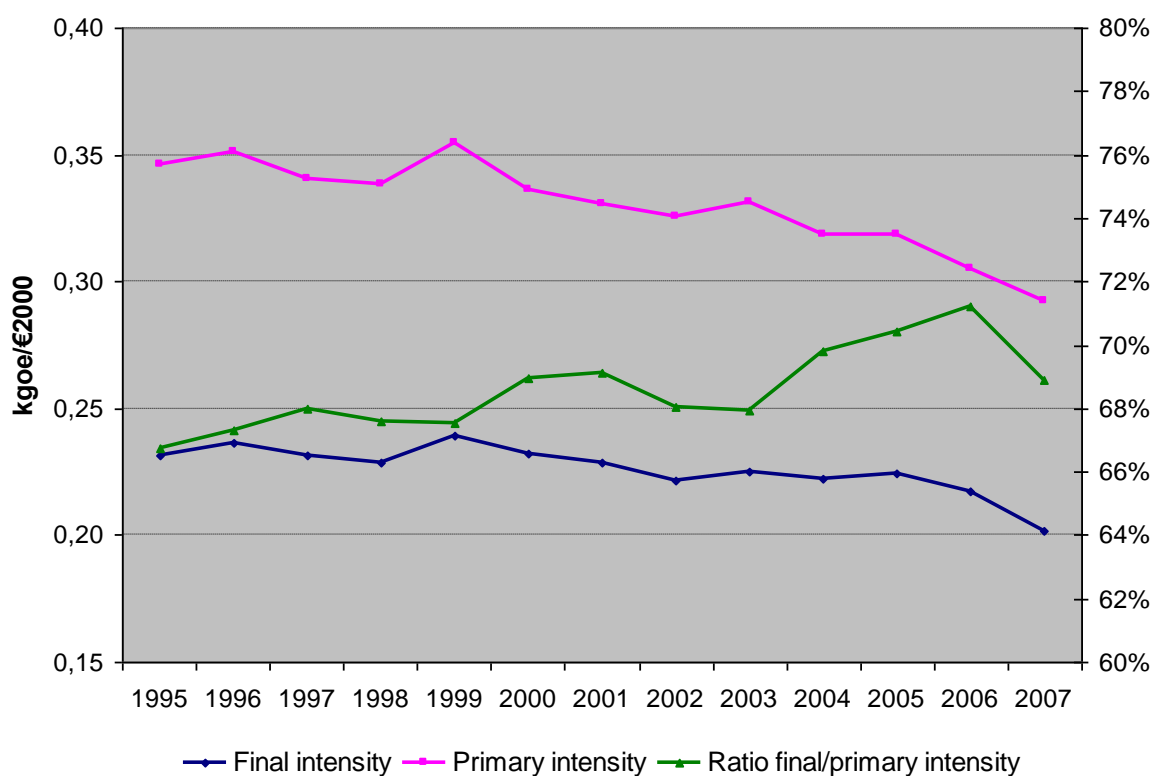


Figure 7 Primary and final energy intensity in Croatia (normal climate)

## 3.2 Industry

The premise for the analysis of improving efficiency in energy consumption in industry is the development of the structure and demand of energy sources in the preceding period. Energy demand is monitored in the following industrial branches:

- Food, beverage and tobacco (Nace 15 - 16)
- Textiles, clothing, leather (Nace 17 +18+ 19)
- Wood, wood products (Nace 20)
- Paper, pulp and printing products (Nace 21 - 22)
- Pulp and paper (Nace 21)
- Chemicals (Nace 24 )
- Non metallic minerals (Nace 26)
- Steel (Nace 27.1 + 27.2 + 27.3 + 27.51+27.52)
- Non ferrous metals (Nace 27.4+27.53+27.54)
- Machinery and metals products (Nace 28-33)
- Fabricated metals (Nace 28)
- Transport equipment (Nace 34-35)
- Other manufacturing (Nace 25+33+36+37)
- Rubber and plastics (Nace 25)
- Non-energy mining (Nace 13 - 14)
- Construction (Nace 45)

In addition to these industrial branches, energy demand is also monitored in the production of energy intensive products, such as:

- Cement
- Glass (Nace 26.1)

Aluminium

Ferroalloys

Figure 8 shows the development of energy demand in individual industrial branches. The average annual growth rate of energy demand in the processing industry in the period from 1995 to 2007 was 1.5%. Energy demand was increased in the majority of industrial branches, with the exception of the iron and steel industry, and the textile industry, which saw a reduction in energy demand. The increasing trend of energy consumption in individual industrial branches was of varying intensity, with growth rates ranging from 0.5% for the chemical industry to 6.6% in the transport industry.

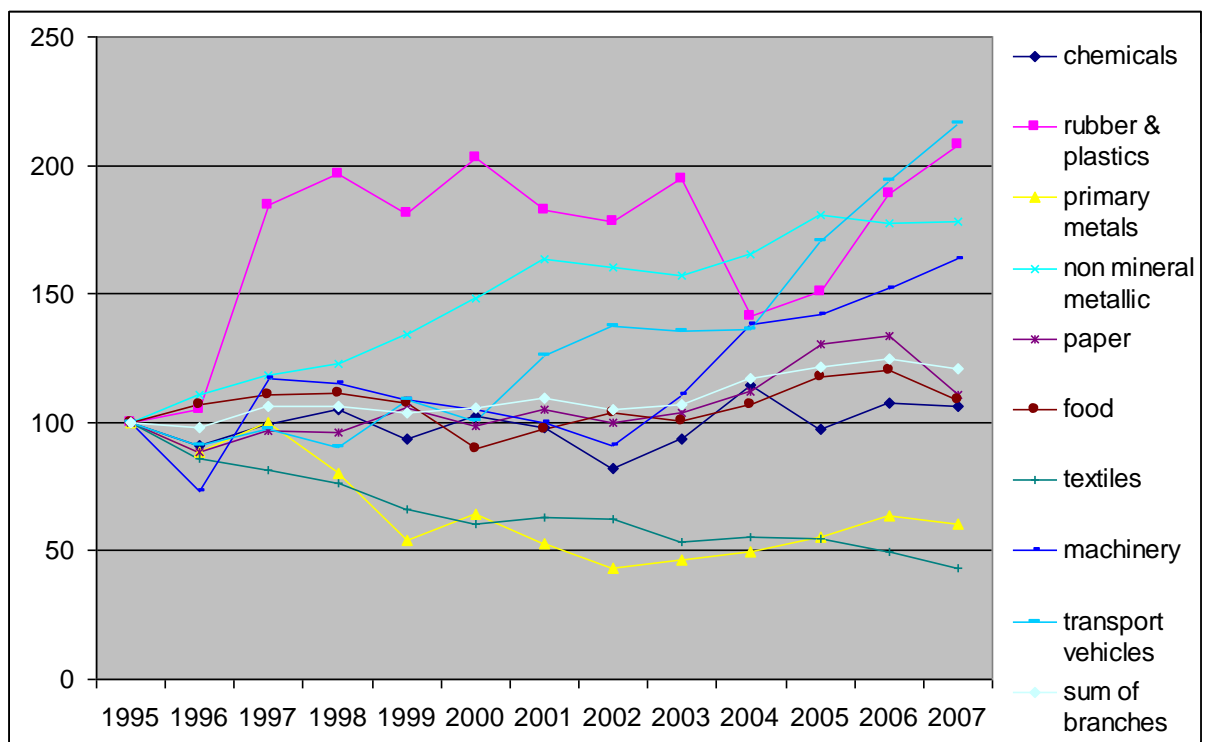


Figure 8 Final energy demand by industrial branches in Croatia

The stated development of growth of energy demand in individual industrial branches is due to significant structural changes in the share of individual industrial branches in the total energy demand in the processing industry. Figure 9 shows the share of individual industrial branches in the initial and final year of the observed period.

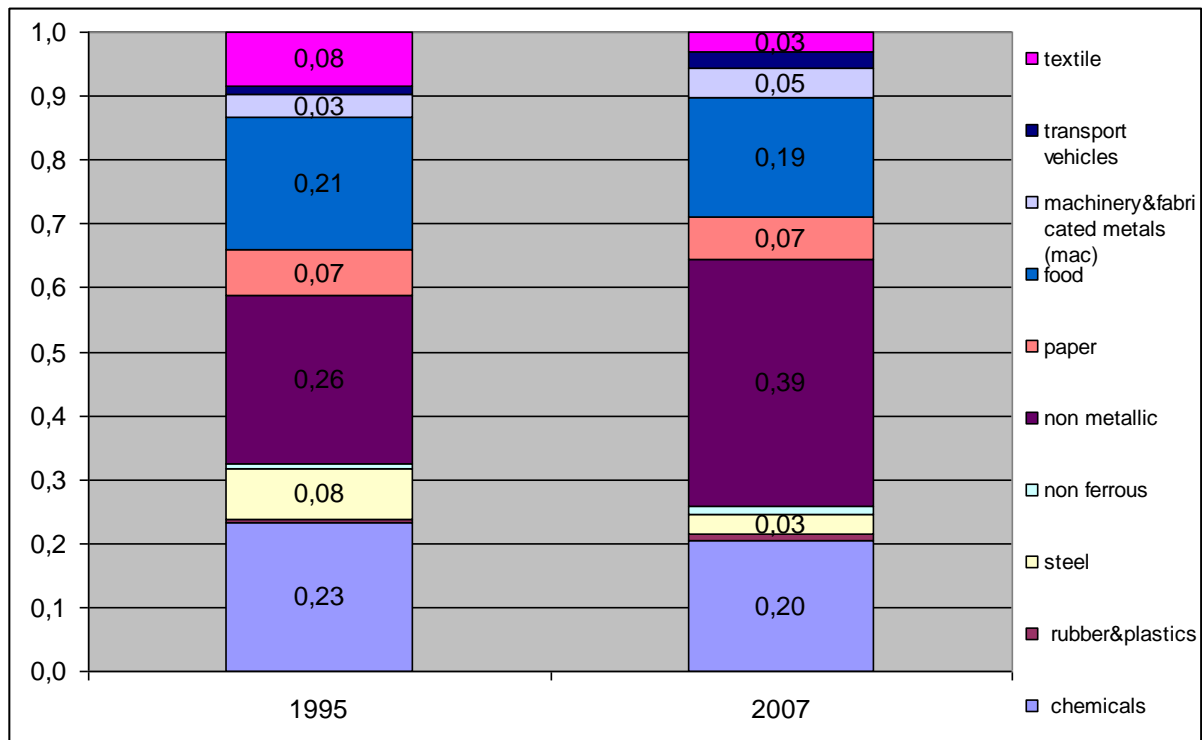


Figure 9 Industrial branches shares in energy consumption

The greatest energy consumption in Croatian industry is achieved in the non-metal mineral industry, with an increase from 26 to 39% in the observed period. The chemical industry is also very significant, though its share was decreased from 23 to 19%, followed by the food industry, which was also decreased from 21 to 19%. The share of other industrial branches are significantly less, and others to be mentioned are the paper industry, machinery and the metal industry, iron and steel industry, and the textile industry. The share of the paper industry remains unchanged, the share of the iron and steel and textile industries was reduced, while the share of the machinery and metal production industries was increased.

In order to determine and monitor the development of efficiency of energy consumption in industry, it is necessary to know more than just the energy consumption; other things impacting or connected to the level of energy consumption must also be known. This is above all the achieved value added in individual energy branches, the scope index of industrial production and the physical production for energy intensive products.

Value added and the scope index of industrial production are monitored in the industrial branches in which energy consumption is monitored. If the achieved energy consumption in individual industry branches and the accompanying value added are included in the equation, the energy intensity is determined. This indicates how much energy is

required to achieve a unit of value added. The development of energy intensity in individual industrial branches is shown in Figure 10. It is evident that the energy intensity is declining in all industrial branches, and as such, overall intensity in the observed period was reduced by an average annual rate of 3 percent. The energy intensive of the processing industry was 30.7% less in 2007 than in 1995, meaning that 30.7% less energy was required to create a unit of added value. However, energy intensity is not the best indicator of efficiency of energy use in industry, as various industrial branches have very different levels of energy intensity, and so changes in the structure of the industrial branch have a significant impact on the trends of total intensity.

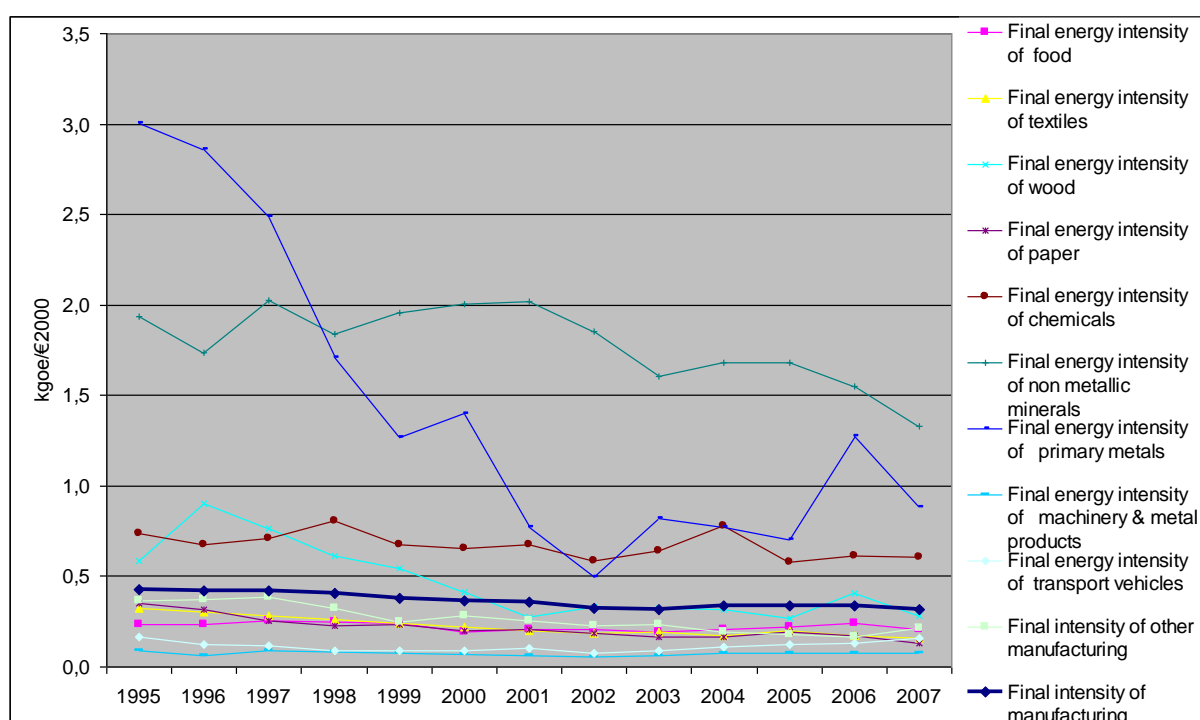


Figure 10 Energy intensities by industrial branches

In the 1995-2007 period, the final energy consumption (actual change) has increased by 1.5%/year with the growth of the added value by 4.2%/year (activity effect), as is shown in Figure 11. Energy intensity effect (intensity with constant structure and without structural changes) has decreased by -3.4%/year in period 1995-2007 while the actual intensity (intensity with structural changes) has decreased by 2.6%/year in same period (Table 3). Structural effect is calculated as the difference between the regarded energy intensity and the energy intensity at constant structure.

