Hendal

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1 INTRODUCTION AND METHODOLOGY

The IG BCE's Foundation for Labor and the Environment is a non-profit, legally responsible foundation under civil law. The focus of its work is predominantly on the sectors within the IG BCE's organizational area. Stiftung Arbeit und Umwelt ("Foundation Work and Environment") of IG BCE in Berlin is working on the "green@work" project, which is funded by the European Commission. Stiftung Arbeit und Umwelt turned to agency Hendal to conduct a research assignment on the chemical, pharmaceutical and energy industry in Croatia.

The research study was conducted using the secondary data.

As a basic method of this kind of research secondary (desk) research was used, which is most suitable for obtaining basic source of valid and officially published secondary data.

During the preparation of the paper, the data from the following sources were used:

- The competent ministry (Ministry of Economy and Sustainable Development)
- Sector Analyses by The Institute of Economics, Zagreb
- Business Croatia, database of business companies in Croatia
- Croatian Bureau of Statistics
- Published reports on sustainable development.

All data are available online and can be used for research purposes with a reference to the sources used.

2. SUMMARY

2.1. Implementation of sustainable strategies in Croatian frameworks

The Republic of Croatia, as a party to the United Nations Climate Change Convention (UNFCCC), a **signatory to the Kyoto Protocol and the Paris Agreement** and as a **full member of the EU**, is obliged to compile a national inventory of anthropogenic emissions and removals of all greenhouse gases not controlled by the Montreal Protocol and report to the UNFCCC and the EC.

The Croatian Parliament ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1996 (Official Gazette – International Agreements, no. 2/1996) by which Croatia, as a signatory party, has assumed the scope of its commitments within the framework of the Annex 1 to the Convention.

Croatia ratified the Kyoto Protocol in the April 2007. Under the Kyoto Protocol, Croatia had the obligation to reduce GREENHOUSE GAS emissions from anthropogenic sources by 5 % in the period from 2008 to 2012, relative to the base year 1990. Commitments undertaken by Croatia under the Kyoto Protocol were met as a result of the implementation of mitigation measures and also because of the economic downturn caused by the crisis.

At the 18th Conference of the Parties to the UNFCCC, held in Doha (Qatar) in December 2012, Croatia agreed to be included in the amendment to Annex B of the Kyoto Protocol. Thus, Croatia is committed to reduce GREENHOUSE GAS emissions in the second commitment period of the Kyoto Protocol, from 2013 to 2020. Croatia shares a common commitment with other EU Member States and Iceland, to reduce GREENHOUSE GAS emissions by at least 20 % by 2020 relative to the level of emissions in the base year 1990.

At the end of 2015, at the 21st Conference of the Parties to the UNFCCC (COP21) held in Paris, the global climate agreement was adopted (Paris Agreement). It is an ambitious international agreement, which aims to: (1) hold the increase in the global average temperature to well below 2 ºC above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 ºC, (2) increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low GREENHOUSE GAS emissions development, (3) make finance flows consistent with a pathway towards low GREENHOUSE GAS emissions and climate-resilient development.

The Paris Agreement became legally binding on November 4, 2016, a month after the conditions laid down in the Agreement were met: ratification by at least 55 parties, whose emissions cumulatively make up 55 % of the global GREENHOUSE GAS emissions. Unlike the Kyoto Protocol, the Paris Agreement commits all countries to take measures to limit emissions and at the same time strengthens the role of civil society, organizations, financial institutions, cities, and other subnational authorities. European Union has ratified the Paris Agreement and has committed itself to reducing GREENHOUSE GAS emissions by at least 40 % until 2030, compared to the emission level in 1990. Croatia ratified the Paris Agreement in May 2017.

The Agreement also requires the establishment of an international registry to identify the contribution of each country (Intended Nationally Determined Contribution, INDC). Through the INDC each member state of the Convention defines the GREENHOUSE GAS emission reduction target, with regular monitoring activities of the set targets achievement.

Following the European directives, **Croatia has adapted its development strategies to the principles of sustainability**, emphasizing concrete measures whose implementation will achieve the set goals of increasing energy efficiency and the use of renewable energy sources and decarbonization of all sectors of energy consumption and production. **Croatia's energy development strategy until 2030, with a view to 2050, envisages a significantly higher share of renewable energy production, higher energy efficiency and reduction of greenhouse gas emissions, as well as the Integrated National Energy and Climate Plan (NECP) for the period from year 2021 to year 2030**.

The **Fund for Environmental Protection and Energy Efficiency** has a key role in encouraging the implementation of measures to increase energy efficiency at the national level and energy management at the local level. The Fund finances energy renovation projects and projects for the use of renewable energy sources, as well as various activities to encourage low-emission mobility.

Beneficiaries of the Fund's resources can be local and regional self-government units, institutions, companies, civil society organizations and citizens, and the right to co-finance projects is exercised by applying to public tenders and calls with appropriate documentation.

In March 2020, as part of the Green Plan and in line with the new industrial strategy, the European Commission presented a new Action Plan for the Circular Economy, which includes proposals for more sustainable product design, waste reduction and citizen empowerment (introducing, for example, the right to repair). A special focus is on resource - intensive sectors, such as electronics and information and communication technology, plastics, textiles, and construction.

In **February 2021, European Parliament voted on a new circular economy action plan** and called for additional measures to achieve a carbon-neutral, environmentally sustainable, non-toxic, and fully circular economy.

In order to encourage the implementation of waste prevention activities, as the most efficient and sustainable way of using resources, all EU member states, including the Republic of Croatia, are obliged to develop a Waste Prevention Plan. Therefore, the Republic of Croatia has harmonized its legislation with the acquis EU through the provisions of the Law on Sustainable Waste Management, i.e., the Waste Management Plan for the period 2017-2022. According to the above regulations, prevention of occurrence waste means measures taken before a substance, material or product becomes waste, with the aim of reducing the amount of waste including the reuse of the product and extending its life, reducing the negative impact of waste on the environment and human health and products.

The advantage of countries like Croatia, which started with the concept of a circular economy relatively late, is reflected in the fact that they can learn from the mistakes of others. Germany and Sweden are pioneers of this practice, but they have also made mistakes, both in technology and in building the whole system.

As a good example, Croatia had 11% less landfilled waste from 2016 to 2018. Landfills are being rehabilitated continuously, and at the end of 2019 there were 223 closed landfills, with another 94 active ones. Continuous work is being done to improve the system of monitoring the fulfillment of prescribed goals and to implement measures to reduce waste disposal, which is supported by the adoption of the Decision on the order and dynamics of landfill closure (Official Gazette 3/2019, 17/2019). The decision was made in order to implement measure 4.1 - development of a plan for closing the non-hazardous waste landfill prescribed in the Waste Management Plan of the Republic of Croatia 2017-2022 (Official Gazette 3/2017), and in accordance with the document: Dynamics of closing the non-hazardous waste landfill territory of the Republic of Croatia.

2.2. Economic situation of three industries

ENERGY INDUSTRY

According to the data of Business Croatia, in 2019, 15 business entities were active in the activity "Extraction of crude petroleum and natural gas", while 921 were active in the activity "Supply of electricity, gas, steam and air conditioning".

The largest business entity in 2019 was INA dd, with its total revenues in the amount of HRK 21 613 303 400. A significant part of its business is related to business with the Government of the Republic of Croatia, its ministries, and agencies. INA d.d. thus has a dominant position in Croatia in the exploration and production of renewable energy and gas and the sale of gas and petroleum products.

On a year-on-year basis, they recorded a growth of 12.7 %, which is primarily the result of higher wholesale, lack of supply from the refinery in Bosanski Brod and increased sales. At the same time, the costs of raw materials and energy recorded a decline of 29 %, because of the overhaul of the Rijeka Refinery in the period from January to May 2019. The number of employees decreased from 4,125 employees in 2018 to 3,789 employees in 2019 (down by 8.1 %).

The number of employees at the level of ten leading companies in this industry increased by 2.8 %, from 10,449 employees in 2018 to 10,742 employees in 2019. Ten leading companies cumulatively recorded positive operations in 2019 (HRK 2.4 billion in profit), with both profit and gross margin increasing significantly compared to the previous year. Reported profit was higher by 28.5 % and gross margin by 28 %. Of the ten leading companies, two companies ended 2019 with a loss, HEP-Toplinarstvo d.o.o. with a loss of HRK 38.4 million and E.ON Energija d.o.o. with a loss of 3.3 million. The remaining eight leading companies in the activity "Electricity, gas, steam and air conditioning supply" concluded 2019 with a positive business result.

A stronger increase in the number of employees than an increase in total income resulted in a 2.4 % decrease in labor productivity. The value of the current liquidity ratio for the ten leading companies in electricity, gas, steam, and air conditioning supply lower than 1.5 (1.4) indicates that in 2019 they had certain difficulties in maintaining liquidity. However, compared to the previous year, liquidity increased by 3.3 %. The indebtedness ratio of the top ten companies in the activities of electricity, gas, steam and air conditioning supply in the amount of 0.45 in 2019 indicates a relatively low indebtedness of companies.

Measured by total revenues, ten leading companies within the electricity, gas, steam, and air conditioning supply in 2019 are HEP dd, Prvo plinarsko društvo d.o.o., HEP-Proizvodnja d.o.o., HEP-Operator distribucijskog sustava d.o.o, HEP ELEKTRA d.o.o., HOPS d.o.o., GEN-I Hrvatska d.o.o., E.ON Energija d.o.o., HEP-Toplinarstvo d.o.o. and HEP-Opskrba d.o.o.

CHEMICAL INDUSTRY

In the Croatian economy, total industrial production in 2020 recorded a year-on-year decline of 2.7 %. Despite the pandemic, the production of chemicals and chemical products in 2020 in Croatia recorded a year-on-year growth of 11.3 %.

The rubber and plastic products industry recorded a year-on-year decline of 7.5 %.

The positive trends in the activities of the chemicals and chemical products industry over the past year were accompanied by an increase in wages, while employment declined slightly. Compared to the previous year, exports of the chemical and chemical products industry in 2020 were lower by 2.0 %, while imports recorded a slight growth of 0.4 %. Along with the decline in manufacturing activity, developments in the plastics and rubber products industry were marked by declining employment, while wages continued to rise. The plastics and rubber industry recorded a year-on-year decline in both imports and exports, with exports down 0.6 % and imports down 1.3 %. Both industries are characterized by dependence on imported raw materials, which results in a high foreign trade deficit.

The contribution of the chemical industry sector to the economy is also visible in the data on gross domestic value, employment, and the number of active business entities. The share of the chemical industry sector in the gross domestic value of the manufacturing industry in 2018 was 6 %, with the share of the chemicals, chemical products and man-made fibers industry being 2.1 % and the share of the rubber and plastics industry 3.9 %. The total number of employees in the chemical industry sector in December 2020 was 16,389 or 7.3 % of the total employment of the manufacturing industry. According to Business Croatia, business entities in the chemical industry make up as much as 7.9 % of business entities in the Croatian manufacturing industry.

PHARMACEUTICAL INDUSTRY

The Central Bureau of Statistics announced that the production of basic pharmaceutical products and pharmaceutical preparations in June 2020 was 8.5 % higher compared to the same month in 2019 according to the seasonally and calendar-adjusted index. However, in the first six months of year 2020, the production of pharmaceutical products and preparations decreased by 0.3 % year on year. The pharmaceutical industry is thus one of many industries that in the first half of 2020 recorded a decline in production, which in that period at the level of total industry amounted to 6.4 %. Trends in this industry, as in others, in the first half of year 2020 were significantly marked by the impact of the COVID-19 disease pandemic and the activities carried out to combat it.

Monthly change rates calculated from seasonally and calendar-adjusted indices indicate a decrease of 8.8 %in March 2020 compared to February 2020 and 17.7 % in May compared to April. After a decrease of 25.1 %in January 2020 compared to December 2019, in February compared to January, production in this industry increased by 46.4 %.

The monthly increase, by 31.1 %, was achieved in April 2020. In June, the production of pharmaceutical products increased by 4.7 % compared to May 2020. Inventories of finished pharmaceutical products at manufacturers in June 2020 decreased by 14.1 % compared to the same month in 2019. Compared to May 2020, they increased by only 0.4 %.

2.3. Greenhouse gas inventory in Croatia – by years and by sectors

GREENHOUSE GAS INVENTORY FOR THE PERIOD FROM 1990 TO 2019

In 2019, total greenhouse gas emissions, amounted to 23,605 kt CO2 eq (CO2 emission equivalent), which represents a reduction in emissions by 24.05% compared to on emissions in the base year 1990 (31,387 kt CO2 eq).[1]

GODINA	1990.	1995.	2000.	2005.	2010.	2015.	2016.	2017.	2018.	2019.
CO_2 eq (kt)	31.387	22.487	25.564	29.731	27.753	23.912	24.000	24.738	23.536	23.605

Summary table 1. Greenhouse gas emissions from 1990 to 2019 in Croatia (source: Ministry of Economy and Sustainable Development Institute for Environmental and Nature Protection)

The general decline in economic activity and energy consumption from **1991 to 1994**, mostly caused by the war in Croatia, directly caused a **decline in total greenhouse gas emissions** in that period.

As the entire national economy was in transition, **some energy-intensive industries reduced their activities or even stopped production** (e.g., blast furnace in Sisak, primary aluminum production in Šibenik, coke production in Bakar), which significantly affected the reduction greenhouse gas emissions. Between **1995 and 2008, emissions began to grow** at an average rate of 3% per year.

Due to the reduction of economic activity from **2008 to 2019 emissions have been steadily declining apart from 2017 when there was an increase in emissions due to forest fires**.

The biggest reasons for the increase in emissions in the period from 1995 to 2008 are the sectors Energy (Electricity and heat production; Transport), Industrial processes (Cement production; Lime production; Ammonia production; Nitric acid production; Halogenated hydrocarbon consumption) and Waste. The increase in the subsector Electricity and heat production is mostly caused by higher consumption of liquid fuels. Recently, producers of cement, lime, ammonia, and nitric acid have reached their highest production capacity, which is maintained at emission levels. Municipal solid waste disposal and wastewater treatment and drainage have the largest impact on emission growth in the Waste sector.

[1] Inventar stakleničkih plinova 2021 (za razdoblje od 1990. do 2019.) – sažetak: Ministarstvo gospodarstva i održivog razvoja Zavod za zaštitu okoliša i prirode: available at: Inventar 2021 - sažetak.pdf (haop.hr)

The main reasons for reducing greenhouse gas emissions from 2008 to 2019 are the economic crisis and the beginning of the implementation of measures to reduce CO2 emissions according to the National Energy Efficiency Action Plan for the period from 2014 to 2016 and the period from 2017 to 2019.

TOTAL GREENHOUSE GAS EMISSIONS BY SECTORS OF THE REPUBLIC OF CROATIA FROM 1990 TO 2019

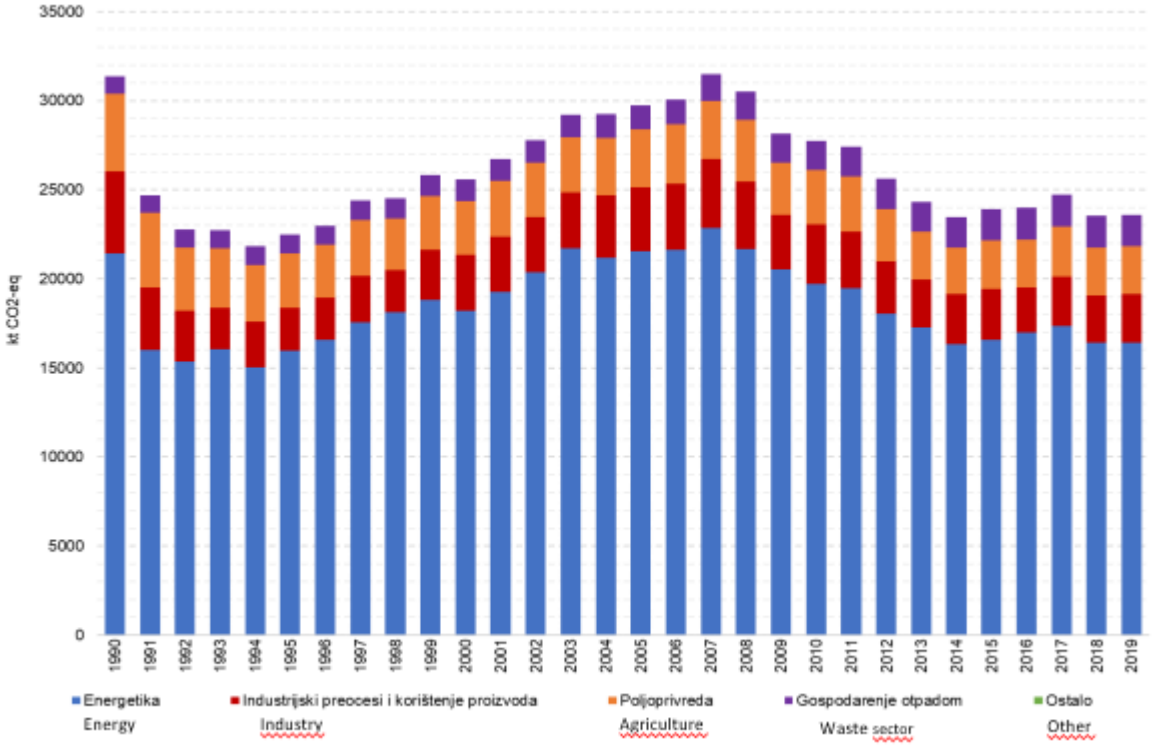
The main cause of greenhouse gas emissions are anthropogenic activities that are calculated in 5 sectors in accordance with the international methodology:

- Energy,
- Industrial processes and product use,
- Agriculture,
- Land use, land conversion and forestry (LULUCF), and the
- Waste sector.

In 2019, total greenhouse gas emissions amounted to 23,605 kt CO2 eq, with the largest contribution coming from the Energy sector (around 69.6%). They are followed by Industrial Processes with 11.6%, Agriculture with 11.4% and the Waste Sector with 7.4%

Sinks removals of greenhouse gases are related exclusively to the LULUCF sector and amounted to 5,556.8 kt CO2 eq in 2019. Excluding sinks removals, net greenhouse gas emissions in 2019 amounted to 18,048 kt CO2 eq[2].

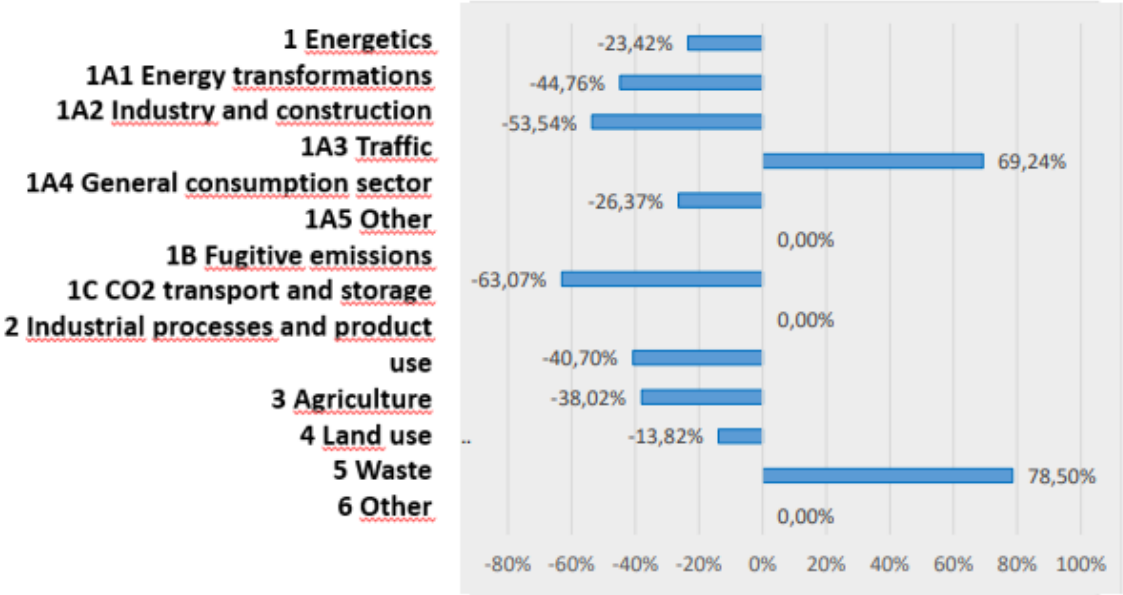
[2] Ibid.



Summary figure 1. Greenhouse gas emissions by sectors from 1990 to 2019 in Croatia (source: Ministry of Economy and Sustainable Development Institute for Environmental and Nature Protection)

Changes in emissions and removals of greenhouse gas sinks by individual subsectors compared to the base year 1990 are shown in Summary Figure 2. The largest increase in emissions in 2019 compared to 1990 was recorded in the Waste sector, followed by the Transport sub-sector, while in all other sub-sectors a decrease in emissions compared to 1990 was recorded[3].

[3] Ibid.



Summary figure 2. Changes in emissions by subsectors compared to 1990 (source: Ministry of Economy and Sustainable Development Institute for Environmental and Nature Protection)

➔ ENERGY SECTOR

The Energy sector is the main source of greenhouse gas emissions in Croatia. Emissions from activities in this sector represent almost 70% of total greenhouse gas emissions. In 2019, there was an increase in emissions from this sector by 0.04% compared to 2018, while compared to the base year, a decrease of 23.4% was recorded. Most of the emissions of this sector occur as a result of fuel combustion (more than 95%). The activities that contribute the most to the greenhouse gas emissions of this sector are: transport (40.16%), energy transformations (23.85%), general consumption sector (18.92%) and industry and construction (14.81%).[4]

➔ INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR

Greenhouse gas emissions calculated within this sector are emissions resulting from physical and chemical processes of conversion of raw materials into industrial products, due to the use greenhouse gases in products (HFCs and PFCs), and due to the use of carbon from fossil fuels for non-energy

[4] Ibid.

purposes. The key source of emissions in this sector is the production of other non-metallic mineral raw materials, which includes the production of cement, lime, and the use of limestone in various industries (e.g., sugar production). The production of chemicals and chemical products, primarily ammonia, contributes with 23.57% of emissions from this sector, while the use of substitutes for ozone-depleting substances mainly in cooling systems contributes 20.2% in 2019.

2.4. SWOT analysis

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
EU membership (EU funds money)	Bureaucratic dispute - inert institutions	Learning from other countries' experience	Loss of jobs by shutting down the plant
Low level of production and low waste production compared to other EU countries	Reluctance to change	Creating new jobs of custom occupations	Penalties for non-compliance on a national level
Low carbon footprint on a national level	Unfinished work with closed landfills	Involve citizens in the recycling of waste (other than bottles) by using incentives	Ignorance of citizens as a first instance (too much recyclable household waste leads to aversion to recycling)
Rich natural resources (water, arable land...)	Focus on tourism – not on industry	Large companies are prone to new sustainable development policies - good public image	Resistance of small companies (no alternative for plastic as a material)
High possibility to use renewable energy sources	Large companies have to adapt to CO2 measures	Possibility to provide education on transition to circular economy	Lack of knowledge on how to implement circular economy
Excellent geographical position in comparison to other countries	Transition Fund in two counties (Sisak-Moslavina and Istria) - insufficient funds for adjustment	High level of employment in service industries	Unpreparedness for sudden external threats (earthquake, corona)
Improved foreigners' perception of the country (clean country)	Delay in the implementation of the Paris Agreement	Building of a stable and diversified economy	Decline in total population and average population aging (reduction of the working population)
Highly educated workforce	The cost of transition to a circular economy	Utilization and functional management of natural energy sources	Economic inequality of regions

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Good intra-territorial land connection within Croatia	High level of corruption in the country	Achieving good monitoring of the environment and effective protection of nature parts and environmental components	Emigration from smaller communities to larger cities (search for new jobs)
	Non-use of own production resources	Retraining of workers for new occupations	Weakening of the competitiveness of domestic companies if they do not adapt to the circular economy
	Low export – high import (of all goods and energy)	Promotion of new technologies and investment in education about climate-neutral technologies	Expensive substitutes for plastic materials

SWOT analysis (source: Hendal market research)

2.5. The National Recovery and Resilience Plan for 2021-2026

The National Recovery and Resilience Plan for 2021-2026 was presented to the public in early months of year 2021. It is expected to start implementing at the end of 2021, after being approved by the Council of the European Union based on a proposal from the European Commission[5].

By the end of 2021, Croatia can already expect the payment of around 6.1 billion kuna, which is an advance of 13% of the total amount of grants provided under the Plan.

Croatia has requested the financing of 152 investments through this program, but it has also committed to implement 77 reforms.

Disbursement of grants from the Mechanism is made based on the execution of performance indicators defined by the Recovery and Resilience Plan, for each of the planned reforms and investments.

The plan is structured to include five components and one initiative:

- **Economy**
- Public administration, judiciary, and state property
- Education, science, and research
- Labor market and social protection
- Health care
- Initiative: Renovation of buildings

Sustainable development is one of the sub-components of the economy.

More than 50 percent of funds will be directed to the economy, as the most important component of the National Recovery and Resilience Plan, i.e., about 26 billion kuna through direct grants in the form of financial instruments, i.e., loans, guarantees, interest rate subsidies and grants for specific purposes (reduction of carbon footprint in production, higher energy efficiency, digital vouchers, or support for digitization of business processes).

[5] Nacionalni plan oporavka i otpornosti 2021.-2026.: Vlada Republike Hrvatske: available at: https://vlada.gov.hr/UserDocsImages/2016/Sjednice/2021/Travanj/55%20sjednica%20VRH/Dokumenti%20NOVO/55%20-%201%20NPOO.pdf

Economic projects will be financed through subcomponents:

- **strengthening competitiveness and green transition**
- **energy transition for a sustainable economy**
- **improvement of water management and waste management**
- **development of a competitive, energy sustainable and efficient transport system**
- **improving the use of natural resources and strengthening the food supply chain**
- **development of sustainable, innovative, and sustainable tourism**

The National Recovery and Resilience Plan focuses on these priorities, to ensure, in addition to returning to the pre-crisis level of activity, greater resilience of the economy to some future shocks. In this regard, in the long run it is necessary to focus activities on strengthening the competitiveness and innovation of the economy through the systematic integration of sustainable development, green and digital transition and development progress based on innovation, new technologies and internationalization of business. Therefore, the goals of the reforms in the Recovery Plan will be the application of the model of sustainable development, with better water resources management, a more efficient waste management system and the transition to a circular economy.

The European Commission has accepted all the proposed investments and the concept of the Croatian Government with which the National Recovery Plan was prepared, but the green light should still wait until the end of July, which is the deadline by which the European Commission must issue its assessment.

The plan with which the Croatian Government went towards the commission is worth HRK 48.7 billion, which is about HRK 1.2 billion more than the allocated HRK 47.5 billion.

2.6. Just Transition Fund

Achieving climate neutrality by 2050 is an ambitious and painful plan for some EU member economies. The transformation should be facilitated by the 17.7 billion euro Just Transition Fund, which has been given the green light by the European Parliament. Part of that money is available specifically to the Istrian and Sisak-Moslavina counties, the only two in Croatia that have the right to use the fund. The two counties cannot be different: one is among the poorest, recently destroyed by earthquakes, the other among the richest, but what they have in common is that they emit the most greenhouse gases.

In Sisak due to the chemical and refinery industry, and in Istria on account of electricity production (from coal in Plomin, which generates 6% of total energy in the country) and the cement industry.

The challenge of decarbonization, reducing greenhouse gas emissions, is especially in the fact that these industries employ many people. According to the European Commission, a transit in the Sisak refinery from crude oil refining to more sustainable alternatives will affect about 7% of the county's population.

The carbon-intensive local industry underscores the scale of the decarbonization challenge that requires a reorientation of long-term investments towards innovative, climate-neutral technologies that will employ the local workforce. The preliminary assessment considers it appropriate that the Fund for a Fair Transition focus on interventions in these regions, it is pointed out in the investment review of the Fund in the period from 2021 to 2027, which refers to Croatia.

Although more than twice as modest as the first proposal, the Fund, backed by 615 MEPs, will subsidize the green transition of regions currently dependent on coal and fossil fuels and mitigate the negative economic effects of the green transition. These are funds for retraining workers, assistance in finding new employment, transformation of existing facilities in the fossil fuel industry, sustainable mobility, but also the construction of, for example, nursing homes. The range is wide, so the money can support micro companies, business incubators, universities and public research institutions, investments in new energy technologies and energy efficiency.

The transition to green and more sustainable technologies represents an opportunity for the development of the European economy, but also a cost that affects the global competitiveness of domestic entrepreneurs.[6]

[6] Poslovni dnevnik, 20 05 2021 edition, “Preorijentiranost na niskougljičnost već zabrinjava na tisuće radnika”

The Green Plan Investment Plan envisages the mobilization of at least one trillion euros in ten years through EU and national budgets, public and private investment, measures to facilitate and encourage green investment (private and public), attractive investment conditions and technical assistance for the selection of sustainable projects. In 25 % of all EU funds, it is intended for action in the field of climate, 30 percent of the InvestEU program and the encouragement of green investments with the support of the European Investment Bank.

While Istria has propulsive tourism, Sisak-Moslavina County does not have such a safety network. After the year 2020 earthquake, the future of the area depends on revitalization, and part of the solution could be found in the broad criteria of the Fund for a Fair Transition.

3. REPORT PART 1

3.1. ENERGY INDUSTRY

3.1.1. Introduction and trends

In 2019, gross domestic product increased by 2.9 % compared to the previous year, as well as the total final energy consumption which increased by 0.9 %. The total primary energy supply decreased by 0.8 %. The total gross electricity consumption decreased by 0.7 % while net electricity consumption (without transmission and distribution losses) increased by 0.2 % for the same period. The total transmission and distribution losses for the observed period decreased by 9 %. In the period from 2014 until 2019, gross domestic product increased at an average annual rate of 2.9 %. In the same period, the total primary energy supply increased at an average annual rate of 0.2 %, while the total final energy consumption increased at an average annual rate of 2.1 %. Electricity consumption showed a positive trend, with gross electricity consumption and net electricity consumption increasing at an average annual rate of 1.5 % and 1.8 %, respectively. Transmission and distribution losses decreased at an average annual rate of 1.3 %.

The stated trends of gross domestic product, total primary energy supply, total final energy consumption and electricity consumption resulted in the decrease of energy intensity of all energy activities in 2019, as compared to 2018. Energy intensity of the total primary energy supply and energy intensity of the total final energy consumption decreased by 3.6 % and by 2 %, respectively. Energy intensity of gross electricity consumption and net electricity consumption decreased by 3.5 % and 2.6 %, respectively. Also, during the period from 2014 to 2019, all observed energy intensities achieved a decreasing trend. Energy intensity of the total primary energy supply and total final energy consumption decreased at an average annual rate of 2.7 % and 0.8 %, respectively. Energy intensity of gross electricity consumption decreased at an average annual rate of 1.4 %, while energy intensity of net electricity consumption decreased at an average annual rate of 1.1 %.

Figure 1 shows trends in the total primary energy supply in the period from 1988 until 2019. As compared to the previous year, the total primary energy supply in 2019 decreased by 0.8 %. In the period from 2014 until 2019, the total primary energy supply increased at an average annual rate of 0.2

%. From 1992 until 2019, when Croatia's total primary energy supply was at its minimum, the total primary energy supply grew at an average annual rate of 0.9 %.[7]

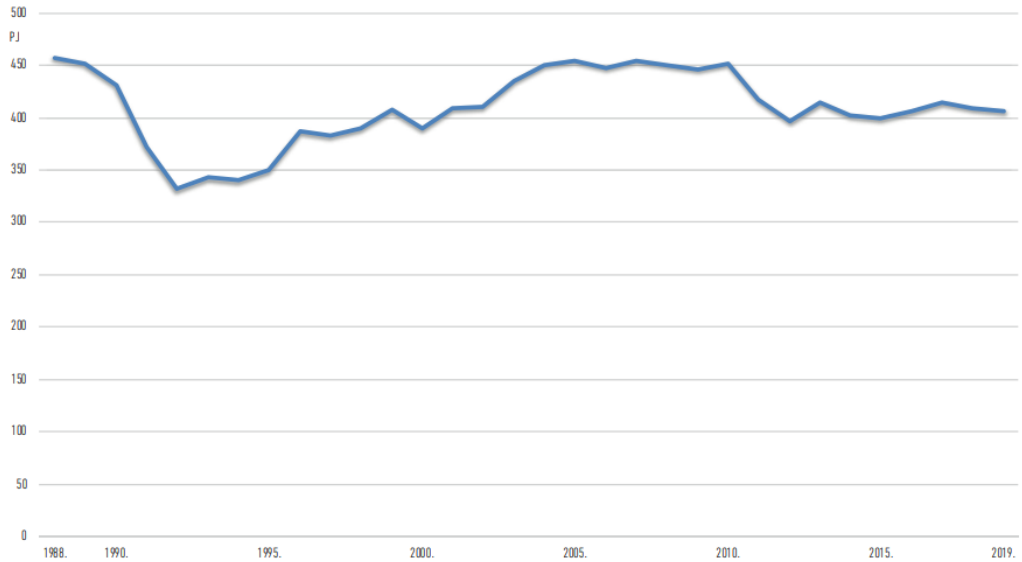


Figure 1: Total primary energy supply (source: Ministry of Economy and Sustainable Development)

Figure 2 shows trends in gross and net electricity consumption in the period from 1988 until 2019. In the period from 2014 until 2019, gross and net electricity consumption increased at an average annual rate of 1.5 % and 1.8 %, respectively. From 1992, when Croatia had the lowest energy consumption, until 2019, gross electricity consumption increased at an average annual rate of 1.8 %, whereas net electricity consumption had a slightly faster increase at an average annual rate of 2 %. In the same period, electricity losses increased at a slower rate, on average by 0.4 % per year. In 2019, gross electricity consumption in Croatia decreased compared to the previous year, so that gross electricity consumption amounted to 18 893.3 GWh, while net electricity consumption increased and amounted 17 234.3 GWh.

[7] Ministarstvo zaštite okoliša i energetike. (2019). Energija u Hrvatskoj 2018.: Godišnji energetski pregled. Zagreb: Ministarstvo zaštite okoliša i energetike Republike Hrvatske: http://www.eihp.hr/wp-content/uploads/2020/04/Energija2018.pdf

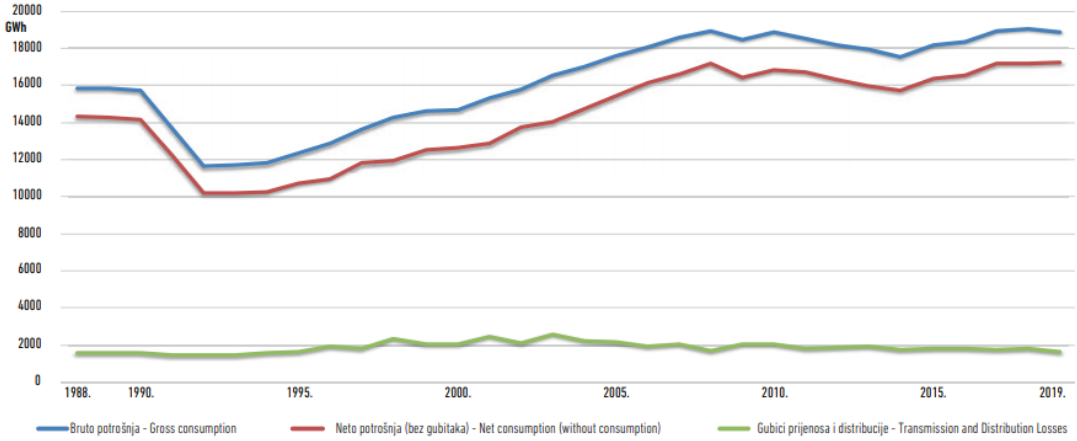


Figure 2: Electricity consumption (source: Ministry of Economy and Sustainable Development)

Figures 3 and 4 present values of energy intensities of the total primary energy supply and gross electricity consumption. They are calculated using gross domestic product determined by the application of purchasing power parities and expressed in US$ 2010. In 2019, for the realization of one thousand US$ 2010 determined by PPP, 108 kg of tons of oil equivalent of the total gross energy was used in Croatia, which is 11 % above the European Union average (EU 28). More favorable values of energy intensity of the total primary energy supply were recorded in 27 observed countries (including the average for EU 28), while other countries presented in the above-said Figure had a worse energy intensity. In 2019, gross electricity consumption in Croatia for one thousand US$ 2010 of GDP, determined by PPP amounted to 210 kWh, which is 16.8 % above the European average (EU 28). When compared to individual European countries, energy intensity of gross electricity consumption in twenty-five countries shown in the Figure was lower.[8]

[8] Ibid.

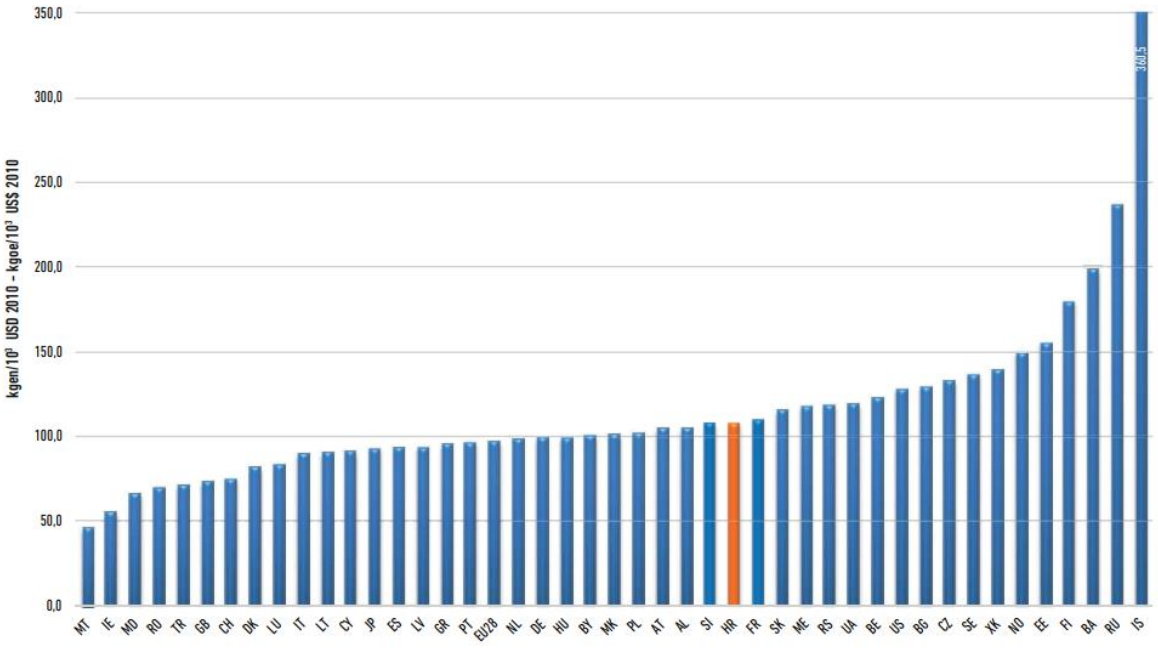


Figure 3: Total primary energy supply intensity – PPP (source: Ministry of Economy and Sustainable Development)

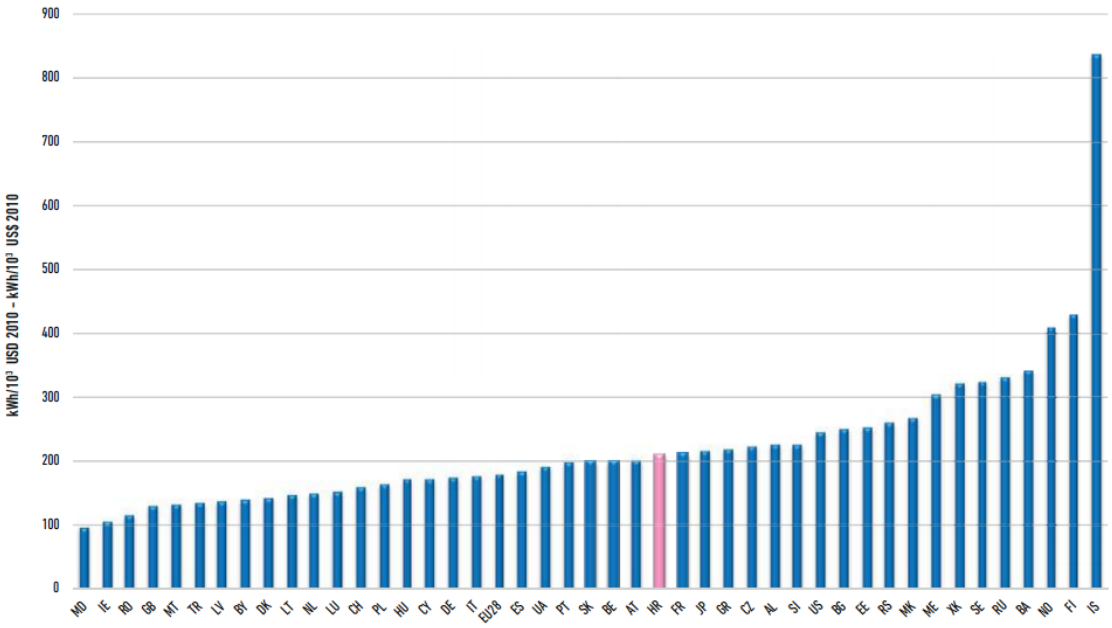


Figure 4: Gross electricity consumption intensity – PPP (source: Ministry of Economy and Sustainable Development)

3.1.2. Primary energy production

Primary energy production in the period from 2014 until 2019 is described in the Table 1. Figure 5 shows trends in the primary energy production from 1988 onwards. In 2019, the primary energy production decreased by 9.3 % compared to the previous year. Energy production from other renewable sources (wind energy, solar energy, biogas, liquid biofuels, and geothermal energy) increased by 20.4 %, while the production of other primary energy sources decreased. Natural gas production decreased by 16.1 %, while crude oil production decreased by 3.6 %. Heat production from heat pumps decreased by 4 %, while fuel wood and other solid biomass decreased by 0.4 %. Energy production from hydropower decreased by 24.5 %.[9]

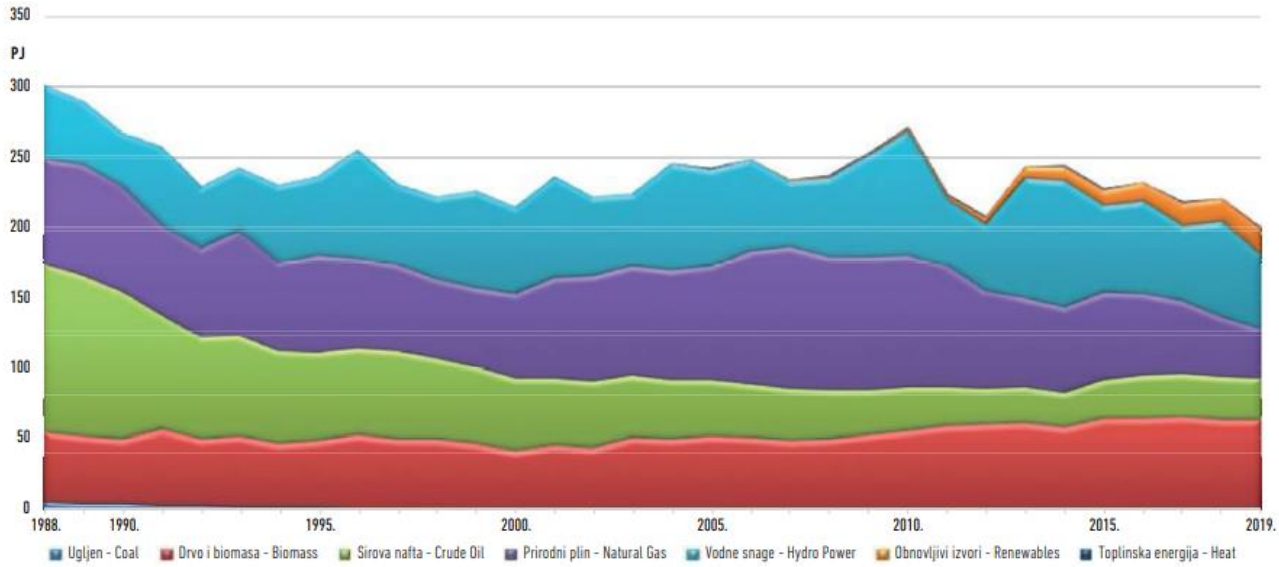


Figure 5: Primary energy production (source: Ministry of Economy and Sustainable Development)

	2014.	2015.	2016.	2017.	2018.	2019.		2019./18.	2014.-19.
	PJ							%	
Ogrjevno drvo i biomasa • Fuel Wood and Biomass	57,97	64,19	64,15	64,67	63,06	62,79		-0,4	1,6
Sirova nafta • Crude Oil	25,38	28,62	31,47	31,79	31,26	30,13		-3,6	3,5
Prirodni plin • Natural Gas	60,52	61,61	57,52	51,76	43,07	36,13		-16,1	-9,8
Vodne snage • Hydro Power	88,99	61,63	65,63	53,81	66,98	51,54		-23,1	-10,3
Toplinska energija • Heat	0,52	0,62	0,66	0,67	0,63	0,61		-4,0	3,1
Obnovljivi izvori • Renewables	10,58	10,99	12,90	16,10	16,21	19,51		20,4	13,0
UKUPNO • TOTAL	**243,95**	**227,65**	**232,33**	**218,79**	**221,21**	**200,71**		**-9,3**	**-3,8**

Table 1: Primary energy production (source: Ministry of Economy and Sustainable Development)

[9] Ibid.

During the six-year period, from 2014 until 2019, primary energy production in Croatia decreased at an average annual rate of 3.8 %. Decreasing trend was recorded in the production of natural gas and hydropower, whereas the production of other primary forms of energy increased. The production of natural gas decreased at an average annual rate of 9.8 %, while hydropower decreased at an average annual rate of 10.3 %. The fastest increasing production was that of renewable energy with an average annual rate of 13 %, while the production of crude oil increased at an average annual rate of 3.5 %. The production of fuel wood and other solid biomass as well as heat produced by heat pumps increased at an average annual rate of 1.6 % and 3.1 %, respectively.

The shares of individual energy forms in the total primary energy production in two characteristic years of the past period are given in Figure 6. [10]

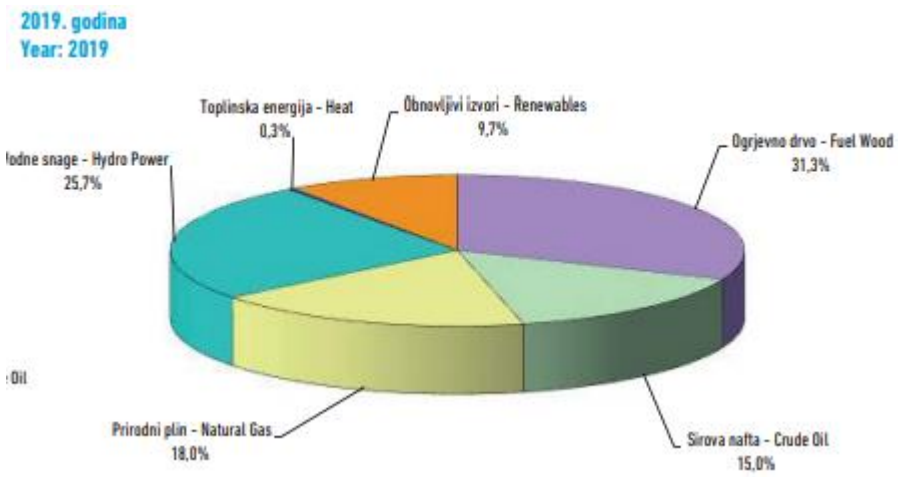


Figure 6: Shares in primary energy production (source: Ministry of Economy and Sustainable Development)

[10] Ibid.

The following four Figures (7, 8, 9, 10) present the total primary energy production and the production of individual primary energy forms per capita in Croatia and in forty-four European countries, including the European Union (EU 28), USA and Japan. Along with the primary energy production, specific production of natural gas, crude oil, and electricity in hydropower plants is shown. In the total primary energy production, which also includes nuclear energy, twenty-eight countries had more favorable situation compared to specific production in Croatia, mainly due to the use of nuclear energy in some of these countries. Nine countries had a higher specific production of natural gas, seven countries had a higher specific production of crude oil and eleven countries had a higher specific production of hydroelectricity.[11]

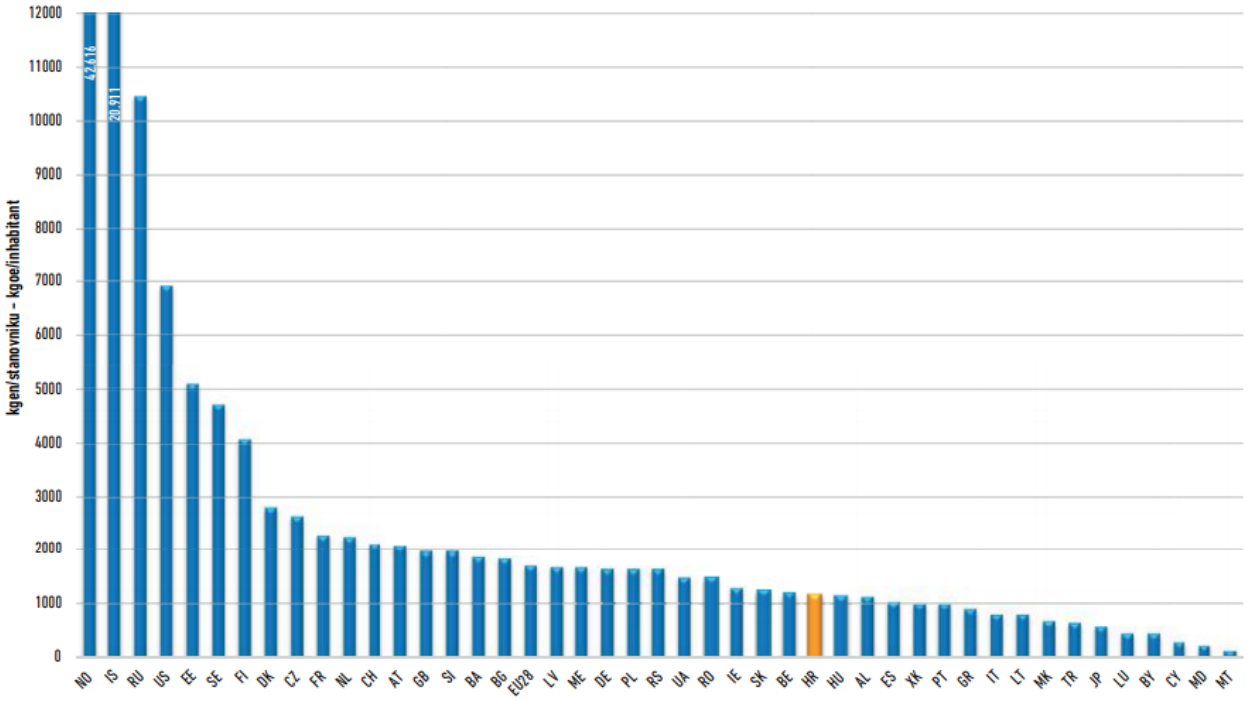


Figure 7: Primary energy production per capita (source: Ministry of Economy and Sustainable Development)

[11] Ibid.

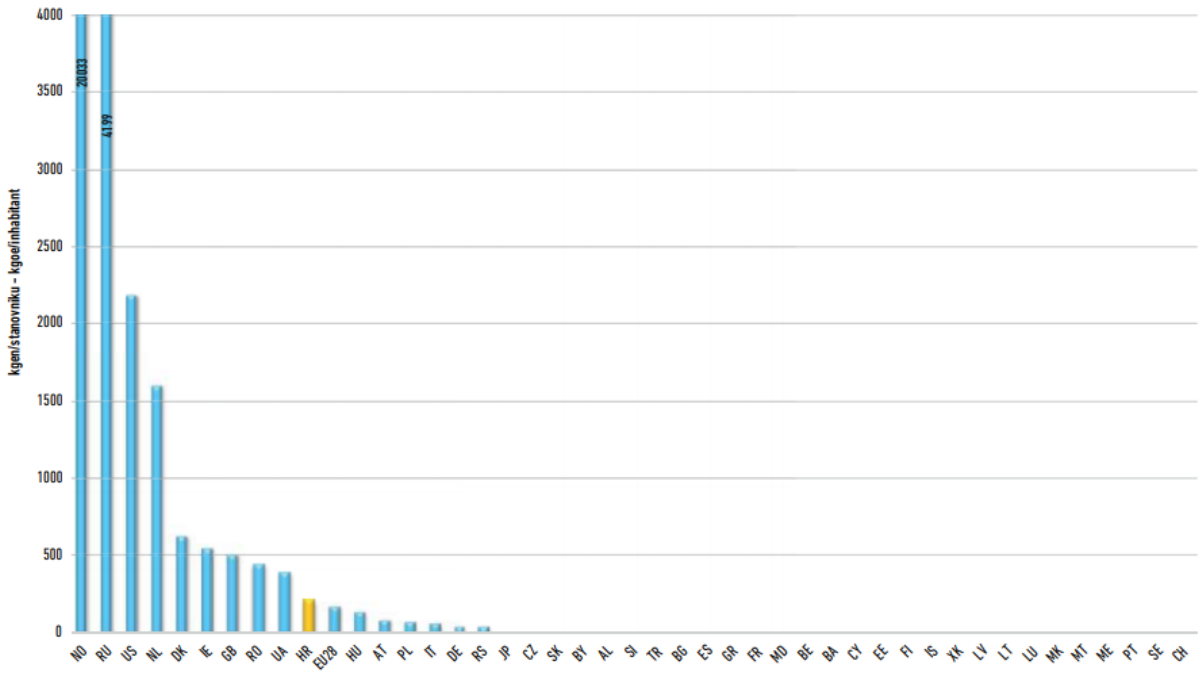


Figure 8: Natural gas production per capita (source: Ministry of Economy and Sustainable Development)

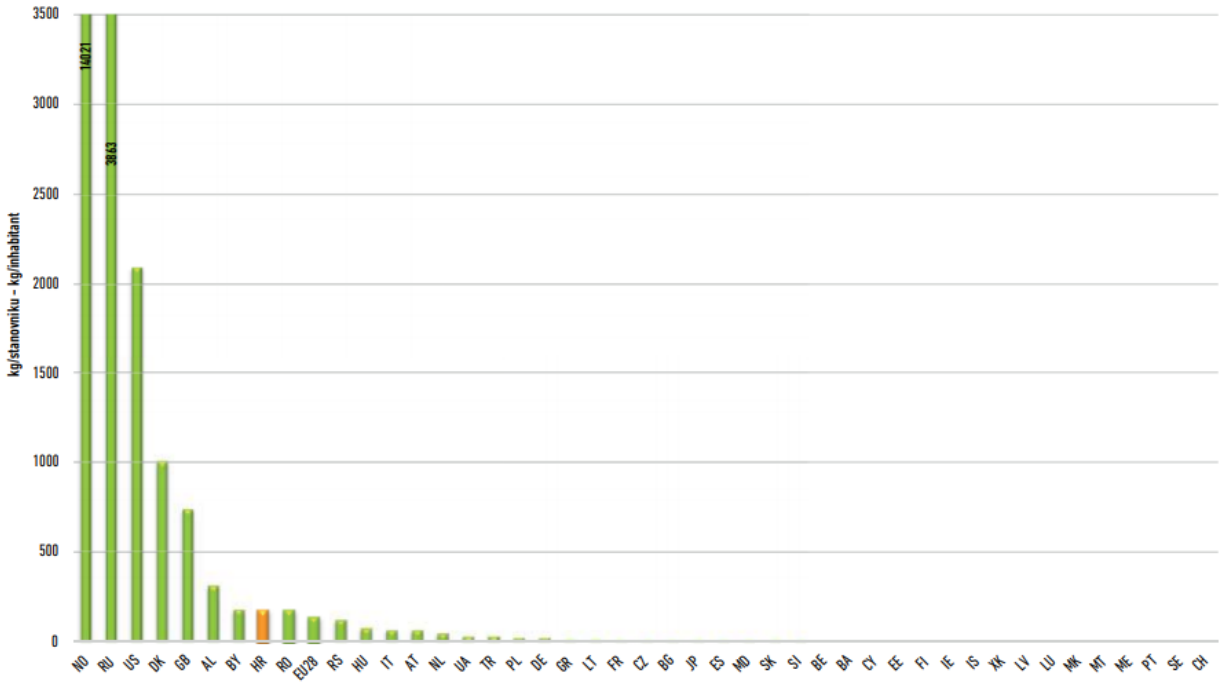


Figure 9: Crude oil production per capita (source: Ministry of Economy and Sustainable Development)

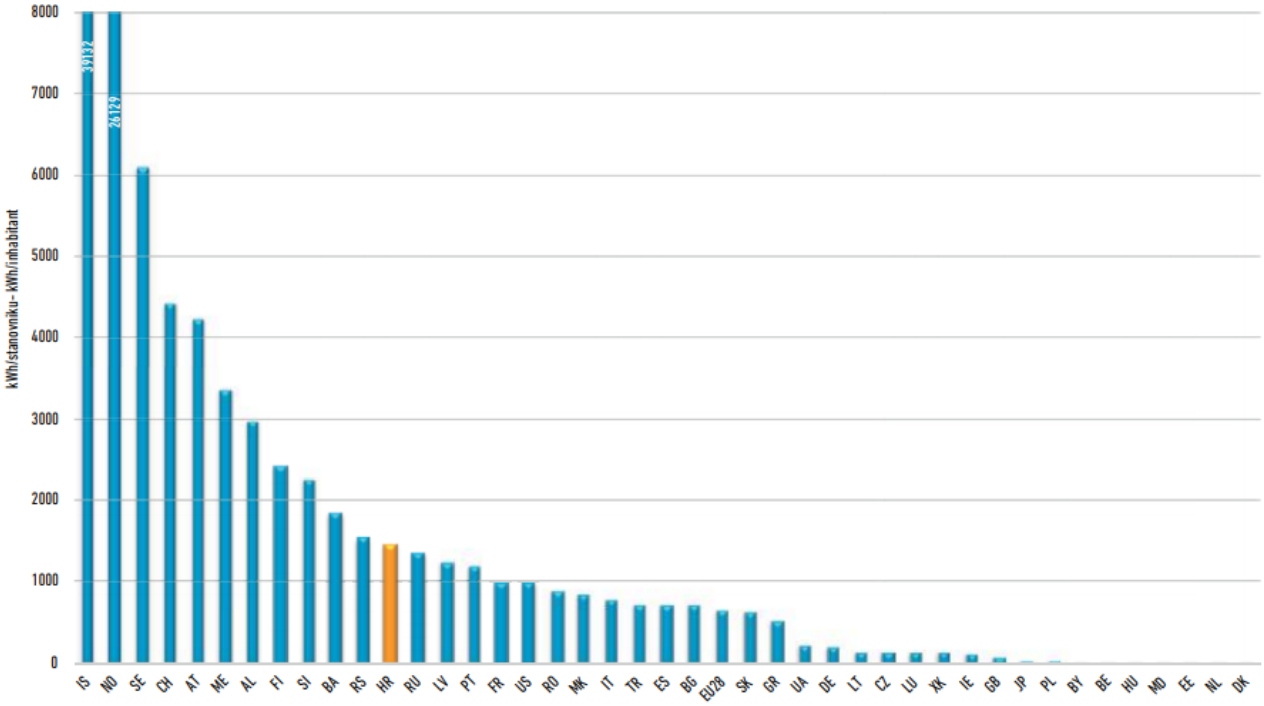


Figure 10: Hydroelectricity production per capita (source: Ministry of Economy and Sustainable Development)

3.1.3. Energy import and export

Table 2 shows energy import in the period from 2014 until 2019, while Figure 11 presents trends in the import of certain energy forms in the period from 1988 until 2019. In 2019, the total energy import in Croatia increased by 3.7 %, compared to the previous year. The import of almost all energy forms increased, only the import of crude oil decreased by 32.4 %. The import of natural gas increased by 26.1 %, while the import of electricity increased by 23.7 %. The import of petroleum products also increased by 31.1 %, as well as the import of coal and coke which increased by 15.9 %.

The import of fuel wood and other solid biomass significantly increased, by as much as 60.1 %. During the period from 2014 to 2019, energy import in Croatia increased at an average annual rate of 5.3 %. Only the import of coal and coke decreased by an average annual rate of 5.6 %, while the import of other energy forms increased. Fuel wood and biomass import increased at an average annual rate of 58.1 %, the import of natural gas increased at an average annual rate of 12.1 %, the import of petroleum

products increased at an average annual rate of 7.1 % and the import of crude oil increased at an average annual rate of 1.6 %. The import of electricity increased at an average annual rate of 6.2 %.[12]

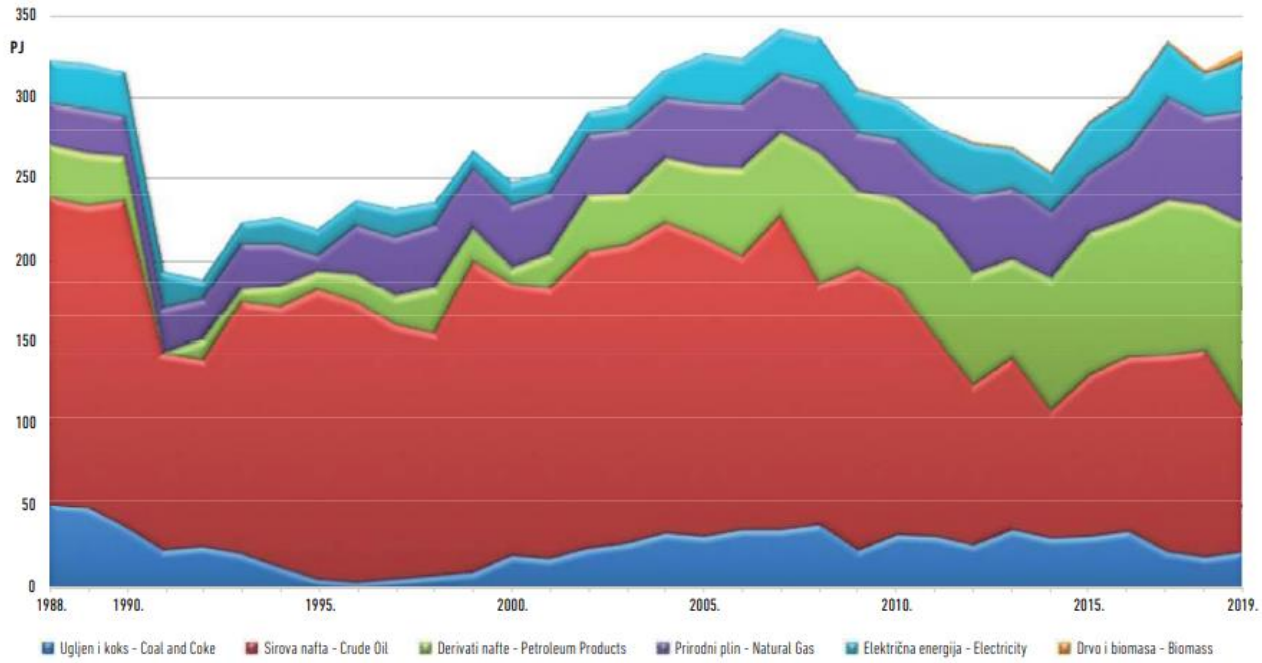


Figure 11: Energy import in Croatia (source: Ministry of Economy and Sustainable Development)

	2014.	2015.	2016.	2017.	2018.	2019.		2019./18.	2014.-19.
	PJ							%	
Ugljen i koks • Coal and Coke	30,46	32,11	34,49	22,57	19,69	22,82		15,9	-5,6
Sirova nafta • Crude Oil	79,05	99,41	107,32	120,33	126,63	85,66		-32,4	1,6
Derivati nafte • Petroleum Products	80,78	85,49	83,33	93,48	86,75	113,73		31,1	7,1
Prirodni plin • Natural Gas	39,19	36,33	44,01	63,10	55,05	69,40		26,1	12,1
Električna energija • Electricity	24,40	31,93	31,43	34,16	26,66	32,97		23,7	6,2
Drvo i biomasa • Biomass	0,49	1,18	1,21	1,54	3,02	4,83		60,1	58,1
UKUPNO • TOTAL	**254,36**	**286,45**	**301,80**	**335,16**	**317,79**	**329,41**		**3,7**	**5,3**

Table 2: Energy import in Croatia (source: Ministry of Economy and Sustainable Development)

[12] Ibid.

The shares of certain energy forms in the total energy in 2019 are shown in Figure 12.

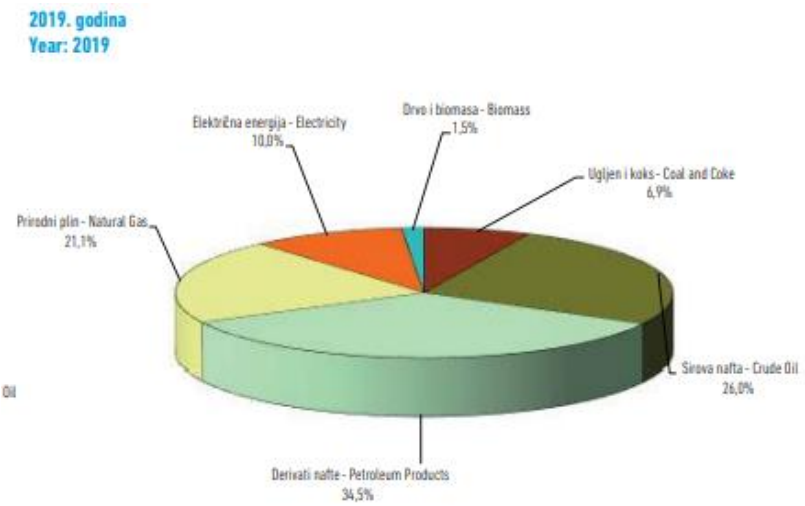


Figure 12: Shares of imported energy by energy form (source: Ministry of Economy and Sustainable Development)

The structure of energy forms exported from Croatia in the period from 2014 until 2019 are given in Table 3 and Figure 13 for the period from 1988 until 2019. In 2019, the total energy export from Croatia decreased by 3.2 %. The export of fuel wood and biomass, petroleum products and natural gas decreased, while the export of coal and coke as well as electricity increased. The greatest decrease was recorded for natural gas and equaled 36.2 %. The export of petroleum products decreased by 10.3 %, and the export of fuelwood and biomass by 9.5 %.

The export of coal and coke increased by 26.4 % and the export of electricity increased by 50 %. In the period from 2014 until 2019, energy export increased at an average annual rate of 3.3 %. It is a consequence of the increased export of petroleum products and electricity, while other energy forms experienced a decreasing trend. The average annual increase rate of petroleum product export was 7.2 %, and the average annual increase rate of electricity was 1.4 %. The average annual decrease rate of natural gas was 30.1 %, while the export of fuel wood and other biomass decreased at an annual rate of 2.6 % and 9.9 %, respectively. In 2019, for the first time after the year 2000, crude oil was also exported from Croatia.[13]

[13] Ibid.