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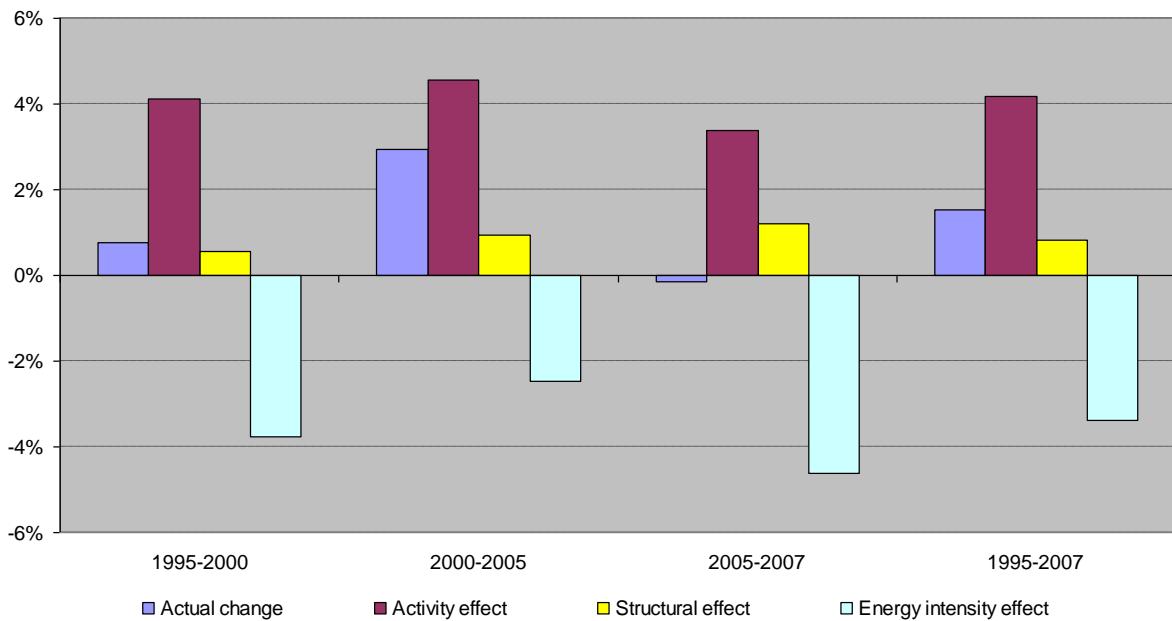


Figure 11 Explanatory factors of the energy consumption of industry

Table 3 Explanatory factors of the energy consumption of industry

	1995-2000	2000-2005	2005-2007	1995-2007
Actual change	0.8%	2.9%	-0.2%	1.5%
Activity effect	4.1%	4.5%	3.4%	4.2%
Structural effect	0.5%	0.9%	1.2%	0.8%
Energy intensity effect	-3.8%	-2.5%	-4.6%	-3.4%

### 3.3 Households

Between 1992 and 2007, final energy consumption of Croatian households grew from 1.18 Mtoe to 1.72 Mtoe. The increase of energy consumption in 1996 was mainly due to the colder weather but also with the increasing of living standard, since the population size, the number of households and dwellings have not changed much in Croatia during the period. Figure 12 presents development of household energy consumption between 1992 and 2007 (because of the rapid energy decrease in period 1990-1992 due to the war operations).

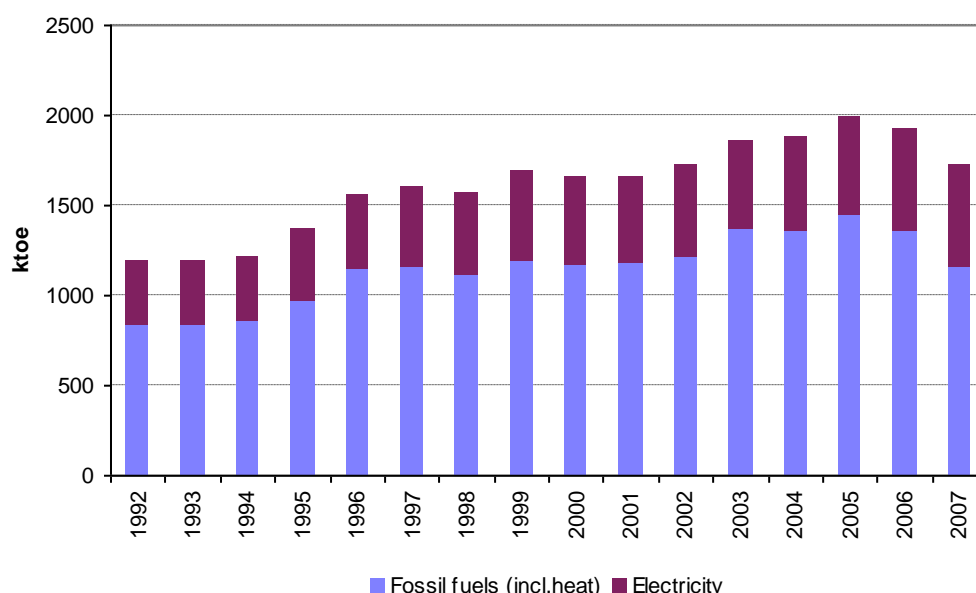


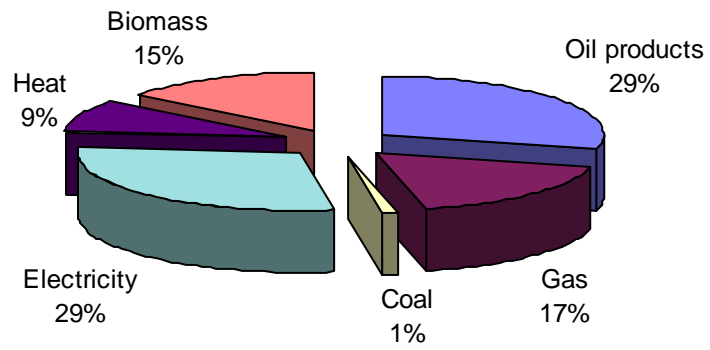
Figure 12 Development of household energy consumption between 1992-2007

The highest market share in final consumption of households 1992 was for electricity and oil products (29%), and in 2007 their shares increased for electricity to 37% and decreased for oil (22%) (Figure 13). The share of gas increased from 17% in 1992 to 24% in 2007. Biomass consumption decreased from 15% to 10% so the share of heat (from 9% to 7%). Consumption of coal in households is very small (around 1%).

The share of space heating in total energy consumption of households in 2007 was same as in 1992 (57%), Figure 14). The share of electric appliances and lighting and of water heating remained stable (11% and around 12%) in the period, while the share of cooking decreased from 16% to 12%.

Energy Efficiency Policies and Measures in Croatia in 2007

**1992**



**2007**

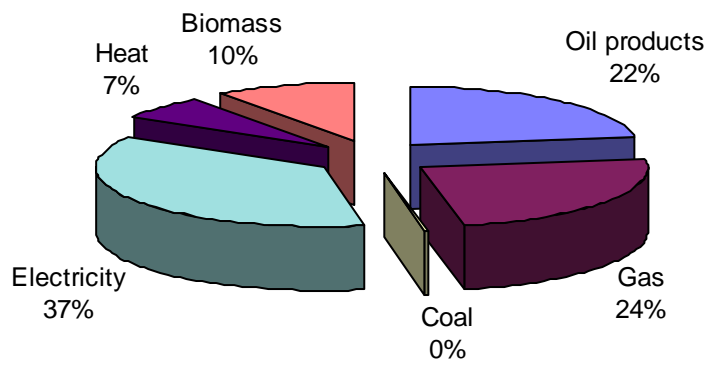


Figure 13 Final energy consumption of households by energy carrier

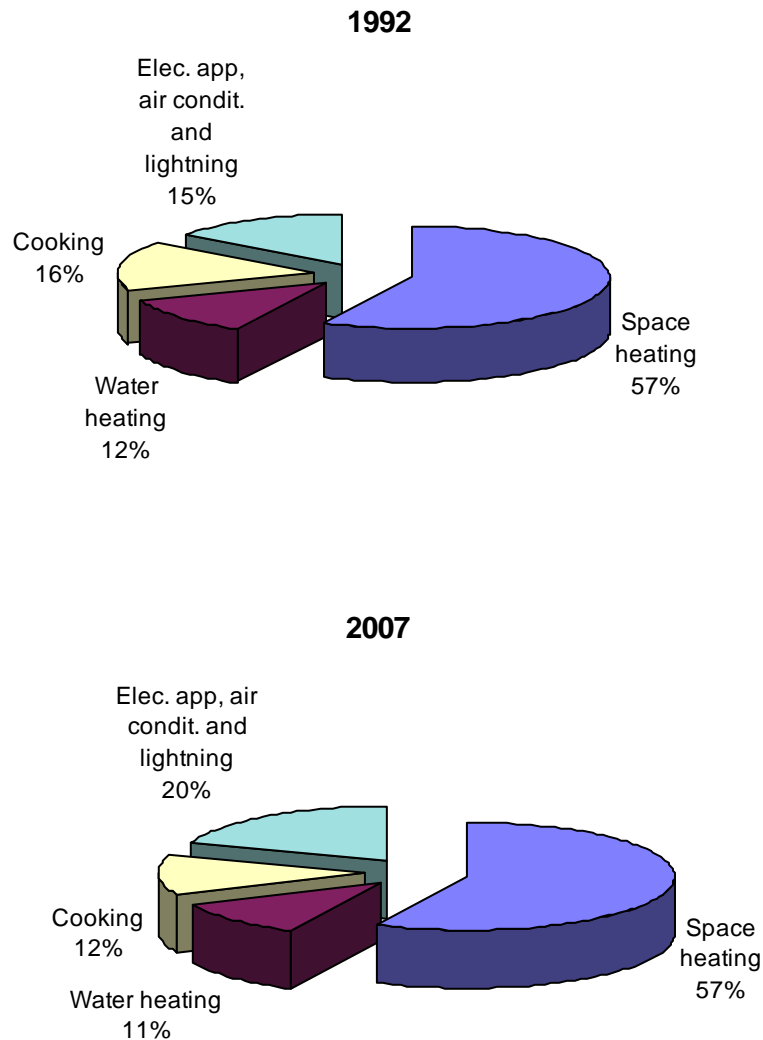


Figure 14 Households energy consumption by end-uses

Figure 15 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 1992-2007 was 1.8%/year, 2.4%/year for space heating and 3.8%/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). The reason for growth in specific energy consumption for space heating in households was better living standard and increase in share of central heated apartments.

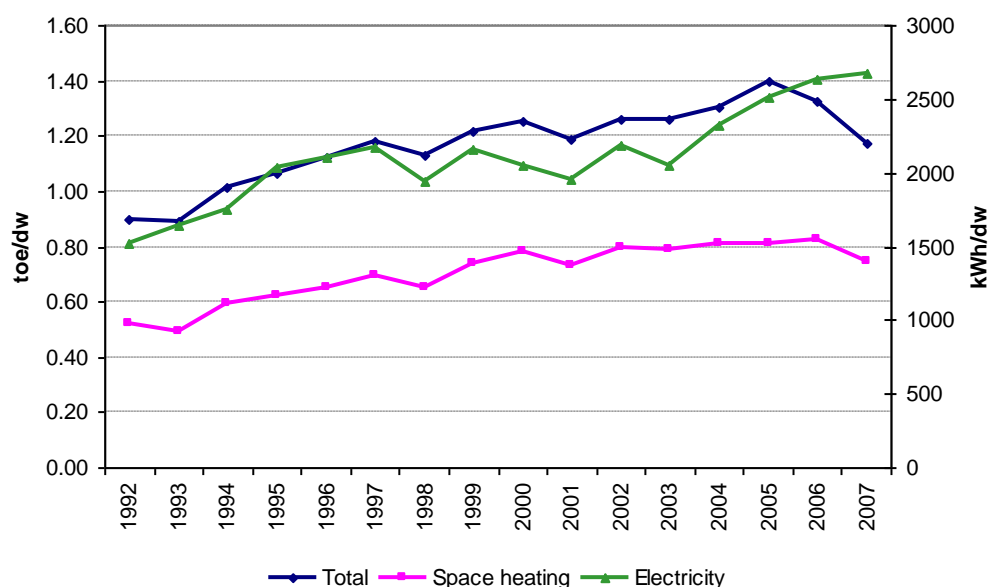


Figure 15 Unit consumption of households in toe/dwelling (total and space heating climate corrected and electrical appliances, air conditioning and lighting)

### 3.4 Services

Electricity has the highest share in energy consumption in service sector with a stable value of 51% during the whole period. There was a decrease for heat from 11% to 6%. The share of oil and gas remained stable at around 18%, while the share of coal is very small (under 1%), as shown in Figure 16.

Because there are no available data on total energy consumption by sub-sector for the service sector in Croatia, Figure 6 presents electricity consumption by sub-sector; there was almost no changes in share of electricity consumption by sub-sectors. Hotels represents the largest share of the electricity consumption 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 1998-2007, with decrease rate of

## 7 Energy Efficiency Policies and Measures in Croatia in 2007

0.1%/year (Figure 18). The unit consumption for electricity increased with growth rate of 2.3%/year.

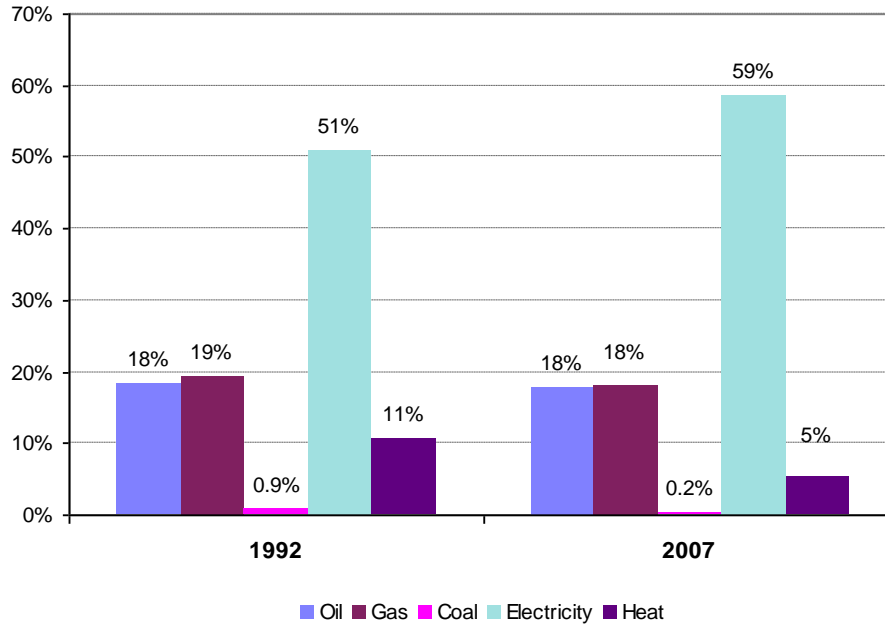


Figure 16 Final energy consumption of services by energy carrier

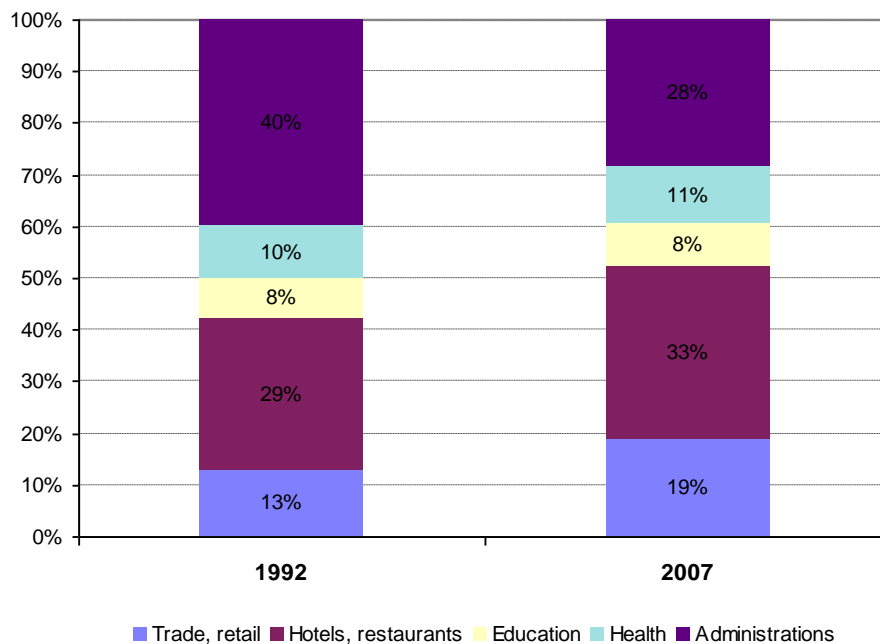


Figure 17 Electricity consumption of services by sub-sector

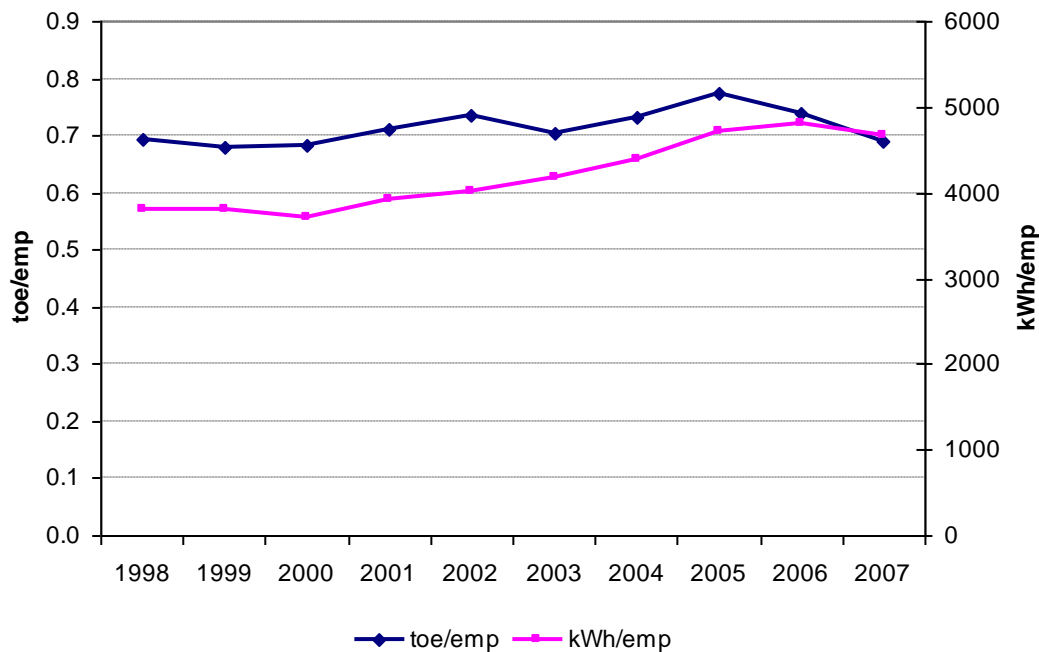


Figure 18 Energy consumption per employee in services (with climate corrections)

### 3.5 Transport

From the energy efficiency point of view, the transport sector is the most specific sector in respect to the use of liquid fuels as primary energy source, together with the use of electricity in the rail transport and public transport and the use of LPG in the road transport. The potentials for an energy efficiency increase in this sector are to be found mostly in increased vehicle occupancy, usage of more energy efficient engines and vehicles and appropriate driving regimes.

One of the basic indicators of energy efficiency in the transport sector is modal structure i.e. the share of different transport modes. For instance, the share of rail transport compared to road transport is an indicator of energy efficiency in the cargo transport.

The structure of tone kilometers (tkm) in the cargo transport shows that the primary transport mode in the cargo transport in the Republic of Croatia is road transport, although the Croatian general modal structure is still more favorable than the modal structure of the EU27.

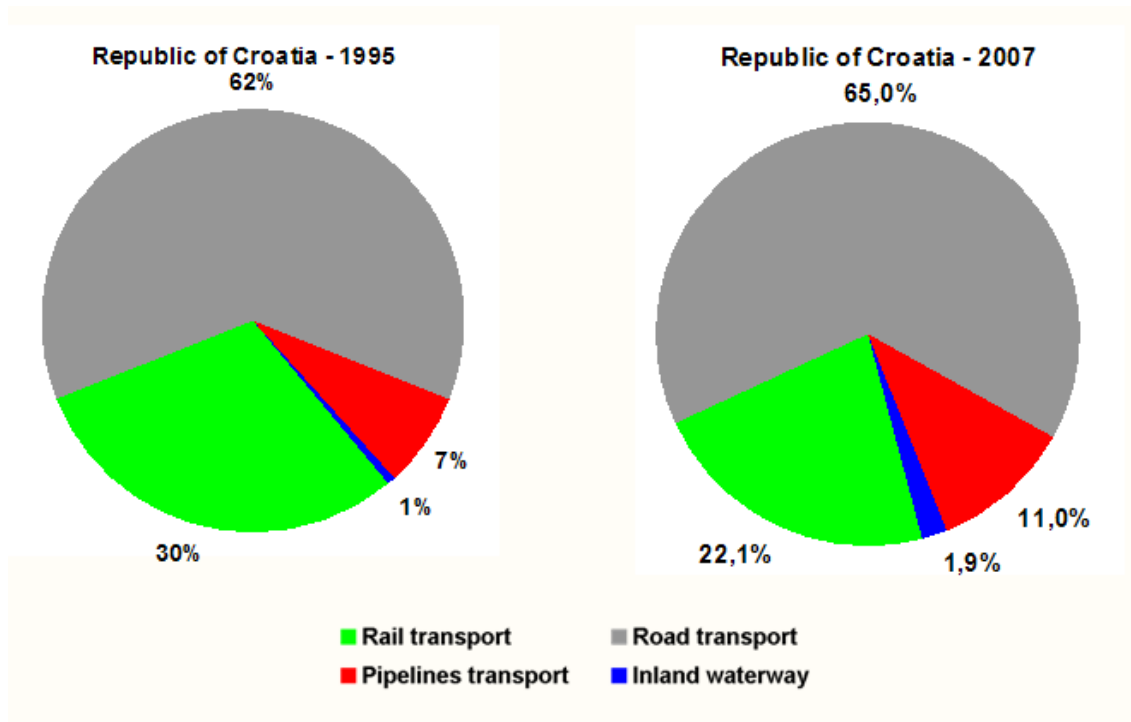


Figure 19 Modal structure of cargo transport in the Republic of Croatia (year 2007)

It should be mentioned that sea and coastal transport is excluded from this comparison in order to avoid a distorted picture it may create due to large distances covered in the international sea transport resulting in a large number of tkm compared to other transport modes.

As expected, the modal structure of passenger kilometers (with an estimation for the road transport with private cars in Croatia based on the number of registered private cars, average vehicle occupancy and average annual mileage) shows the highest share of private cars in total passenger kilometers (pkm).

The share of private cars in road transport in total pkm in Croatia is rather higher compared to the EU27. However, this happens at the expense of a lower share of air transport. Furthermore, the share of public transport is rather higher in the EU 27, partially due to the impact of the new member states with a historically higher share of public transport compared to the EU 15 (although in most of the new EU member states the share of private cars in passenger transport and trucks in cargo transport increased significantly).

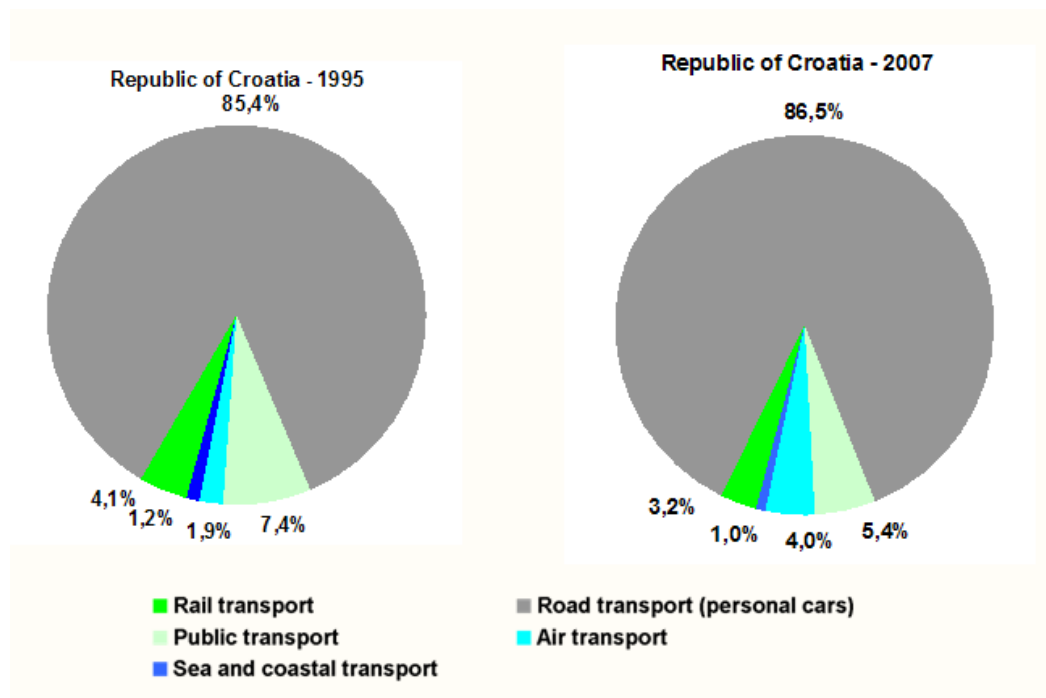


Figure 20 Modal structure of passenger transport in the Republic of Croatia (year 2007) and EU27 (year 2006)

Between 1995 and 2007 in the Republic of Croatia the number of registered private vehicles almost continuously increased with an average yearly increase of 5.7 percent. Thus, the number of registered private cars grew from around 817 229 in 1995 to 1 500 585 in 2007 year (this presents approximately 323 vehicles per 1 000 inhabitants, which means that every third inhabitant of Croatia owns a car).

In the Republic of Croatia in the period from 1995 until 2007 there was a large increase in the number of new diesel passenger cars (increased by 219 percent overall), with a further upward trend. In the total passenger car stock structure, the share of gasoline-run cars decreased from 80.5 percent in 1995 to 65.8 percent in 2007, while the share of diesel-run cars increased from 17.5 percent up to 30.9 percent in 2007. The share of liquefied petroleum gas (LPG)-run cars increased from 2.0 percent in 1995 year up to 3.3 percent in 2007, as shown in the following figure. The total number of LPG vehicles in 2007 is estimated at 50 000.

## 7 Energy Efficiency Policies and Measures in Croatia in 2007

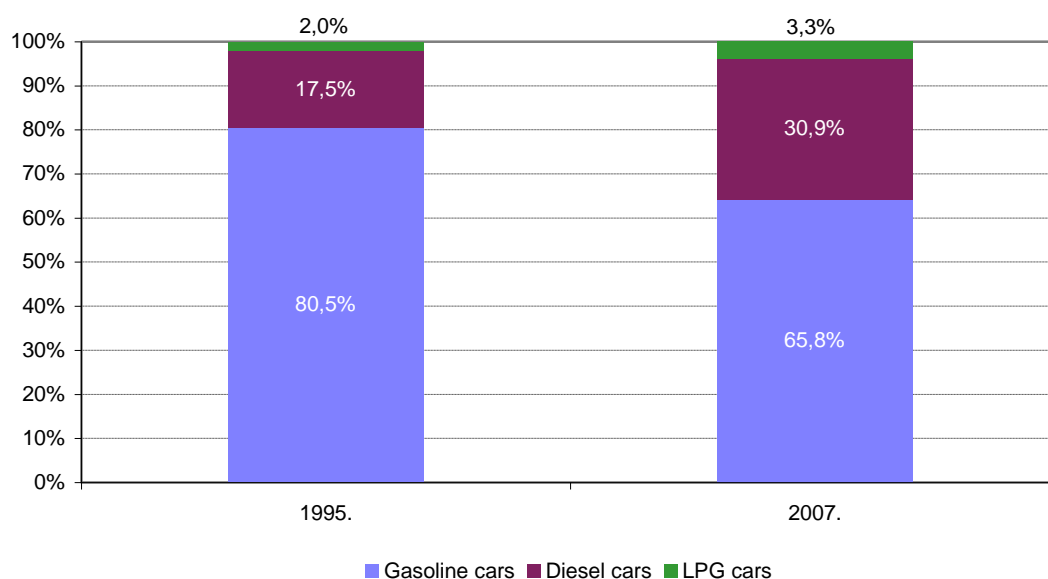


Figure 21 Structure of the cars by fuel type

The structure of diesel personal vehicles mainly consists of cars in category of engines between 1.3 – 2.0 liters, despite fastest growing category of diesel vehicles with engine volumes grater than 2.0 liters. Majority of the gasoline powered cars constitute of Otto engines in category between 1.3 – 2.0 liters engines and what represents at the same time fastest growing category of gasoline cars.

Mentioned structure discovers costumer behaviour changes directed towards needs for grater and more powerful vehicles, while at the same time positive energy efficient trend has been kept by purchasing more efficient vehicles (bigger share of diesel vehicles). This positive structural changes mechanism is established purely on market based principles by provision of more favourable prices of diesel fuel on the market over the period, hence without presence of any other incentive measures.

In the Republic of Croatia, between 1995 and 2007, total energy consumption in the transport sector increased by 95 percent, from 1.121 Mtoe up to 2.192 Mtoe with an average yearly growth of 5.2 percent.

Road transport made 90.1 percent of the total consumption in 1995, while in 2007 it a 93.1 percent share. Beside road transport, the share of domestic air transport increased from 2.5 percent to 2.8 percent. At the same time, the share of rail transport decreased from 4.6 percent in 1995 to 2.4 percent in 2007 as well as the share of the domestic water transport which decreased from 2.8 percent to 1.7 percent.

## Energy Efficiency Policies and Measures in Croatia in 2007

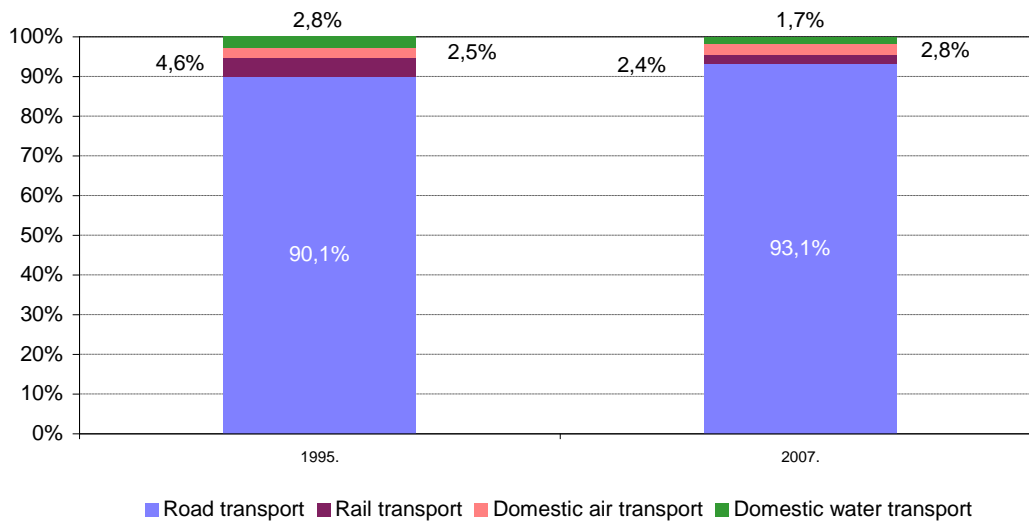


Figure 22 Fuel consumption by transport mode

In energy consumption of the road transport, the share of passenger vehicles slightly increased from 60.6 percent in 1995 up to 62.2 percent in 2007, while the share of trucks increased from 17.5 percent in 1995 up to 22.7 percent in 2007. The share of consumption in buses and light duty vehicles declined from 6.4 percent to 3.3 percent, and 15.3 percent to 11.6 percent respectively.