	2014.	2015.	2016.	2017.	2018.	2019.		2019./18.	2014.-19.
	PJ							%	
Ugljen i koks • Coal and Coke	1,24	1,21	1,13	1,00	0,58	0,74		26,4	-9,9
Biomasa • Biomass	11,99	12,48	13,07	13,95	11,60	10,49		-9,5	-2,6
Sirova nafta • Crude Oil						5,19			
Derivati nafte • Petroleum Products	65,06	78,92	88,52	106,27	102,46	91,93		-10,3	7,2
Prirodni plin • Natural Gas	15,01	12,71	13,55	6,93	3,92	2,50		-36,2	-30,1
Električna energija • Electricity	10,17	7,49	11,52	9,12	7,26	10,89		50,0	1,4
UKUPNO • TOTAL	**103,46**	**112,82**	**127,80**	**137,27**	**125,83**	**121,75**		**-3,2**	**3,3**

Table 3: Energy export from Croatia (source: Ministry of Economy and Sustainable Development)

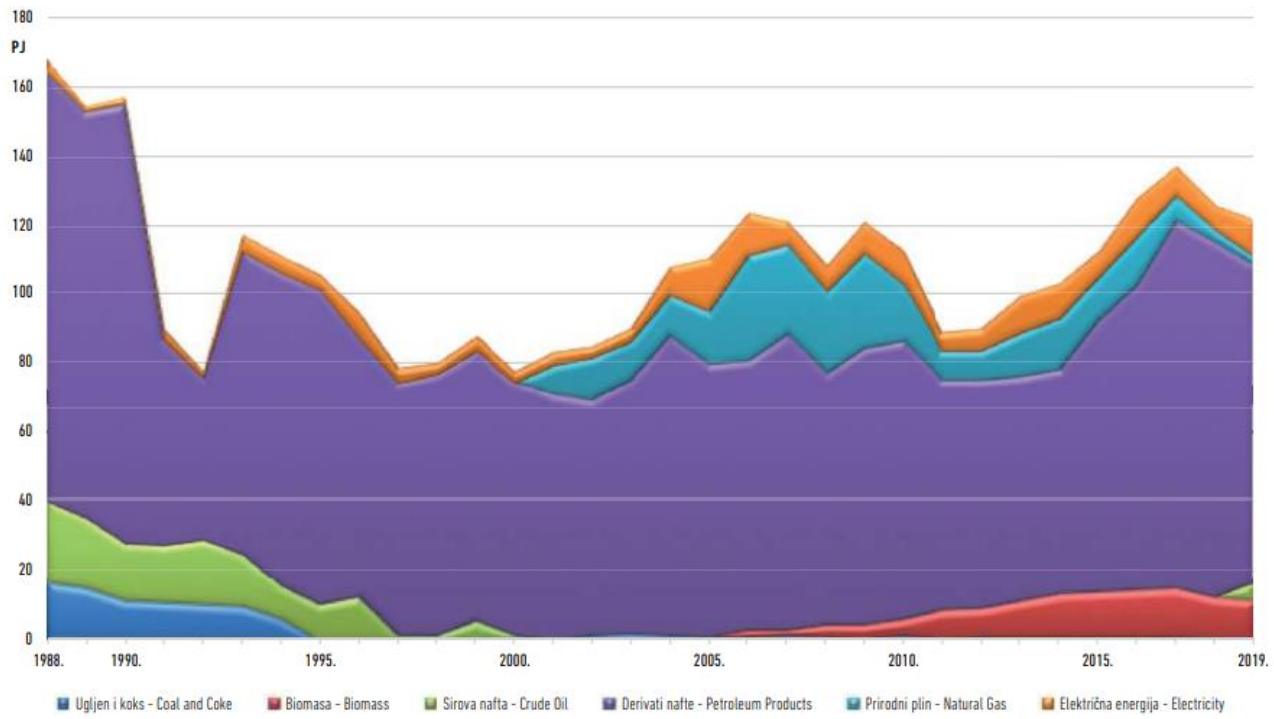


Figure 13: Energy export from Croatia (source: Ministry of Economy and Sustainable Development)

Figure 14 presents the shares of individual energy forms in the total energy exports from Croatia in 2019.

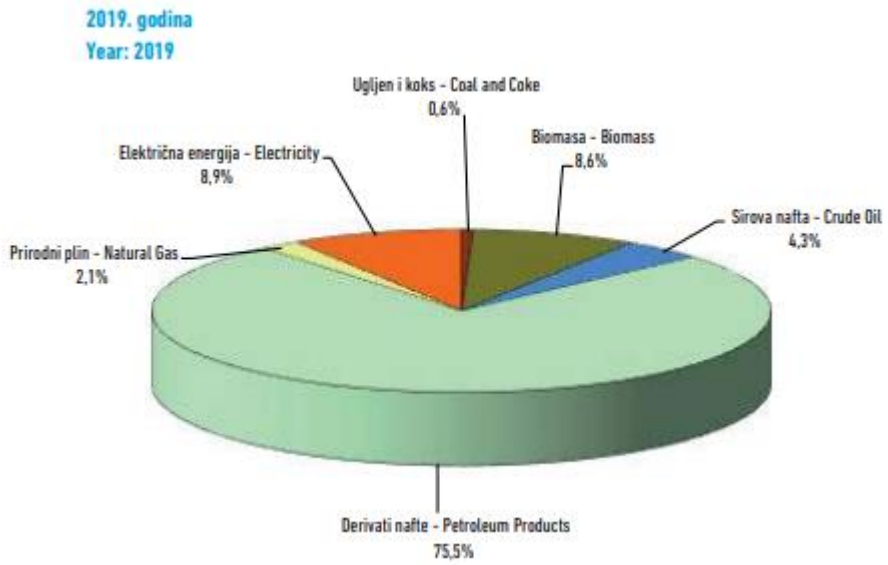


Figure 14: Shares of exported energy by energy form (source: Ministry of Economy and Sustainable Development)

3.1.4. Total primary energy supply

The shares of specific energy forms in the total primary energy supply during the period from 2014 until 2019 are given in Table 4. Figure 15 shows the trends in the total primary energy supply during the period from 1988 onward. In 2019, the total primary energy supply in Croatia decreased by 0.8 % as compared to the previous year. Thereby the fuel wood and biomass increased by 1.8 %, renewables increased by 27.7 %, imported electricity increased by 13.8 % and coal and coke by 2 %. The total consumption of other energy forms decreased. The consumption of heat from heat pumps decreased by 4 % and liquid fuels by 1 %. Energy from hydro power decreased by 23.1 % compared to the previous year.

In the period from 2014 until 2019, the total primary energy supply increased at an average annual rate of 0.2 %. In this period, there was a decrease in the consumption of coal and coke as well as hydro power, while the consumption of all other energy forms increased. The consumption of coal and coke decreased with an average annual rate of 8.1 %, and hydro power decreased with an average annual rate of 10.3 %. The consumption of other renewable sources increased with a high average annual rate

of 16 %, and the imported electricity increased with an average annual rate of 9.2 %. The consumption of liquid fuels as well as the consumption of natural gas increased with an annual rate of 1.2 % and 3.6 %, respectively. The consumption of heat from heat pumps also increased with an average annual rate of only 3.1 %, while the consumption of fuel wood and biomass increased with an average annual rate of 3.3 %.

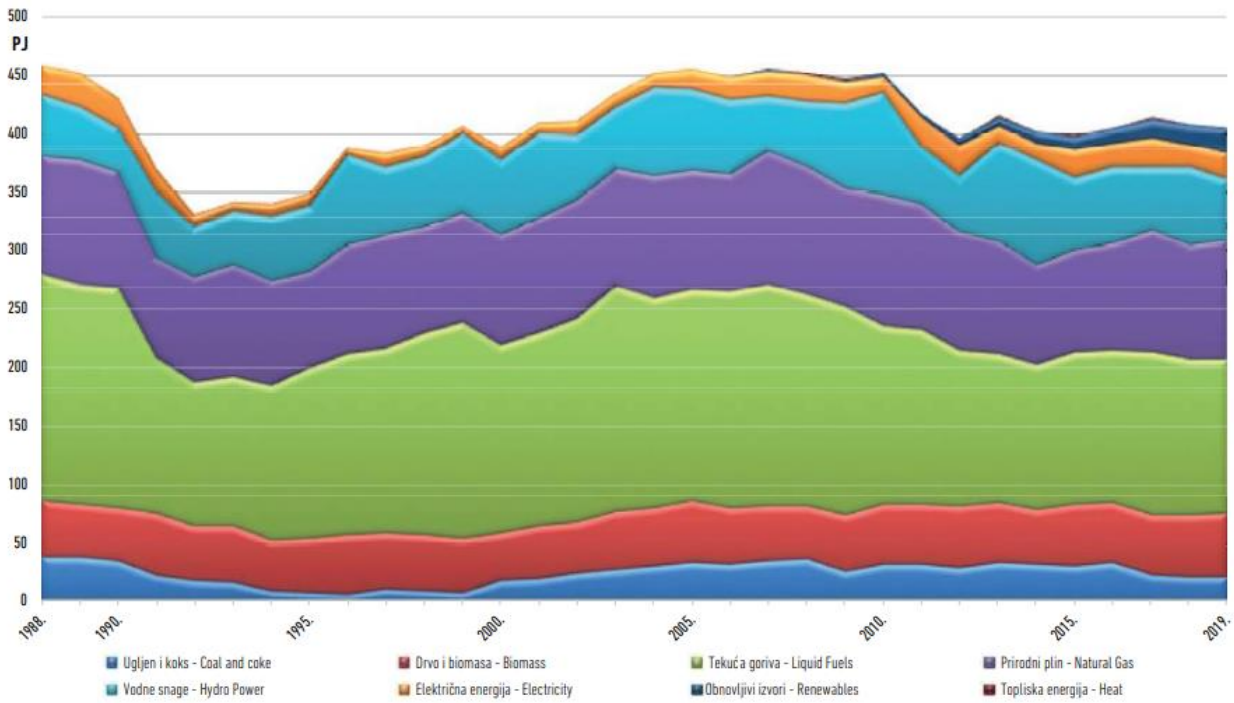


Figure 15: Total primary energy supply (source: Ministry of Economy and Sustainable Development)

	2014.	2015.	2016.	2017.	2018.	2019.		2019./18.	2014.-19.
	PJ							%	
Ugljen i koks • Coal and Coke	31,59	29,86	32,14	21,65	20,36	20,77		2,0	-8,1
Drvo i biomasa • Biomass	46,12	52,69	52,47	52,09	53,20	54,18		1,8	3,3
Tekuća goriva • Liquid Fuels	125,80	130,92	130,78	139,83	134,52	133,21		-1,0	1,2
Prirodni plin • Natural Gas	84,62	87,16	91,08	104,67	96,43	101,22		5,0	3,6
Vodne snage • Hydro Power	88,99	61,63	65,63	53,81	66,98	51,54		-23,1	-10,3
Električna energija • Electricity	14,23	24,44	19,91	25,03	19,40	22,08		13,8	9,2
Toplinska energija • Heat	0,52	0,62	0,66	0,67	0,63	0,61		-4,0	3,1
Obnovljivi izvori • Renewables	10,52	11,36	12,90	16,11	17,32	22,12		27,7	16,0
UKUPNO • TOTAL	**402,40**	**398,68**	**405,56**	**413,86**	**408,85**	**405,72**		**-0,8**	**0,2**

Table 4: Total primary energy supply (source: Ministry of Economy and Sustainable Development)

Figure 16 presents the shares of individual energy forms in the total primary energy supply in 2019.[14]

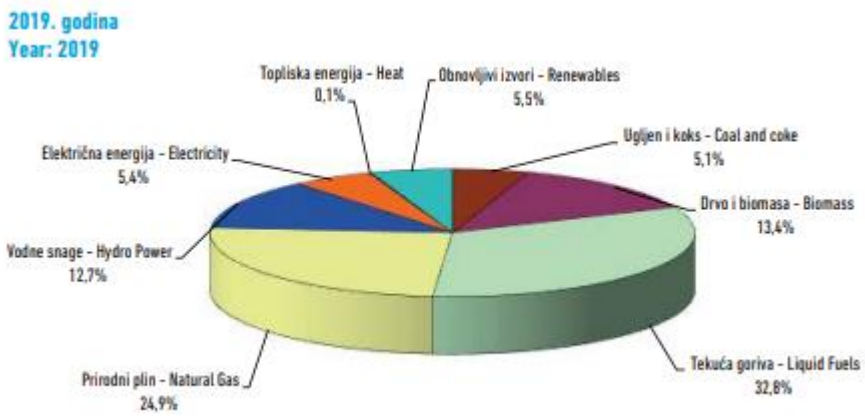


Figure 16: Shares in the total primary energy supply (source: Ministry of Economy and Sustainable Development)

Four diagrams below (17, 18, 19, 20) show the total primary energy supply per capita, total consumption of liquid fuels per capita, total consumption of natural gas per capita, and total consumption of coal per capita in Croatia and European countries, the European Union (EU 28), USA and Japan. In 2019, the total primary energy supply per capita in Croatia amounted to 2,349 kg of oil equivalent, and relative to the comparable total primary energy supply in the European Union (EU 28) it was 32.4 % lower. Nine countries had lower consumption, whereas in the other thirty-five observed countries, including the EU 28 average, it was greater.

The average consumption of liquid fuels per capita was 788 kg of oil equivalent. A lower per capita consumption was realized in thirteen countries, and consumption was 29.7 % below the European average. Similar relations were recorded in the consumption of natural gas where the consumption per capita (586 kg of oil equivalent) was 23.3 % lower than that of the European Union. Twenty-three countries had lower consumption, while the remaining twenty-one countries had greater consumption. Compared to the European Union, coal consumption lagged furthest behind. In 2019, coal consumption per capita in Croatia amounted to 103 kg of oil equivalent, which is 75.7 % below the average coal consumption in the European Union, which amounts to 425 kg of oil equivalent. Coal consumption was

[14] Ibid.

lower in ten of the observed countries, while the remaining thirty-four countries had higher coal consumption levels.[15]

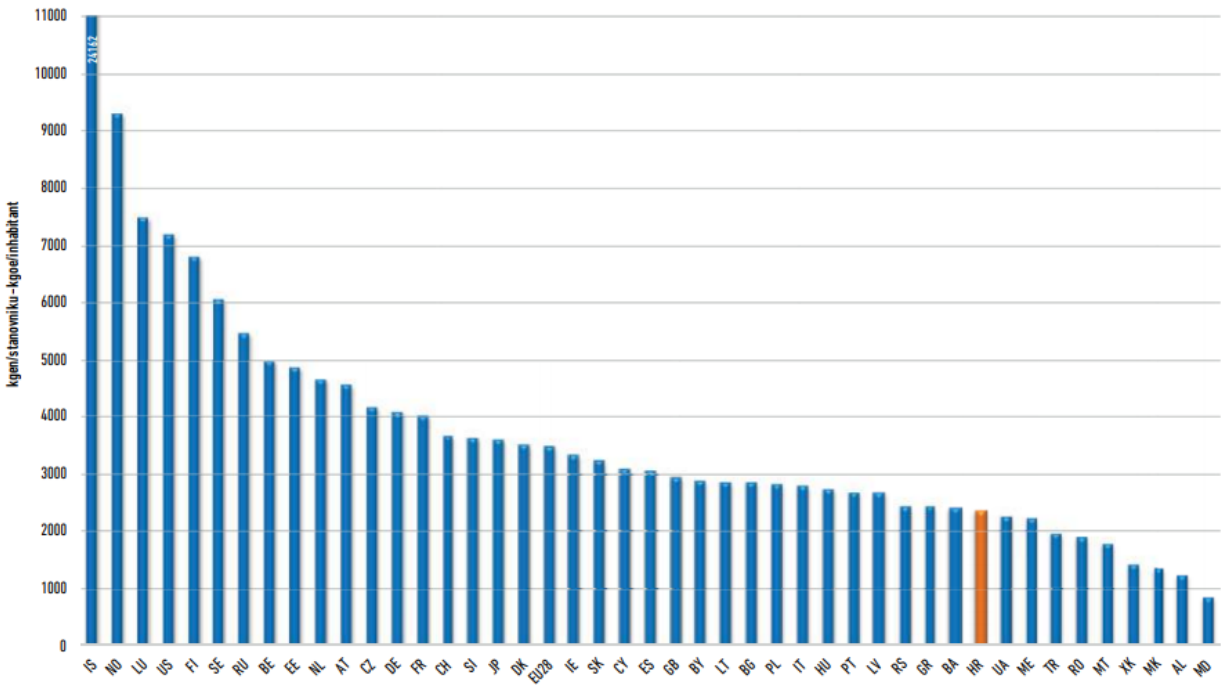


Figure 17: Total energy consumption per capita (source: Ministry of Economy and Sustainable Development)

[15] Ibid.

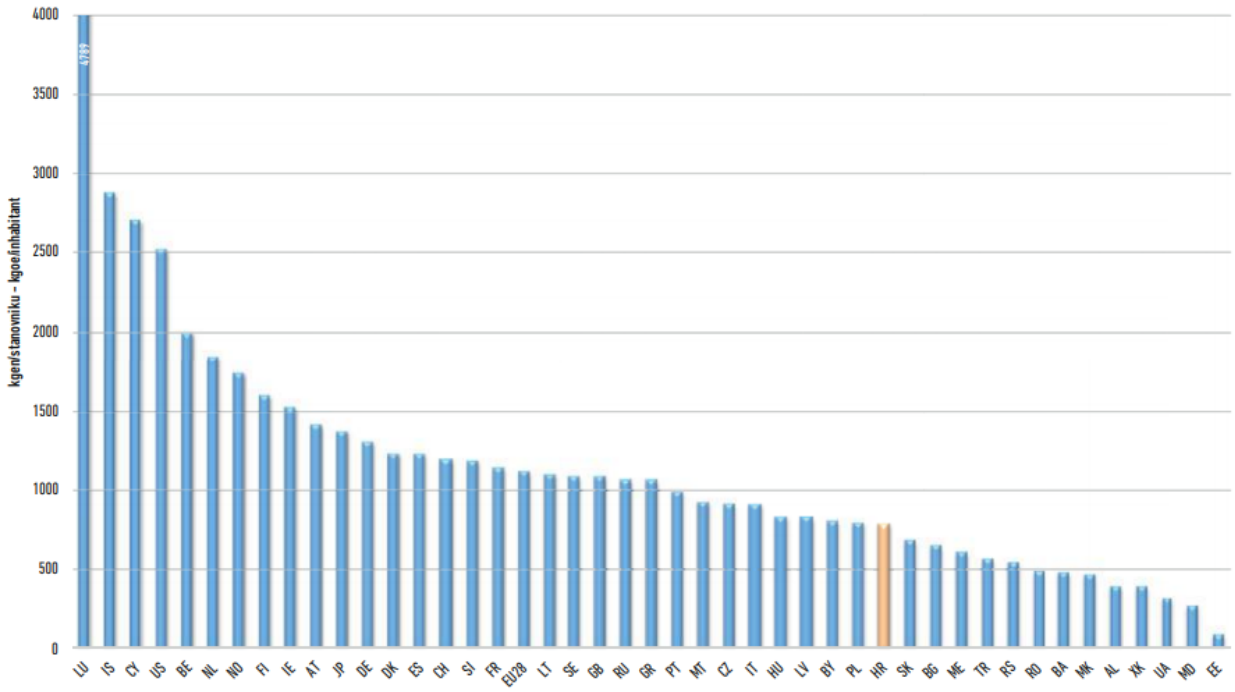


Figure 18: Total consumption of liquid fuels per capita (source: Ministry of Economy and Sustainable Development)

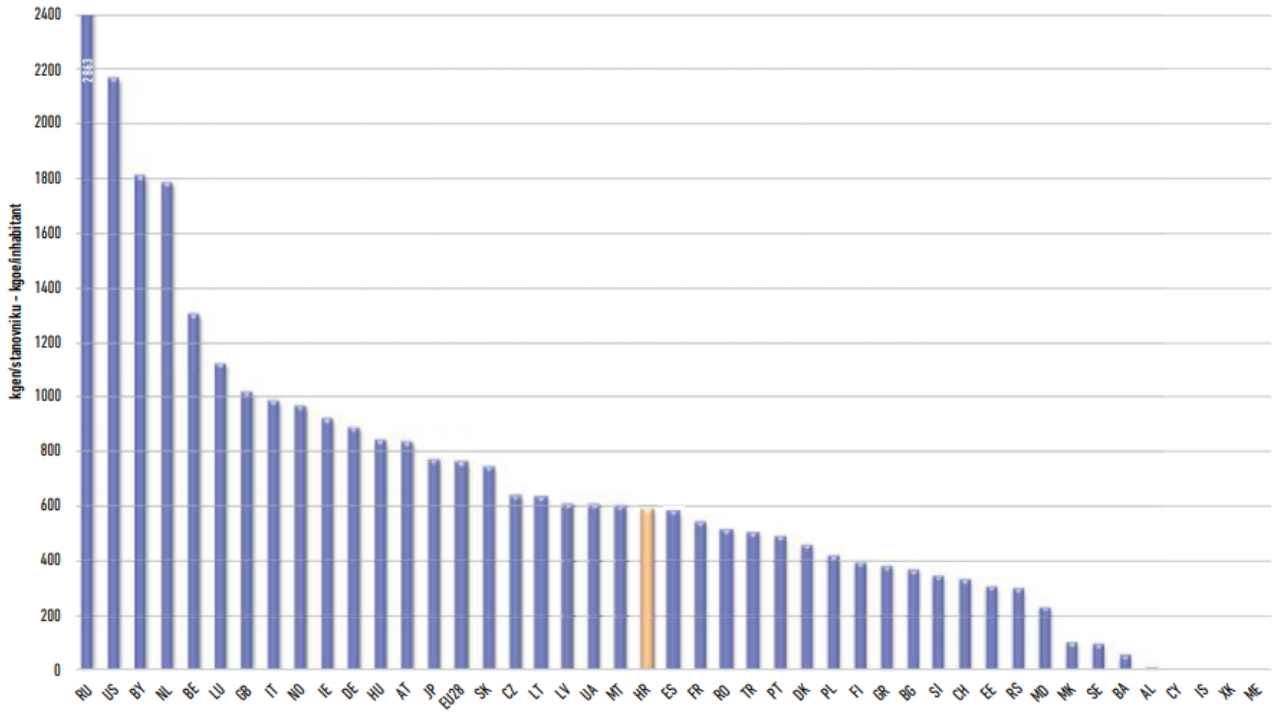


Figure 19: Total consumption of natural gas per capita (source: Ministry of Economy and Sustainable Development)

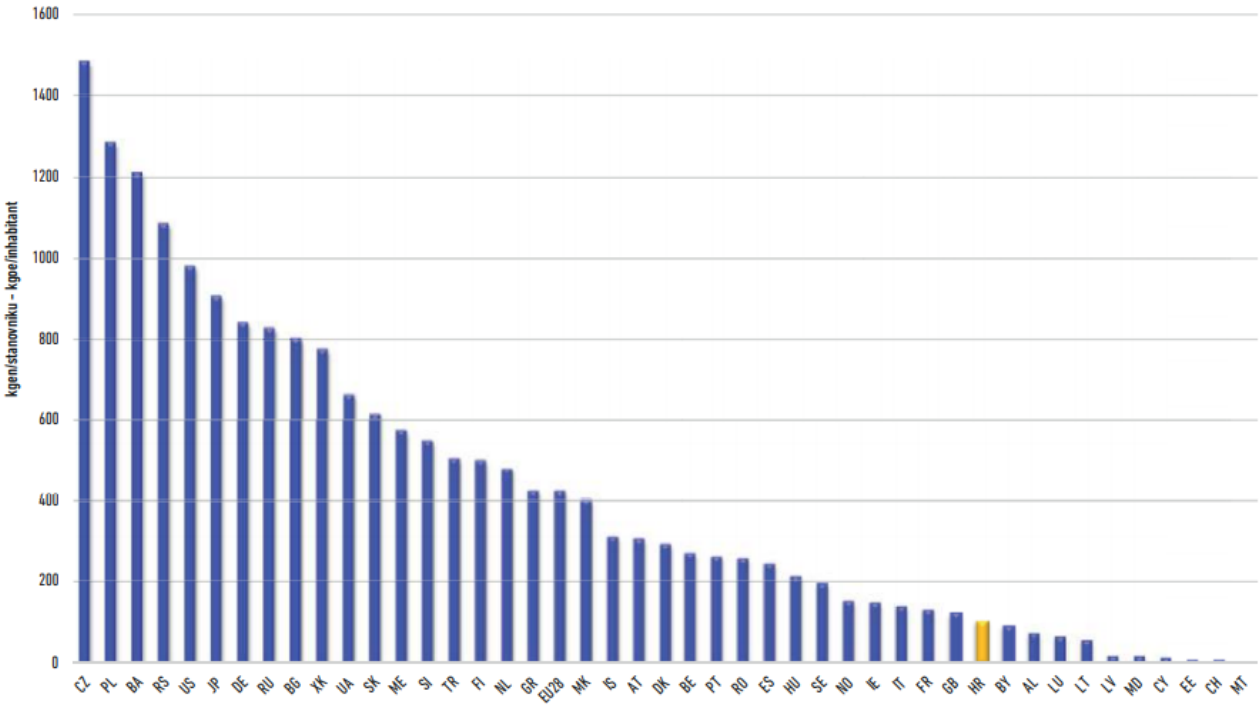


Figure 20: Total consumption of coal and coke per capita (source: Ministry of Economy and Sustainable Development)

Figure 21 presents trends in energy self-supply in the past period. Energy self-supply is the relation between the total primary energy production and the total primary energy supply. In 2019, it amounted to 49.5 %, which represents a decrease of 4.6 % compared to the previous year.[16]

[16] Ibid.

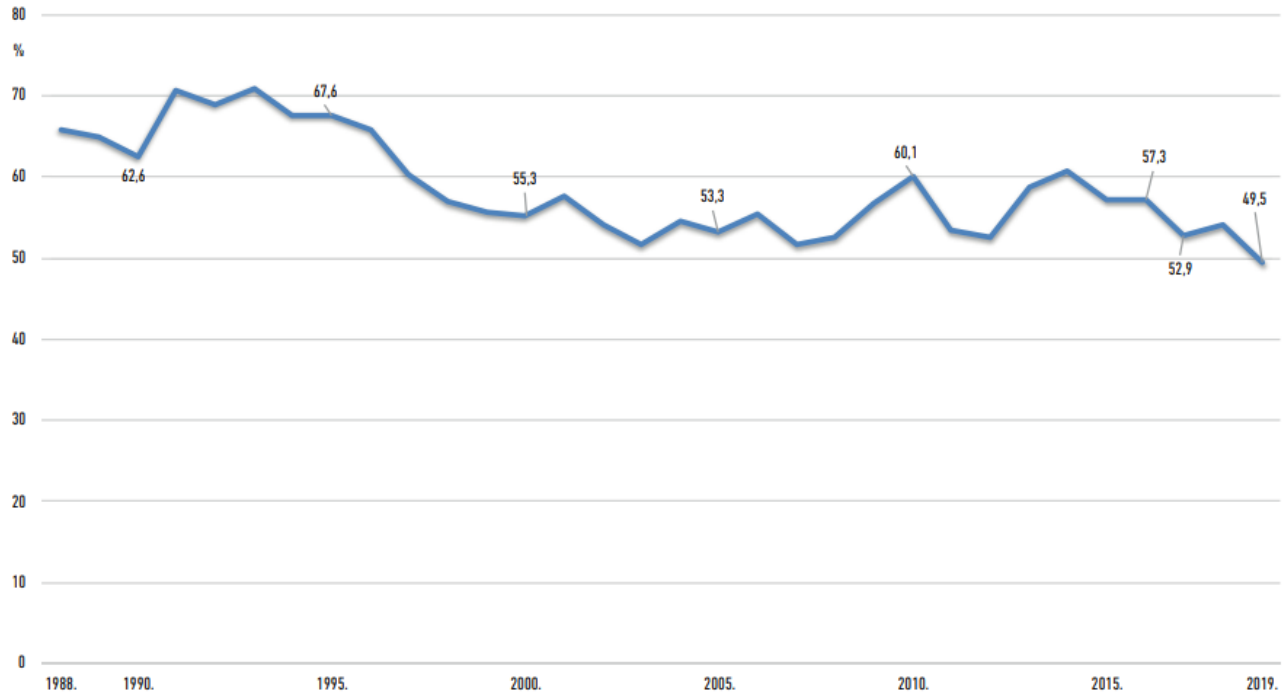


Figure 21: Primary energy self-supply in Croatia (source: Ministry of Economy and Sustainable Development)

3.1.5. Energy efficiency in industry

For energy efficiency analyzes in industry, a relationship between energy intensity and direct energy consumption is observed, with a focus on indicators of individual industries in the year 2019 compared to the previous year. The energy intensity here is taken as the ratio of physical energy consumption, regarding all fuels, and added value in the regarded industrial branch.

Non-metallic mineral industry had the largest energy share in manufacturing consumption, with a share of 32%, where the cement industry has most influence. Compared to the previous year, there was a consumption drop of -4.5%. It was followed by the food processing industry, with 17% share, but with a slight increase by 1.6% compared to the previous year. Then followed chemical industry with 13.4 % of share in the consumption, with a 3,2% increase compared to the previous year. The largest increase in energy consumption, about 14%, was present in the wood industry. Further significant share had the paper and printing industry, 6.1% with a 5% increase, as well as the paper and board industry, 3.4% and the increase of 1.7%. In total, the manufacturing industry had a slight consumption increase, compared to 2018.

In 2019, energy intensity in industry changed only slightly, on average, compared to the previous year, less than 1%. The highest increase in energy intensity was in the wood industry, above 14%, which correlates with the largest increase in energy consumption in all sectors, since 2018. Further noticeable intensity increase happened in the primary metals industry, above 4%. The paper industry had a slight increase of 1.4%. Paper industry and wood industry both have the highest absolute values of energy intensity, with 183, and 150 ktoe/milHRK2000. The average intensity for industry in total is 74.7 ktoe/milHRK2000.

The largest drop in energy intensity, almost -25%, was present in the rubber and plastics industry. A smaller drop happened in fabricated metals, -3.6%, then textile, clothing, and leather industry with -3.4%, while the group of other industries has the average intensity decrease of -9.8% compared to 2018. Other individual branches do not have significant changes. The energy intensity, as the ratio of attained consumption of final energy and added value at constant prices, related to the same ratio for index year 2000, is graphically given in Figure 22.

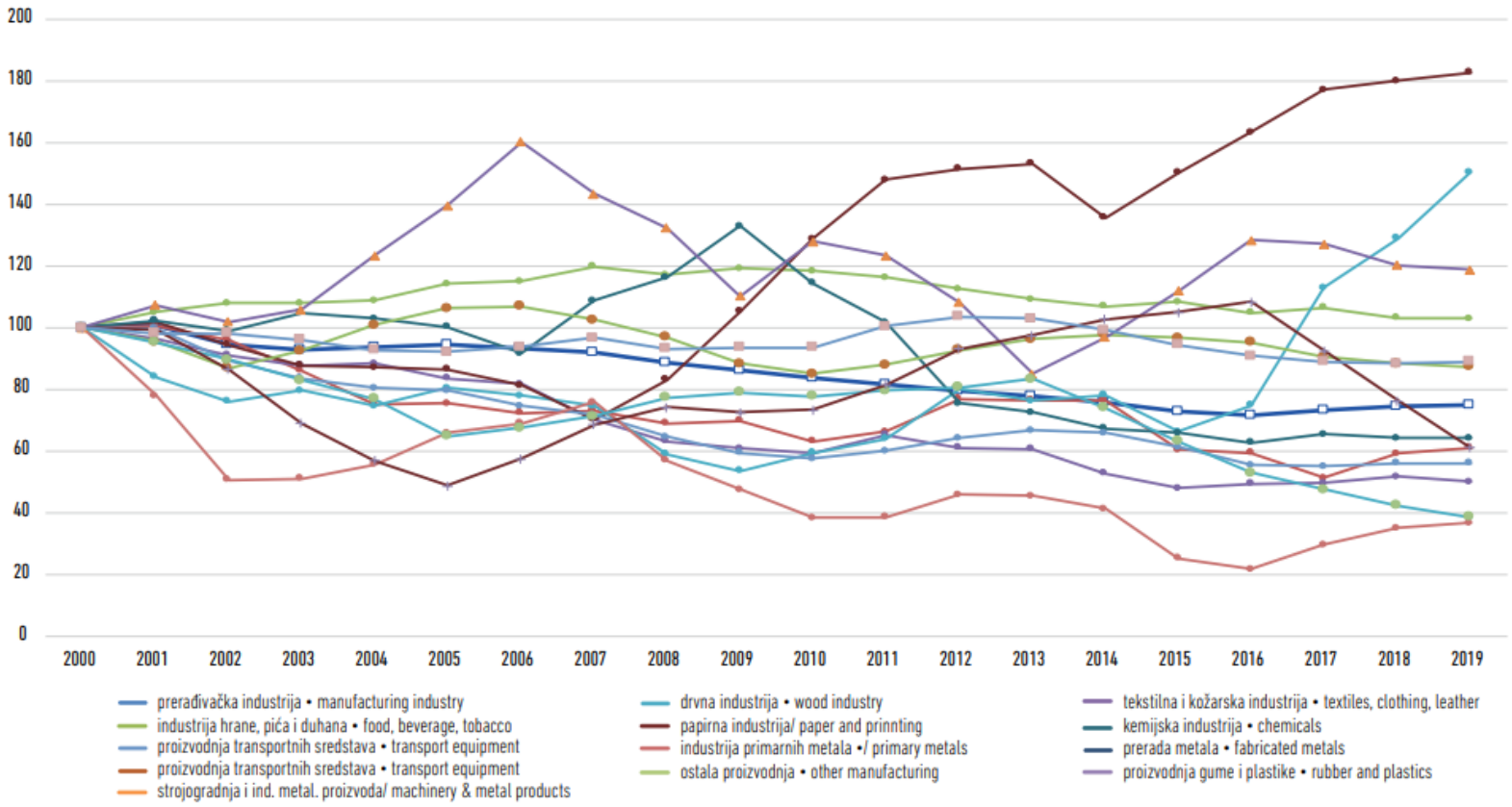


Figure 22. Energy intensities of manufacturing industry branches in the period 2000 – 2019 (source: Ministry of Economy and Sustainable Development)

The energy efficiency level is measured by an index which is the ratio of total final energy consumption and of production index for a regarded industrial branch, compared to the analogue ratio for the index year 2000. In 2019, energy intensity in consumption of manufacturing industries, in total, continued with the slight decreasing trend, on average, which means an increase in efficiency. The index increase, and consequential efficiency drop, compared to 2013, is significant in the wood industry, and compared to 2018 the index has a 3.2% increase. That, as for previous indicators, is influenced by higher energy consumption. The paper industry had the second highest index value, but compared to the previous year before, the increase is less than 1%. The transport vehicles industry had a 5.2% index increase. Other industrial branches had no significant changes, compared to the previous year. Energy efficiency index (ODEX) for industry in 2019 is given in Figure 23.[17]

[17] Ibid.

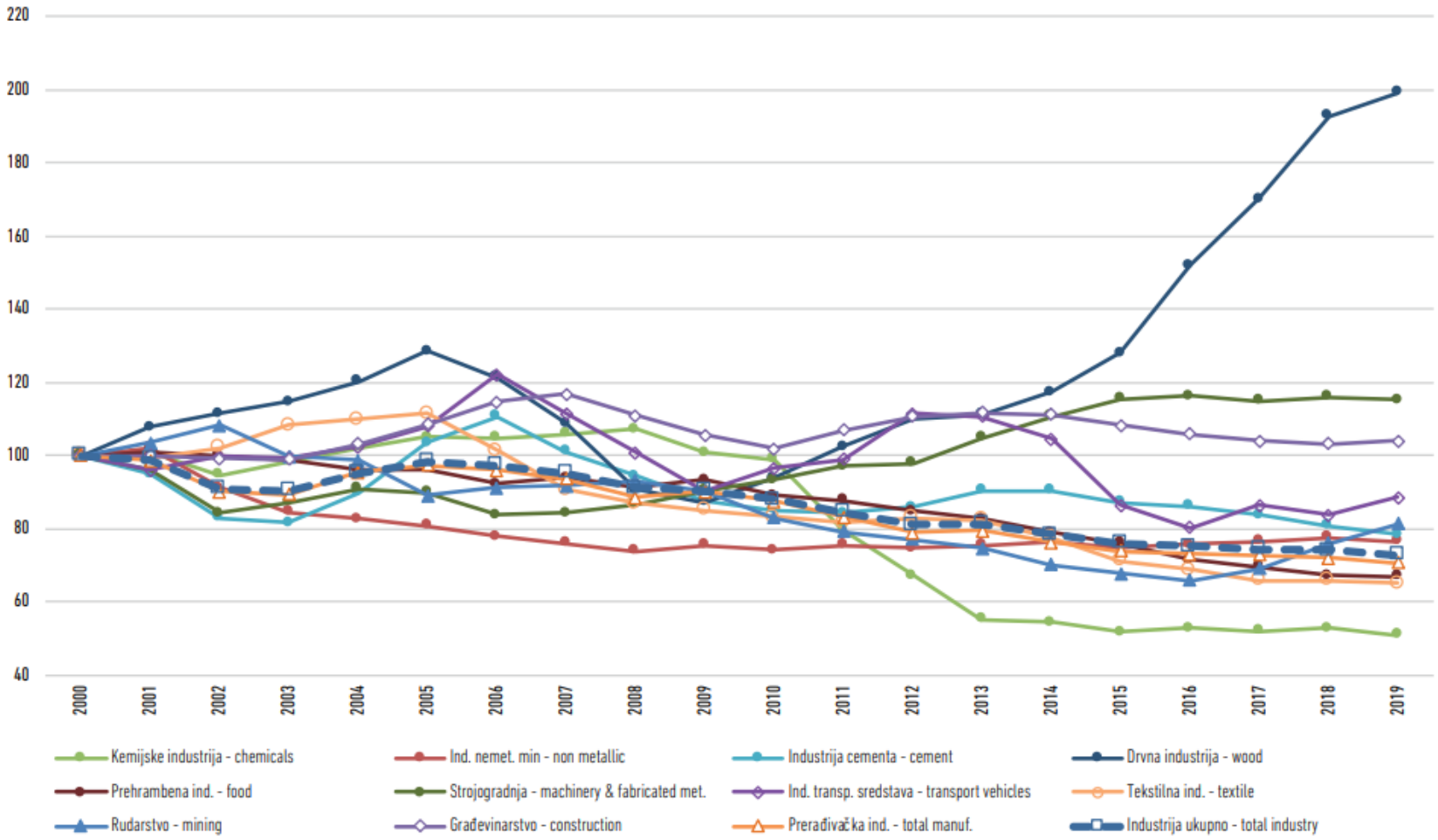


Figure 23: Energy efficiency index (ODEX) for industry for the period 2000 – 2019 (source: Ministry of Economy and Sustainable Development)

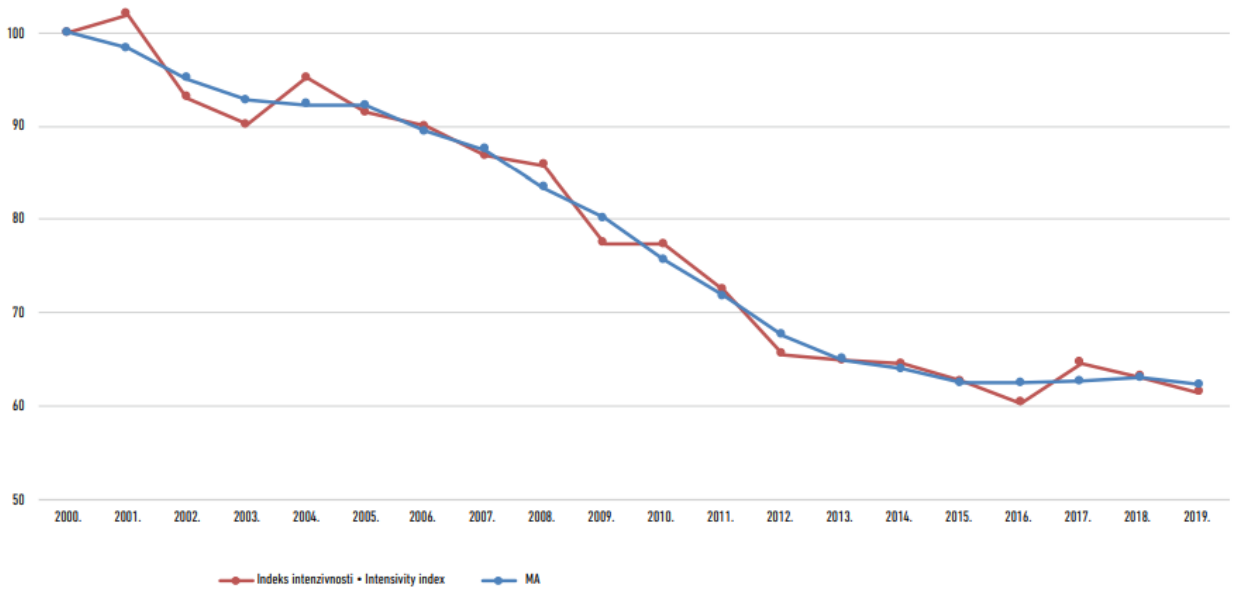


Figure 24: Index of energy intensity in industry 2000-2019 (source: Ministry of Economy and Sustainable Development)

One more indicator of energy use in industry is the energy intensity index, with the use of gross added value, given in the Figure 24. This indicator shows a relative ratio between energy consumption (in PJ) and gross value added (in HRK at 2000 level) against the reference year 2000. In Figure 24, the red line is showing the intensity index itself (marked as efficiency index), and its mean value as the 3-year average (marked as MA). The energy intensity trends in industry, regarding the mean value, did not changed significantly over the past years, with a slight drop last year. On an annual basis, there was a small drop in the last two years, with variations in the previous period. The factors that cause these variations are the reduction of specific energy consumption per unit of product, meaning the increased efficiency, then economic difficulties, effective increase of market value of the production, structural changes in industries[18].

[18] Ibid.

3.1.6. International activities on greenhouse gas emission reductions

The Croatian Parliament ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1996 (Official Gazette – International Agreements, no. 2/1996) by which Croatia, as a signatory party, has assumed the scope of its commitments within the framework of the Annex 1 to the Convention.

Croatia ratified the Kyoto Protocol in the April 2007. Under the Kyoto Protocol, Croatia had the obligation to reduce GREENHOUSE GAS emissions from anthropogenic sources by 5 % in the period from 2008 to 2012, relative to the base year 1990. Commitments undertaken by Croatia under the Kyoto Protocol were met as a result of the implementation of mitigation measures and also because of the economic downturn caused by the crisis.

At the 18th Conference of the Parties to the UNFCCC, held in Doha (Qatar) in December 2012, Croatia agreed to be included in the amendment to Annex B of the Kyoto Protocol. Thus, Croatia is committed to reduce GREENHOUSE GAS emissions in the second commitment period of the Kyoto Protocol, from 2013 to 2020. Croatia shares a common commitment with other EU Member States and Iceland, to reduce GREENHOUSE GAS emissions by at least 20 % by 2020 relative to the level of emissions in the base year 1990.

At the end of 2015, at the 21st Conference of the Parties to the UNFCCC (COP21) held in Paris, the global climate agreement was adopted (Paris Agreement). It is an ambitious international agreement, which aims to: (1) hold the increase in the global average temperature to well below 2 ºC above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 ºC, (2) increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low GREENHOUSE GAS emissions development, (3) make finance flows consistent with a pathway towards low GREENHOUSE GAS emissions and climate-resilient development.

The Paris Agreement became legally binding on November 4, 2016, a month after the conditions laid down in the Agreement were met: ratification by at least 55 parties, whose emissions cumulatively make up 55 % of the global GREENHOUSE GAS emissions. Unlike the Kyoto Protocol, the Paris Agreement commits all countries to take measures to limit emissions and at the same time strengthens the role of civil society, organizations, financial institutions, cities, and other subnational authorities. European Union has ratified the Paris Agreement and has committed itself to reducing GREENHOUSE

GAS emissions by at least 40 % until 2030, compared to the emission level in 1990. Croatia ratified the Paris Agreement in May 2017.[19]

The Agreement also requires the establishment of an international registry to identify the contribution of each country (Intended Nationally Determined Contribution, INDC). Through the INDC each member state of the Convention defines the GREENHOUSE GAS emission reduction target, with regular monitoring activities of the set targets achievement.

3.1.7. Carbon dioxide emissions in Croatia

National GREENHOUSE GAS inventory is calculated using the IPCC methodology, developed within the framework of the UNFCCC Convention. The Croatian inventory is under the Ministry of Economy and Sustainable Development. Executive institution for the preparation of the inventory is EKONERG Ltd. from Zagreb, in cooperation with the Ministry.

The CO2 represents the most important greenhouse gas monitored in the energy sector, since CO2 is the major anthropogenic source of global warming, and emissions from fuel combustion have a dominant influence on total CO2 emissions.

According to the preliminary results for the year 2019, the CO2 emissions from the stationary and mobile energy sources amounted to 15.3 million tons, which is 0.7 % less than the emission in the previous year and 23.7 % less than the emission in 1990. In the observed period from 2014 to 2019, the CO2 emission increased by an average annual rate of 0.2 %.

In 2019, stationary energy sources emitted 57.5 % of CO2, namely 23.9 % of CO2 were emitted from energy production and transformation plants, 16.8 % from manufacturing industries and construction and 16.8 % from non-industrial combustion furnaces. Road transport contributed to total energy emissions with 41.0 %, while off-road transport contributed with 1.5 %. Off-road transport includes aviation, railways, and navigation.

In addition to the energy sector, production processes without fuel combustion (mainly cement industry), extraction and distribution of fossil fuels (CO2 extraction from natural gas at CPS Molve) and

[19] Ibid.

other non-energy sources are also significant sources of CO2 emissions, which contribute with 12 to 16 % in the total national CO2 emissions in Croatia. The trend in CO2 emissions from fossil fuel combustion, as well as contribution of individual energy subsectors, are given in Figure 25 and Table 5.

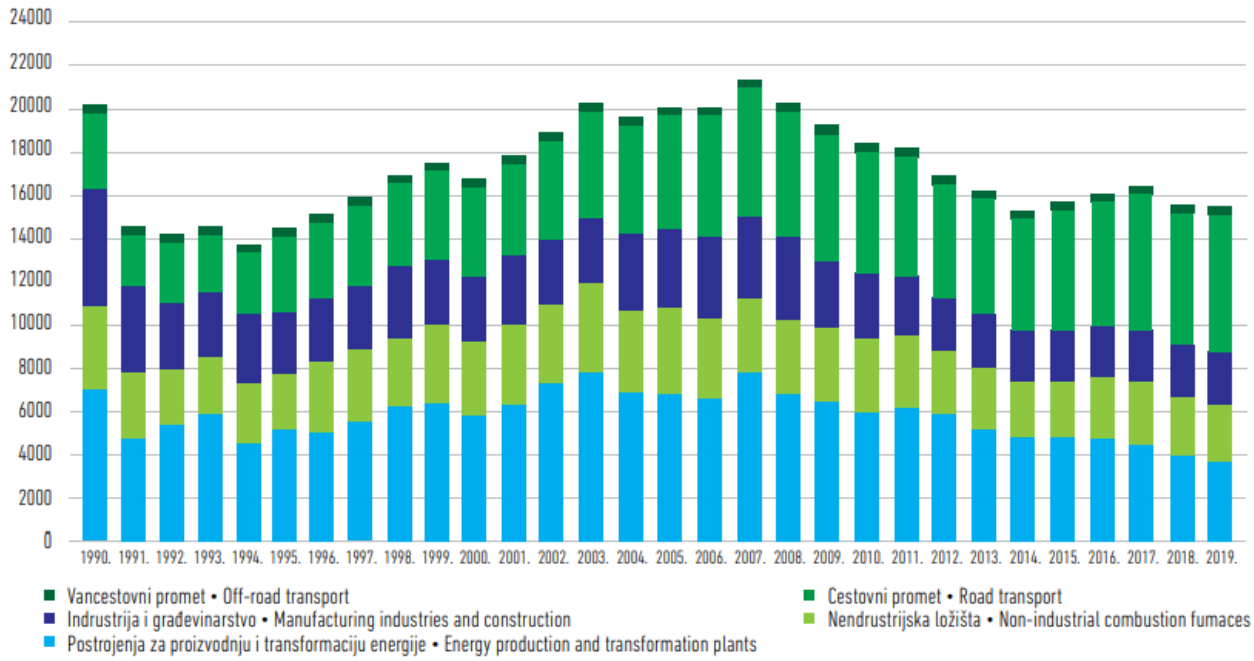


Figure 25: Trend in CO2 emissions from fuel combination (source: Ministry of Economy and Sustainable Development)

	2014.	2015.	2016.	2017.	2018.	2019.*	2019./18.	2014.-19.
	tisuće tona			thousand metric tons			%	
Postrojenja za proizvodnju i transformaciju energije • Energy production and transformation plants	4 744	4 719	4 847	4 465	3 908	3 656	-6,4	-5,1
Neindustrijska ložišta • Non-industrial combustion furnaces	2 531	2 720	2 790	2 821	2 747	2 568	-6,5	0,3
Industrija i građevinarstvo • Manufacturing industries and construction	2 324	2 223	2 229	2 430	2 411	2 571	6,6	2,0
Cestovni promet • Road transport	5 346	5 671	5 885	6 343	6 113	6 274	2,6	3,3
Vancestovni promet • Off-road transport	234	217	221	227	228	233	2,2	-0,1
Ukupno • Total	**15 179**	**15 549**	**15 972**	**16 286**	**15 406**	**15 301**	**-0,7**	**0,2**

Table 5: CO2 emissions from energy subsectors in the period from 2014 to 2019 (source: Ministry of Economy and Sustainable Development)

Specific CO2 emission factor per kWh of consumed or produced electricity varies from year to year and depends on:

- hydro-meteorological conditions and production of electricity from hydro power plants,
- electricity generation from other renewable energy sources,
- electricity import,
- electricity delivery from NPP Krško,
- transmission and distribution losses,
- structure of combusted fossil fuels in thermal power plants, public and industrial CHP plants.

Specific CO2 emission factors per consumed and produced electricity in Croatia are shown in Table 6.

	2014.	2015.	2016.	2017.	2018.	2019.*	Prosjek/Average 2014.-2019.
	kg/kWh						
Specifični faktor emisije CO_2 po ukupno potrošenoj el. energiji u Hrvatskoj Specific CO_2 emission factor per total electricity consumption in Croatia	0,151	0,148	0,163	0,131	0,106	0,121	0,137
Specifični faktor emisije CO_2 po ukupno proizvedenoj el. energiji u Hrvatskoj Specific CO_2 emission factor per total electricity production in Croatia	0,195	0,236	0,233	0,207	0,148	0,179	0,200

Table 6: Specific CO2 emission factor (kg/kWh) in the period from 2014 to 2019 (source: Ministry of Economy and Sustainable Development)

3.1.8. Renewable energy sources in Croatia - trends

The year 2020 was an important year for many indicators due to the end of the political period of the common policy of the European Union, which already has a defined continuation until 2030, with a view to 2050.[20]

Through Directive 2009/28 / EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77 / EC and 2003/30 / EC (hereinafter: RED I), the common goal of the European Union on the share of energy from renewable energy sources of 20 %in the gross final energy consumption in 2020 has been defined.

[20] B. Kulišić, I. Rašić, Ekonomski institut Zagreb (The Institute of Economics Zagreb), 12/2020, nr. 82, year 9, ISSN: 1848-8986, "Sektorske analize – Energetika: obnovljivi izvori energije" (Sector analyzes - Energy: renewable energy sources): https://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_energetika_prosinac_2020.pdf

The individual targets for each Member State are defined in Table A, Annex I of the Directive, based on the share of energy from the renewable energy sources in gross final energy consumption in 2005. Within this national target, each Member State had to develop sub-sectoral targets (electricity, heating and cooling, transport) and trajectories to meet the overall target in the National Action Plan for Energy from the renewable energy sources. Within the sub-sectoral targets, only the share of renewable energy in transport is set at 10 %for each member state.

By adopting RED I, Croatia has committed itself to increasing the use of energy from the renewable energy sources. With the accession of the Republic of Croatia to the European Union, RED I was amended by Council Directive 2013/18 / EU of 13 May 2013 adapting Directive 2009/28 / EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources accession of the Republic of Croatia (text relevant to the EEA) where the national target for the share of energy from the renewable energy sources in gross final energy consumption for 2020 is set at 20 %, starting from 12.6 %of the share in 2005.

The new targets for the period up to 2030 have been set through Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance) (hereinafter: RED II). RED II increases the share of energy from the renewable energy source to 32 % by 2030, with the possibility of further increasing that share through the revision envisaged in 2023.

The share of energy from the renewable energy sources in transport is also increasing to 14 %for all member states, and sustainability criteria are being introduced for obtaining energy from solid, liquid and gaseous biofuels. In early 2020, the European Commission adopted a complex European Green Plan program (European Commission, 2020), according to which the synergistic effect of various policies would achieve a vision of a sustainable, carbon-neutral continent by 2050, where economic growth is separated from greenhouse gas growth.

The Clean Energy Package (European Commission, 2019) is an integral part of the European Green Plan. Under the European Green Plan, in September 2020, the European Commission proposes to increase the targeted reduction of greenhouse gas emissions from 40 % to at least 55 % in 2030 compared to 1990. In March 2020, the European Commission adopted a legal proposal for a European climate law, which also includes a proposal to increase the targeted reduction of greenhouse gas emissions to at least 55 % by 2030 compared to 1990. The European Parliament has accepted the Commission's

proposal and increased the target of reducing greenhouse gas emissions to at least 60 % in 2030 compared to 1990.[21]

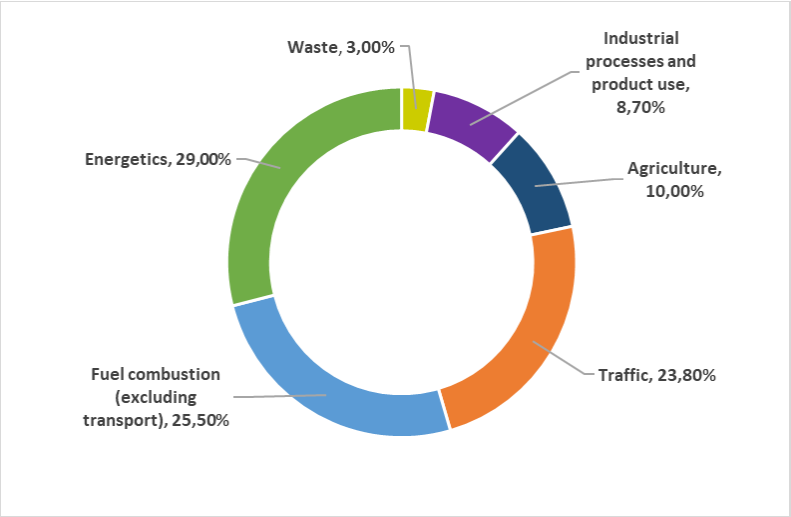


Figure 26: Shares of greenhouse gas emissions by source in the European Union for 2017 (source: Sector Analysis – Energy industry)

Anthropogenic greenhouse gas emissions are mostly related to the consumption of energy in the daily activities of society and occur as a by-product of fuel combustion in power plants, cars, or homes. Agriculture, industry, and the waste sector are also sources of greenhouse gas emissions. In 2017, EU greenhouse gas emissions were reduced by 19 % compared to 1990 levels, representing an absolute reduction of 935 million tons of CO2 equivalents, putting the EU on track to meet its 2020 target, i.e., reduction of greenhouse gas emissions by 20 % by 2020 and by 40 % by 2030 (if the target remains unchanged) compared to 1990.

Emissions related to fuel combustion accounted for 78.3 %of total EU greenhouse gas emissions in 2017: energy (29 %), fuel combustion (25.5 %) and transport (23.8 %). Compared to 1990, most sources reduced greenhouse gas emissions, except for the transport sector, which increased by 9 percentage renewable energy compared to 1990, or 23.8 % in 2017.[22]

In 2019, the Republic of Croatia had 27.47 % of energy from renewable energy sources in gross final consumption, of which the share of electricity was 49.7 % and heating and cooling 36.79 %. In 2019, it

[21] Ibid.

[22] Ibid.

was realized an increase in the share by 0.42 percentage points compared to 2018, which can be attributed to the increase in electricity production from renewable sources and increasing the use of energy from renewable sources in transport. Energy share from renewable sources in transport in gross final energy consumption amounted to is 5.85 % in 2019.[23]

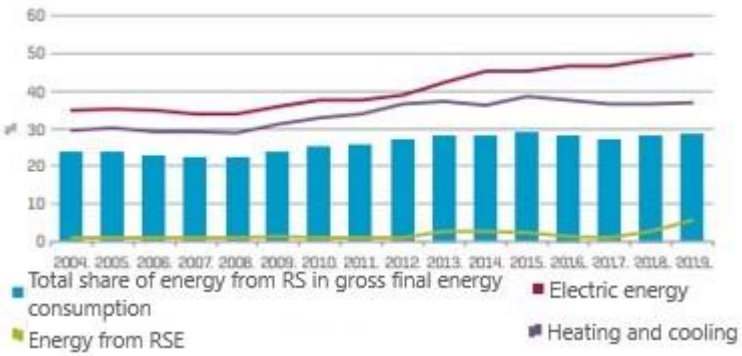


Figure 27: Shares of energy from renewable sources in gross final consumption in Croatia (2014-2018) and sub-sector shares (source: Sector Analysis – Energy industry)

According to data for 2019, in Croatia, in the structure of electricity production from the renewable energy sources, the largest share of 74 % had waterpower, which includes the production of electricity from large hydropower plants. It is followed by energy from wind with a 15 % share and energy from biomass with 5 % as the third single most important source of electricity from the renewable energy sources. Biomass is considered as a renewable fuel that can be in solid (firewood, wood chips, pellets, briquettes…), gaseous (gases from anaerobic fermentation - biogas, biomethane and gases from thermal processes) or liquid (biodiesel, bioethanol and other liquid biofuels that are used in traffic) form.

Electricity from solid biofuels (mainly wood chips and wood residue) accounted for 5.1 % of total electricity production from the renewable sources, while electricity from biogas presented collectively with other renewable sources energy accounted for 3.6 %. Compared to 2018, all sources of electricity from the renewable sources recorded an increase in 2019, except for water energy, whose production decreased by 2 percentage points. New plants to produce electricity from solid biofuels increased production in 2019 by 52 percentage points, and from solar energy by 11 percentage points compared to the previous year. Wind electricity production increased by 6 percentage points compared to 2019.

[23] Ibid.

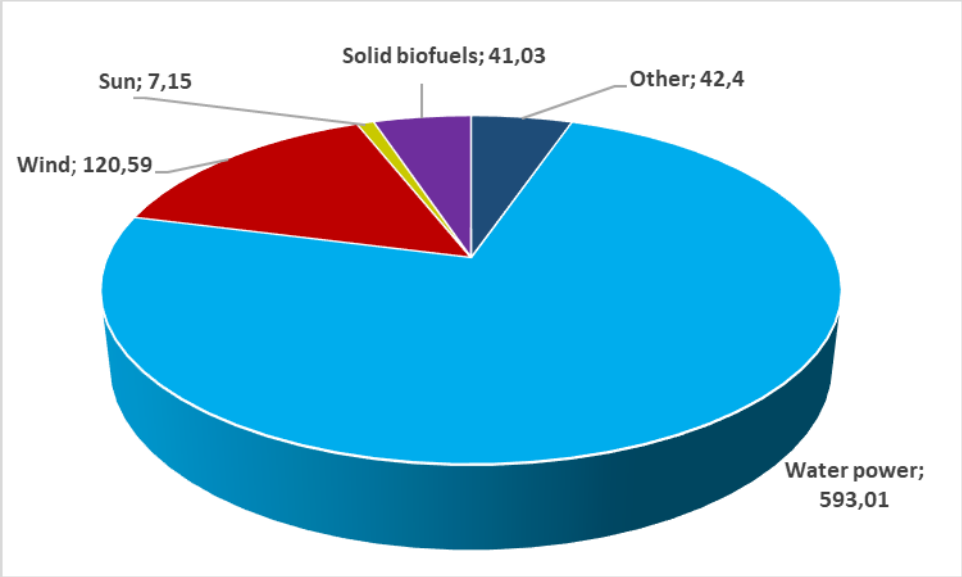


Figure 28: Structure of electricity produced from renewable sources in Croatia, 2019, (in ktoe3) (source: Sector Analysis – Energy industry)

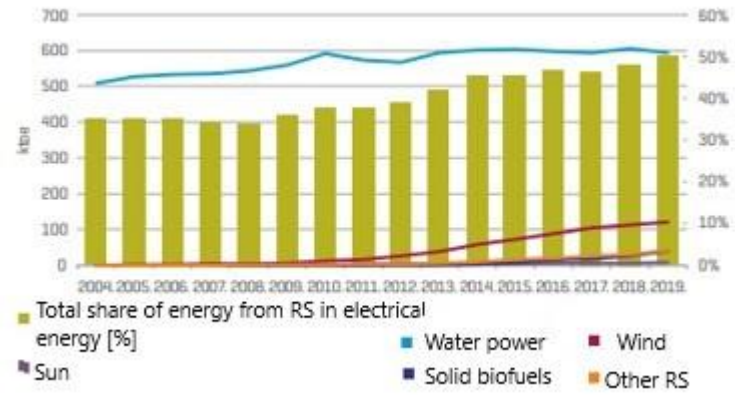


Figure 29: Trends in electricity production from renewable sources in Croatia in 2004-2019 and related shares (source: Sector Analysis – Energy industry)

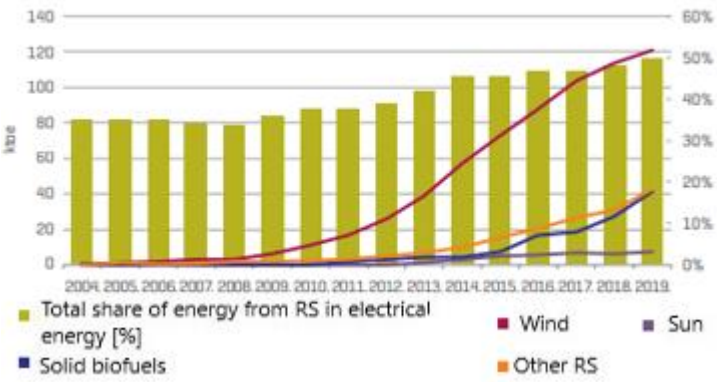


Figure 30: Trends in electricity production from renewable sources, except for hydropower plants, in Croatia 2004-2019 and related shares (source: Sector Analysis – Energy industry)

In the transport sector, the largest share of energy from the renewable energy sources refers to compliant biofuels (85.2 %), while electricity recorded a share of 14.8 % in 2019. In 2019, the total amount of compliant fuel used as renewable sources energy in transport increased by 132 percentage points (from 27.01 to 62.8 ktoe), which is a total increase of 93 % compared to 2018. All biofuels were in accordance with Articles 17 and 18 of ROW I and thus there were no non-compliant biofuels on the Croatian market.

In 2019, the share of electricity in energy from the renewable sources in transport recorded a year-on-year increase of 1 percentage points in rail and a decrease of 3.3 percentage points in total traffic. The share of electricity from the renewable sources in road traffic is still negligible and amounts to 0.01 ktoe or 0.01 %.

Due to the methodology for calculating the share of renewable sources in transport, described in RED I, which attributes stimulating multipliers for liquid biofuels from waste and by-products and electricity, the energy share of renewable sources in transport is different from the administrative share related to achieving the target of 10 % by 2020. In 2019, it was 5.85 % with an administrative value of 126.1 ktoe, which is 137 percentage points more than the year 2019.[24]

[24] Ibid.

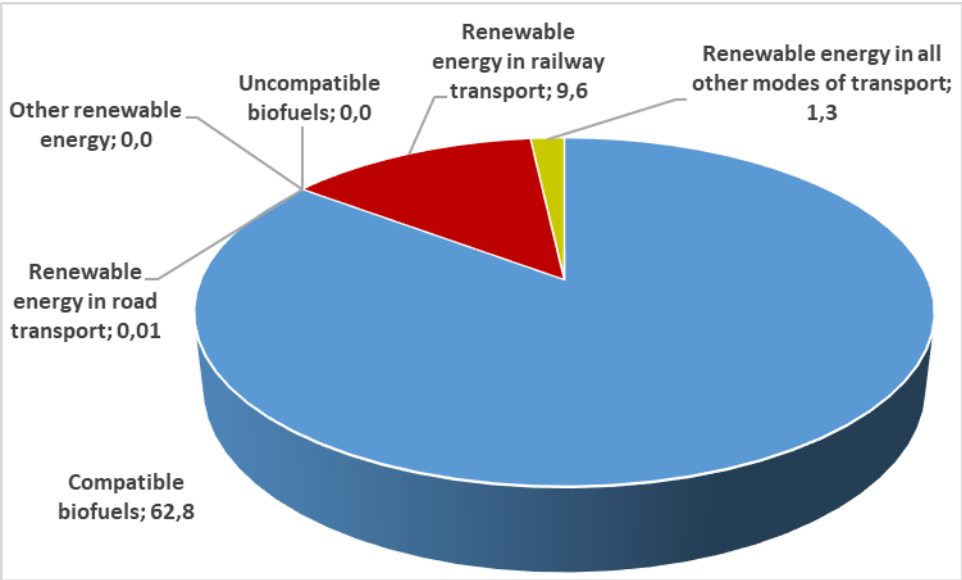


Figure 31: Individual shares of renewable energy sources in transport in Croatia in 2019 (in ktoe3) (source: Sector Analysis – Energy industry)

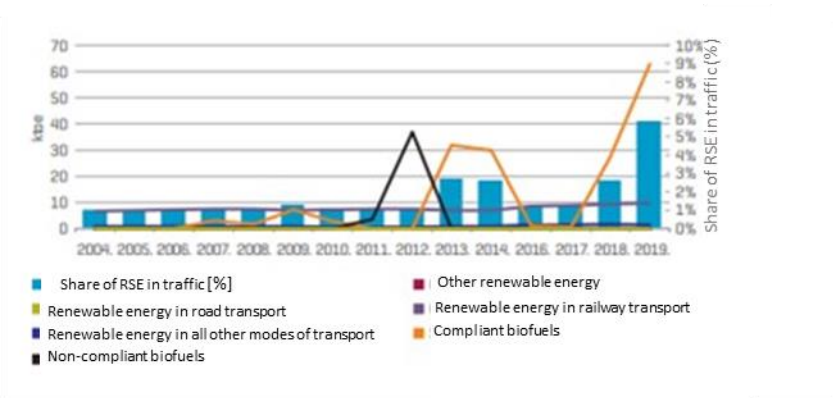


Figure 32: Movement of energy from renewable sources in transport in Croatia in 2004-2019 and related shares (source: Sector Analysis – Energy industry)

If we look at the shares of individual renewable energy sources in the heating and cooling sector in 2019, we can see that the largest share, of 91 %, is recorded by the final energy consumption from the renewable energy source, which mostly refers to firewood for space heating and hot water. This is followed by heat generated with a share of 7 % and energy from heat pumps, which makes up only 1 % of all renewable energy sources in the heating and cooling sector.