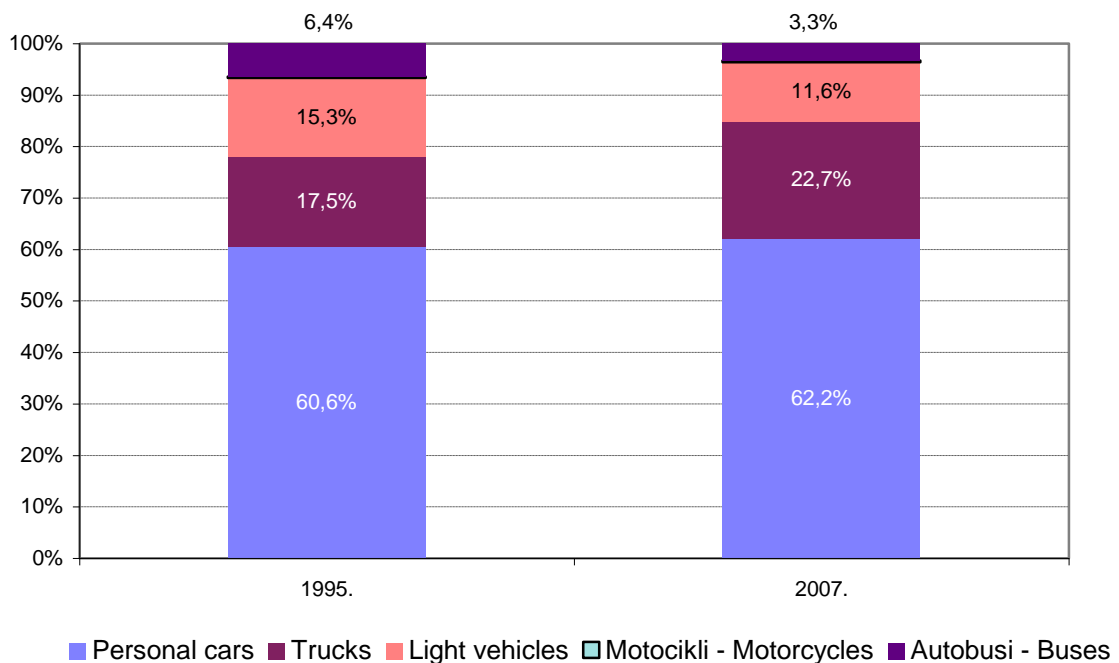


Figure 23 Energy consumption in road transport by type of vehicles

The specific consumption of cars (litres/100km) in Croatia has been substantially decreasing between 1995 - 2007 by 0.89%/year, while at the same time EU15 obtained 0.76%/yearly and EU27 member states achieved 1.17%/yearly.

Key driver for a such positive trend comes from the gradually substitution of the existing vehicles with new and technologically more enhanced vehicles which average yearly purchasing rate in Croatia amounted 15.4%.

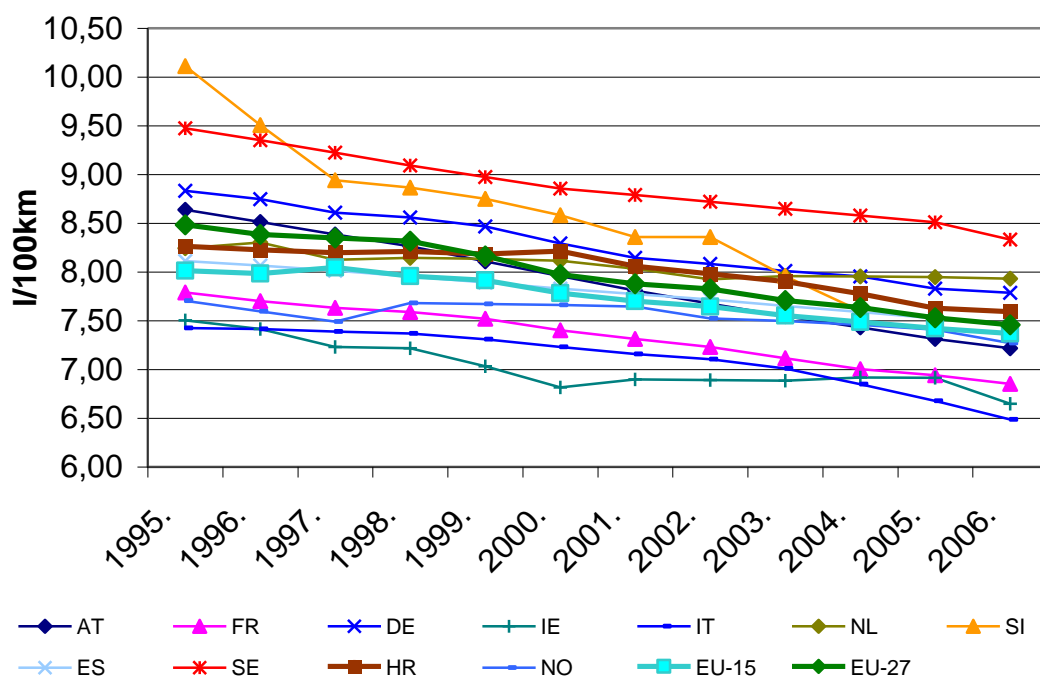


Figure 24 Specific consumption of personal cars

Freight transport has its specificity regarding energy efficiency since it is primarily a function of particular structure of transport meanings by which goods are carried on. Thus countries which use mostly rail transport such as Italy, Germany, Poland, Austria, ..., etc, have most efficient freight transport when it comes to the specific energy consumption by transported tonne kilometre. Share of specific categories of heavy duties have also a high influence on final energy efficiency. Namely, higher share of bigger and biggest loading categories of trucks (over 7.5 tones of carrying capacity) significantly contribute to the total increase of energy efficiency.

Despite biggest share of light duty vehicles in Croatia < 3.5 tones of carrying capacity, 78% in total number of all registered freight vehicles in the Republic of Croatia in year 2007, efficiency of the freight transport in Croatia has approached to the average level of efficiency in EU27 member countries.

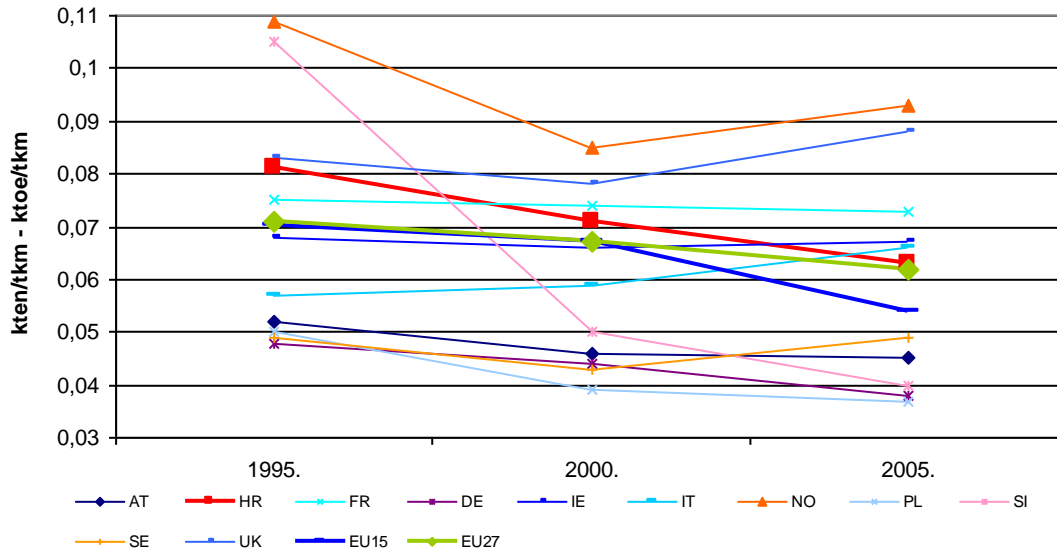


Figure 25 Total specific consumption of goods transport (ktoe/tkm)

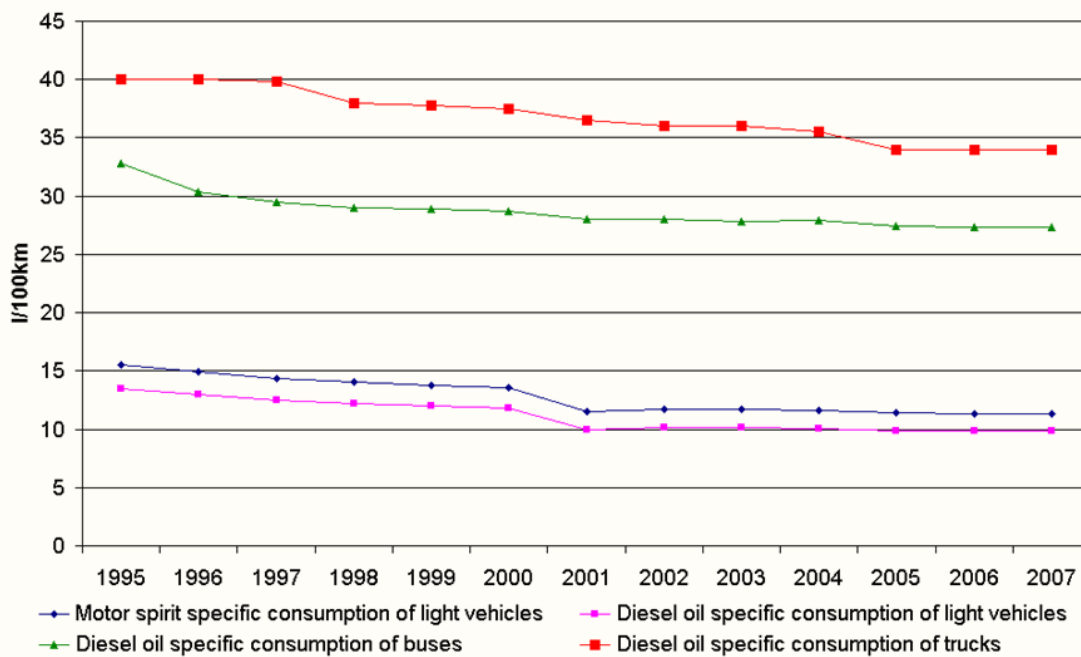


Figure 26 Specific consumption of buses, light duty vehicles and trucks (l/100 km)

### 3.6 Assessment of energy efficiency/savings through ODEX: total and 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 chemicals sector and households sector.

In the period 1995-2007 the energy efficiency index for the whole economy (ODEX) decreased by 12%, compared to 14% decrease for the EU-27. The industrial sector (machinery) and transport sector (trucks&light vehicles) contributed the most to this development.

The total energy savings was 0,88 Mtoe.

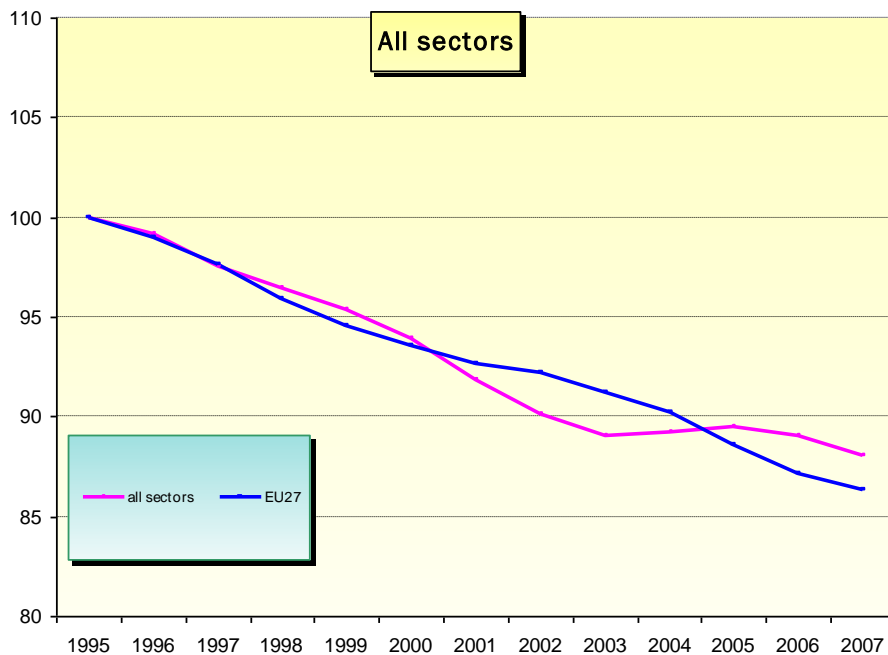


Figure 27 Energy efficiency index for all sectors

In order to avoid the influence of the structural effect, i.e. in order to determine the most realistic indicator for the development of efficiency of energy consumption in industry that is comparable among sectors and in other areas, the ODEX energy efficiency index was developed. The unit energy consumption is determined for each industrial

branch, and such unit consumption is reduced to an index, with an index of 100 in the base year (1995). The advantage of this approach is that unit consumption can be expressed in different units, after which they are turned into an index. Figure 3.7 shows the development of the index of energy efficiency in individual industrial branches and in the overall processing industry. For the iron and steel industry, cement industry and paper industry, the unit energy consumption is determined per unit of product, i.e. per kilogram of steel, cement and paper produced. For all other industrial branches, the unit consumption of energy is determined in relation to the index of physical scope of production in individual industrial branches. The total aggregated index of energy efficiency for the processing industry is determined based on the index of individual industrial branches and a weighted factor that represents the share of individual branches of industry in the total energy consumption in the processing industry.

The results in Figure 27 show that energy efficiency improved by 11.2% in the processing industry in Croatia in the period from 1995 to 2007. In other words, improved energy efficiency in industry in the observed period unfolded at an average annual rate of 1.05%. Based on the ODEX for the processing industry, it is also possible to directly determining the energy savings resulting from more efficient use.

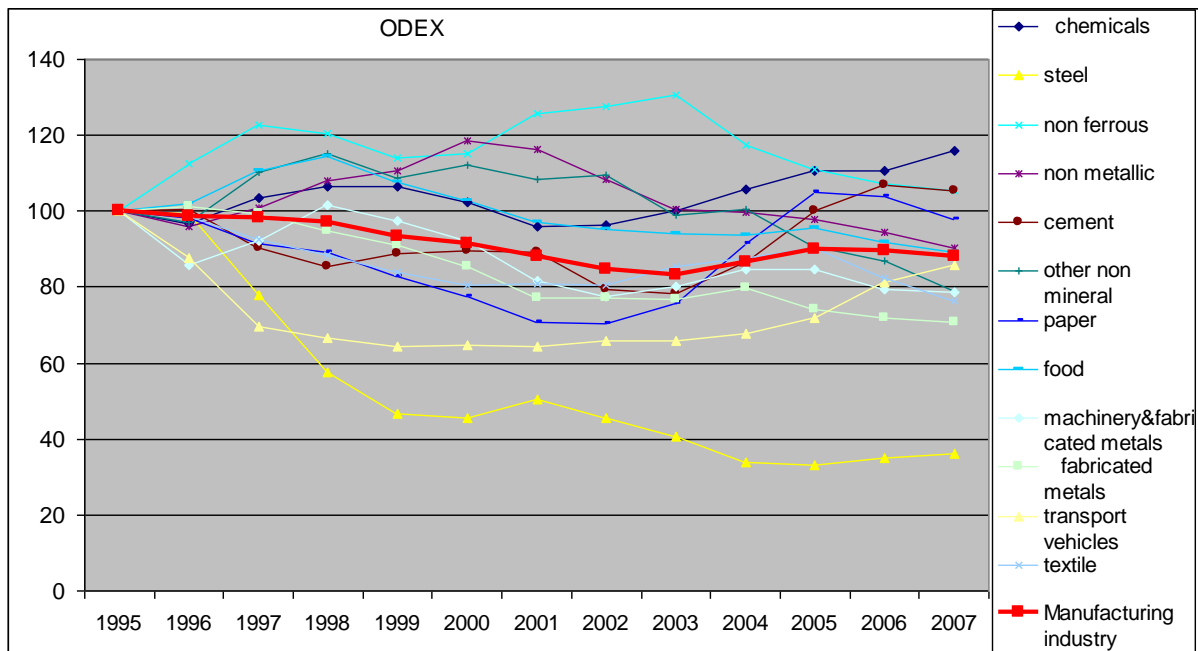


Figure 28 Index of energy efficiency (ODEX) in industry

In the period from 1995 to 2007, total energy efficiency index (ODEX) of transport rose by 20.2 percent. Sector with greatest enhancement obtained is definitely railways, 41.1%, mainly due to the fact that loading factor of particularly existing passenger

transport rose tremendously. However it does not contribute to total enhancement of transport sector, since its modal share in total mobility is still rather small.