Compared to 2018, the share of final energy consumption from renewable sources decreased by 3 percentage points, the share consumption of derived heat recorded an increase of 28 percentage

points, and energy consumption from heat pumps recorded a decrease in the share by 4 percentage points in 2019.[25]

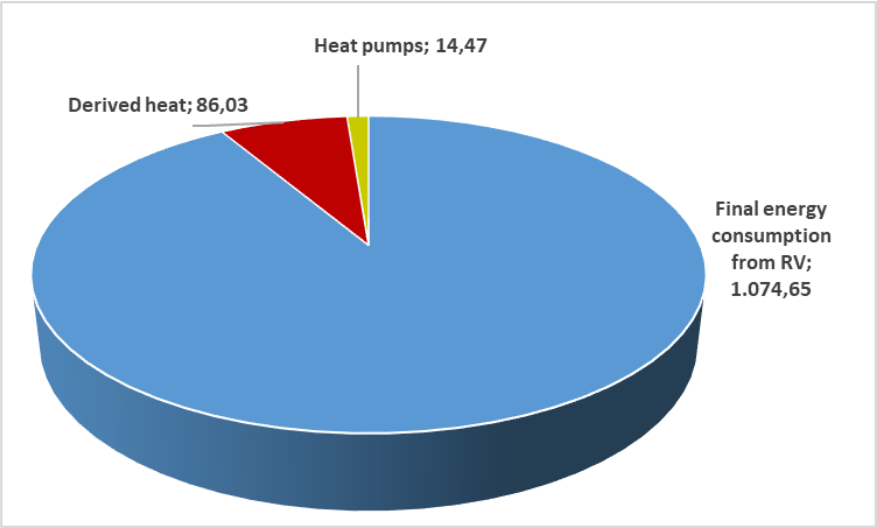


Figure 33: Individual shares of renewable sources in heating and cooling, 2019 8 (in ktoe) (source: Sector Analysis – Energy industry)

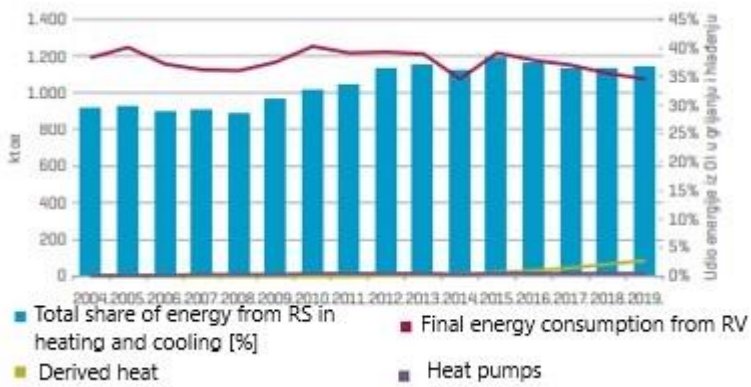


Figure 34: Trends in energy from renewable sources in the heating and cooling sector 2004-2019 and related shares (source: Sector Analysis – Energy industry)

[25] Ibid.

3.1.9. Renewable energy sources in Croatia – historical progress

From the beginning of the establishment of the system for stimulating the production of electricity from renewable energy sources (RES) and cogeneration in the Republic of Croatia (July 2007) until the end of 2019, there were 1,374 contracts for the purchase of electricity from RES plants with a total installed capacity of 950 MW. Compared to 2018, during 2019, 10 contracts of 6.3 MW expired or were terminated (4 contracts for solid biomass power plants and 4 contracts for biogas power plants and 2 contracts for solar power plants).[26]

During the establishment of the incentive system, there were three changes in the tariff system, i.e., the amount of the contracted purchase price for the delivered electricity and the calculation methodology. Thus, 66 % of concluded contracts refer to the Tariff System from 2012, 19 % to the Tariff System from 2013, and only 13 % of contracts to the initial Tariff System from 2007.

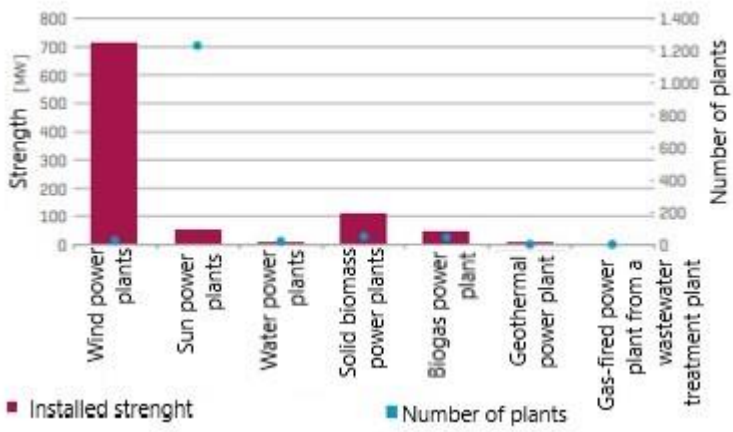


Figure 35: Renewable energy power plants as part of the electricity purchase system until 2019 (source: Sector Analysis – Energy industry)

In 2019, 2,332 GWh of electricity was produced from renewable energy in 1,374 plants in the incentive system with a total installed capacity of 940 MW. The installed capacity of the plant increased compared to 2018 by 13 percentage points. By October 2020, there were 1,350 plants in the incentive system, a year-on-year decline of 2 %.

[26] Ibid.

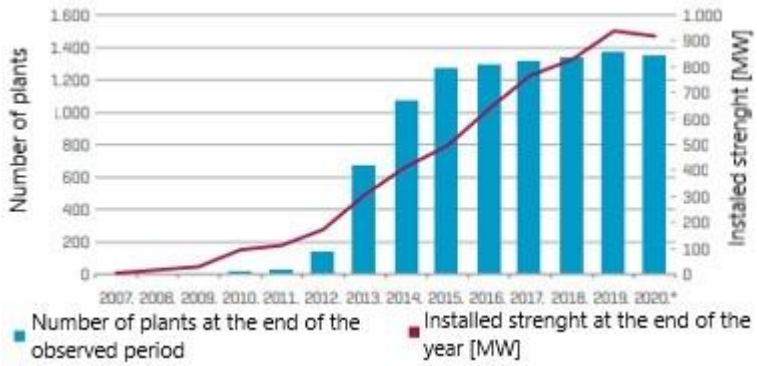


Figure 36: Relationship between the number of plants and the installed capacity in plants to produce electricity from renewable sources in the incentive system during the period 2007-2019 (preliminary data for 2020) (source: Sector Analysis – Energy industry)

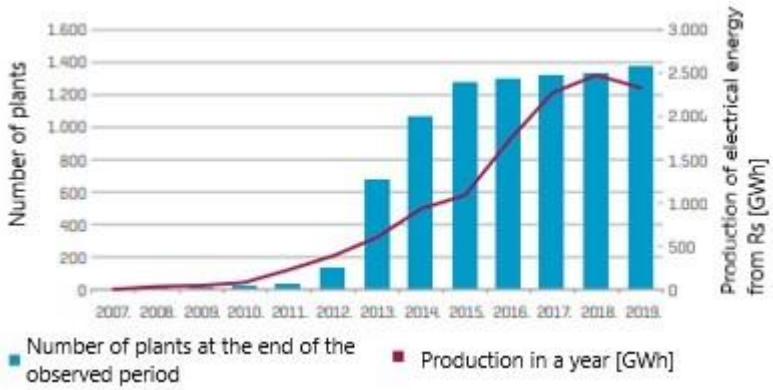


Figure 37: Ratio of the number of plants and production of electricity from renewable sources in the incentive system during the period 2007-2019 (source: Sector Analysis – Energy industry)

In the structure of power plants at the renewable sources in the incentive system in 2020 (October), the largest production of electricity from the renewable sources is realized by wind power plants with 56 %, followed by solid biomass power plants with 22 % and biogas power plants with 15 %. In the realized production of electricity from the renewable sources in October 2020, the shares were: wind power plants 78 %, biomass power plants 9 %, solar power plants 6 %, and biogas power plants 5 %. Since 2019, the production of electricity from a geothermal source (10 MW) has been recorded for the first time and its energy share is 1 %.[27]

[27] Ibid.

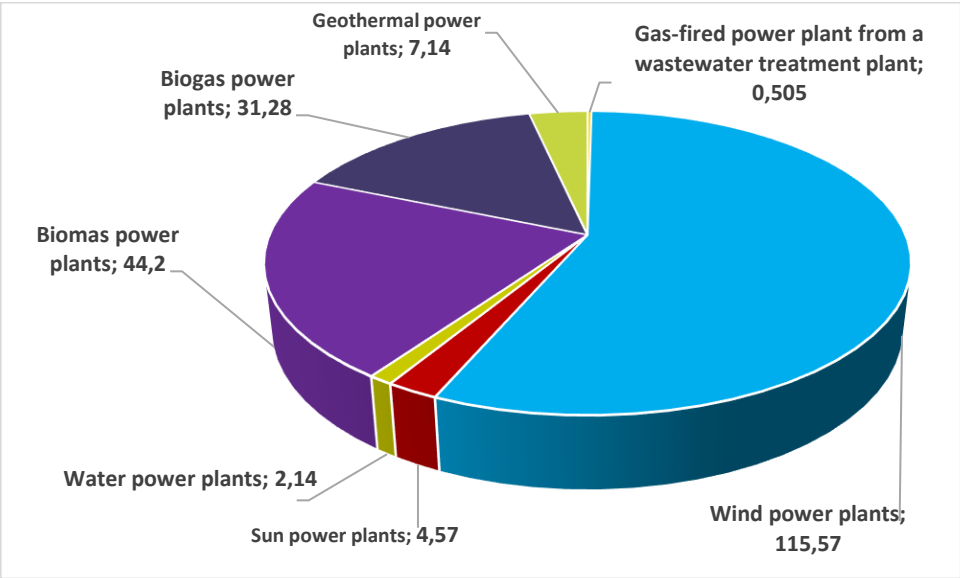


Figure 38: Structure of electricity production from renewable sources, by October 2020 (in GWh) (source: Sector Analysis – Energy industry)

Most incentives in 2019 were paid for electricity from wind farms (46 %), followed by solid biomass power plants (24 %) and biogas power plants (19 %). In 2019, in the payment of incentives for electricity produced from the renewable sources by technology, the largest year-on-year increase of 54 % was achieved by biomass power plants. Hydropower plants increased the amount of the incentive paid by 17 %, biogas power plants by 9 %, wind farms by 8 %, and solar power plants by 4 %. Collectively, the paid incentive funds for the produced electricity from the renewable energy sources increased by 22 % compared to 2018.[28]

[28] Ibid.

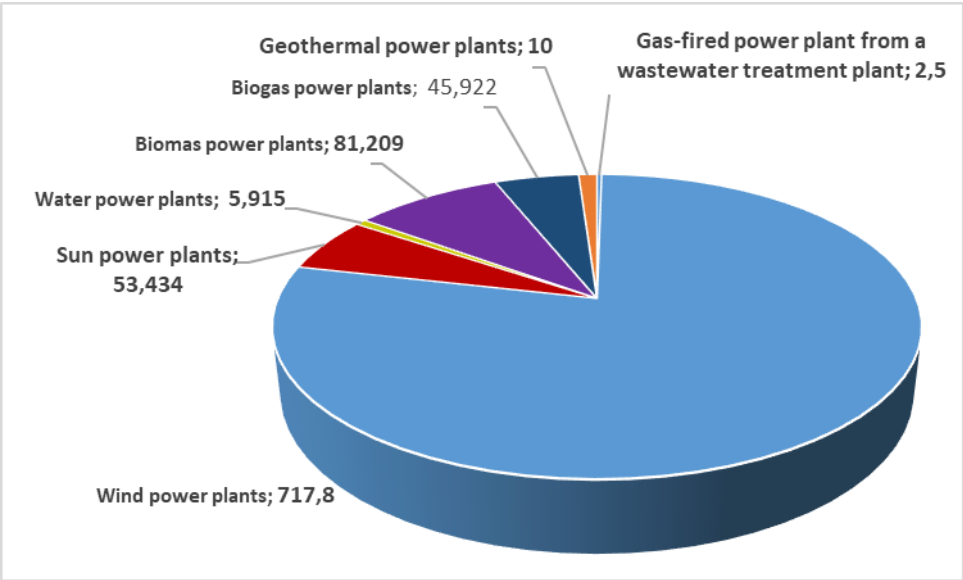


Figure 39: Structure of renewable power plants, until October 2020 (in MW) (source: Sector Analysis – Energy industry)

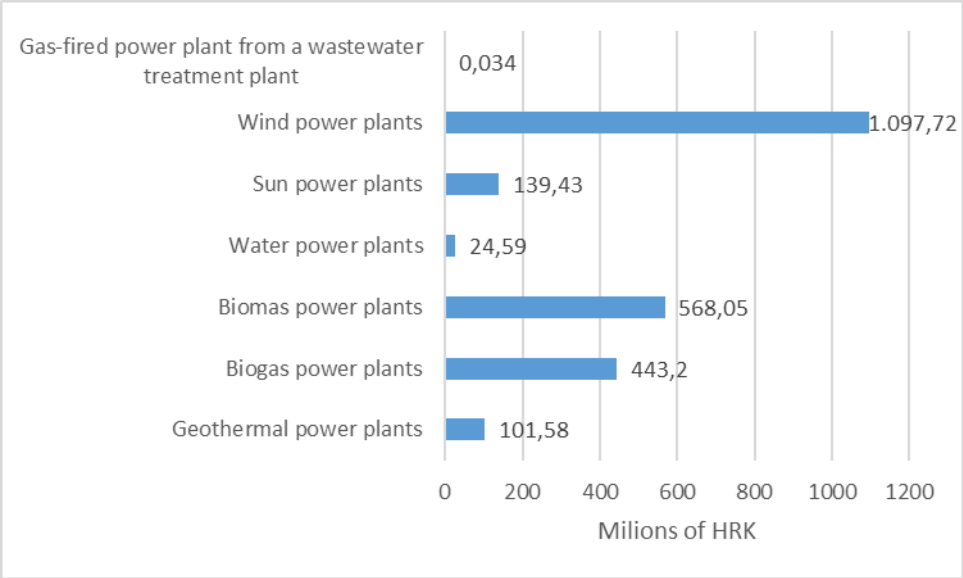


Figure 40: Incentives paid (excluding VAT) by individual technologies of renewable energy power plants in 2019 (source: Sector Analysis – Energy industry)

3.1.10. Leading companies in the industry

According to the data of Business Croatia, in 2019, 15 business entities were active in the activity "Extraction of crude petroleum and natural gas", while 921 were active in the activity "Supply of electricity, gas, steam and air conditioning".

The largest business entity in 2019 was INA dd, which with its total revenues in the amount of HRK 21,613,303,400. A significant part of its business is related to business with the Government of the Republic of Croatia, its ministries, and agencies. INA d.d. thus it has a dominant position in Croatia in the exploration and production of renewable energy and gas and the sale of gas and petroleum products.

According to data from Business Croatia, INA d.d. made a gross profit of HRK 801,958,500 in 2019 (Table 7). Compared to 2018, total revenues decreased by 1.4 %, while profits decreased by as much as 51.6 %. If we look at the structure of total revenues, the largest part consists of sales revenues, which in 2019 amounted to HRK 21,096 million and accounted for 97.6 % of total revenues.[29]

	2018.	2019.	2019./2018.
Total income	21.924,40	21.613,30	98,6
Profit before tax [in milions of HRK]	1.657,20	802	48,4
Number of employees	4.125	3.789	91,9
Gross margin [%]	7,6	3,7	49,1
Asset profitability	6,4	3	46,5
Labor productivity [income in thousands of HRK per employee]	5.315,01	5.704,22	107,3
Turnover ratio of total assets	1,1	1	93,3
Current ratio	1	0,8	79,2
Total indebtedness ratio	0,2	0,3	128,3

Table 7: Selected business indicators of the company INA dd, 2018 and 2019 (source: Sector Analysis – Energy industry)

On a year-on-year basis, they recorded a growth of 12.7 %, which is primarily the result of higher wholesale, lack of supply from the refinery in Bosanski Brod and increased sales in key markets. At the same time, the costs of raw materials and energy recorded a decline of 29 %, because of the overhaul of the Rijeka Refinery in the period from January to May 2019. The number of employees decreased from

[29] Ibid.

4,125 employees in 2018 to 3,789 employees in 2019 (down 8.1 %). It is interesting to note that the company has been recording a downward trend in the number of employees since 2015. While in 2015 INA d.d. employed 7,605 workers, in 2019 it employed 3,816 of them. Overview of selected financial indicators of INA d.d. for 2018 and 2019 is given in Table 7.

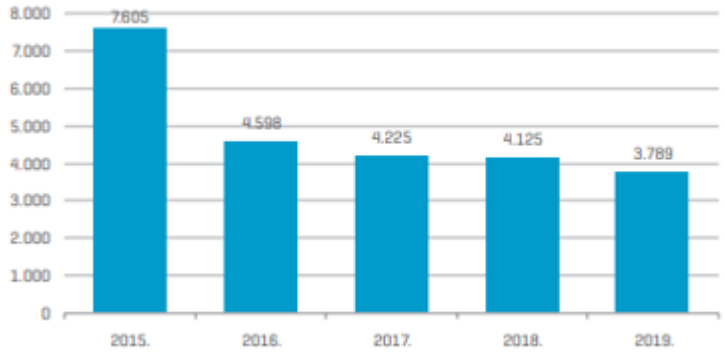


Table 8: Number of employees in the company INA dd, from 2015 to 2019 (source: Sector Analysis – Energy industry)

A more detailed insight into the state and dynamics of trends in the activity "Electricity, gas, steam and air conditioning supply" is provided by the analysis of financial indicators of ten leading companies (Table 7). The main features of the operations of leading companies in the activities of electricity, gas, steam, and air conditioning supply in 2019 are a slight increase in revenue and an increase in employment and profit (Table 7). The total revenues of the ten leading companies in this industry in 2019 amounted to HRK 33.4 billion and were only 0.3 % higher than in 2018 (Table 8).

The number of employees at the level of ten leading companies in this industry increased by 2.8 %, from 10,449 employees in 2018 to 10,742 employees in 2019. Ten leading companies cumulatively recorded positive operations in 2019 (HRK 2.4 billion in profit), with both profit and gross margin increasing significantly compared to the previous year. Reported profit was higher by 28.5 % and gross margin by 28 %. Of the ten leading companies, two companies ended 2019 with a loss, HEP-Toplinarstvo d.o.o. with a loss of HRK 38.4 million and E.ON Energija d.o.o. with a loss of 3.3 million. The remaining eight leading companies in the activity "Electricity, gas, steam and air conditioning supply" concluded 2019 with a positive business result.[30]

[30] Ibid.

	2018.	2019.	2019./2018.
Total income	33.254,80	33.360,60	100,3
Profit before tax [in milions of HRK]	1.853,80	2.381,30	128,5
Number of employees	10.449	10.742	102,8
Gross margin [%]	5,6	7,1	128
Asset profitability	2,2	2,8	129
Labor productivity [income in thousands of HRK per employee]	3.182,60	3.105,60	97,6
Turnover ratio of total assets	0,5	0,4	98,2
Current ratio	1,3	1,4	103,3
Total indebtedness ratio	0,5	0,5	98

Table 9: Average values of selected performance indicators of the top ten companies in the activity "Electricity, gas, steam and air conditioning supply", 2018 and 2019 (source: Sector Analysis – Energy industry)

A stronger increase in the number of employees than an increase in total income resulted in a 2.4 % decrease in labor productivity. The value of the current liquidity ratio for the ten leading companies in electricity, gas, steam, and air conditioning supply lower than 1.5 (1.4) indicates that in 2019 they had certain difficulties in maintaining liquidity. However, compared to the previous year, liquidity increased by 3.3 %. The indebtedness ratio of the top ten companies in the activities of electricity, gas, steam and air conditioning supply in the amount of 0.45 in 2019 indicates a relatively low indebtedness of companies. At the same time, its value was 2 %lower than a year earlier.

Table 10 shows the key indicators of the ten leading companies within the electricity, gas, steam, and air conditioning supply. Measured by total revenues, within the ten leading companies in this sector in 2019 are HEP dd, Prvo plinarsko društvo d.o.o., HEP-Proizvodnja d.o.o., HEP-Operator distribucijskog sustava d.o.o, HEP ELEKTRA d.o.o., HOPS d.o.o., GEN-I Hrvatska d.o.o., E.ON Energija d.o.o., HEP-Toplinarstvo d.o.o. and HEP-Opskrba d.o.o.[31]

Compared to the previous year, the increase in revenues in 2019 was achieved by only four companies: HEP d.d. (11.7 %), HEP ELEKTRA d.o.o. (8.9 %), HEP-Proizvodnja d.o.o. (5.9 %) and E.ON Energija d.o.o. (0.9 %). On the other hand, the largest year-on-year decline in revenues in 2019 was recorded by Prvo plinarsko društvo d.o.o. (-13.2 %) and HEP-Opskrba d.o.o. (-11.4 %), followed by HEP-Operator

[31] Ibid.

distribucijskog sustava d.o.o. (-6.2 %), GEN-I Hrvatska d.o.o. (-5.7 %), HOPS d.o.o. (-2.1 %) and HEP-Toplinarstvo d.o.o. (-0.5 %). Favorable values of the liquidity ratio in 2019 are recorded by only two companies, HEP d.d. and HEP-P Proizvodnja d.o.o., while the values of this indicator in the remaining eight companies indicate difficulties in maintaining liquidity.

	Total income [in milions of HRK]	Indebtedness ratios	Current ratios	Gross margin
HEP d.d.	10.519,9	0,25	1,75	11,7
Prvo plinarsko društvo d.o.o.	7.090,5	0,78	1,08	3,4
HEP-Proizvodnja d.o.o.	4.238,3	0,88	2,79	10,8
HEP-Operator distribucijskog sustava d.o.o.	3.748,4	0,59	0,83	5,0
HEP ELEKTRA d.o.o.	2.940,5	0,84	1,18	4,6
HOPS d.o.o.	1.727,2	0,17	0,79	9,6
GEN-I Hrvatska d.o.o.	932,4	0,86	1,16	0,4
E.ON Energija d.o.o.	917,5	0,98	0,86	-0,4
HEP-Toplinarstvo d.o.o.	736,4	0,85	0,96	-5,2
HEP-Opskrba d.o.o.	509,5	0,99	1,00	0,5

Table 10: Ten leading companies in activity "Electricity, gas, steam and air conditioning supply" - selected financial indicators, 2019 (source: Sector Analysis – Energy industry)

3.1.11. Final energy consumption in industry

The shares of specific energy forms in the final energy consumption in industry in the period from 2014 until 2019 are given in Table 11. The same trends in the period from 1988 until 2019 are given in Figure 41. In 2019, energy consumption in industry increased by 0.3 %, compared to the previous year. Such increase in the final energy consumption was the result of increase in the consumption of biomass, natural gas and steam and hot water, while consumption of all other energy forms decreased. The biggest increase, expressed as percentage, was recorded in the use of fuel wood and other biomass, and amounted to 12.9 %. Increases in the consumption of natural gas and steam and hot water were 2.2 % and 7.9 %, respectively. The consumption of electricity decreased by 2 %, the consumption of coal and coke decreased by 10 % and the consumption of liquid fuels decreased by 3.6 %.[32]

In the period from 2014 until 2019, the final energy consumption in industry increased at an average annual rate of 1.9 %. In this period, there was an increasing trend in the consumption of most energy forms, except for liquid fuels, coal and coke whose consumption decreased at an average annual rate of 3.9 % and 2.2 %, respectively. The fastest growing consumption was that of fuel wood and biomass with an average annual growth rate of 19.5 %. Consumption of electricity, natural gas and steam and hot water increased at average annual rates of 1.9 %, 3.3 % and 3.2 %, respectively.

[32] Ministarstvo zaštite okoliša i energetike. (2019). Energija u Hrvatskoj 2018.: Godišnji energetski pregled. Zagreb: Ministarstvo zaštite okoliša i energetike Republike Hrvatske: http://www.eihp.hr/wp-content/uploads/2020/04/Energija2018.pdf

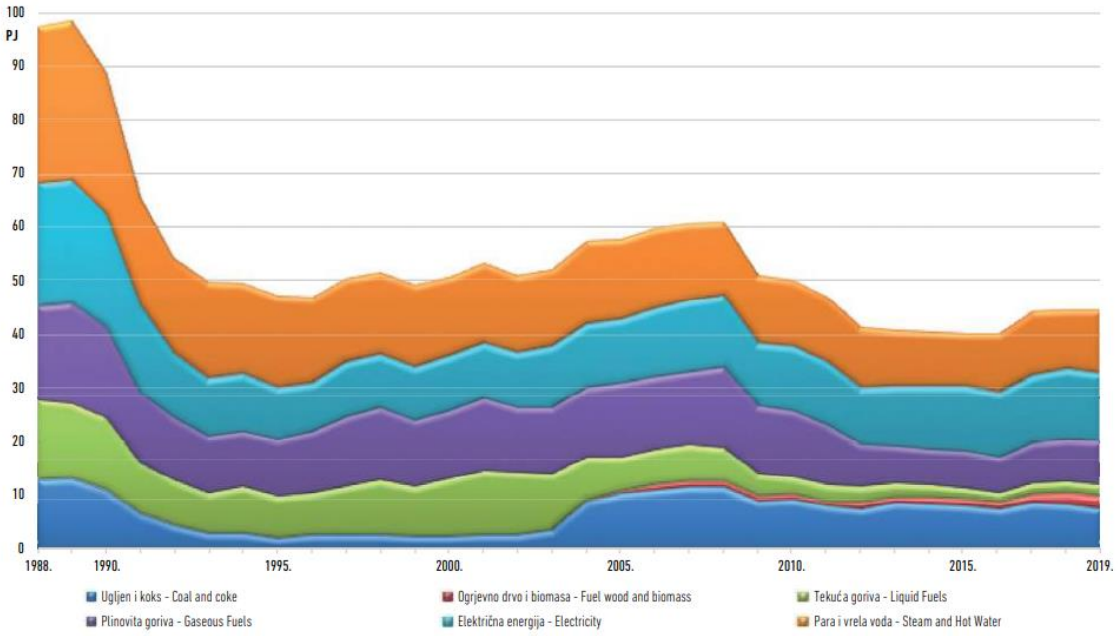


Figure 41: Final energy consumption in industry by energy form (source: Ministry of Economy and Sustainable Development)

	2014.	2015.	2016.	2017.	2018.	2019.		2019./18.	2014.-19.
	PJ							%	
Ugljen i koks • Coal and Coke	8,54	8,05	7,61	8,81	8,48	7,64		-10,0	-2,2
Ogrjevno drvo i biomasa • Biomass	0,92	1,17	0,98	1,25	1,99	2,24		12,9	19,5
Tekuća goriva • Liquid Fuels	2,40	2,19	2,02	2,06	2,04	1,96		-3,6	-3,9
Plinovita goriva • Gaseous Fuels	7,21	7,30	6,85	7,88	8,29	8,48		2,2	3,3
Električna energija • Electricity	11,59	12,09	12,08	12,74	13,00	12,74		-2,0	1,9
Para i vrela voda • Steam and Hot Water	9,98	9,62	10,77	11,74	10,83	11,68		7,9	3,2
UKUPNO • TOTAL	**40,63**	**40,42**	**40,30**	**44,48**	**44,62**	**44,75**		**0,3**	**1,9**

Table 11: Final energy consumption in industry by fuel (source: Ministry of Economy and Sustainable Development)

The shares of energy forms that participated in the energy supply of industry in 2019 are presented in Figure 42.

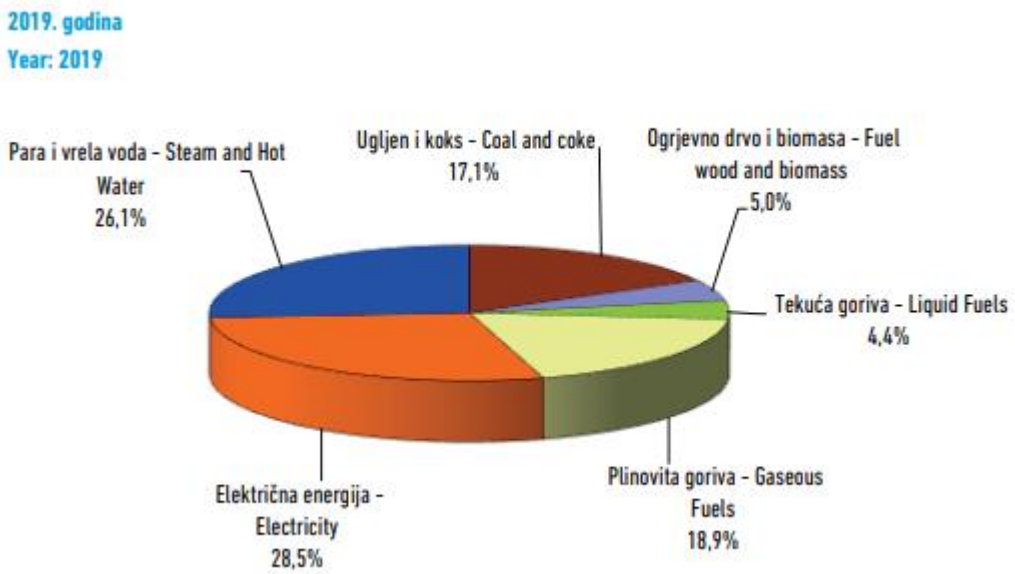


Figure 42: Shares of energy forms in final energy consumption in industry (source: Ministry of Economy and Sustainable Development)

The final energy consumption by industrial subsectors in 2014 and 2019 is presented in Table 12. The same trends in the period from 1988 until 2019 are given in Figure 43. [33]Compared to the previous period, most industry branches increased their consumption, while the iron and steel industry, the non-metallic minerals industry and the construction materials industry reduced energy consumption. Consumption in the iron and steel industry decreased by 11.1 %, in the non-metallic minerals industry by 1 % and in construction materials industry by 2.6 %. The increase in energy consumption in the paper industry was 4.4 %, and in the chemical industry 3.8 %. In the rest of the industry, the non-ferrous metals industry and the food industry, increased consumption at the rates of 3.3 %, 2.3 % and 1.4 %, respectively. In the period from 2014 until 2019, the final energy consumption in industry increased at an average annual rate of 1.9 %. Increased trend in energy consumption occurred in most industries, and only in the food industry and the iron and steel industry energy consumption had a decreasing trend, at average annual rates of 1.8 % and 1.3 %. Energy consumption of the non-ferrous metals and paper industries increased the fastest, at average annual growth rates of 7.8 % and 6.7 %, respectively.

[33] Ibid.

Energy consumption in other branches of industry grew somewhat slowly, so in the rest of the industry the average annual growth rate was 5.1 %. In the chemical industry energy consumption increased at an average annual rate of 2.3 %. Energy consumption in the non-metallic minerals industry and in the construction, materials industry increased at an average annual rate of 1.7 %.[34]

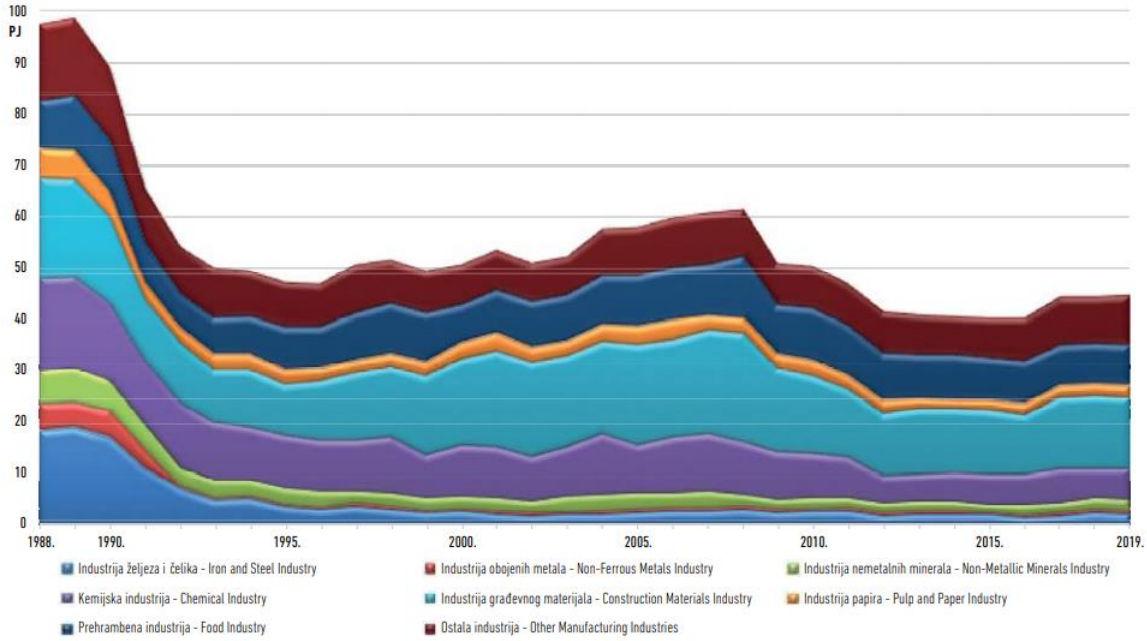


Figure 43: Final energy consumption by industrial sector (source: Ministry of Economy and Sustainable Development)

	2014.	2015.	2016.	2017.	2018.	2019.		2019./18.	2014.-19.
	PJ							%	
Industrija željeza i čelika • Iron and Steel Industry	2,12	2,14	1,51	1,59	2,23	1,99		-11,1	-1,3
Industrija obojenih metala • Non-Ferrous Metals Industry	0,58	0,31	0,29	0,68	0,82	0,84		2,3	7,8
Industrija nemetalnih minerala • Non-Metallic Minerals Industry	2,13	1,92	2,34	2,40	2,34	2,32		-1,0	1,7
Kemijska industrija • Chemical Industry	5,54	5,88	5,88	6,64	5,99	6,22		3,8	2,3
Industrija građevnog materijala • Construction Materials Industry	12,52	12,51	11,57	13,85	14,01	13,64		-2,6	1,7
Industrija papira • Pulp and Paper Industry	1,63	1,75	2,37	2,11	2,15	2,25		4,4	6,7
Prehrambena industrija • Food Industry	8,58	8,05	8,19	7,90	7,73	7,84		1,4	-1,8
Ostala industrija • Other Manufacturing Industries	7,53	7,87	8,16	9,32	9,33	9,64		3,3	5,1
UKUPNO INDUSTRIJA • TOTAL INDUSTRY	**40,63**	**40,42**	**40,30**	**44,48**	**44,62**	**44,75**		**0,3**	**1,9**

Table 12: Final energy consumption by industrial sector (source: Ministry of Economy and Sustainable Development)

[34] Ibid.

The shares of industrial branches in the total final energy consumption in industry in 2019 are presented in Figure 44. [35]

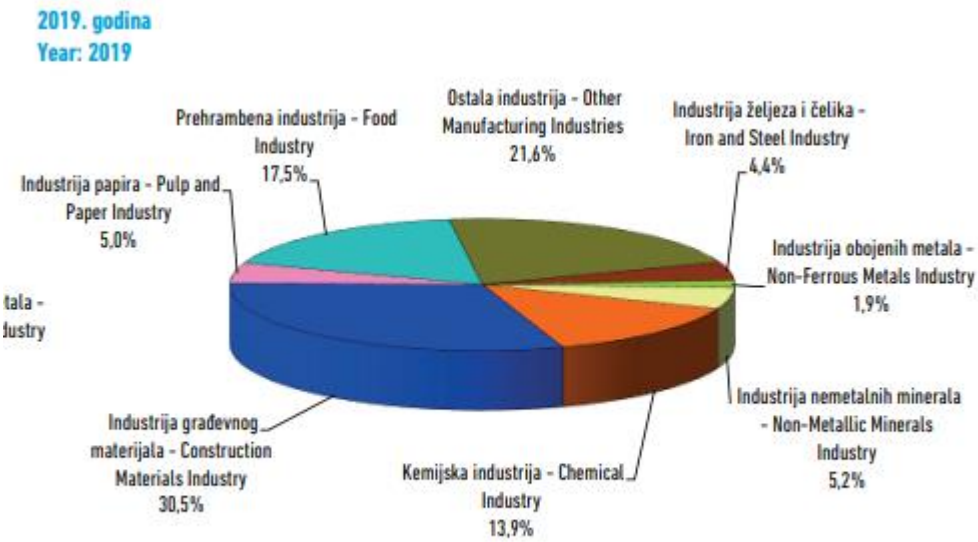


Figure 44: Shares of industrial sectors in final energy consumption (source: Ministry of Economy and Sustainable Development)

[35] Ibid.

3.2. CHEMICAL INDUSTRY

3.2.1. Introduction and trends

In the period from January to November 2020, the manufacturing sector of the European Union recorded a year-on-year fall of 10,6 %, and the chemical sector of 4,4 %. Globally, during the first three quarters of 2020, the production of the chemical sector has recorded a decline of 1,8 % compared to the same period last year. In the Croatian economy, total industrial production in 2020 recorded a year-on-year fall of 2,7 %. For comparison, a year earlier total industrial production has accomplished a modest year-on-year growth of 0,6%, while in 2018 it has accomplished a year-on-year fall of 1%. Thereat, the production of chemicals and chemical products has recorded a year-on-year growth of 11,3 %, while the industry of the rubber and plastic products has recorded a year-on-year fall of 7,5 %.

According to the last available data from March 2021, chemical industry sector makes 0,76 % of the gross domestic product (GDP) of the Republic of Croatia. Of that, 0,26 % of GDP was generated by the production of chemicals, chemical products, and artificial fibers, while the production of rubber and plastic products accounted for 0,49 % of GDP that year. At the same time, the % of production of chemicals, chemical products and artificial fibers in the total gross value added of manufacturing was 2,1 %, while the % of production of rubber and plastic products was 3,9 %. For comparison, a year earlier in the production of chemicals and chemical products 2,6% was accomplished, and in the industry of the rubber and plastic products 4% of the gross domestic value of the entire manufacturing industry.

In the total employment of the manufacturing industry in 2020, the sector of the chemical industry participated with a 7 %. Seen separately, the industry of the chemicals and chemical products accounted for 2,5 %, and the industry of the plastics and rubber for 4,5 % of total manufacturing sector employment in 2020. Sector of the chemical industry participated with 1,2% of the total employment in Croatian economy in 2020.[36]

[36] Rašić, Ekonomski institut Zagreb (The Institute of Economics Zagreb), 03/2021, nr. 84, year 10, ISSN: 1848-8986, "Sektorske analize – Kemijska industrija" (Sector analysis - Chemical industry); https://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_Kemijska%20industrija_o%C5%BEujak%202021.pdf

Looking at the areas of the national classification of activities, the fall in production activity in 2020, compared to the previous year, was recorded in mining and quarrying (-0,7 %), while the manufacturing industry grew by 4,7 %, and electricity supply, gas, steam, and air conditioning of 13,9 %. Within the manufacturing industry, the largest year-on-year fall in activity was recorded in clothing production - C14 (-15,8 %), followed by in the manufacture of motor vehicles, trailers, and semi-trailers - C29 (-14,9 %) and in beverage production - C28 (-13,9 %). On the other hand, the largest year-on-year growth in production activity in 2020 was achieved in addition to the production of chemicals and chemical products - C20 (11,3 %), production of finished metal products, except machinery and equipment - C31 (19,3 %), production of basic pharmaceutical products and pharmaceutical preparations - C18 (11,1 %) and repair and installation of machinery and equipment - C33 (10,9 %).

The industry of the chemicals and chemical products two years in a row records year-on-year growth of production activities. After the year-on-year growth of 2,3 % in 2019, in 2020 it records the growth of high 11,3%. For comparison, this industry has achieved negative % of growth (14,2% and 9,9%) on all-year level in 2017 and 2018, while during the period from 2014 to 2016 its production activity was continuously increasing. If we look at the seasonally adjusted data, we can see that in the third quarter of 2020 the production activity of chemicals and chemical products was higher by 4,7 % compared to the previous quarter, to decrease by 3,8 % in the last quarter.

Figure 45: Production of chemicals and chemical products, from January 2011 to December 2020, 2015 = 100 (source: Sector Analysis - Chemical industry)

Year-on-year growth of productional activity in the industry of the chemicals and chemical products was followed with the increasing of the salary, while the employment has recorded a slight fall. The average gross salary paid in December of 2020 in the industry of the chemicals and chemical products was 9.254 HRK, which was 1,6 % below the average of the economy and 8,9 % above the average of the entire manufacturing industry. Compared to December of 2019, the average monthly gross wages of employees in this industry nominally increased by 2,7 %. Year-on-year employment in 2020 decrease by an average of 1,2 %.[37]

The industry of the plastics and rubber in 2020 has recorded a year-on-year fall of 7,5%, and with that was interrupted the six-year period of its continuous growth (Figure 46). For comparison, in 2019 the year-on-year growth of 3,6% was recorded, and in the 2018 it was 16,2 %. Despite the year-on-year fall, seasonally adjusted data renewable energy to a slight recovery of this industry in the second half of last year. After the production activity of the plastics and rubber industry decreased compared to the previous quarter by 15,7 % in the second quarter of 2020, it recorded an increase of 15,5 % in the third quarter, and 8,2 % in the last quarter.

Figure 46: Production of rubber and plastic products, from January 2011 to December 2020, 2015 = 100 (source: Sector Analysis - Chemical industry)

[37] Ibid.

The decline in the manufacturing activity of the rubber and plastic products industry during 2018 and 2019 had a negative impact on employment trends, while wages continued to grow. In 2020, the employment of this industry was reduced by an average of 0,4 %. The average nominal gross salary paid in December of 2020 in the rubber and plastic products industry amounted to 7.459 HRK and was nominally higher by 6,1 % compared to the same month in 2019. Nevertheless, despite wage increases, wages in the rubber and plastics products industry remain among the lowest in the manufacturing sector. Lower wages were in other manufacturing, furniture, wood, textile, leather, and clothing. Thus, the salary paid in the plastics and rubber industry in December of 2020 was 21 % lower than the average of the economy and 12 % lower than the average of the entire manufacturing industry.[38]

In contrast to prices at the level of the entire manufacturing industry, which in December of 2020 decreased by 3,2 %, compared to the same month in 2019, producer prices in the production of chemicals and chemical products in the same period recorded a slight increase of 0,3 %. At the same time, prices of rubber and plastic products fell by an average of 0,4 % year-on-year.

Total labor productivity in the manufacturing industry in the period from January to December of 2020, compared to the same period in 2019, recorded a growth of 0,2 %. The industry of chemicals and chemical products recorded a year-on-year increase in labor productivity of 15 %, while the labor productivity of the rubber and plastics industry recorded a year-on-year decline of 7,4 %. The increase in labor productivity of the chemicals and chemical products industry can be attributed to an increase in production activity accompanied by a decrease in employment during the same period. On the other hand, the decline in labor productivity of the plastics and rubber industry is a consequence of a stronger decline in its production activity than the decline in employment.

In the total exports of the manufacturing industry realized from January to December of 2020, the chemical sector participated with 10,3 %, with the industry of chemicals and chemical products participating with 6,4 %, and the processing of plastics and rubber with 3,8 %. At the same time, the chemical sector accounted for 14,4 % of the total imports of the processing industry (9,5 % of the chemical and chemical products industries and 4,9 % of plastic and rubber processing). Compared to the previous year, exports of the chemical sector in 2020 decreased by 2,1 %, and imports by a slight 0,4 %.

[38] Ibid.

A decline in exports was recorded in both industries. The industry of chemicals and chemical products thus recorded a decline in exports of 2,9 %, while imports grew slightly by 0,4 %. At the same time, exports of the plastics and rubber industry fell by 0,6 % year-on-year and imports by 1,3 %. Due to dependence on imported raw materials, both industries have a foreign trade deficit. The foreign trade deficit in the production of chemicals and chemical products in 2019 amounted to 7.8 billion HRK, and rubber and plastic products to 3.6 billion HRK.

Compared to 2016, the total production of the chemicals and chemical products industry in 2020 was lower by 12 %, while compared to 2011 it was higher by 5,7 %. This trend is largely due to a sharp decline in the production activity of this industry during 2017 and 2018 (Figure 47). Nevertheless, in 2019 and 2020, the industry of chemicals and chemical products recorded positive trends, which are reflected in the annual growth rates of production activity of 2,3 and 11,3 %.

During the period from 2016 to January of 2021, this industry also recorded an increase in employment (Figure 48). In January of 2021, the chemicals and chemical products industry employed 5,891 workers, which is 506 (or 9,4 %) workers more than in January 2016. The share of the chemicals and chemical products industry in the total employment of the manufacturing industry remained unchanged, at the level of 2,6 %. However, if we look more closely at the employment trends of this industry over the last two years, we can see that after a sharp decline in the number of employees from January 2019 to January 2020, last year was followed by a period of increasing the number of employees. Thus, compared to January 2020, in January 2021, this industry employed as many as 321 (or 3.2 %) more workers.

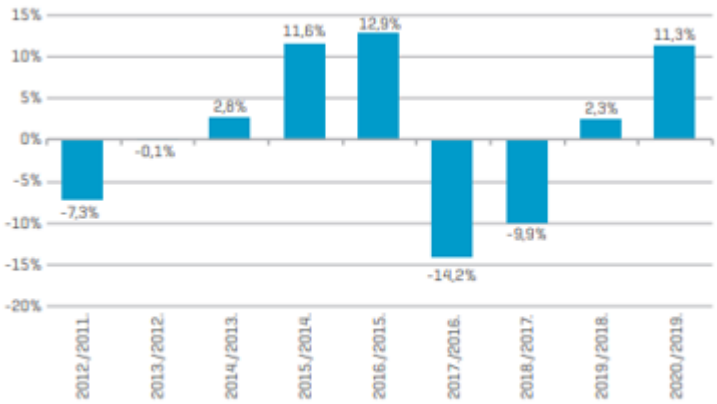


Figure 47: Annual rates of change in the production activity of the chemical and chemical products industry, 2012-2020 (source: Sector Analysis - Chemical industry)

Average monthly gross wages paid in 2020 in the chemicals and chemical products industry were nominally 15.8 % higher than the 2016 average. If we compare the ratio of wages paid in the production of chemicals and chemical products and wages paid at the level of the entire manufacturing industry during the period from 2016 to 2020, during the entire observed period wages paid in this industry were above the manufacturing average. at the state average level.[39]

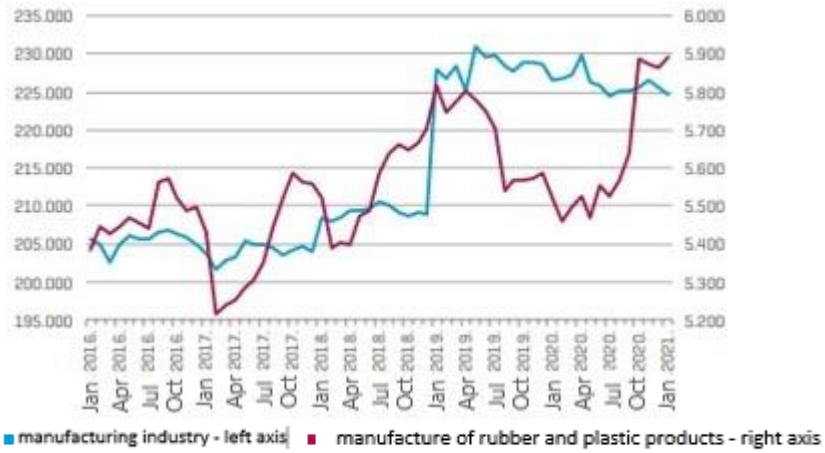


Figure 48: Employees in legal entities, manufacturing, manufacture of chemicals and chemical products, from January 2016 to January 2021 (source: Sector Analysis - Chemical industry)

The total production of the plastics and rubber processing industry in 2020 was 8.1 % higher than in 2011 and 17.7 % higher than in 2016. This industry, after a period of growth from 2014 to 2019, in 2020 recorded a year-on-year decline of 7.5 % (Figure 49).

[39] Ibid.

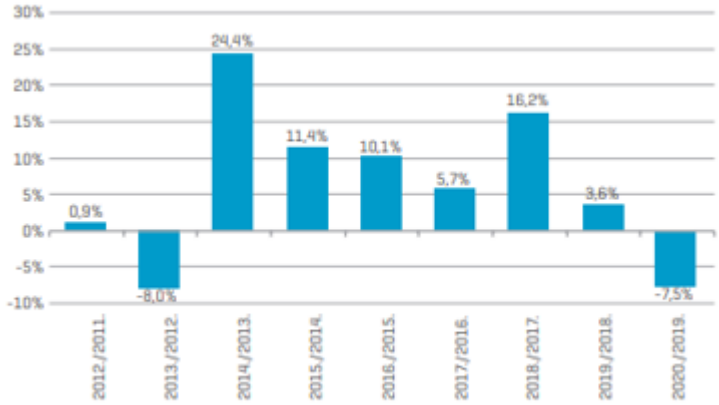


Figure 49: Annual rates of change in production activity of rubber and plastic products, from 2012 to 2019 (source: Sector Analysis - Chemical industry)

The rubber and plastics industry employed 10,491 workers in January 2021, which is 29.4 % (2,384) more workers compared to the same month in 2015. Figure 50 shows that, with minor oscillations, the period from January 2016 to July 2019 was marked by an increase in the number of employees in the rubber and plastic products industry. This was followed by a period of slight reduction in the number of employees which lasted until August 2020, only to lead to an increase in employment again. Thus, compared to the same month in 2020, in January 2021, this industry employed 321 more workers (a total of 10,491 people) (Figure 50). Unlike the chemical and chemical products industry, whose share in the total employment of the manufacturing industry remained unchanged from 2016 to 2021, the share of the plastics and rubber processing industry is growing, from 3.9 %in January 2016 to 4.7 % of total manufacturing industry employment in January this year.[40]

[40] Ibid.

Figure 50: Employees in legal entities, activity of manufacturing, manufacture of rubber and plastic products, from January 2016 to January 2021 (source: Sector Analysis - Chemical industry)

Average gross wages paid in 2020 in the plastics and rubber processing industry were nominally higher by 23.4 % compared to the 2016 average. If we analyze the movement of average monthly gross wages of the plastics and rubber industry during the period from 2016 to 2020, it can be noted that positive year-on-year nominal growth rates of average gross wages were recorded in all years of the observed period. The average monthly gross wage paid in this industry throughout the period from 2016 to 2020 was below the average wage in the manufacturing industry and the average of the economy.

Average monthly gross salary	2016.	2017.	2018.	2019.	2020.	Indeks 2020. 2016.
Republic of Croatia (in HRK)	7.752	8.055	8.448	8.766	9.216	118,9
Processing industry	6.940	7.230	7.624	7.974	8.396	121,0
Croatia = 100	89,5	89,8	90,2	91,0	91,1	101,8
Production of chemicals and chemical products (in HRK)	7.742	7.955	8.273	8.665	8.968	115,8
Processing industry = 100	111,6	110	108,5	108,7	108,7	97,4
Croatia = 100	99,9	98,8	97,9	98,8	97,3	97,4
Production of rubber and plastic products (in HRK)	5.945	6.253	6.659	7.013	7.337	123,4
Processing industry = 100	85,7	86,5	87,3	87,9	87,4	102,0
Croatia = 100	76,7	77,6	78,8	80,0	79,6	103,8

Table 13: Average monthly gross earnings per person in paid employment in legal entities in Croatia, manufacturing, manufacture of chemicals and chemical products and manufacture of rubber and plastic products, 2016-2020 (source: Sector Analysis - Chemical industry)

After the prices of manufacturers of chemicals and chemical products recorded year-on-year growth for two years in a row (in 2018 by 0.9 % and in 2019 by 0.8 %), in 2020 they fell (-1.9 %) (Figure 51).

The year-on-year decline in 2020 was also recorded by the prices of producers of rubber and plastic products, by 1.3 %. For comparison, in the previous three years, producer prices in this industry recorded a slower growth, at a year-on-year rate of 1.9 % in 2017, 1.2 % in 2018 and 0.1 % in 2019.

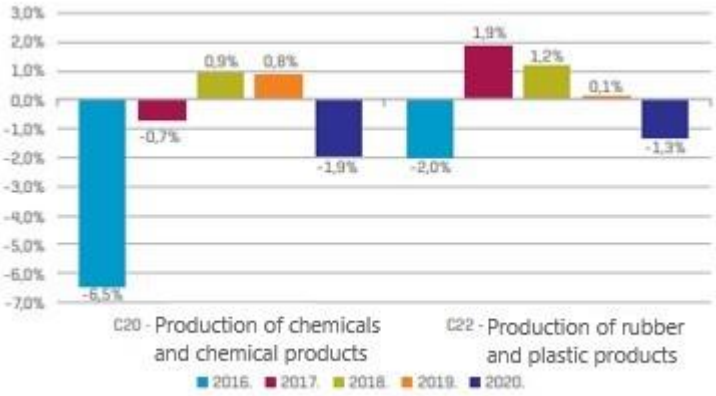


Figure 51: Annual rates of change in producer prices on the domestic market, manufacturing, manufacture of chemicals and chemical products and manufacture of rubber and plastic products, 2016-2020 (source: Sector Analysis - Chemical industry)

The productivity of the chemical and chemical products industry from January to December 2020 was 15 %higher than in the same period in 2019, while it was 7.4 %lower in the rubber and plastic products industry (Table 14). For comparison, in 2018 the productivity of the chemical and chemical products industry recorded a year-on-year decline, and in 2019 an increase. At the same time, labor productivity in the rubber and plastic products industry grew by 15 %year on year in 2018, and by 1.4 % in 2019.

Labor productivity indices	2016.	2017.	2018.	2019.	2020.
Processing industry	105,8	101,2	99,9	102,9	99,8
Production of chemicals and chemical products	109,5	85,1	89,6	104,5	115
Production of rubber and plastic products	112,4	102,8	115	101,4	92,6

Table 14: Labor productivity indices, manufacturing, manufacture of chemicals and chemical products and manufacture of rubber and plastic, 2016-2020 (source: Sector Analysis - Chemical industry)

Table 15 shows the development of foreign trade of the chemical sector during the period from 2016 to 2020. Exports of the chemicals and chemical products industry in 2020 were higher by 17.1 % compared to 2016, and imports by 17.6 %. Due to almost equal increase in exports and imports during the observed period, the coverage of imports by exports of this industry remained almost unchanged, i.e., decreased by only 0.2 percentage renewable energy (from 42.3 to 42.1 %). During the observed period, the highest value of both exports and imports of the chemicals and chemical products industry was achieved in 2018 (HRK 5.9 billion in exports and HRK 13.9 billion in imports). At the same time, the lowest value of both exports and imports was recorded by this industry in 2016, HRK 4.8 billion in exports and HRK 11.5 billion in imports.

In the period from 2016 to 2020, the production of rubber and plastic products recorded a cumulative growth of exports of 23.4 % and imports of 12.1 %. Due to stronger growth of exports than imports, there was an improvement in the foreign trade balance and an increase in the coverage of imports by exports of this branch. Thus, the coverage of imports by exports of rubber and plastic products increased from 44.3 % in 2016 to 48.7 % in 2020. For comparison, in 2010, the coverage of imports by exports of rubber and plastic products was only 24.7 %. The increase in the coverage of imports by exports of rubber and plastic products is an indicator of the gradual reduction of import dependence on raw materials as well as its shift to placement on foreign markets.[41]

[41] Ibid.

Average monthly gross salary	2016.	2017.	2018.	2019.	2020.	Indeks 2020. 2016.
Production of chemicals and chemical products						
Export [in milions of HRK]	4.846,0	5.434,0	5.904,5	5.843,7	5.674,0	117,1
Processing industry [in %]	5,9	5,8	6,1	6,2	6,4	109,3
Import [in milions of HRK]	11.458	12.355	13.948	13.465	13.479	117,6
Processing industry	8,8	9	9,1	8,8	9,5	107,8
Covered imports by exports [in %]	42,3	44,0	42,3	43,4	42,1	99,5
Production of rubber and plastic products						
Export [in milions of HRK]	2740,6	2966,2	3295,9	3402,8	3381,1	123,4
Processing industry [in %]	3,3	3,2	3,4	3,6	3,8	116,4
Import [in milions of HRK]	6.193	6.671	7.222	7.034	6.945	112,1
Processing industry [in %]	4,7	4,7	4,7	4,6	4,9	104,0
Covered imports by exports [in %]	44,3	44,5	45,6	48,4	48,7	109,9

Table 15: Foreign trade, manufacturing, manufacture of chemicals and chemical products and manufacture of rubber and plastic products, 2016-2020 (source: Sector Analysis - Chemical industry)

3.2.2. Leading companies in the industry

The operations of leading companies in the production of chemicals and chemical products during 2019 were marked by an increase in total revenues and an increase in profit (Table 16). The total revenues of the ten leading companies in this sector in 2019 amounted to HRK 4.2 billion and were higher by 5.4 %compared to the previous year. Unlike in 2018, when a cumulative loss of HRK 445.4 million was realized at the level of ten leading companies in this industry, in 2019 a gross profit of HRK 266.5 million was realized. Petrokemija d.d. made the largest contribution to such developments, concluding 2018 with a loss of HRK 470.8 million, while it ended 2019 with a gross profit of HRK 140.4 million. The number of employees decreased from a total of 3,357 in 2018 to 3,265 in 2019 (a decline of 2.7 %). The increase in revenues of the ten leading companies in the production of chemicals and chemical products, followed by a decrease in employment, resulted in an increase in labor productivity of 8.4 %.[42]

[42] Ibid.

	2018.	2019.	2019./2018.
Total income [in milions of HRK]	3.965,60	4.181,40	105,4
Profit before tax [in milions of HRK]	-445,40	266,5	-59,8
Number of employees	3.357	3.265	97,3
Gross margin [%]	-11,2	6,4	17,6 p.b.
Asset profitability [in %]	-9,3	5,5	14,8 p.b.
Labor productivity [income in thousands of HRK per employee]	1.181,30	1.280,70	108,4
Turnover ratio of total assets	0,8	0,9	110,9
Current ratio	0,94	0,97	102,7
Total indebtedness ratio	0,72	0,66	91,4

Table 16: Average values of selected indicators of the top ten companies in the production of chemicals and chemical products, 2018 and 2019 (source: Sector Analysis - Chemical industry)

Financial data show that the leading producers in the chemical industry in Croatia still have problems with indebtedness and maintaining liquidity. The value of the current liquidity ratio for the ten leading manufacturers in the chemical industry in 2019 was 0.9, which compared to 2018 represents an improvement of only 2.7 %. The debt ratio in 2019 was 0.66. Although it is below the 0.72 level in 2018, its value indicates the weak ability of these companies to cover their short-term and long-term liabilities to creditors and investors. The key performance indicators of the ten leading companies from the Croatian chemical sector in 2019 are shown in Table 17.[43]

[43] Ibid.

	Total income [in millions of HRK]	Indebtedness ratios	Current ratios	Gross margin
Petrokemija d.d.	2.134,4	0,58	1,21	6,6
Saponia d.d.	508,9	0,41	1,88	-5,2
Messer Croatia Plin d.o.o.	229,6	0,19	2,50	13,4
Hempel d.o.o.	211,5	0,47	1,42	4,2
Chromos-Svjetlost d.o.o.	198,4	0,09	8,19	11,9
Scott Bader d.o.o.	192,4	0,60	1,05	2,7
Ireks Aroma d.o.o.	192,0	0,08	7,93	8,3
Adriatica Dunav d.o.o.	184,6	0,71	1,32	2,5
Meteor Grupa - Labud d.o.o.	181,5	0,83	0,69	5,6
Dioki d.d. u stečaju	147,8	1,10	0,51	36,1

Table 17: Ten leading companies in the production of chemicals and chemical products - selected financial indicators, 2019 (source: Sector Analysis - Chemical industry)

Measured by total revenues, at the top of the list of ten leading companies in the chemical industry in 2019 are Petrokemija d.d. (with HRK 2.1 billion in total revenues), Saponia d.d. (with HRK 508.9 million in total revenues) and Messer Croatia Plin d.o.o. (with HRK 229.6 million in total revenues). This is followed by the companies Hempel d.o.o., Chromos-Svjetlost d.o.o., Scott Bader d.o.o., Ireks Aroma d.o.o., Adriatica Dunav d.o.o., Meteor Grupa - Labud d.o.o.3 and Dioki d.d. in bankruptcy.

According to the data of Business Croatia, the decrease in revenues in 2019 compared to the previous year was achieved by five companies: Saponia d.d. (-27.7 %), Adriatica Dunav d.o.o. (-9.2 %), Hempel d.o.o. (-8.6 %), Scott Bader d.o.o. (-4.2 %) and Ireks Aroma d.o.o. (-2.4 %). On the other hand, the largest year-on-year revenue growth in 2019 was recorded next to Dioki d.d. in bankruptcy (507.6 %) Meteor Grupa - Labud d.o.o. (48.9 %), followed by Petrokemija d.d. with a year-on-year revenue increase of 14.2 %. High indebtedness in 2019 marked the operations of Dioki d.d. in bankruptcy, Meteor Group - Labud d.o.o., Adriatica Dunav d.o.o., Scott Bader d.o.o. and Petrokemija d.d.

According to the provisional unaudited financial results, Petrokemija d.d. In 2020, it generated total revenues of HRK 1,805.4 million and total expenses of HRK 1,540.4 million, which resulted in a net profit of HRK 267.0 million (Petrokemija d.d., 2021). For comparison, Petrokemija d.d. made a net profit of HRK 140 million in 2019. Sales revenues amounted to HRK 1,788 million, which is a decrease of 15 %compared to 2019. The decline in sales revenue is largely due to the decline in sales prices and a smaller part in the decline in sales volumes.

In the unaudited financial report on the operations of Petrokemija d.d. in 2020, it is renewable energy out that the COVID-19 disease pandemic did not have a negative impact on the company's operations. On the other hand, the positive impact on the operations of Petrokemija d.d. last year it had a significantly lower price of natural gas as well as efficiency increase measures implemented in the company in previous periods. The planned major overhaul, which was to be carried out during the summer of 2020, was postponed to January this year due to the inability of some suppliers to deliver spare parts within the agreed deadlines and then valid travel restrictions.

According to the data of Business Croatia, in 2019, in activity C22 "Manufacture of rubber and plastic products", there were 796 active business entities that generated total revenues of HRK 6.7 billion. Analysis of financial indicators of ten leading companies in the production of plastic and rubber products indicates positive trends in the sector during 2019 (Table 17)[44]

The main characteristics of the business of the observed group of producers of plastic and rubber products are the increase in income and employment, and profit business. The total revenues of the ten leading companies in this sector in 2019 amounted to 2.3 billion kuna and were higher by 8.8 %compared to the previous year. The number of employees increased from a total of 1,486 in 2018 to 1,787 in 2019 (an increase of 20.3 %). Ten leading producers in both observed years, 2018 and 2019, operated cumulatively with profit, with a cumulative profit of HRK 94.1 million in 2018 and HRK 123.8 billion in 2019 (growth of 31.6 %).

Stronger employment growth (0.3 %) than revenue growth resulted in a 9.5 % decrease in labor productivity. The value of the current liquidity ratio of the ten leading plastic and rubber producers higher than 1.6 indicates that the companies do not have significant difficulties in settling short-term liabilities. The value of the indebtedness ratio in 2019 takes the value of 0.50 and is almost at the level of the previous year. In the same period, the turnover ratio of total assets also recorded a slight increase of 1.5, which means that the average duration of turnover of total assets increased only slightly. In 2018, each kuna of assets resulted in HRK 1.35 of revenue, while in 2019, HRK 1.37 of revenue was generated for each kuna of assets. After covering the production costs of the observed companies in 2019, 5.3 % remained, and in 2018 4.4 % of total revenues.

[44] Ibid.

	2018.	2019.	2019./2018.
Total income [in milions of HRK]	2.159,50	2.348,90	108,8
Profit before tax [in milions of HRK]	94,10	123,8	131,6
Number of employees	1.486	1.787	120,3
Gross margin [%]	4,36	5,27	120,9
Asset profitability [in %]	7,41	6,46	87,2
Labor productivity [income in	1.453,20	1.314,40	90,5
Turnover ratio of total assets	1,35	1,37	101,5
Current ratio	1,82	1,65	90,6
Total indebtedness ratio	0,51	0,5	99,5

Table 18: Average values of selected business indicators of the top ten companies in the production of plastics and rubber, 2018 and 2019 (source: Sector Analysis - Chemical industry)

Viewed at the level of individual companies, the increase in total revenues in 2019 compared to 2018 was achieved by eight of the ten leading manufacturers of plastics and rubber, with the largest increase achieved by Bomark Pak d.o.o. (36.9 %), followed by Aquaestil plus d.o.o. (10 %). The decrease in total revenues on a year-on-year basis was recorded by Telur d.o.o., by 10.6 %, and Sipro d.o.o., by 4.8 %. Among the top ten manufacturers of plastic and rubber products, the only company is Alpla d.o.o. It ended 2019 with a loss of HRK 5.9 million. The largest gross profit in 2019 was made by Gumiimpex-GRP d.o.o. (HRK 40.6 million) and Muraplast d.o.o. (HRK 30.1 million). At the same time, the highest liquidity was recorded by Bifix d.o.o. (8.3), Gumiimpex-GRP d.o.o. (2.2) and Alpla d.o.o. (2.1). The weakest ability to finance short-term liabilities was marked by the operations of Vargon d.o.o. (0.97).

	Total income [in milions of HRK]	Indebtedness ratios	Current ratios	Gross margin
Bomark Pak d.o.o.	558,5	0,66	1,13	2,73
Gumiimpex-GRP d.o.o.	441,8	0,35	2,21	9,20
Muraplast d.o.o.	346,9	0,37	1,71	8,69
Aquaestil plus d.o.o.	185,3	0,48	2,03	5,05
Alpla d.o.o.	159,1	0,56	2,07	-3,70
Sipro d.o.o.	150,0	0,61	1,57	0,47
Vargon d.o.o.	147,2	0,60	0,97	7,37
Marlex d.o.o.	135,4	0,56	1,31	9,48
Telur d.o.o.	112,4	0,65	1,76	1,32
Bifix d.o.o.	112,4	0,23	8,34	7,53

Table 19: Ten leading companies in the production of plastics and rubber - selected financial indicators, 2019 (source: Sector Analysis - Chemical industry)

Two companies from the production of chemicals and chemical products, Petrokemija d.d. and Saponia d.d, are listed on the Zagreb Stock Exchange, while no company was listed on the Zagreb Stock Exchange from the activity of plastic and rubber production. Starting from November 25, 2019 to March 5, 2021, Kutina Petrokemija d.d. was part of the CROBEXplus index and the CROBEXindustry sector index and was excluded from both indices by a revision on March 5, 2021. Circumstances caused by the COVID-19 disease pandemic were also reflected in developments in the domestic capital market. Thus, trade statistics on the Zagreb Stock Exchange in 2020 were marked by the volatile movement of the index, which was particularly pronounced in the first half of the year. On a year-on-year basis, most indices fell, except for the CROBEXindustry index, which grew by 9.19 %year on year, the CROBEXconstruct index, which rose by 61.74 %, and the CROBEXturist index, which grew slightly by 0.61 %. The CROBEX index fell 13.8 %and the CROBEXtr index 12.5 %. Shares of Petrokemija d.d. in 2020, they recorded a value increase of 24.17 %year-on-year. For comparison, the shares of Petrokemija d.d. in 2019, they recorded a year-on-year growth of 87.91 %and were ranked seventh out of ten stocks with the highest growth in 2019. Shares of Saponia d.d. in 2020, they recorded a year-on-year increase in value of 47.59 %.