Second largest enhancement in terms of positive index trend has been achieved in category of trucks & light duty vehicles, where energy efficiency index rose by 23.8 percent. Major drivers which determinate this trend are: boosting of new and technologically enhanced light duty vehicles on the market, significant increase of loading factor due to transport demand change – a lot of SMEs required smaller vehicles with a grater occupancy. Moreover, sector of light duty vehicles has recorded greatest yearly sales rates of new vehicles in observed period, 6.1%.

As for the ODEX index in category of personal cars, it has decreased by 10 percent. The main argue for this energy efficiency comes from the fact that this sector records highest yearly rates of new technologically enhanced purchased vehicles (6.1%).

*Significant increase of diesel technology and new more efficient vehicles in general*

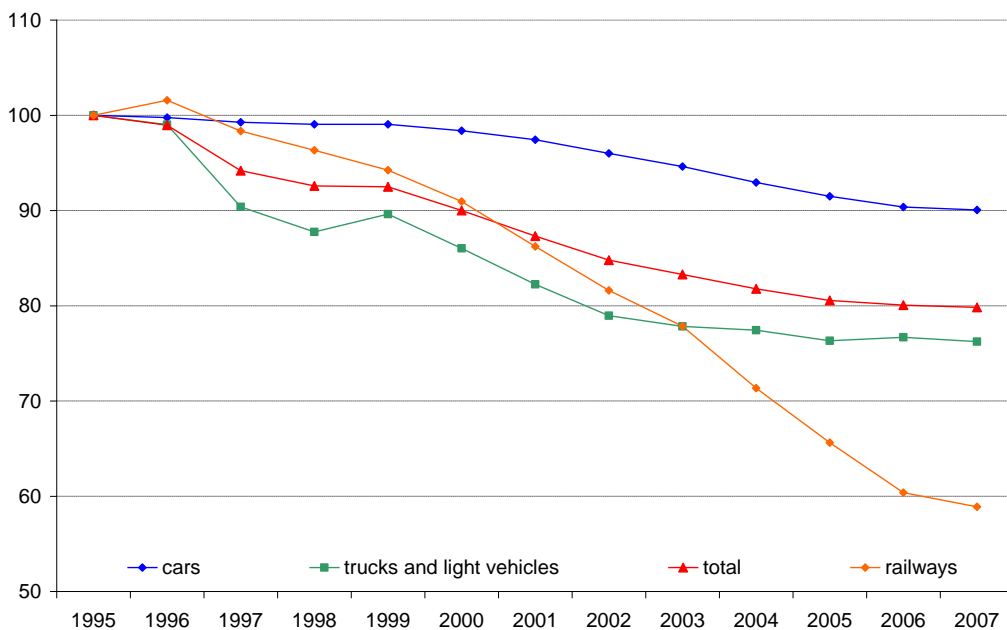


Figure 29 Energy efficiency index ODEX in the transport sector in the Republic of Croatia

In the period from 2000 until 2007, average yearly rate of achieved energy efficiency in traffic sector was 1.9%/yearly. Obtained rate of energy efficiency is almost twice higher than compulsory rate which has been settled by the Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC); within the period 2009 – 2016 average yearly savings should amount 1%/yearly for all sectors in final consumption in all EU member states.

Energy Efficiency Policies and Measures in Croatia in 2007

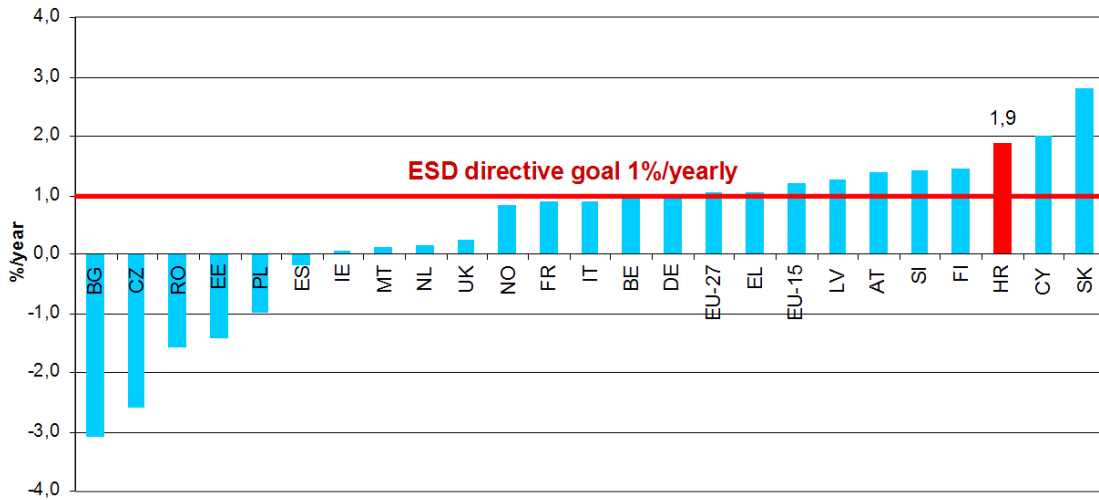


Figure 30 Average yearly rate of energy savings in Croatian transport sector in period between 2000 - 2007

Between 1995 and 2007 the technical energy efficiency index in the households sector improvement was 2%, while the trend in EU-27 showed energy efficiency index improvement for 9%.

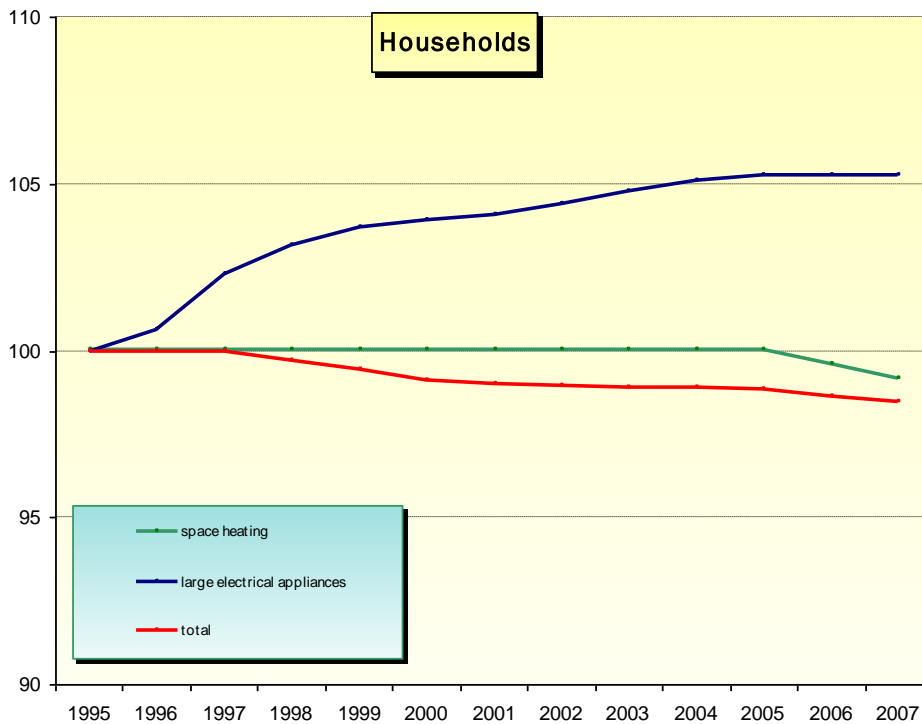


Figure 31 Energy efficiency index for households

### 3.7 CO<sub>2</sub>-emissions trends

Total CO<sub>2</sub> emissions (emissions from final consumers) in Croatia have increased by 56% since 1992. The highest increase was in transport sectors and after that in households, services and agriculture sectors. The emissions increasing in industry sector was 22%.

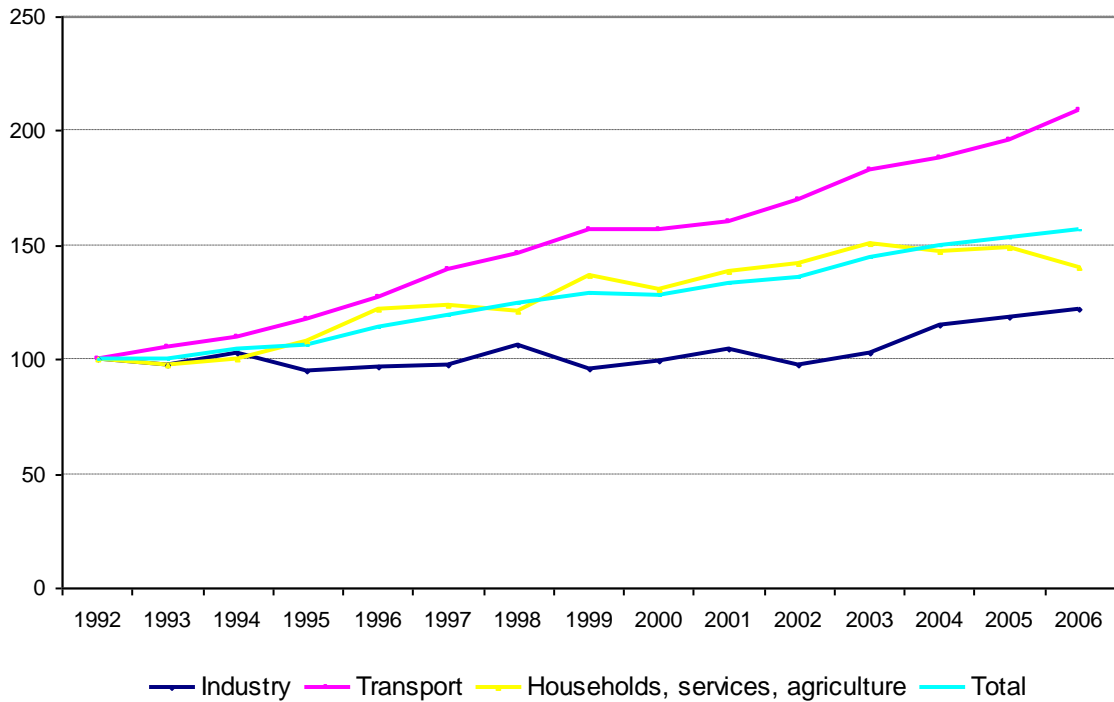


Figure 32 Total CO<sub>2</sub> emissions by sector (1992=100)

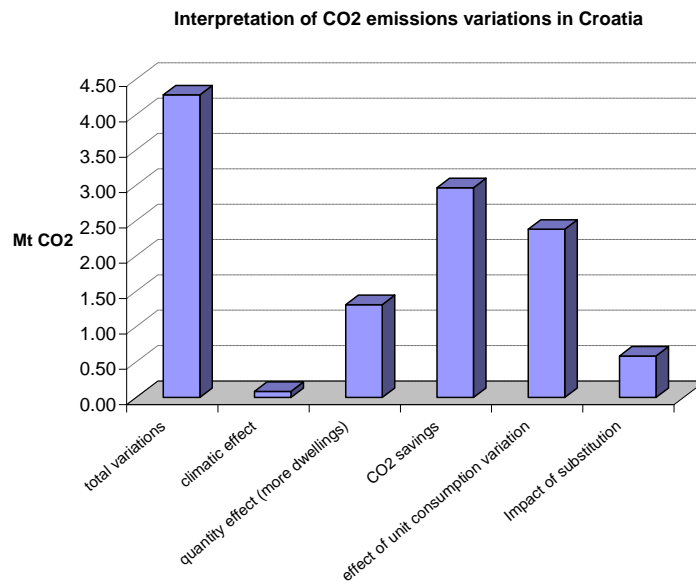


Figure 33 Interpretations of CO<sub>2</sub> emission variations in Croatia

## **4 Energy efficiency measures**

### **4.1 Recent Energy Efficiency Measures**

#### **4.1.1 Residential Sector**

##### **Ordinance on energy certification of buildings**

This Ordinance has been adopted in September of 2008, while it is going to be put into force from April 2010.

The Ordinance lays down requirements as regards:

- buildings for which an energy certificate is required, and exemptions from energy certification,
- energy classes of buildings, from A+ (<15 kWh/m<sup>2</sup>) to G (>250 kWh/m<sup>2</sup>) energy for heating
- the content and format of an energy certificate, the issuance and validity period thereof,
- energy certification of new and existing buildings that are sold, rented out or leased,
- public sector buildings obliged to display the energy certificate to the public, the display method and energy certification,
- obligations of investors or owners of buildings,
- energy certification procedure, and
- Registry of energy performance certificates for buildings.

The energy certificate is issued on the basis of calculation data (EN 13790) and on the basis of energy audit. It is issued by authorized persons who have required education degree, appropriate working experience (5 years), who are successfully trained for energy audits and certification of buildings.

## 4.1.2 Transport Sector

### FINANCIAL INCENTIVES

Croatian Fund for Environmental Protection and Energy Efficiency has announced launching of two financial facilities for promotion of green transport technologies introduction on the market for ongoing fiscal year 2009 as follows:<sup>2</sup>

#### 1<sup>st</sup> Financial Facility

The Fund will encourage and stimulate all programmes and projects which will foster implementation of the clean vehicles by conducting and enhancing technical (engine efficiency improvement, replacement of conventional vehicle engines with more environmental friendly, decrease of roll and air resistance, drivers education) and organisational measures (toll fees, congestion charging, parking space control, parking fees, freight transport control in urban areas, urban traffic infrastructure control) in passenger and freight transport, and especially in field of alternative fuels introduction (**Compressed Natural Gas, Biogas**, Bio diesel, Bio ethanol, LPG and Hydrogen) as well as propulsion system equipped with batteries and fuel cells.

Utilisation of CNG and LPG is in headline of priorities since there is high readiness within stakeholders for their implementation realisation, such are those which use light duty vehicles within its business activities, provide public transportation service (city buses), taxi operators, driver schools and public companies (example: waste collecting operators – garbage trucks, etc.). The financial assets will be allocated as support for the new CNG/LPG refuelling stations commissioning as well as partial coverage of the retail price differences between conventional and EEV vehicle, and city buses propelled with CNG/LPG.

Public Invitation to tender is expected to be launched in second half of 2009, and it depends on realisation of the Fund's Incomes. The investment structure will be as follows: Interest Free loans and subsidiaries for trade associations, respectively financial aids (reimbursement free) for local & regional authorities, co-financing up to 40% of eligible costs except for Local Authorities on islands or in highland area for which is eligible up to 60% and finally for Special Care Areas is set up to 80%.”

According to preliminary Fund's budget allocation, there will be ensured around 3.000.000,00 kn (~405.405,00 Euros) for this purpose.

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<sup>2</sup> (Source: Scope of the Working Programme of the Environment Protection and Energy Efficiency Fund for 2009 Fiscal Year;

<http://www.fzoeu.hr/hrv/pdf/Program%20rada%20Fonda%20za%202009.pdf> , pages 37 & 38)

### 2<sup>nd</sup> Financial Facility

Furthermore, the Fund for Environmental Protection and Energy Efficiency together in collaboration with the Ministry of Sea, Transport and Infrastructure as well as with the Ministry of Economy, Labour and Entrepreneurship has announced for the fiscal year 2009 to start with the realisation of the Programme for Negative Transport Impact on the Environment Reduction – diminishing of the road vehicles pollutants from two categories: heavy duty and buses. The programme will offer supportive assets for yearly substitution of 1000 ecologically unacceptable vehicles within period 2009 – 2011. This action should provide significant pollution reduction and respectable financial savings. Within mentioned period there will be launched enough assets to support substitution of ~ 3000 freight vehicles powered on engines with unacceptable ecological standards (EURO 0,1,2,3) and school buses with ecologically friendly vehicles which standard is equal or greater than EURO 5 eco-standard (in Croatia is currently in force EURO 4 standard). The Fund will allocate subsidiaries to the legal entities in amount up to 50.000,00 kn (~ 6.757,00 Euros). For the Programme implementation the Fund has to assure 150.000.000,00 kn (~20.270.270,00 Euros).”

Public tender was launched in May of the 2009.

### **4.1.3 Industrial Sector**

#### Industrial Energy Efficiency Network (IEEN)

The core mission of IEEN is to increase awareness and knowledge about the possibilities of investing in energy efficiency, including the demo projects, training and education and M&T; encourage investment in all industries and all the technology of industrial processes, to benefit from the degree of measures with low investment costs (behavioural changes, maintenance and organization)

IEEN addressed following key expected results:

- Establishment of SGE
- M & T (monitoring and analysis of energy consumption, setting goals)
- Energy audits
- Benchmarking
- Demo projects (implementation of projects, best practices and disseminate information about them)

- Training and education

Through IEEN a series of activities aimed at promoting the respondent in the industry it is expected to be conducted. The main aim is to improve awareness and knowledge of leaders and employees of industrial enterprises in order to take advantage of potential respondent measures with a very low cost implementation. It is also necessary to establish the organizational structure of the company (energy management), and install information systems for monitoring and analyzing consumption and goal setting (M & T). In this manner, it is going to be created extensive databases on energy consumption in industry and furthermore will be developed indicators that are going to be used for benchmarking with companies from the same branch in Croatia, but also in the EU.

IEEN will lead Operative affiliation of the Fund for Environmental Protection and Energy Efficiency. According to previous developments, it is expected that IEEN is going to be launched in 2010.

The potential for energy savings is estimated at 10% of the average sector consumption. This is approximately equal to 2.89 PJ in the 2016 and 0.96 PJ in 2010. Assessment includes all forms of energy.

#### **4.1.4 Tertiary Sector**

“Bringing Own House in Order” Program

Program “Bringing Own House in Order” is adopted by the Croatian Government in May 2008 through a joint initiative of the Ministry of Economy and UNDP. The milestone in program execution was interpreted through the energy audit performing in the Ministry of Economy’s building. The program will last until 2013, with the possibility of its extension. It is expected that the establishment of proper organizational structure in government buildings will generate energy savings even and after the official end of the project.

The goal of this program is to improve energy efficiency and establish the sustainable energy management in all government buildings. The program includes the following activities:

- Establish a central registry and system for monitoring energy consumption in all government facilities,
- Implementation of energy audits in priority facilities,

- Energy certification of public buildings,
- Series of educational and motivational workshops and seminars for employees of state administration.

#### **4.1.5 Cross-cutting measures**

On 15<sup>th</sup> December 2008 the Croatian Parliament has brought and put into force a new Law on Rational Use of Energy in Final Consumption.

The Law determinates the scope of rational use of energy in final consumption, adoption of programs and plans for energy efficiency improvement and its enforcement, energy efficiency measures and particularly role of energy services and audits, responsibilities of public sector, energy subject and big consumer as well as the rights of customer which will adopt measures for energy efficiency.

The purpose of this Law is to achieve targets of the sustainable energy development: reduction of the negative impact on environment derived from the energy sector, improvement of the security of supply, demand fulfilment of energy consumers and fulfilment international obligation of the Republic of Croatia in field of green house gases reduction with adaptation of energy efficiency measures in sectors of final energy consumption.

The most significant deliverables from the Law that are going to be issued within period of one year are as follows:

- National Energy Efficiency Programme (NEEP) for final energy consumption in form of systematic document covering 10 years time period
- NEEP will be accompanied with National Energy Efficiency Action Plan (NEEAP) in final consumption – document planned to cover 3 years time period
- National Declarative Energy Efficiency Target delivered from NEEP – A comprehensive planned energy savings target in final consumption
- Programs and plans for energy efficiency in local communities – counties, by which is fortified general energy efficiency policy and its implementation procedure
- It will be defined energy efficiency programme for big energy consumers, basic planned document of big consumer covering 3 years time period; it will consist of total and breakdown structure of energy consumption as well as characteristic of its consumption, evaluation of the current energy efficiency state, aims,

measures for energy efficiency improvement, assets sources and other necessary data

- Big energy end user is defined as an end user which yearly final energy consumption exceeds boundary amounts of consumption prescribed by Law act
- Public sector is obliged to manage with final energy consumption in efficient manner
- Definition of energy audits, energy services and contracting of the energy impacts
- The owner of a building or particular part of a building in which is installed central heating system with power greater than 20 kW has an obligation to execute periodical energy auditing of a heating boiler
- The owner of a building or particular part of a building in which is installed central ventilation system with power greater than 12 kW has an obligation to execute periodical energy auditing of a ventilation system
- Defined will be conditions and criteria for educating energy auditors, as well as its rights and obligations
- Defined will be criteria for execution of energy service
- The structure of Energy Impact Treaty is defined
- Definition of Eco - design will be issued from the relevant Ministry

Mentioned Law acts and deliverables are not yet issued, but due time is set for December of 2009, according to the article No. 35 of the Law.

## **4.2 Patterns and Dynamics of Energy Efficiency Measures**

### **4.2.1 Residential Sector**

Beginning of the energy efficiency measures application in Residential Sector has started upon establishing Fund for Environmental Protection and Energy Efficiency in 2004. Majority of the measures were in category of financial ones. Typical projects were replacement of primary heating fuel (fuel oil and diesel were replaced with natural

## 7 Energy Efficiency Policies and Measures in Croatia in 2007

gas or liquefied petrol gas), heat recovery systems, improvement of central heating system efficiency, lighting system reconstruction and alike.

In 2008 has been launched set of legislative measures which have a goal to implement Energy Performance of buildings Directive (EPBD).

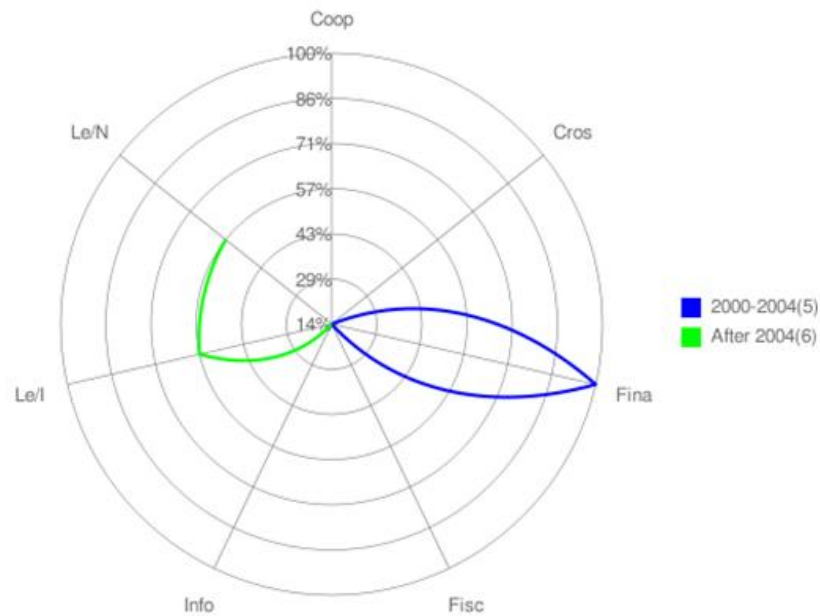


Figure 34 Structure of adopted energy efficiency measures in residential sector

### 4.2.2 Transport Sector

Energy efficiency development in transport sector could be mainly acknowledge to diesel price which has been all over the period lower than gasoline price and consequently has attracted more efficient diesel vehicles on the market.

However, parallel with presence of this pure least cost market driver, several measures has been analysed, proposed and adopted in order to encourage additional energy efficiency performance activities in this fast growing energy demand sector.

A timescale overview in adopted measures portfolio could be summarized as follows: Within period 2000 – 2004 dominant were following group of the measures: financial incentives (approved from the Fund but unfortunately not utilized in reality in sufficient scale), one fiscal measure (Exemption for Eco Test Fee Payment for Vehicles Powered on LPG and CNG), one infrastructure measure (Procurement of New Tilting Trains for the Croatian Railways).

In second half of period from 2004 – nowadays dominant measures that have been adopted are from legislative/normative and co-operative measures, such as: obligation to procure certain share of environmentally friendly vehicles in public procurement procedure of public transport operators or

Further potential of measures to be implemented is highly seen in information – education category, such as eco driving school, etc.

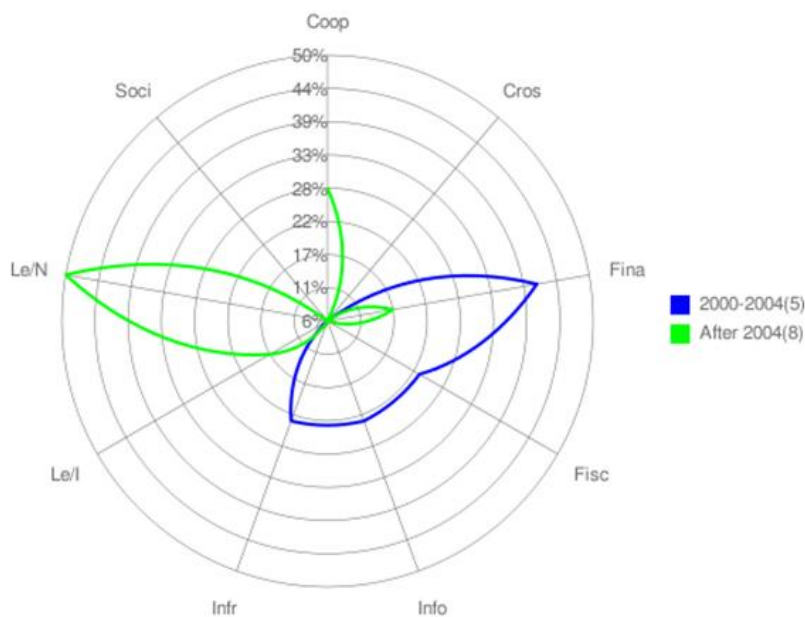


Figure 35 Structure of adopted energy efficiency measures in transport sector

### 4.2.3 Industrial Sector

Similar to trends of energy efficiency measures implementation in residential sector, application of measures in Industrial sector has started upon establishing Fund for Environmental Protection and Energy Efficiency in 2004. Majority of the measures were designated as financial ones. Typical projects that gained financial support were: replacement of primary heating fuel (fuel oil and diesel were replaced with natural gas or liquefied petrol gas), heat recovery systems, improvement of central heating system efficiency, lighting system reconstruction and alike.

In 2007 Regulation on CO<sub>2</sub> emission fees has been put into force. The regulation imposes charge for every unit of CO<sub>2</sub> emitted into the atmosphere. Fees are not applied for CO<sub>2</sub> emissions from biomass fuel combustion, biodegradable waste combustion and combustion of sludge. Per unit of CO<sub>2</sub> emitted fees are fixed for 2007, 2008 and 2009. It is up to Croatian government to determine the amount of fee for next periods.

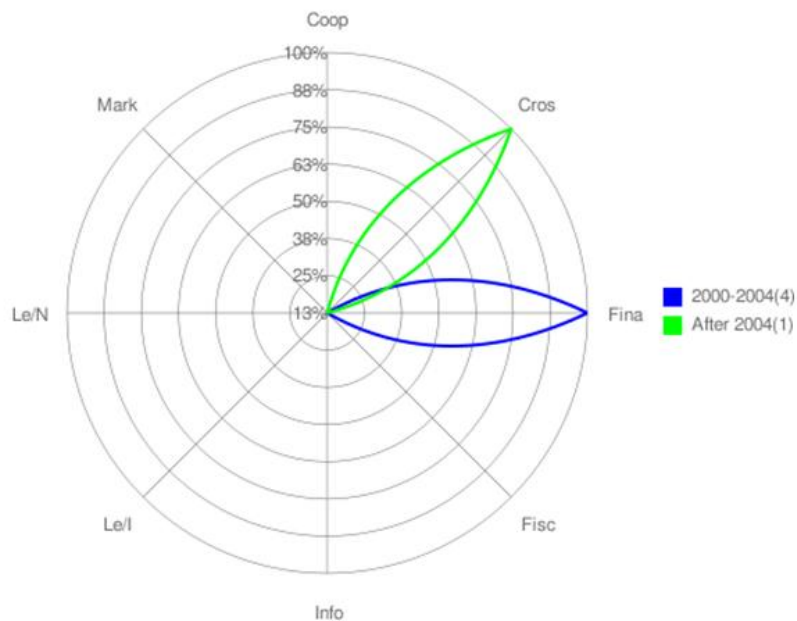


Figure 36 Structure of adopted energy efficiency measures in industrial sector

#### 4.2.4 Tertiary Sector

Similar to trends of energy efficiency measures implementation in residential and industry sector, application of measures in tertiary sector has started upon establishing Fund for Environmental Protection and Energy Efficiency in 2004. Majority of the measures were designated as financial ones. Typical projects that gained financial support were: replacement of primary heating fuel (fuel oil and diesel were replaced with natural gas or liquefied petrol gas), heat recovery systems, improvement of central heating system efficiency, lighting system reconstruction and alike.

In 2007 has been launched Energy Management in the Cities and Counties Project as a joint Initiative of Ministry of Economy and UNDP Croatia. The program represents a milestone in further legislative measures category implementation.