3.2.3. The role of the chemical industry of the EU in the transition to a circular economy

CEFIC recently presented its vision for the future of Europe by 2050 (Mid Century Vision for the Future of Europe) 8, according to which the European economy would be transformed into a circular and climate-neutral one by the middle of the 21st century. The transition to a circular economy would significantly contribute to addressing global challenges related to scarce resources, reducing greenhouse gas emissions through better use and reuse and recycling of materials already existing in the economy, reducing waste, creating new occupations and jobs and stimulating economic growth. Renewable energy in a circle means contributing to the fulfillment of the Paris Agreement and the broader development goals of the 2030.9 United Nations Sustainable Development Program.

According to CEFIC's vision, the European chemical industry will be positioned at the very center of the European circular economy by the middle of this century. From the product design phase to the final phase of the product life cycle, the chemical industry can offer innovative solutions that benefit the entire chemical sector and the entire value chain, enabling industries to become more circular. Whether

it is recycling paper, battery or plastic, the process is basically chemical. While the 20th century required the recycling of waste that filled landfills and polluted the environment, the 21st century is working on the development and application of technologies for the separation and recycling of carbon from carbon dioxide (CO2) emissions.[45]

By converting waste into valuable, new raw materials, the chemical industry in the circular economy takes on a key role as a recycler. To enable a successful transition to a carbon-smart and circular future in Europe and around the world, it is necessary to establish a supportive, stimulating, and prosperous policy framework, starting with the EU's industrial strategy to enable industry to achieve the Green Agenda. It is then necessary to promote cross-sectoral value chain platforms. Initiatives such as the European Circular Plastics Alliance are key to the success of the circular economy. Within these platforms, the participation of civil society organizations will also be important to increase awareness and social acceptance. It is necessary to make a progressive transition from a waste-oriented policy framework to a resource-oriented policy framework. Waste policies should be coordinated and harmonized at EU level to create a single market for materials where resources can be easily transported, sold, and reused.

For example, the use of chemical recycling technologies in providing circular solutions will be an opportunity to contribute to increasing recycling rates and the use of biologically based circular raw materials in Europe. Smart, coherent, science-based, and cost-effective policies and legislation need to be formulated and implemented.

Data from the European Environment Agency (EEA) show that the EU-27 chemical industry, including the pharmaceutical industry, is achieving solid results in terms of reducing greenhouse gas emissions. This has been achieved thanks to the efforts made within the chemical industry towards the development and use of cleaner technologies and the transition to less carbon-intensive energy sources, with the aim of increasing energy efficiency. In addition to increasing the energy efficiency of our own processes, innovations in the chemical industry also help increase the energy efficiency of users and their products.

[45] Ibid.

Thus, the chemical industry of the EU-27 in 2018 emitted a total of 128.3 million tons of CO2 equivalent of greenhouse gases, which is a decrease of 52.5 %compared to a total of 270.3 million tons in 1990. A significant part of the reduction in greenhouse gas emissions over the past years is associated with a reduction in nitric oxide (N2O), which has a higher global warming potential than CO2 and is released because of certain chemical processes. According to the EEA, CO2 is the most important greenhouse gas emitted through the European Union's chemical industry. In 2018, CO2 accounted for 90.7 %of total greenhouse gas emissions at EU-27 level. EU CO2 emissions in that year amounted to 116.4 million tons, which was 24.5 %below 1990 levels. On the other hand, N2O greenhouse gas accounts for 5.1 %of total EU-27 greenhouse gas emissions in the EU. 2018.

In 2018, N2O emissions in the EU-27 were 6.5 million tons, which was 92.6 %below 1990 levels. Compared to 2017, N2O emissions decreased by 13.5 %. The data show that CH4 emissions increased, while emissions of other greenhouse gases such as carbon dioxide (CO2), fluorocarbons (HFCs), nitrogen oxides (N2O), sulfur hexafluorides (SF6) and perfluorocarbons (PFCs) decreased during the same period.

3.2.4. Conclusion and expectations

The crisis caused by the COVID-19 disease pandemic has hit the entire processing sector of the European Union hard and has led to a reduction in total production at EU-27 level. In the first three quarters of 2020, the manufacturing sector of the European Union recorded a year-on-year decline of 10.6 %, and the chemical industry recorded a decline of 4.4 %. The decline in chemical industry production has been offset by increased demand for chemicals used to produce critical products used in public health (e.g., plexiglass, protective equipment, drugs, disinfectants, etc.). Seen by the largest EU member states, France and Italy were the hardest hit by the crisis. Globally, the production of the chemical sector during the first three quarters of 2020 recorded a decline of 1.8 %compared to the same period last year. The positive year-on-year growth rate of production in the first three quarters of 2020 was recorded only by China (0.7 %), while all other world markets recorded a year-on-year decline.

In the Croatian economy, total industrial production in 2020 recorded a year-on-year decline of 2.7 %. Despite the pandemic, the production of chemicals and chemical products in 2020 in Croatia recorded a year-on-year growth of 11.3 %. The rubber and plastic products industry recorded a year-on-year decline of 7.5 %.

The positive trends in the activities of the chemicals and chemical products industry over the past year were accompanied by an increase in wages, while employment declined slightly. Compared to the previous year, exports of the chemical and chemical products industry in 2020 were lower by 2.0 %, while imports recorded a slight growth of 0.4 %. Along with the decline in manufacturing activity, developments in the plastics and rubber products industry were marked by declining employment, while wages continued to rise. The plastics and rubber industry recorded a year-on-year decline in both imports and exports, with exports down 0.6 % and imports down 1.3 %. Both industries are characterized by dependence on imported raw materials, which results in a high foreign trade deficit.

The contribution of the chemical industry sector to the economy is also visible in the data on gross domestic value, employment, and the number of active business entities. The share of the chemical industry sector in the gross domestic value of the manufacturing industry in 2018 was 6 %, with the share of the chemicals, chemical products and man-made fibers industry being 2.1 % and the share of the rubber and plastics industry 3.9 %. The total number of employees in the chemical industry sector in December 2020 was 16,389 or 7.3 % of the total employment of the manufacturing industry. According to Business Croatia, business entities in the chemical industry make up as much as 7.9 % of business entities in the Croatian manufacturing industry.[46]

There are 384 registered business entities active in the chemicals and chemical products industry, and 796 in the rubber and plastics industry. It is interesting to note that Petrokemija d.d. has been achieving a positive business result for two years in a row. Positive impact on the business of Petrokemija d.d. in 2020 it had a significantly lower price of natural gas as well as efficiency increase measures implemented in the company in previous periods. After making a net profit of HRK 140 million in 2019 for the first time in a long time, according to the provisional unaudited financial results for 2020, Petrokemija d.d. made a net profit of HRK 267 million in 2020. The unaudited financial report of Petrokemija's operations in 2020 also renewable energy out that the COVID-19 disease pandemic did not have a negative impact on the company's operations. Despite the positive business results, Petrokemija d.d. As of March 5, it is not part of the CROBEXplus index and part of the CROBEXindustry sector index. Osijek Saponia d.d. as of March 5 this year, it is no longer part of the CROBEX and CROBEXtr indices, but it is still part of the CROBEXplus index and the CROBEXindustry sector index.

[46] Ibid.

Although CEFIC forecasts 3 % growth in EU chemical industry production for 2021, the longer-term economic outlook remains highly uncertain due to the current COVID-19 pandemic and its on renewable energy economic effects. As is generally known, the consequences of the second wave of the COVID-19 pandemic are not yet known, and some EU countries are currently facing a third wave of pandemics, which is quite serious and will certainly affect the activity of the chemical sector in Croatia and the European Union. in the coming months. In these circumstances, there is a need for rapid and effective implementation of the EU's Economic Recovery Plan, which needs to be firmly embedded in the EU's industrial strategy and the Green Agenda. This would ensure that financing the recovery achieves an industrial transformation that will be sustainable over time and contribute to a resilient economy.

3.3. PHARMACEUTICAL INDUSTRY

3.3.1. Introduction and trends

The Central Bureau of Statistics announced that the production of basic pharmaceutical products and pharmaceutical preparations in June 2020 was 8.5 % higher compared to the same month in 2019 according to the seasonally and calendar-adjusted index. However, in the first six months of year 2020, the production of pharmaceutical products and preparations decreased by 0.3 % year on year. The pharmaceutical industry is thus one of many industries that in the first half of 2020 recorded a decline in production, which in that period at the level of total industry amounted to 6.4 %. Trends in this industry, as in others, in the first half of year 2020 were significantly marked by the impact of the COVID-19 disease pandemic and the activities carried out to combat it. [47]

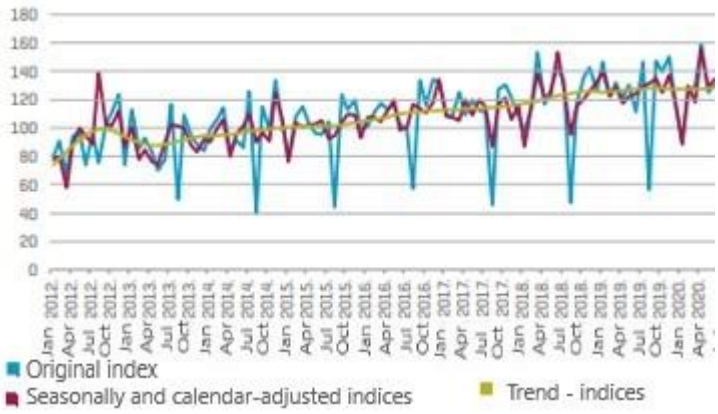


Figure 52: Manufacture of basic pharmaceutical products and pharmaceutical preparations (2015 = 100) (source: Sector Analysis – Pharmaceutical industry)

Monthly change rates calculated from seasonally and calendar-adjusted indices indicate a decrease of 8.8 %in March 2020 compared to February 2020 and 17.7 % in May compared to April. After a decrease of 25.1 %in January 2020 compared to December 2019, in February compared to January, production in this industry increased by 46.4 %.

[47] Lj. Božić, Ekonomski institut Zagreb (The Institute of Economics Zagreb), 09/2020, nr. 79, year 9, ISSN: 1848-8986, "Sektorske analize – Farmaceutska industrija" (Sector analysis - Pharmaceutical industry): https://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_farmaceutska_rujan_2020.pdf

The monthly increase, by 31.1 %, was achieved in April 2020. In June, the production of pharmaceutical products increased by 4.7 % compared to May 2020. Inventories of finished pharmaceutical products at manufacturers in June 2020 decreased by 14.1 % compared to the same month in 2019. Compared to May 2020, they increased by only 0.4 %.

In June 2020, there were 5,228 employees in the production of pharmaceutical products and preparations. The number of employees in June 2020 increased by 4.6 %compared to the same month of 2019. The increase in employment in the pharmaceutical industry in the first six months of 2020 was 4.4 % compared to the first half of 2019. Labor productivity in June 2020 decreased by 4.6 % year-on-year.

The average monthly gross salary of employees in the production of basic pharmaceutical products and preparations in June 2020 amounted to HRK 14,656, which is 2.3 % more compared to the same period of the previous year (2019). Average gross salary in Croatia was 58.5 % higher than average gross salary in Croatia for the month June 2020. The average gross salary for 2019 in the pharmaceutical industry amounted to HRK 15,437. Year-on-year, gross wages in this industry increased by 9 %. From January to May 2020, pharmaceutical products, and preparations worth 2.8 billion kuna were exported, which is a decrease of 13 % compared to the first five months of 2019. In the same period, imports of pharmaceutical products reached HRK 5.5 billion. Compared to the same period last year, imports of pharmaceutical products increased by as much as 21.5 %.[48]

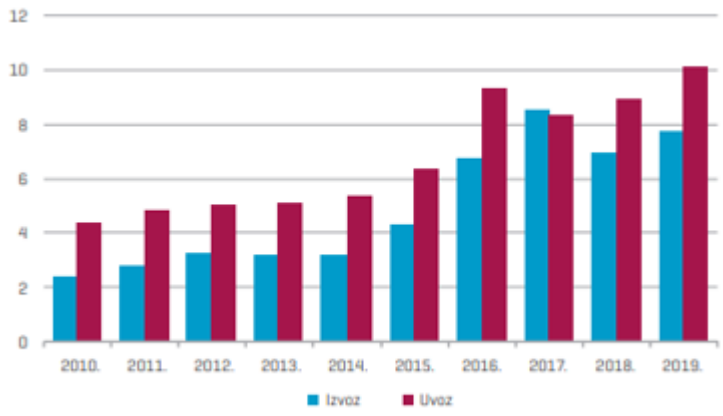


Figure 53: Foreign trade, production of basic pharmaceutical products and pharmaceutical preparations from 2010 to 2019, in billions of kuna (source: Sector Analysis – Pharmaceutical industry)

[48] Ibid.

In 2019, exports of pharmaceutical products reached HRK 7.7 billion. This represents an increase of 12 % compared to 2018. In 2019, pharmaceuticals worth HRK 10.1 billion were imported. This year-on-year increase in imports of 13.4 % further reduced the coverage of imports by exports of pharmaceutical products to 76.6 %in 2019. Consumer prices of pharmaceutical products in June 2020 were 1.3 %higher compared to the same month in 2019. Also, pharmaceutical products in June 2020 were 40 % more expensive than the average prices of pharmaceutical products in 2015. In June 2020, the prices of pharmaceutical products on the domestic market increased by 1.6 %, and on the non-domestic market by 2 % compared to the same month of 2019. In the Report on the Consumption of Medicines, the Croatian Agency for Medicines and Medical Devices states that in 2018, medicines worth HRK 6.6 billion were consumed in Croatia. Thus, the trend of increasing drug consumption in Croatia continued. The increase in the value of drugs consumed compared to 2017 was 8.06 %.

Measured in financial terms, the largest share in total drug consumption in 2018 was related to drugs for the treatment of malignant diseases and immunomodulators - as much as 24 %. They are followed by drugs that act on the nervous system (13 %) and drugs that act on the digestive system and drugs that act on the cardiovascular system with proportions of 12 %.

As for prescription drugs, according to data published by the Croatian Institute of Public Health, 8.3 % of prescribed drugs in 2019 relate to anxiolytics. Specifically, there are 4,541,093 prescriptions for this group of drugs. They are followed by beta-adrenergic receptor blockers, which accounted for 6.2 %, and antacids with 5.9 % and ACE-combination inhibitors with 5.2 %. [49]

3.3.2. Leading companies in the industry

The leading company in the pharmaceutical industry in Croatia in terms of total revenue generated in 2019 is Pliva d.o.o. The total revenue of this company accounts for 66 %of the total revenue of the ten leading companies in the sector. Among the top three manufacturers of pharmaceutical products and preparations in Croatia are Belupo d.d. and JGL d.d. Their total revenues were significantly lower than the revenues generated by Pliva. The three leading pharmaceutical companies generated a total of 84 %of total revenues at the level of the top ten, which, in addition to the three companies listed, also

[49] Ibid.

includes Hospira Zagreb d.o.o., Genera d.d., PharmaS d.o.o., Krka-Farma d.o.o., Fidifarm d.o.o., Apipharma d.o.o. and BioGnost d.o.o.

The analysis of the ten leading pharmaceutical companies in 2019 shows an improvement compared to the results from 2018. Total revenues increased by 15.2 %, while gross profit tripled year-on-year. Ten leading companies employed 3.81 %more employees and achieved an increase in labor productivity of 11 %. Liquidity has also improved at the level of ten leading pharmaceutical companies. The liquidity ratio for the ten leading companies exceeds 2, and therefore companies generally have no problems maintaining current liquidity. The decrease in indebtedness at the level of ten leading companies in the sector is also noticeable. The value of the indebtedness ratio indicates that the ten leading companies in the sector are not over-indebted.

	2018.	2019.	2019./2018.
Total income [in milions of HRK]	6.259,10	7.212,90	115,24
Profit before tax [in milions of HRK]	461,40	1.469,90	318,57
Number of employees	4.704	4.883	103,81
Asset profitability [in %]	1,3	1,5	111,02
Gross margin [%]	7,37	20,38	276,44
Current ratio	1,21	2,09	172,95
Total indebtedness ratio	0,42	0,28	67,19

Table 20. Business indicators of ten leading companies in the pharmaceutical sector in Croatia in 2018 and 2019 (source: Sector Analysis – Pharmaceutical industry)

However, if the business is analyzed individually for the leading companies in the sector, some exceptions can be noticed. Although the revenues of leading companies generally increased year on year, Krka-Farma, Fidifarm and BioGnost generated slightly lower revenues in 2019 than in 2018. The largest decrease in total revenue was recorded by BioGnost, by 12 %compared to 2018. Of those who generated revenues higher than 2018, it is worth mentioning Apipharma whose increase in total revenues was 91 %.

Pliva had the highest labor productivity in 2019. When it comes to the number of employees, it should be noted that nine out of ten leading companies employed more workers or maintained the same level

of employment as in 2018. The only exception is Krka-Farma, where the number of employees decreased by 4.3 %. [50]

	Total income [in milions of HRK]	Index 2019/ 2018.	Indebtedness ratio	Current ratio	Gross margin	Labor productivity
Pliva Hrvatska d.o.o.	4.767,5	117,48	0,24	1,7	24,63	2,1
Belupo d.d.	724,0	103,91	0,28	3,0	12,22	0,6
JGL d.d.	575,9	125,66	0,45	2,7	13,32	1,1
Hospira Zagreb d.o.o.	361,2	101,53	0,15	3,2	12,28	1,0
Genera d.d.	239,6	120,97	0,57	2,7	9,58	1,0
PharmaS d.o.o.	215,4	133,51	0,68	1,5	6,08	2,4
Krka-Farma d.o.o.	164,6	94,01	0,05	6,8	4,03	0,9
Fidifarm d.o.o.	98,7	97,48	0,22	3,3	29,09	1,8
Apipharma d.o.o.	33,5	190,96	0,59	1,6	39,87	1,0
BioGnost d.o.o.	32,6	88,18	0,42	1,7	4,45	0,8

Table 21: Business indicators of ten leading pharmaceutical manufacturers in Croatia in 2019 (source: Sector Analysis – Pharmaceutical industry)

The current liquidity ratio indicates that all ten companies have a satisfactory ability to meet short-term liabilities. Namely, the value of the current liquidity ratio in none of the ten leading companies is below the limit of 1.5, which is considered the minimum acceptable, and most of them have a current liquidity ratio higher than 2. Among companies at the limit of acceptable liquidity is PharmaS. Other pharmaceutical companies whose current liquidity level is below 2 are Pliva, Apipharma and BioGnost.

In terms of indebtedness, most companies in the pharmaceutical sector are renewable energy well. Genera, PharmaS and Apipharma are slightly more indebted, as well as JGL, whose value of the indebtedness coefficient is on the verge of acceptable. Thanks to the increase in total revenues and a large increase in gross profit, the gross margin of the ten leading companies in the sector also increased. Apipharma, Fidifarm and Pliva had the largest gross margins in 2019.[51]

[50] Ibid.

[51] Ibid.

3.3.3. Conclusion and expectations

The first half of 2020 in the pharmaceutical industry, as well as in other industries, was marked by the COVID-19 disease pandemic. The effects will be able to be fully analyzed when annual data become available, but it is already clear that reduced patient access to health services and delays in examinations, diagnostic procedures, and non-emergency procedures to stop the spread of coronavirus have led to reduced global drug consumption. According to a review by Evaluate Pharma, the world's leading manufacturers of pharmaceuticals and preparations have already adjusted their sales projections due to the impact of measures to combat the COVID-19 pandemic. The decrease in expected sales this year is particularly pronounced in companies that produce oncology drugs, which represent the best-selling group of drugs. Drugs from this group are the largest revenue generator for the world's largest pharmaceutical companies, and it is assumed that due to the reduction of diagnostic procedures in the months of locking at the global level, significantly fewer diseases were diagnosed than in regular work. The same goes for chronic diseases and medications that can only be used with a prescription.

The pharmaceutical industry in Croatia generally had good results in 2020. However, it is to be expected that the consequences of the closure and measures to combat coronavirus will leave a mark on the business results of this activity. Already, the results for the first six months, which include the locking period, indicate a certain decrease in the production and export of pharmaceutical products and preparations.[52]

[52] Ibid.

4. REPORT PART 2 – GREEN DEAL

4.1. INTRODUCTION

This chapter will present some of the leading companies from individual sectors according to published sustainable development reports on their web.

Only those companies that have published the sustainable development report and which - according to previously mentioned data – are part of top ten companies in the sector, will be presented here.

It should be clear that all reports are taken from companies 'websites and contain only items that companies can boast about, and a section on the problems they face is missing. Therefore, reports should be read with caution.

4.2. ACHIEVING CLIMATE NEUTRALITY THROUGH JUST TRANSITION FUND

Achieving climate neutrality by 2050 is an ambitious and painful plan for some EU member economies. The transformation should be facilitated by the 17.7 billion euro Just Transition Fund, which has been given the green light by the European Parliament. Part of that money is available specifically to the Istrian and Sisak-Moslavina counties, the only two in Croatia that have the right to use the fund. The two counties cannot be different: one is among the poorest, recently destroyed by earthquakes, the other among the richest, but what they have in common is that they emit the most greenhouse gases.

In Sisak due to the chemical and refinery industry, and in Istria on account of electricity production (from coal in Plomin, which generates 6% of total energy in the country) and the cement industry.

The challenge of decarbonization, reducing greenhouse gas emissions, is especially in the fact that these industries employ many people. According to the European Commission, a transit in the Sisak refinery from crude oil refining to more sustainable alternatives will affect about 7% of the county's population.

The carbon-intensive local industry underscores the scale of the decarbonization challenge that requires a reorientation of long-term investments towards innovative, climate-neutral technologies that will employ the local workforce. The preliminary assessment considers it appropriate that the Fund for a Fair

Transition focus on interventions in these regions, it is pointed out in the investment review of the Fund in the period from 2021 to 2027, which refers to Croatia.

Although more than twice as modest as the first proposal, the Fund, backed by 615 MEPs, will subsidize the green transition of regions currently dependent on coal and fossil fuels and mitigate the negative economic effects of the green transition. These are funds for retraining workers, assistance in finding new employment, transformation of existing facilities in the fossil fuel industry, sustainable mobility, but also the construction of, for example, nursing homes. The range is wide, so the money can support micro companies, business incubators, universities and public research institutions, investments in new energy technologies and energy efficiency.

The transition to green and more sustainable technologies represents an opportunity for the development of the European economy, but also a cost that affects the global competitiveness of domestic entrepreneurs.[53]

The Green Plan Investment Plan envisages the mobilization of at least one trillion euros in ten years through EU and national budgets, public and private investment, measures to facilitate and encourage green investment (private and public), attractive investment conditions and technical assistance for the selection of sustainable projects. In 25 % of all EU funds, it is intended for action in the field of climate, 30 percent of the InvestEU program and the encouragement of green investments with the support of the European Investment Bank.

While Istria has propulsive tourism, Sisak-Moslavina County does not have such a safety network. After the year 2020 earthquake, the future of the area depends on revitalization, and part of the solution could be found in the broad criteria of the Fund for a Fair Transition.

4.3. CHALLENGES IN CROATIAN IMPLEMENTATION OF THE GREEN DEAL

MEASURES FOR THE DEVELOPMENT OF MARKETS FOR CLIMATE-NEUTRAL PRODUCTS OF THE CIRCULAR ECONOMY

Each segment for itself, climate-neutral products and products arising from the circular economy seek **strong incentives by government institutions** to achieve **a change in behavior**, that is, to make them 'business as usual', i.e., mainstream. Behavioral changes are difficult to achieve without additional

[53] Poslovni dnevnik, 20 05 2021 edition, "Preorijentiranost na niskougljičnost već zabrinjava na tisuće radnika"

financial measures, and therefore desirable behavior should be strongly encouraged, i.e., undesirable activities should be punished.

PROMOTION OF THE COMPETITIVENESS OF CLIMATE-NEUTRAL, CIRCULAR ECONOMY SOLUTIONS THROUGH DEMAND-SIDE MEASURES

The development of a market that will use climate-neutral technologies and that will sustainably use solutions from the circular economy primarily in the first phase requires the **provision of co-financing**. **National institutions need programs to help raise awareness of the need to build a sustainable society** by using just such, sustainable solutions.

Also, an emphasis should be put on active promotion of new technologies and investment in education about climate-neutral technologies and solutions coming from the circular economy, in order to encourage the use of new solutions.

ALTERNATIVE OR COMPLEMENTARY OPTIONS FOR CARBON PRICING MECHANISMS TO BE DEVELOPED AT EU LEVEL, TAKING INTO ACCOUNT THEIR IMPACT ON EMISSIONS, MARKETS, AND INVESTMENTS

The price of emission units is continuously rising, which certainly affects the energy sector, the production sector, and the financial sector (due to the availability of funds for new projects). What is missing is related to projects implemented by companies and individuals in the segment of low-carbon technologies or the circular economy, but this is not valued in any way. For example, a private person installs solar panels on a house. This certainly saves electricity, but these savings are not visible, i.e., these savings cannot be certified, converted into securities, and traded. This element is very lacking in the system and could further motivate individuals to make additional investments.

CUSTOMERS AND CONSUMERS TO BE EMPOWERED FOR THE TRANSITION TO CARBON NEUTRALITY

The **new Law on Renewable Energy Sources will enable end consumers to buy green energy directly**, which will have a greater possibility of influencing the behavior of producers and directing them in the implementation of emission reduction measures.

In addition, this law will enable a simpler production procedure at the place of origin (prosumers), which will make it easier for end users to decide on investing in low-carbon technologies, i.e., renewable energy sources.

Finally, it should be noted that the regular implementation of energy efficiency measures in buildings (apartment buildings and family houses) significantly contributes to the positive attitude of end users to the implementation of measures and achieving climate neutrality.

MEASURES FOR THE DEVELOPMENT OF CLIMATE-NEUTRAL SOLUTIONS

Climate-neutral products require strong incentives from state institutions to achieve climate neutrality, and there is a good example in the way the Fund for Environmental Protection and Energy Efficiency is used (*example: energy renovation of family houses is a program of the Government of the Republic of Croatia with the aim of increasing the energy efficiency of family houses and reducing energy consumption and CO2 emissions into the atmosphere*).

New solutions would not be possible without co-financing from programs available to both companies and individuals.

INDUSTRIAL DEMONSTRATORS FOR KEY BREAKTHROUGH TECHNOLOGIES AND THE WAY IT SHOULD BE DONE

Yes, for the development and promotion of new technologies in any case it is good to have a 'demonstration' plant.

In previous years, the Republic of Croatia participated in projects that were of a 'demonstration' nature. Companies from the Republic of Croatia are involved in the development of plants that use alternative forms of energy, using the funds available from the EU program. Therefore, further co-financing of 'demonstration' facilities with funds from EU programs or national programs is greatly welcomed, with the aim of proving climate neutrality of technology and its possible multiplicity.

ESTABLISHMENT OF LARGER R&D&I PROGRAMS TO BRING SOLUTIONS CLOSER TO THE MARKET AND ACHIEVE BETTER INTEGRATION WITH NATIONAL PROGRAMS

By better **connecting the R&D&I community with industry and** the **real sector**, **more can be achieved and the processes of placing new products on the market can be accelerated**. It is necessary to involve the real sector in the R&D&I process at an early stage, so that good solutions will quickly find their way

to the market. Nationally, there are such examples, primarily in the construction sector (e.g., ECO-SANDWICH[54]*), but other sectors also have the potential to take advantage of similar practices.

**Project ECO-SANDWICH (Energy Efficient, Recycled Concrete Sandwich Facade Panel) was supported by 16 relevant institutions in Croatia, including two relevant Ministries (Republic of Croatia, Ministry of Environment and Nature Protection and Republic of Croatia, Ministry of Construction and Physical Planning), city of Koprivnica and city of Samobor, associations of relevant stakeholders, international energy agencies (ABEA, SOFENA), University of Ljubljana, Faculty of Architecture, the Regional Environmental Center in Romania and in Croatia.*

Project funded by the European Commission within the framework of CIP-EIP-Eco-Innovation 2011 Program.

Objectives of the project:

- *Encourage the re-use and recycling of construction and demolition waste (CDW) to shift CDW management from disposal to recycling and reduce utilization of natural resources thus preventing landscape degradation*
- *Promote the substitution of conventional thermal insulation materials by mineral wool produced using innovative and sustainable technology, leading to a reduced environmental impact*
- *Promote implementation of prefabricated, energy efficient products in order to enable reduction of primary energy consumption in residential and commercial buildings*
- *Reduce embodied energy, embodied carbon and production of by-product wastes*
- *Ability to recycle ECO-SANDWICH panel at the end of its life*
- *Modernize the production line making it capable of producing the ECO-SANDWICH® as well as to develop marketing strategy for the introduction of a new, eco-innovative product*
- *Development of a marketing strategy for the introduction of an innovative, environmentally friendly, and sustainable product*
- *Set up a mechanism to exploit across Europe*

[54] ventilated prefabricated wall panel utilising recycled CDW and mineral wool produced using innovative and sustainable Ecose technology for reduction of primary energy consumption in building stock.

ACCESS TO PRIVATE CAPITAL TO BE FACILITATED AT REASONABLE COST

At the moment, intensive work is being done at EU level to implement the Sustainable Financing Action Plan. It ensures that projects that will not have a negative impact on the climate and the environment have priority and that more favorable funds will be available to them. The foundations laid by the Sustainable Financing Action Plan can be the basis on which all privately funded projects are valued in a similar way.

ACCESS TO AND AVAILABILITY OF CLIMATE-NEUTRAL ENERGY AT GLOBALLY COMPETITIVE PRICES

The availability of climate-neutral energy should be a priority for national authorities. Co-financing programs for the use of climate-neutral energy sources have shown that the interest in them is exceptional and that their application significantly contributes to the overall reduction of emissions. Therefore, co-financing programs for the installation of new, more technologically advanced solutions should be the focus of all programs.

ACCESS TO ALTERNATIVE SOURCES OF RAW MATERIALS BY PROMOTING THE USE OF RENEWABLE AND (CARBON-BASED) VALUABLE MATERIALS BEYOND ENERGY PRODUCTION

It is necessary to raise awareness that the raw materials used are very often a non-renewable resource. Therefore, one should think about the way in which it is possible to use one's waste as a raw material.

There is a good example in the energy sector where biowaste can be converted into a useful energy source – gas; OR waste wood that can be used for heat generation purposes.

To help with this, the Croatian Chamber of Commerce has created a platform Waste Exchange that connects companies that have certain waste materials with companies that can use them as raw materials. This helps to conserve resources and build sustainable management systems.

MAPPING OF ENERGY AND NON-ENERGY INFRASTRUCTURE AND SUPPLY

All stakeholders using new, climate-neutral solutions need to be more strongly connected. In order to achieve this, all institutions should be actively involved in this process. This process is challenging primarily due to insufficient capacity of employees in institutions, but by using new technologies, it is possible to achieve the desired. In addition, much can be achieved by forming cross-sectoral groups to help define mapping methods.

CHALLENGES OF THE EU GREEN PLAN IN HR

The European Green Plan is an extremely comprehensive document, and its understanding requires the full commitment of all stakeholders. The implementation of action plans will certainly be a challenge for all institutions in HR. Certainly, the institutions, procedures, speed of project preparation and responsible implementation of the tender will certainly be the biggest challenge. In the above, we should not forget the fact that Croatia faced two devastating earthquakes.

However, Croatia will have at its disposal generous funds from various EU funds and programs, which will certainly facilitate the transformation of the economy from a 'carbon-based' to a 'carbon-neutral'.

THE ISSUE OF SUSTAINABILITY IN HR

Sustainability in the Republic of Croatia has been considered extremely important by the business sector for many years. Institutionally, sustainability is not in the priority activities of any institution, but segments of sustainability policy are divided between various institutions. Encouraging discussions on sustainability is part of the activities of business associations as a large number of companies also operate in the international market. The issue of sustainability will be intensified through activities related to the implementation of the Action Plan for Sustainable Financing.

CO2 REDUCTION - HOW IT WILL WORK IN HR

Reduction of greenhouse gas emissions is defined by Croatian legislation. Activities calling for a further reduction for the manufacturing sector of 55% will only be part of the new legislation and will follow guidelines from the European Union level. **At this point, the manufacturing sector has significantly reduced its emissions, and in the process, a significant number of companies have shut down production.**

Further emission reductions are expected in the transport sector and through the implementation of energy efficiency measures in buildings.

ELECTRICITY PRODUCTION ACCORDING TO THE NEW PLAN

Energy production is well described by the Integrated National Energy and Climate Plan for the Republic of Croatia. This Plan plans the use of all resources for the production of electricity and heat. In addition to the mentioned Plan, the Low Carbon Strategy, which was recently adopted, should certainly be

considered, and the combination of measures from the mentioned documents will define the national energy mix.

JOB SECURITY FOR INDUSTRIAL EMPLOYEES IN HR

It is difficult to predict the safety of employees in the industry sector. Therefore, all institutions should actively work on lifelong learning and enable employees to quickly adapt to new challenges. Flexibility and readiness to acquire new knowledge will help employees to meet the challenges of new jobs prepared and without fear.