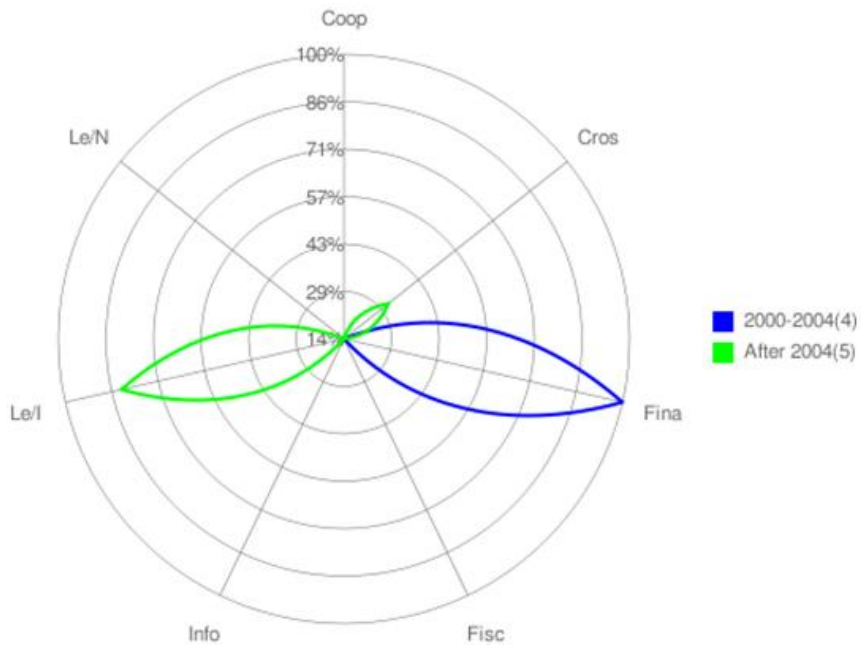


Figure 37 Structure of adopted energy efficiency measures in tertiary sector

#### 4.2.5 Cross-cutting measures

A pillar general cross – cutting measure responsible for further measures implementation development was definitely Resolution on Environmental Protection and Energy Efficiency Fund establishment with its core missions brought in June 2003. The Fund officially started with its operations on January 1<sup>st</sup> 2004. The aim of the Fund is to provide additional financing for national energy programmes promoting energy efficiency and renewable energy sources. Until October 2007 the Fund has financed about 300 projects in energy efficiency, renewable energy sources or clean vehicles domain.

In 2007 has been brought A Tariff System for Electricity Production from Renewable Energy Sources and Cogeneration Power Plants (National Gazette 33/2007), in order to encourage electricity production from mentioned sources.

Recently, in December 2008, the Croatian Parliament has brought and put into force a new Law on Rational Use of Energy in Final Consumption (National Gazette 152/08).

The purpose of this Law is to achieve targets of the sustainable energy development: reduction of the negative impact on environment derived from the energy sector, improvement of the security of supply, demand fulfilment of energy consumers and fulfilment international obligation of the Republic of Croatia in field of green house gases reduction with adaptation of energy efficiency measures in sectors of final energy consumption.

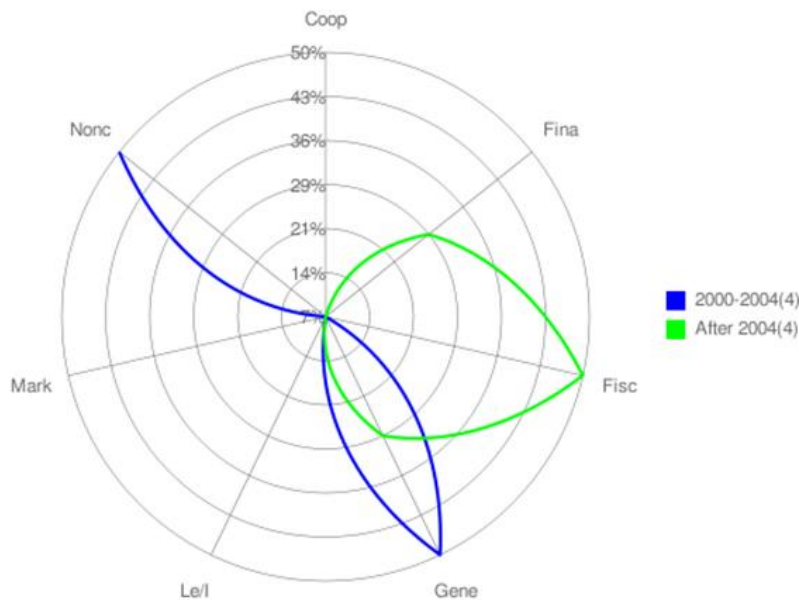


Figure 38 Structure of adopted energy efficiency cross-cutting measures

### **4.3 Innovative Energy Efficiency Measures**

#### REMOVING BARRIERS TO ENERGY EFFICIENCY

Along with activities directed towards citizens and business sector, such as national and local info campaign on energy efficiency, seminars, free preliminary energy audits of buildings and recommendations for citizens, project activities also include 2 large scale projects– *Systematic Energy Management (SEM) in the Cities and Counties of the Republic of Croatia* and *Bring your House in Order*. SEM Project targets buildings owned by local and regional municipalities, while Bring your house in order project goals towards enhancing energy efficiency in state and local government facilities.

Related projects are:

- Energy management in cultural heritage sites
- Energy strategy of Republic of Croatia
- Masterplan for energy efficiency

Information system for energy management

## 4.4 Energy efficiency measure evaluations

### 4.4.1 Semi-quantitative Impact Estimates of Energy Efficiency Measures

#### 4.4.1.1 Residential sector

Measure title	Semi quantitative Impact
Thermal Protection of Buildings	High
Energy Labelling - household appliances	Low
FZOEU energy efficiency programme	Medium
FZOEU renewables promotion programme	Medium
The Physical Planning and Building Act	Unknown
Action plan for transposing the EPBD in the Croatian legislation	Unknown
Ordinance on energy certification of buildings	Unknown
Technical Regulation Concerning Energy Economy and Thermal Protection in Buildings	Unknown

**4.4.1.2 Transport sector**

<b>Measure title</b>	<b>Semi quantitative Impact</b>
FZOEU bio fuels promotion	Low
Procurement of New Tilting Trains for the Croatian Railways	Low
Implementation of Bio Fuels into the Transport Sector of the Republic of Croatia in 2007	Low
Exemption for Eco Test Fee Payment for Vehicles Powered on LPG and CNG	Low
Promotion of Bicycle Use in the City of Zagreb	Low
Regulation on bio fuels quality	Low
Promotion of the CNG vehicles utilization in the Republic of Croatia	Medium
Procurement of a bio diesel buses for the Zagreb's public transport company ZET	Low
Promotion of Clean Vehicles Market Development	Low
Implementation of Bio Fuels into the Transport Sector of the Republic of Croatia in 2008	Low
Availability of Fuel Consumption Efficiency and CO <sub>2</sub> Emissions Data for New Cars	Low
Procurement of a CNG buses for the Zagreb's public transport company ZET	Medium
The Programme for Negative Transport Impact on the Environment Reduction – diminishing of the road vehicles pollutants from two categories: heavy duty and buses	Medium
Obligation for environmentally friendly heavy duty vehicles procurement in public transportation sector	Medium

**4.4.1.3 Industry sector**

<b>Measure title</b>	<b>Semi quantitative Impact</b>
FZOEU energy efficiency programme	Medium
FZOEU and MINGORP energy audits programme	Low
FZOEU renewables promotion programme	Medium
Regulation on CO <sub>2</sub> emission fees	Low
Industrial Energy Efficiency Network (IEEN)	Medium

**4.4.1.4 Tertiary sector**

<b>Measure title</b>	<b>Semi quantitative Impact</b>
Thermal Protection of Buildings	High
FZOEU energy efficiency programme	Medium
FZOEU and MINGORP energy audits programme	Low
FZOEU renewables promotion programme	Medium
Regulation on CO <sub>2</sub> emission fees	Low
Energy Management in the Cities and Counties - (SGE) Project	Medium
“Bringing Your House in Order” Program	Medium

#### **4.4.2 Lessons from Quantitative Energy Efficiency Measure Evaluations**

##### Energy Management in Cities and Counties Project (SGE) – Tertiary sector

The project was launched as a joint Initiative of Ministry of Economy and UNDP Croatia in December of 2007. The project duration is four years, then after it is considered that SGE will be fully established at the national level and prepared for self-sustaining.

The principal goal of the measure is to increase efficiency of energy consumption in the city and county offices and its facilities.

Technically speaking, this measure has two specific objectives:

1<sup>st</sup>: To establish an organizational structure (Energy efficiency team) in local and regional self-government authorities that will enable continuous monitoring and analysis of energy consumption in their own facilities, to conduct activities to raise awareness and knowledge of employees and provide Energy Management, and local energy planning (according to the requirements of The Energy Law)

2<sup>nd</sup> To install the software solutions for implementation of the SGE

In each county it should be established the office for energy management. In addition, every major city (with a minimum of 12-15 thousand people) should have its own office for the energy management. This will be a way to connect all the IT systems, which will enable monitoring and analysis of energy consumption from one central location. Smaller settlements will be covered by county offices.

This kind of local authority's organization will be prescribed by the Law on rational Utilization of Energy in Final Consumption.

By joining the SGE program, each city will have to sign a memorandum that requires reducing of their energy consumption by 5% on yearly basis. Estimates show that these savings can be achieved only by establishing an organizational structure and by applying behavioural changes.

The potential for energy savings is estimated to at least 5% of average spending in the public sector. This is approximately 0.65 PJ in the 2016 and 0.20 PJ in 2010. These assessments include all forms of energy.

Financial promotion of clean vehicles – Transport sector

Promotion of Clean Vehicles Program consists of promotional and financial measures that aim to increase the share of purchased "cleaner" vehicles. It will be encouraged car purchasing with emissions less than 130 g / km of CO<sub>2</sub>, hybrid cars and cars that use alternative fuels.

The aim of this measure is to encourage greater market penetration of electric, hybrid and alternative fuels propelled vehicles (bio fuels, LPG and CNG).

Promotional mechanisms will include the use of free parking spaces, the use of yellow tape in the cities, etc.

The most important part of the program includes financial incentives for the purchase of such vehicles. Incentive scheme will be established by the Fund for Environmental Protection and Energy Efficiency.

The potential for energy savings is estimated at 2% of the average sectoral consumption. This is approximately equal to 1.46 PJ in the 2016 and 0.21 PJ in 2010. Assessment includes gasoline and diesel.

Even though the measure is not yet active, it is expected to be launched in 2010.

## **5 National Developments under the EU Energy Efficiency Directive and the 20% Energy Efficiency Target of the EU**

The National Energy Efficiency Action Plan (NEEAP) of the Republic of Croatia meets the requirements of Article 14.1 of Directive 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services, which requires the European Union Member States to submit their respective energy efficiency action plans to the European Commission. As part of the accession negotiations with the European Union, the Republic of Croatia took on the obligation of transposing the requirements of the Directive into the national legislation, and of drafting the first NEEAP<sup>3</sup>.

The NEEAP contains a description of measures aimed at improving energy efficiency in Croatia. It is planned to be implemented in order to meet the set targets in 2010 and 2016 and to meet the requirement that the public sector be the leader of activities in the field of energy efficiency. It also contains descriptions of initiatives and measures that are already implemented in Croatia. Energy efficiency has an important role in Croatia's energy policy, which is clearly stated in the current energy development strategy<sup>1</sup>. Improved efficiency in all areas of the energy sector is one of the objectives defined in the strategy, which relates to the production, transmission, distribution and final consumption of energy. However, it should be stressed that there is much more that can be done in Croatia, and that there is significant potential for improving energy efficiency, especially in the building sector. This Action Plan will make it possible to focus on the implementation of energy efficiency policy and monitor its success over the next three years.

In accordance with the Directive, the second NEEAP will be drafted and submitted in 2011.

Within the framework of the Directive on energy end-use efficiency and energy services (the ESD Directive), direct energy demand in Croatia in 2005 totalled 235.70 PJ. Of that, 34% of energy demand was for households, 34% for transport, 13% for industry, 12% for the service sector, 4% for agriculture and 3% for construction.

Croatia has still not established or applied an emissions trading scheme (ETS). However, a preliminary list of installations that will be included in the ETS has been drawn up. Energy consumption in these installations is excluded from the calculation of the national indicative target.

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<sup>3</sup> Source: Prvi nacionalni akcijski plan za energetska ucinkovitost 2008-2010, [www.mingorp.hr](http://www.mingorp.hr)

The national objective for improving energy efficiency has been determined using the methodology provided in Annex 1 of the ESD Directive. For this purpose, data on direct energy consumption for the period 2001 to 2005 have been used. The data have been taken from the official statistics (energy balance) of the Republic of Croatia, published annually by the Ministry of the Economy, Labour and Entrepreneurship (MELE).

The first NEEAP includes a package of measures for the most significant sectors of direct energy demand: households, services, industry and transport. The official statistics recognize three main sectors of direct energy demand: industry, transport and other. Other sectors include households, services (the official statistics do not differentiate public from commercial services), agriculture and construction. However, due to their small share in the total energy demand, and due to the developmental trends in the agriculture and construction subsectors, a decision was made to not develop measures that would exclusively be directed at those subsectors. However, it should be stressed that the majority of the intersectoral and horizontal measures are also applicable to these subsectors.

The first NEEAP contains measures already in effect in Croatia, and measures planned to be implemented in the forthcoming three year period, most of which will be implemented until at least 2016. Table 1-1 gives a summary of the expected energy savings in each of the four abovementioned main sectors of direct energy demand. The expected energy savings by sector have been determined for the packages of measures applied for that sector. The calculation is based on an assessment of the effect of each individual measure that was previously identified in the Energy Efficiency Programme (EEP) of the Republic of Croatia, most of which were based on the available data in the database of the MURE-ODYSSEE project. It must be noted that the majority of sectoral and intersectoral measures are strongly overlapping. As such, this overlap needs to be taken into consideration and thus it is more justified to assess energy savings at the level of the entire sector than at the level of each individual measure.

Table 1-1 also shows the national indicative targets for 2010 and 2016, expressed in PJ, in order to remain in line with the official energy statistics of the Republic of Croatia. The table shows that the expected energy savings that will result from the application of all the proposed measures are higher than the set target. However, the implementation of the first NEEAP in Croatia is just the initial phase in the systematic application of the overall national energy efficiency policy. The remaining shortcomings in the legislative and institutional framework for energy efficiency will have to be removed in the next three-year period. In particular, three key activities will need to be implemented:

- adoption of an Act on Efficient Energy Use;

- complete transposition and implementation of the requirements of the Energy Performance of Buildings Directive into the Croatian legislation;
- strengthening institutional capacities with the adoption of the Operative branches of the FZOEU for energy efficiency (hereinafter: OPEnU).

Therefore, it is more realistic to predict slower accomplishment in the forthcoming three-year period, though in abundance with the set target of a 1% improvement of energy efficiency per year. In the second three-year period, it is expected that energy savings will be higher, due to the good establishment of the legislative and institutional framework, and the previous three-year experience. Lower energy savings are again expected in the final three-year period, as by that time the potential low-cost measures will already be in use. Based on the analyses and assumptions, the set targets are 3% in 2010 and 9% in 2016.

Table 4 National indicative targets for energy savings

<b>National indicative annual target for energy savings for 2016 (PJ)</b>		<b>19.77</b>
<b>National indicative annual target for energy savings for 2010 (PJ)</b>		<b>6.59</b>
<b>Planned measures for improving energy efficiency and reaching targets</b>	<b>Expected annual savings to the end of 2010 (PJ)</b>	<b>Expected annual savings to the end of 2016 (PJ)</b>
Package of measures for the household sector	2.62	7.17
Package of measures for the service sector	1.14	3.68
Package of measures for industry (not ETS)	1.24	4.05
Package of measures for the transport sector	1.60	6.59

<b>Total expected savings:</b>	<b>6.60</b>	<b>21.49</b>
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### **Measures for the implementation of Article 5 of the ESD Directive on measures in the public sector**

The new Public Procurement Act states that energy efficiency may be one of the criteria of public procurement. In order to take advantage of this legal possibility, the Guidelines for Green Public Procurement will be drafted and applied. The Guidelines will first be used by the central state administration in order to stimulate others to its use by example. In this way, measures (b) and (c) listed in Annex VI of the ESD Directive will be implemented.

The Act on Efficient Energy Use will be passed in 2008 and the accompanying implementing provisions are planned to be passed during 2009. These will prescribe the obligations of implementation of cost-effective measures of energy efficiency in public buildings identified during the conducted energy audit. This will ensure the implementation of measure (e) from Annex VI of the ESD Directive. Conducting energy audits will be regulated by law and via the Ordinance on the energy certification of buildings, to be passed in 2008.

### **Measures for the implementation of Article 7 of the ESD Directive on availability of information**

Information about possible improvements to energy efficiency must be made available to energy end users in Croatia by means of a national information campaign jointly carried out by the MELE and UNDP as part of the project "*Removing the barriers for energy efficiency in Croatia*". This campaign has funding until 2009, when the said project will be completed. In order to continue these activities after 2009, it is necessary to improve and strengthen the institutional capacities.

### **Necessary legislative and institutional changes**

The Act on Efficient Energy Use is planned to be passed in 2008. This Act will regulate the requirements for improved energy efficiency in the public sector at the national, regional and local levels. The accompanying implementing regulations are planned to be passed in 2009. The transposition of the EPBD Directive into the Croatian legislation, in particular the adoption of the Ordinance on energy certification of buildings, is expected in 2008.

The current institutional capacities are insufficient for the implementation of all measures planned under the NEEAP. Therefore, the establishment and start of operations of the Operative Office of the FZOEU for energy efficiency (OPEnU) is planned for 2008 and 2009. This will be an independent organizational unit within the FZOEU and will be responsible for the implementation and monitoring of energy efficiency policy. This implementing body for energy efficiency policy will be a specially organised unit under the FZOEU, and is intended to substitute the typical institutional support of the Agency for Energy Efficiency and Renewable Resources in the organisational, personnel and operative sense.

The OPEnU will be responsible for coordinating the implementation of elements of the NEEAP and for monitoring and verifying energy savings, in line with Article 4(4) of the ESD Guidelines. Furthermore, each local and regional self-government unit will stimulate the establishment of an energy management office to deal with local energy planning, and an EE Info Centre where citizens can obtain all information about ways to save energy.

## **Annex 1**

### **Energy Efficiency Measure Summary by Country**

**Household**

Code	Title	Status	Type	Starting Year	Ending Year
<a href="#">CR1</a>	Thermal Protection of Buildings	Ongoing	Legislative/Normative	2005	
<a href="#">CR2</a>	Energy Labeling - household appliances	Ongoing	Legislative/Informative	2008	
<a href="#">CR3</a>	FZOEU energy efficiency programme	Ongoing	Financial	2004	
<a href="#">CR4</a>	FZOEU renewables promotion programme	Ongoing	Financial	2004	
<a href="#">CR5</a>	The Physical Planning And Building Act	Ongoing	Legislative/Normative	2007	
<a href="#">CR6</a>	Action plan for transposing the EPBD in the Croatian legislation	Ongoing	Legislative/Normative	2008	
<a href="#">CR7</a>	Ordinance on energy certification of buildings	Ongoing	Legislative/Informative	2008	
<a href="#">CR8</a>	Technical regulation concerning energy economy and thermal protection in buildings	Ongoing	Legislative/Normative	2008	

7Energy Efficiency Policies and Measures in Croatia in 2007

## Transport

Code	Title	Status	Type	Starting Year	Ending Year
<a href="#">CR1</a>	FZOEU bio fuels promotion	Ongoing	Financial	2004	
<a href="#">CR4</a>	Procurement of New Tilting Trains for the Croatian Railways	Completed	Infrastructure	2000	2007
<a href="#">CR5</a>	Implementation of Bio Fuels into the Transport Sector of the Republic of Croatia in 2007	Ongoing	Legislative/Normative	2007	2007
<a href="#">CR6</a>	Exemption for Eco Test Fee Payment for Vehicles Powered on LPG and CNG	Ongoing	Fiscal	2004	
<a href="#">CR7</a>	Promotion of Bicycle Use in the City of Zagreb	Ongoing	Information/Education/Training	2003	
<a href="#">CR8</a>	Regulation on bio fuels quality	Ongoing	Legislative/Normative	2006	
<a href="#">CR9</a>	Promotion of the CNG vehicles utilization in the Republic of Croatia	Proposed (advanced)	Legislative/Normative		
<a href="#">CR10</a>	Procurement of a bio diesel buses for the Zagreb's public transport company ZET	Ongoing	Infrastructure	2007	

Energy Efficiency Policies and Measures in Croatia in 2007

<a href="#">CR11</a>	Promotion of Clean Vehicles Market Development	Ongoing	Financial	2003	
<a href="#">CR12</a>	Implementation of Bio Fuels into the Transport Sector of the Republic of Croatia in 2008	Completed	Legislative/Normative	2008	2008
<a href="#">CR13</a>	Availability of Fuel Consumption Efficiency and CO2 Emissions Data for New Cars	Ongoing	Legislative/Informative	2007	
<a href="#">CR14</a>	Procurement of a CNG buses for the Zagreb's public transport company ZET	Completed	Co-operative Measures	2009	
<a href="#">CR15</a>	The Programme for Negative Transport Impact on the Environment Reduction – Subsidies for EURO 5 heavy duty vehicles procurement	Ongoing	Financial	2009	
<a href="#">CR17</a>	Obligation for environmentally friendly heavy duty vehicles procurement in public transportation sector	Ongoing	Legislative/Normative	2009	

7Energy Efficiency Policies and Measures in Croatia in 2007

**Industry**

Code	Title	Status	Type	Starting Year	Ending Year
<a href="#">CR1</a>	FZOEU energy efficiency programme	Ongoing	Financial	2004	
<a href="#">CR2</a>	FZOEU and MINGORP energy audits programme	Ongoing	Financial	2004	
<a href="#">CR3</a>	FZOEU renewables promotion programme	Ongoing	Financial	2004	
<a href="#">CR4</a>	Regulation on CO2 emission fees	Ongoing	Cross-cutting with sector-specific characteristics	2007	
<a href="#">CR5</a>	Industrial Energy Efficiency Network (IEEN)	Proposed (advanced)	Co-operative Measures	2010	

**Tertiary**

Code	Title	Status	Type	Starting Year	Ending Year
<a href="#">CR1</a>	Thermal Protection of Buildings	Ongoing	Legislative/Normative	2005	
<a href="#">CR2</a>	FZOEU energy efficiency programme	Completed	Financial	2004	2007
<a href="#">CR3</a>	FZOEU and MINGORP energy audits programme	Completed	Financial	2004	2007
<a href="#">CR4</a>	FZOEU renewables promotion programme	Completed	Financial	2004	2007
<a href="#">CR5</a>	Regulation on CO2 emission fees	Ongoing	Cross-cutting with sector-specific characteristics	2007	
<a href="#">CR6</a>	Energy Management in the Cities and Counties - (SGE) Project	Ongoing	Legislative/Informative	2007	2011
<a href="#">CR7</a>	"Bringing Your House in Order" Program	Ongoing	Legislative/Informative	2008	2013

7Energy Efficiency Policies and Measures in Croatia in 2007

**Cross - cutting**

Code	Title	Status	Type	Starting Year	Ending Year
<a href="#">CR1</a>	Environmental protection and energy efficiency fund - establishment (FZOEU)	Ongoing	General Energy Efficiency / Climate Change / Renewable Programmes	2004	
<a href="#">CR2</a>	FZOEU education programmes	Ongoing	Non-classified Measure Types	2004	
<a href="#">CR3</a>	Feed-in tariffs for electricity from renewables and CHP	Ongoing	Financial Measures, Fiscal Measures/Tariffs	2007	
<a href="#">CR4</a>	Energy sector development strategy of the Republic of Croatia	Ongoing	Non-classified Measure Types	2002	
<a href="#">CR7</a>	Rational Utilization of Energy in Final Consumption	Ongoing	General Energy Efficiency / Climate Change / Renewable Programmes	2009	

## **Annex 2**

### **Country Profile**



## Energy Efficiency Profile : Croatia

October 2008

### Energy Efficiency Trends

#### Overview

In the period 1995 - 2006 the energy efficiency bottom-up index for the whole economy (ODEX) decreased by 10,5% close to the level of EU27. The industrial sector (machinery) and transport sector (trucks and light vehicles) contributed the most to this development.

#### Industry

The energy efficiency in the industrial sector improved by 8,8% in 2006 compared with 1995. The machinery and fabricated metals contributed the most to decrease of energy efficiency index in industry (26,3%). The energy efficiency index in other sectors (chemicals, paper and cement) increased by 8,4%, 13,0% and 8,6% respectively.

#### Households

Energy efficiency in the households sector (calculated on four different end-uses) improved by 1,3% in 2006 compared to 1995, mainly because of energy efficiency

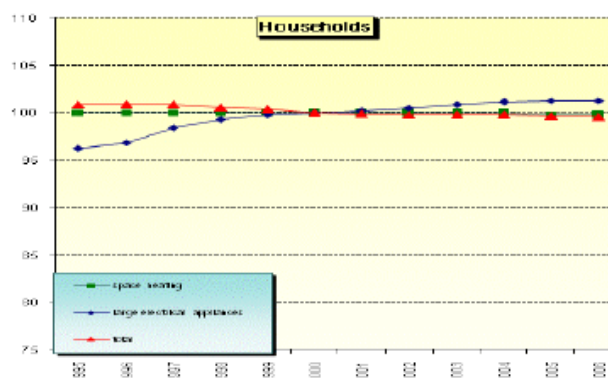
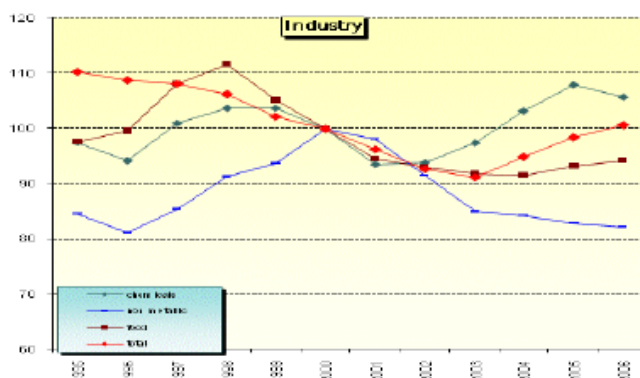
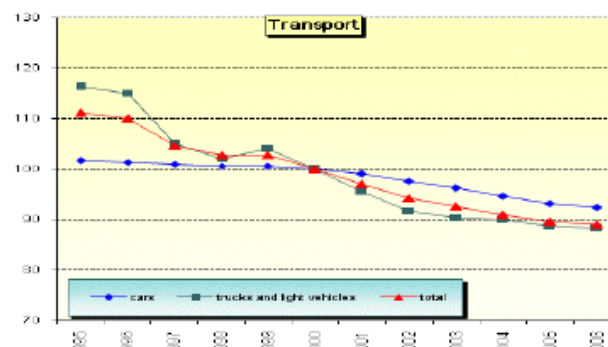
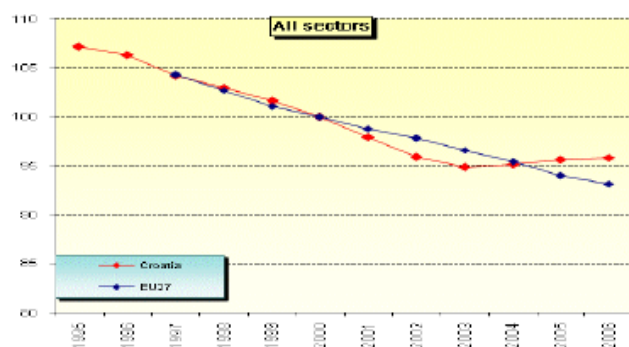
improvement of 8,2% for cooking. The index for space heating shows very small improvement of 0,5% (because of increase in heating comfort and share of central heating), while the index for large appliances increased by 5,3%.

#### Transport

The energy efficiency index of the transport sector improved by 19,8% in 2006 compared to 1995. The highest efficiency improvement was for the trucks and light vehicles (24,0%), while for the cars was 9,1%. The reason way sector of light duty vehicles in category under 3.5 tonnes of carriage achieved such a big improvement in terms of energy efficiency lies in high yearly rate of new vehicles procurement which for the observed period between 1995 - 2006 has amounted to 8,4%.

The specific consumption of cars in litres/100km is regularly decreasing since 1995 (-0.8%/year), with improvements for new cars, since the average rate of procurement of new cars increased for 18.0% yearly.

Energy efficiency index (base 100=2000)



Source: ODYSSEE data base

## Energy Efficiency Policy Measures

### Institutions and programmes

Croatia has signed Energy Charter Treaty in 1994, ratified it in 1997 and in 1998 the Government has confirmed the Protocol on Energy Efficiency and Related Environmental Aspects - PEEREA. PEEREA requires formulation of energy efficiency strategies and policy aims, establishment of appropriate regulatory frameworks, development of specific programmes for the promotion of efficient energy use and development of programmes for reduction of adverse environmental effects from energy sector. Croatia ratified UNFCCC in 1996, while Kyoto Protocol was ratified in 27 April 2007. Croatia is now obliged to reduce its emissions 5% in relation to the base year over the commitment period 2008-2012 and energy efficiency measures are expected to play crucial role in fulfilment of these obligations.

### Industry

The main incentive for energy efficiency projects in industry is coming through programs of the Fund for the environmental protection and energy efficiency, where funding is offered for energy audits and projects with proven improvement measures. Voluntary approaches in industry are being more effective lately, and there is a demand for reliable energy audits, which are offered by various organizations. Financial support is also coming from institutions like reconstruction and development bank, for SMEs and energy efficiency projects. Specific programs are to be set through recently prepared regulative acts.

### Households, Services

Currently there are several actions on implementation of European Directives in Croatian legislation, including Directive on energy performance of buildings 2002/91/EC. Presently, the target deadline for the implementation of the Directive in national legislation is 31 December 2008. Republic of Croatia, jurisdictional Ministry of Environmental Protection, Physical

Planning and Construction at the present is in the process of forming a Committee for implementation of Directive 2002/91/EC on Energy performance of Buildings in national legislation, with obligatory energy certification of buildings. Key issues of implementation are necessary law and regulation changes, preparing quality action plan for the implementation of the directive, forming building registry and education of energy experts trained for energy audits of buildings.

### Transport

Substitution of certain shares of mineral fuels with biofuels is the most important measure for CO<sub>2</sub> reduction which has been adopted in 2007 by Decree for Implementation of Bio Fuels into the Transport Sector of the Republic of Croatia, since Croatia is trying partly to fulfil declared goals from the European Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport. Declared target for the mineral fuels substitution with biofuels for year 2007 was settled up by the Government of the Republic of Croatia to 0.9%, while for the year 2008 was increased on 1.21%. Other strong campaign that has started in early 2007 is focused on promotion of use of compressed natural gas as other possible alternative fuel which has a potential to be used in share than more 5% until year 2020 what could led to 551 kt CO<sub>2</sub> between 2010 - 2020.

### Energy prices and taxes

The gas market liberalisation in the Republic of Croatia resulted in certain changes concerning the structure of the natural gas price for end consumers. Basic gas price elements include natural gas supply price and natural gas transmission price, as well as distribution margin defined by the Croatian Energy Regulatory Agency (CERA). By the end of 2006 CERA published documents that define methodologies and criteria for tariff values determination, so for the first time tariff systems are unbundled.

## Selected Energy Efficiency Measures

Sectors	Title of Measure	Since
Transport	Regulation for Eco Test Fee Payment Exemption for Vehicles Powered on LPG and CNG	2004
Transport	Decree for Implementation of Bio Fuels into the Transport Sector of the Republic of Croatia (yearly basis upgrading)	2007
Transport	Promotion of the CNG vehicles utilization in the Republic of Croatia	2007
Transport	Procurement of a bio diesel buses for the Zagreb's public transport company ZET	2007
Transport	Regulation on Energy Efficiency and CO <sub>2</sub> Emissions of the New Cars Data Availability	2007
Transport	Make Cars Green – Eco Campaign	2008

Source: MURE data base  
[www.mure2.com](http://www.mure2.com)