NON-FINANCIAL REPORTING IN CROATIA

Directive 2014/95 / EU (NFRD) regulates the **obligation of non-financial reporting at the level of the European Union** in order to improve the consistency and comparability of non-financial information published by companies across the European Union. Directive 2014/95 / EU enacts rules on the publication of non-financial and diversity information **by large companies**, **holding companies (groups) and public interest entities**, which implies an important step forward in the standardization of the reporting and formalizing transparency requirements

In Croatia, 31 companies are currently subject to non-financial reporting, and another 10 compile them voluntarily, according to the Croatian Financial Services Supervisory Agency (Hanfa) from the annual educational meeting of Hanfa and companies listed on the Zagreb Stock Exchange on non-financial reporting focused on sustainable development.

According to EU regulations, all issuers that are obliged to compile non-financial reports will have to start publishing for the first two environmental goals from 2022 - climate change mitigation, i.e., adaptation to climate change, while from 2023 they will be obliged to publish data for a total of six environmental objectives (sustainable use and protection of water and marine resources, the circular economy, pollution prevention and a healthy ecosystem). As some companies are foreign owned, no sustainable development reports are available for them nationally, only globally.

PROBLEM OF PLASTIC BAGS AS AN EXAMPLE OF ISSUES FACING CROATIAN COMPANIES AND CONSUMERS

The Waste Directive is being transposed into Croatian legislation together with several other EU directives through the new Waste Management Act. Their draft proposal is currently in public

eConsultation. It is important for the producers of plastic bags that the new Law on Waste Management encourages the circular economy and recycling, as well as the establishment of an extended producer responsibility program. This Directive and the Law introduce targets for the recycling of municipal waste by at least 55% of the mass of municipal waste by 2025, which will increase to 60% by 2030 and 65% by 2035. Namely, plastic bag manufacturers are aware of environmental problems and are ready to change their business in line with the circular economy and use recycling in the production of new bags.

Plastic bags have become synonymous with environmental pollution, although they do not essentially pollute it, but harm it. Namely, plastic bags are made of low- or high-density polyethylene, which is extremely suitable for recycling. Therefore, a circular economy in this activity is possible, but if plastic waste is sorted by type of polymer to allow its reuse. Plastic bags, like all other waste, have no place in the environment, but should be reused through the waste management system. A good example are the drinking bottles in the refund system which are now hard to find in nature.

The draft proposal of the Waste Management Act in Article 16, paragraph 3 provides for a ban on the placing on the market of lightweight plastic bags. The Croatian Chamber of Commerce has offered the Ministry of Economy and Sustainable Development a model that would ban lightweight plastic bags that do not contain a certain share of recyclables. Negotiations are ongoing.

4.4. ENERGY INDUSTRY

Leading companies in the industry are HEP d.d., Prvo Plinarsko društvo d.o.o., HEP-Proizvodnja d.o.o., HEP-Operator distribucijskog sustava d.o.o., HEP Elektra d.o.o., HOPS d.o.o., GEN-I Hrvatska d.o.o., E.ON Energija d.o.o., HEP-Toplinarstvo d.o.o. and HEP-Opskrba d.o.o.

In this chapter two companies will be introduced.

- HEP Group with its daughter companies
- HOPS (Croatian transmission system operator)

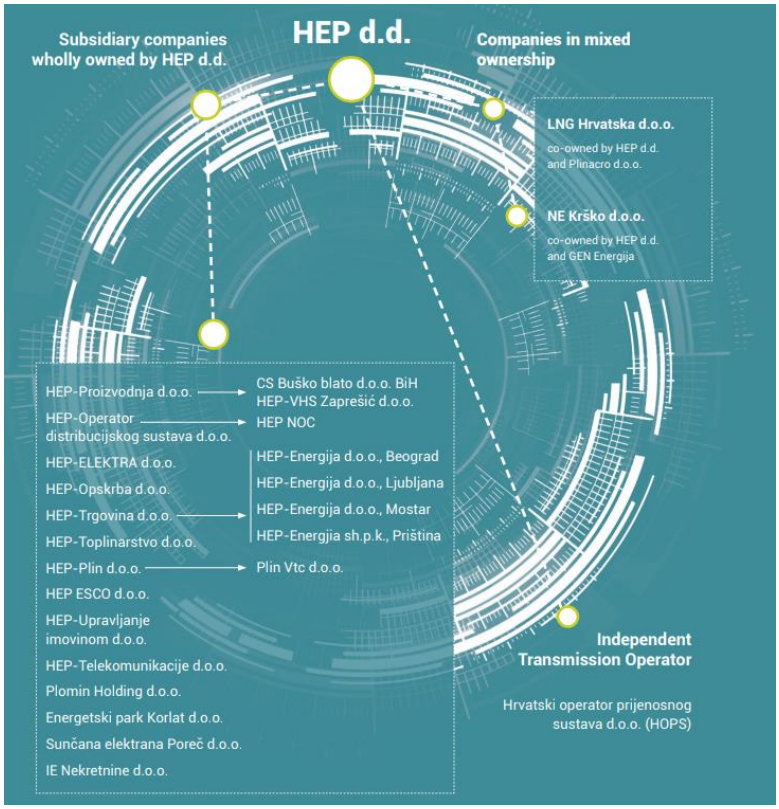
4.4.1. HEP Group

HEP d.d. (Hrvatska Elektroprivreda d.d., with a seat in Zagreb) is a fully state-owned parent company of HEP Group.

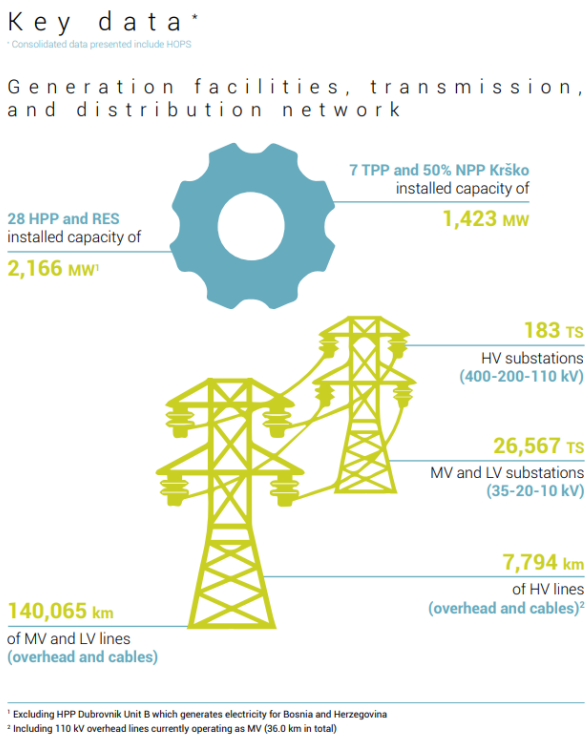
It manages HEP daughter companies and is the owner of assets which are contractually transferred to subsidiaries or daughter companies. The major business segments of HEP Group are generation, transmission, distribution, supply, and trade of electricity. Additionally, HEP Group generates, distributes, and supplies heat, supplies gas in retail and wholesale markets and provides services in energy system and other energy and non-energy sectors.

Croatian transmission system operator (HOPS) has been unbundled from HEP Group, according to ITO model (Independent Transmission Operator).[55]

[55] Annual and Sustainability Report HEP Group; https://www.hep.hr/UserDocsImages//dokumenti/Izvjesce%20o%20odrzivosti//HEP_2019_Annual_Sustainability.pdf



Picture 1: HEP Group (source: Annual and Sustainability Report HEP Group)



Picture 2: Key data HEP Group (source: Annual and Sustainability Report HEP Group)

In late November 2019, Standard & Poor's upgraded the stand-alone credit profile of HEP from bb to bb+ and affirmed the company's baseline rating (BB+) stating that HEP had improved its hydrology and fuel price volatility exposure management. Moody's affirmed HEP's long-term credit rating (Ba2) in 2019 and boosted the outlook from stable to positive. In late 2019, the European Commission adopted the Green Deal for making Europe the first climate neutral continent until 2050. **HEP Group as one of the biggest energy companies in South East Europe sees its opportunity for strengthening its energy sector position based on a green, sustainable, advanced and climate neutral economy**. In its development strategy for the period until 2030, HEP Group has already opted for a sustainable development scenario complementary to the European Green Deal.

As part of ITS renewable scenario, their first acquisition carried out in 2019 was a purchase of an operating solar plant. Solar plant Kaštelir in Istria is the first large non-integrated solar power plant in their system. They also commenced the erection of HEP's first windfarm, VE Korlat (58 MW), which is the first new wind power plant in Croatia to produce electricity without a contract with HROTE (Croatian Energy Market Operator) on guaranteed takeoff at an incentivized price. The solar power plant on the island of Vis was also undergoing construction in 2019. Development of several other solar power plant projects was launched or continued, some in cooperation with local self-government units.

Projects of large conventional power plants were also developed in 2019. At the end of the year, main works on the construction of the **high efficiency combined-cycle** unit in EL-TO Zagreb CCPP (150 MWe, 114 MWt) commenced.

Also, a development project of upgrading the existing Senj **hydropower system by increasing its capacity** by more than 400 MW also continued by preparing project documentation and obtaining permits.

Such many generation-related projects were made possible by a very clear stance of the Croatian Government towards Croatia's transition to the low-carbon energy, and the creation of conditions for investments in renewable energy sector and energy in general. [56]

[56] Ibid.

In addition to business activities aimed at increasing capacities and production from low carbon energy sources, the **implementation of measures and the preparation of energy efficiency increase projects was intensified under the renewable scenario**.

In late 2019, the EU Grant Agreement was signed for the project of **replacing the connection hot-water pipeline** in Osijek, while the **European Commission approved the grant of EUR 57 million for the Zagreb hot-water network revitalization project**. Business activities within Croatia's transition to the low-carbon economy include an accelerated continuation of the eMobility program implementation resulting in the installation of 64 public charging stations adding to a total in - stalled number of 117 EV charging stations from the project started until end 2019.

Among other business activities, gas business is becoming more prominent. Pursuant to the decision passed by the Croatian Government in February 2019, HEP d.d. recapitalized LNG Hrvatska d.o.o. responsible for the construction of the liquefied natural gas terminal, which commenced in April 2019. As a new gas supply route, the LNG terminal will increase the security of supply for HEP and Croatia as a whole.

HEP d.d. continued to operate as a wholesale gas supplier in 2019, the obligation which will expire on 31 March 2021 pursuant to the Regulator's decision (HERA). A significant step forward in gas business development was made by the acquisition of Plin Vtc from Virovitica, a gas distribution and supply company. [57]

4.4.1.1. Stability and security of generation and distribution of energy

The development and investment activities of HEP Group are aimed at maintaining the values and functions of the existing energy infrastructure system and ensuring the long-term stable development of HEP Group's activities.

Investments in renewable energy sources, primarily through the development of projects in wind and solar power technologies, are one of the focuses of a long-term HEP's goal based on the concept of sustainable development.

[57] Ibid.

The basic goal of the investment is the construction of new production facilities, revitalization of existing facilities, replacement, and renewal of obsolete equipment, which increases production and power of production units and increases efficiency to ensure reliability and availability of energy facilities and harmonization of technological development in line with economic development of Croatia. Replacing plants, equipment and de - vices at the end of their life and increasing the efficiency of existing plants and equipment optimizes the production process and reduces the risks of long-term downtime and the occurrence of major and serious malfunctions, thus preventing production losses.

4.4.1.2. Modernization and overhaul of power plants

In 2019, the cycle of **reconstruction and revitalization of hydropower plants continued**. These interventions replace obsolete equipment with new ones at the level of the latest technological and technical solutions, and the improvement of the technological process and modernization of equipment is achieved, often with the introduction of process automation and remote control. The primary goals of revitalization are to increase the availability of power plants for the needs of the power system, to extend the life of hydropower plants and to reduce the costs of maintenance and operation of plants.

Although the primary goal of hydropower revitalization is not to increase power and production, it is, according to previous study research, achieved where possible. In total, because of the investment cycle in the reconstruction, upgrade, and revitalization of existing hydropower plants, HEP expects to generate an additional 160 megawatts of new power. The expected increase in annual production is about 380 million kilowatt hours. The revitalization cycle began in 2012 and by the end of 2019, around HRK 1.4 billion had been invested. By 2030, HEP plans to invest another HRK 2.2 billion.[58]

4.4.1.3. Distribution network development

Continuous improvements in electricity distribution are ensured by the **construction, reconstruction and revitalization of several significant transformer stations and other distribution system facilities**. Key activities in the business area of distribution network development are related to the successful implementation of the investment plan.

[58] Ibid.

In 2019, eight capital investments in connection points and main medium voltage (MV) lines were completed. The total value of completed investments amounts to more than HRK 62.6 million (of which more than HRK 17.6 million was invested in 2019). It should be emphasized that during 2019 in the area of Elektra Sisak the final works on the transition of 10 kV network to 20 kV voltage were intensified, making Elektra Sisak the first electricity distribution area to fully complete the transition from 10 kV to 20 kV operating voltage.

In 2019, HEP ODS continued to invest in the electricity distribution network on the coast and on the islands, planned in the amount of about HRK 800 million for the period 2018-2021. These investments will directly contribute to the further success of Croatian tourism and the creation of better living, working, and staying conditions on the islands, in accordance with the strategic plans of the Government of the Republic of Croatia aimed at creating conditions for sustainable development of Croatian islands.

4.4.1.4. Introduction in advanced networks

Investments in metering devices and infrastructure through the rehabilitation and reconstruction of metering points and connections are especially important in the distribution system. This directly affects the reduction of non-technical losses. As the use of innovations and progress of the digital transition is one of the material issues of the HEP Group, pilot projects are especially important to test various technological solutions that can contribute to the modernization of the distribution system, increase energy efficiency and reliability of electricity supply and development of advanced networks.

The pilot project for the introduction of advanced networks is partly financed by grants provided from EU funds in the amount of HRK 149.95 million. The purpose of the project is the computerization of part of the electricity distribution network. The pilot project is taking place in five distribution areas (Zagreb, Osijek, Split, Zadar and Dubrovnik) and will be implemented until 2022. The remaining HRK 26.86 million for the implementation of the project is provided by HEP ODS. In addition, HEP ODS will invest an additional HRK 52 million, so the total investment in advanced networks will amount to almost HRK 230 million. This project will establish an advanced metering infrastructure, which will enable more accurate calculation of losses and locating areas with increased network losses, monitoring electricity

consumption and its active management at the end user level where 24 thousand existing meters will be replaced by advanced ones. [59]

Summary meters will be installed in 6,125 transformer stations, and the existing 449 transformers will be replaced with new, more energy efficient ones. SINCRO.GRID is one of three projects in the field of advanced networks (Smart Grid) which will use advanced forecasting tools to effectively integrate the activities of all network users to achieve maximum efficiency of the transmission and distribution network. The purpose of the project is to use advanced technical systems and algorithms to manage power flows to improve the quality of voltage in the power system which will result in increased transmission capacity of existing lines, thus ensuring better integration of renewable energy sources into the power system and increase security of network users.

In 2019, work was done on the communication connection of distribution dispatch centers with the HOPS platform for the exchange of data required for calculations in the virtual control center that will manage the reactive power compensation devices in the HOPS network.

3Smart project

In December 2019, the project "Smart building - Smart grid - Smart city" (3Smart) was completed, which is co-financed from the Interreg Danube program. The project brought together 18 partners from six countries in the Danube region, including HEP ODS, HEP ESCO and HEP d.d. The total value of the project is EUR 3.8 million, of which HEP's share is around EUR 444,500. Co-financing of 85 percent of the project costs with EU funds has been approved. The main goal of the project is to prepare a technological and regulatory basis for cross-energy management among buildings, distribution network and urban infrastructures in the Danube region.

Revitalization of heating network

Planned revitalization of the heating network reduces the number of emergency interventions in the heating network, losses in heat transfer and maintenance costs of the network, prevents failures and increases the operational safety of heating systems and reliability of end customers' heat supply.

[59] Ibid.

4.4.1.5. Waste management in HEP Group

In 2019, HEP Group produced a total of 3,105.98 tons of hazardous waste and 81,001.11 tons of non-hazardous waste. The increase in the amount of hazardous waste of 1,650.49 compared to the previous year is a consequence of the cleaning of fuel oil tanks in thermal power plants.

The increase in the amount of non-hazardous waste by 9,306.32 tons refers mainly to non-hazardous construction waste generated because of overhaul, revitalization and rehabilitation of HEP's plants and due to ash generated in bioenergy plants which use untreated wood chips as fuel.

Waste generated in the HEP Group is separated at the place of origin according to the type and properties of waste and, where possible, is managed in accordance with the order of priority of waste management. All waste generated in the HEP Group is handed over, in accordance with legal regulations, to companies that have a waste management permit or are entered in the appropriate register. After handing over the waste to an authorized waste management company, in accordance with legal regulations, the responsibility for the waste producer ceases, and the responsibility passes to the authorized company. Depending on the type of waste and the existing waste management system in Croatia, waste is handed over for further recovery and disposal.

Since Croatia does not have a hazardous waste landfill, and energy reuse capacities are limited and it is thermally possible to recover only some types of waste that are not generated in HEP Group's business processes, authorized waste management companies export hazardous waste. Until the arrival of authorized waste management companies, waste is temporarily stored, for a maximum of one year, in warehouses that are regulated in accordance with the provisions of the Ordinance on waste management.

HEP's only landfill is located on the site of Plomin thermal power plants where only its own non-hazardous production waste is disposed of and only when companies in the surroundings that have a waste recovery permit cannot, in accordance with market requirements take over part of the non-hazardous waste.

During 2019, a total of 8,405.30 tons of non-hazardous waste was disposed of at the landfill in Plomin, which is 11.28 percent of non-hazardous waste produced in Plomin. [60]

Waste management from Krško Nuclear Power Plant (NEK)

Hrvatska Elektroprivreda takes over 50 percent of the annual electricity produced in the Krško Nuclear Power Plant. This makes it re - sponsible for half of the waste produced at this nuclear power plant. During 2019, a total of 287 packages of LILW (low and intermediate lev - el radioactive waste) with a volume of 60.9 m 3 and a net weight of 24,860.3 kg were stored in the Krško NPP, i.e. 1.0971x10-8 m 3 /kWh(el) or 4,493 µg/kWh(el). In 2019. 56 fuel elements of spent fuel were replaced (it is considered high-lev - el radioactive waste (HLW)), i.e. 22,538.84 kg U, or 4.11x10 µgU/kWh(el).

Circular economy - the use of ash in the construction industry

In cooperation with the Faculty of Civil Engineering, University of Zagreb and CKTL (Central Chemical Technology Laboratory), HEP made an analysis of the **possibilities of using wood biomass ash in the construction industry** and thus reduced the amount of waste disposed of in landfills and contributed to meeting the goals of the circular economy. The results of the research showed that wood biomass ash generated in two of HEP's bioenergy plants can be used in the construction industry to produce overpass heads and park curbs. Within the project potential companies were identified that could use ash in their production process after drying as a substitute for minerals and reduce the cost of production.

At the end of November 2019, the European Commission approved funds for the project of replacing sections of hot water highways and distribution networks for 18 settlements in Zagreb. The purpose of this project is to replace 68.5 km of hot water mains and hot water distribution networks in the Zagreb area to achieve the goal of increasing system efficiency.

The total value of the project is HRK 556.13 million, of which HRK 421.50 million are grants from the Operational Program Competitiveness and Cohesion for the financial period 2014-2020, while the remaining HRK 134.63 million is provided by HEP.

[60] Ibid.

In December 2019, HEP Toplinarstvo signed an Agreement for support from EU funds for the project "**Replacement of the connecting hot water pipeline from TPP-HP Osijek to the heating plant Osijek**". The project includes the replacement of the connecting hot water pipeline that is laid between the heating plant and the thermal power plant-heating plant Osijek, about 4.5 km long. The project will ensure further development of hot water consumption, expansion of the hot water network and possible further increase of the efficiency of the central heating system by lowering the temperature regime.

Participation in the KeepWarm Project

During 2019, HEP Toplinarstvo participated in the Keep - Warm project to increase the efficiency of central heating systems (CHS) in Central and Eastern Europe. **The KeepWarm project is funded by the EU and aims to accelerate a cost-effective investment in modernizing district heating systems**, modernizing CHS across the region and reducing greenhouse gas emissions by improving system performance and promoting the transition from fossil fuels to less polluting sources such as renewables. The project brings together eleven project partners from various relevant sectors (energy agencies, national CHS associations, agricultural chambers, research institutes, consulting houses, non-profit organizations) in Central and Eastern Europe. Project partners seek to ensure that best environmentally friendly heating and cooling practices are implemented across Europe, replicating the KeepWarm project approach in other countries and regions.

4.4.1.6. A step forward on the gas market

In 2019, investments were made in facilities and equipment that needed to be replaced or renewed to **increase the reliability of network operation and investments in the preparation and construction of new gas pipelines** in all local governments where HEP Plin distributes gas and where there is a need to expand the network.

The dynamics of realization is conditioned by the obligations from the concession contracts, for the construction of which it is estimated that there is economic justification.

Based on the decision of the Government of the Republic of Croatia in February 2019, HEP increased equity of the company LNG Hrvatska d.o.o. in charge of building a liquefied natural gas terminal, which also began in April. As a new gas supply route, the LNG terminal will increase security of supply for HEP and the whole of Croatia. [61]

4.4.1.7. Sustainable construction and development of energy system

In accordance with the set strategic goals, **HEP intends to increase the share of renewable energy sources from 35 to 50 percent by 2030**. During 2019, most of the investments in the total value of HRK 3.4 billion were focused on the renovation and modernization of production facilities and power system facilities, as well as the construction of new production power facilities.

[61] Ibid.

4.4.1.8. HEP's projects for the construction of renewable sources of energy and high-efficiency cogeneration

In 2019, HEP Group increased the dynamics of the development of renewable energy sources and high-efficiency cogeneration. These are some of the investments:

SPP Kaštelir

In 2019, HEP acquired the company that operated the 1 MW Kaštelir solar power plant. It is the first non-integrated solar power plant in HEP's portfolio.

SPP Cres (Orlec Trinket East)

In 2018, HEP took over the project for the construction of the Cres Solar Power Plant, which had been developed by the Primorje-Gorski Kotar County until then, and in 2019 concluded a contract for the construction of the power plant. This project has multiple positive impacts on the local community and the domestic economy, through financial contributions after the construction of the power plant, but also during the construction itself, because it will involve 60 percent of domestic companies. It will produce electricity without incentives.

SPP Vis

In September 2019, the construction of the Vis solar power plant began, with a connection capacity of 3.5 MW. The expected annual production is about 5 million kWh of electricity, which can meet the needs of about 1,600 households. It will also produce electricity without incentives. The value of the investment is HRK 31.3 million.

SPP Vrlika Jug

The Vrlika Jug solar power plant represents the realization of the first phase of the planned construction in the southern part of the Kosora Work Zone in the town of Vrlika. SPP Vrlika Jug will also produce electricity without incentives.

WPP Korlat

In May 2019, the construction of WPP Korlat began, which will be the first wind farm in HEP's portfolio.

WPP Korlat is located on the eponymous location, eight kilometers north - west of Benkovac. It will be the first new wind farm in Croatia to produce electricity without a guaranteed purchase at an incentive price. The profitability of the investment was determined according to the market prices of electricity.

Solar power plants on the roofs of HEP's office buildings

In accordance with the National Renewable Energy Action Plan, which stimulates the construction of small solar power plants, in 2018, in addition to the construction of large solar power plants with a total planned capacity of 350 MW (by 2030), HEP initiated the construction of 10 to 50 kW solar power plants on roofs own business and production buildings that will use electricity at the place of production. During 2019, HEP financed, and HEP's energy efficiency company HEP ESCO carried out the construction of 22 so - lar power plants to cover its own electricity consumption with a total power of 645 kW. Any surpluses will be delivered over to the network under market conditions.

Block L in PP-TP Zagreb

For this investment worth HRK 900 million, HEP signed in July 2018 a Contract on construction and procurement and installation of equipment and a long-term maintenance agreement with FATA SpA (a member of the Danieli Group) from Italy, and a loan agreement with the European Bank for Reconstruction and Development (EBRD) and the Loan Agreement with the European Investment Bank (EIB). The new 150 MWe and 114 MWt plant will use natural gas and replace two production units at the existing location to ensure long-term heat supply to more than 80,000 residents of western and northern Zagreb and steam to industrial consumers.

The realization of this project is in the function of harmonizing the work of production units with the Directive on Industrial Emissions and meeting the emission limit values prescribed by the environmental permit. At the same time, natural gas, although a fossil fuel, is an acceptable transitional energy source which, due to its lower environmental effects than other fossil fuels, is an important energy source in the long-term transition to a low-carbon economy.

HES Kosinj / HPP Senj 2

In 2019, Hrvatska Elektroprivreda continued to develop the hydropower system (HES) Kosinj and HPP Senj 2, with a capacity of 412 MW and a total investment value of EUR 460 million. These projects represent the second phase of the construction of HES Senj, a system built in the first phase, by which it is intended to use the remaining hydro potential in the Lika and Gacka river basins. [62]

[62] Ibid.

4.4.2. HOPS - Croatian transmission system operator

Croatian transmission system operator (HOPS) has been unbundled from HEP Group, according to ITO model (Independent Transmission Operator).

HOPS reaffirmed its commitment to environmental and nature protection and energy efficiency through intensive activities on the realization of goals and improvement of the environmental management system, as well as the management system energy, which in 2019 resulted in a successful recertification audit of the system according to ISO14001: 2015 and other supervisory system audit according to ISO 50001: 2011.

The European electricity system and the attitudes of EU member states are undergoing a number of significant changes, in which one of the key roles is played by transmission system operators, 42 of them from 35 countries gathered in ENTSO-E, including HOPS, which is also one of the co-founders of the association.[63]

4.4.2.1. Assessment of key impacts and challenges in front of HOPS

Dynamics and rapid change impose a new modern design of the EU electricity market that will enable greater flexibility, market orientation and mechanisms for integrating a larger share of renewable energy sources and better cross-border cooperation.

To this end, the European Commission has adopted a series of regulations aimed at strengthening the security through better integration of renewable energy and strengthening cross-border cooperation.

Transmission system operators operating within the framework ENTSO-E, and thus HOPS, play a significant role in the implementation of this package. In the next medium-term period, significant improvements related to the consolidation and optimization of processes will be expected from transmission system operators.

New EU grid rules for electricity have been announced, which should result in increased security of supply, integration of renewable energy sources and further market development electricity in the EU.[64]

[63] HOPS "Izvještaj o održivosti - 2019" https://www.hops.hr/page-file/I7GMLy24kI7NcLOa05J6A5/godisnji-izvjestaji/Izvje%C5%A1taj%20o%20odr%C5%BEivosti%202019.pdf

New interconnection connections

During 2019, the activities were completed on the preparation of a Feasibility Study (with environmental and social impact assessment) for the project "Strengthening the main Croatian north-south transmission axis while enabling the development of new interconnections", which along the lines in Croatia, it also includes a new cross-border transmission line 400 kV Banja Luka - Lika. This study was funded by the European Bank for Reconstruction and Development (EBRD) with which HOPS in March 2018 signed the Financing Agreement. To complete the Feasibility Study, it enabled the initiation of the next phase in the implementation of the projects that are needed for further integration of renewable energy sources in the south of Croatia.

Revitalization and modernization of the transmission network

HOPS is responsible for the development and construction of the transmission network in the Republic of Croatia and cross-border transmission lines to other networks and for ensuring long-term capacity networks to meet reasonable requirements for transfer of electricity. In accordance with the legal obligation, HOPS has adopted a ten-year plan for the development of the transmission network on an annual basis, based on existing and projected production and system load. After consulting with all interested parties, the ten-year transmission network development plan from year 2020 to 2029. This plan is in line with the current Ten-Year Network Development Plan (TYNDP) of the association. ENTSO-E, which represents a unified European infrastructure development plan, and the environment related for connections to the transmission network.

Submarine cable replacement

Replacement of submarine cables will take place are two phases in the next five years. In the frame first phases in the short term until year 2022, activities are planned on cable replacement on sections Crikvenica-Krk and Dugi Rat-Postira (Brač), while activities on sections of other submarine cables (Hvar-Brač, Krk - Cres- Lošinj and Hvar-Korčula) are planned until 2025. [65]

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[64] Ibid.

[65] Ibid.

4.4.2.2. Environmental influence

HOPS is obliged to ensure quality and reliable supply, with continuous reduction of environmental impact and mitigation of climate change. Recognizing the importance and role of human and organizational capabilities in reducing environmental impact and climate change mitigation, HOPS continuously invests in the education of employees and business partners on these topics.

In the period until 2025, HOPS plans to realize the following most important goals related to certain provisions of these directives:

- Promote and implement the use of renewable energy sources (e.g. photovoltaic panels) on their office buildings and in transformer stations. Harmful and greenhouse emissions are not emitted by the production of electricity from renewable sources gases into the air and reduces dependence on electricity grid energy that can be produced from fossil fuels.
- Plan the procurement of electric and / or hybrid vehicles (zero or reduced air emissions), due to energy efficiency and favorable impact on the climate,
- In HOPS business buildings, enable charging of electric cars and other electric vehicles and provide special parking spaces for electric cars and vehicles,
- Implement automation of office buildings and electronic monitoring of technical building systems HOPS, especially heating and cooling systems.

4.4.2.3. Waste

HOPS produced a total of 532.74 tons of hazardous waste and 353.09 tons of non-hazardous waste in 2019. years. Waste generated at HOPS sites is handed over to authorized waste management companies that have a waste management permit or are registered in one of the registers in competent Ministry of Environmental Protection and Energy. Before handing over to authorized companies the waste is on appropriately separates at the site of origin and disposes of in temporary waste storage facilities (PSO) at ten locations throughout Croatia (PSO Đakovo, PSO Ernestinovo, PSO Slavonski Brod, PSO Žerja vinec, PSO Mraclin, PSO Melina, PSO Pehlin, PSO Konjsko, PSO Bilice and PSO Vozni park). HOPS reports once a year on the quantities and types of waste it produces to the Croatian Environment and Nature Agency through the Pollution Register.

4.4.2.4. Emission

Given that HOPS is registered in the "Register of legal and natural persons-craftsmen engaged in the activity of import / export and placing on the market of controlled substances or fluorinated greenhouse gases, servicing, renewal and use of these substances" continued to successfully service and maintain equipment containing greenhouse gas sulfur hexafluoride SF.

4.4.2.5. Energy and energy efficiency

HOPS recognized energy efficiency as one of the ways to achieve the goals of sustainable development, considering that it contributes to the reduction of emissions greenhouse gases into the environment and thus has a positive impact on climate change mitigation. The application of energy efficiency measures is important in increasing security of energy supply and is the backbone of a single EU energy policy. The goal is to reduce the overall energy consumption by 20% by 2020 in relation to the basic projection, i.e., for the least 32.5% by 203028. During 2019, intensive activities were carried out to achieve the goals and improving the energy management system which is resulted in the successful implementation of other supervisory system audit according to ISO 50001: 2011. Time HOPS reaffirmed its commitment to systemic concern for energy efficiency.

Given that improving energy efficiency can make a significant contribution to reducing greenhouse gas emissions, HOPS decided to renovate the existing, i.e., construct new buildings for their own needs. The activities on the construction and reconstruction of the HOPS office buildings stand out significantly improved the quality of workspace, with the application of high energy standards efficiency. HOPS is during 2019 in compared to 2018 saved 7.07% heat energy, and compared to 2017, this percentage is significantly higher and amounts to 31.09%.[66]

4.4.2.6. Impact on biodiversity

Of particular importance to HOPS is completion preparation of the Environmental and Social Impact Assessment for the purpose of strengthening the main energy axis north - south of the Croatian

[66] Ibid.

transmission system and establishment new interconnections Croatia - Bosnia and Herzegovina (OHL 400 kV Lika - Banja Luka) in March 2019. The study was funded by the European Bank for Reconstruction and Development and developed in accordance with the highest European standards how to ensure optimal protection of the environment and nature. The study places special emphasis on:

- protection of plants and animals
- protection of soil, water, and air quality
- possible impact on climate change
- impact on society, health, and employment
- impact on cultural and historical heritage, etc.

4.4.2.7. Impact on users

HOPS also took care during 2019 on protection against electromagnetic fields from the point of view of occupational exposure, increased sensitivity and regarding public areas, and in accordance with provisions of the Law which must be met by workers performing work with non-ionizing radiation sources.[67]

[67] Ibid.

4.5. CHEMICAL INDUSTRY

The chemical sector includes the production of chemicals and chemical products, then, the production of rubber and plastic products, as well as the production of basic pharmaceutical products and preparations. Given the large number of activities under the umbrella of the same sector, there are also significant differences within the chemical industry. Thus, for example, unlike the production of chemicals and chemical products, the production of plastic and rubber products has been recording positive perennial growth rates for five years in a row, which has encouraged further growth in employment and average wages. The production of rubber and plastic products is also marked by a significantly higher growth in the volume of international trade than the production of chemicals and chemical products.

The chemical industry is facing similar challenges as other industries: high import dependence on raw materials, uncertainties related to fuel stocks, high energy and logistics costs, insufficient investment, and product innovation, as well as insufficient cooperation between industry and science.

Non-competitiveness is as the biggest obstacle in business due to high energy costs, high taxes and parafiscal charges, as well as excessive regulation of the sector that prescribes high environmental and health standards in production processes.

4.6. Petrokemija

Petrokemija d.d. with its core activities production of mineral fertilizers, soot and products based on bentonite clays has a significant impact on environment. The main aspects of the environment are emissions pollutants into the air and water and handling waste. [68]

After the restructuring and stabilization of production, Petrokemija Kutina is facing large investments in the green transition. By 2027, it intends to reduce carbon dioxide emissions by 25 percent - from the

[68] Petrokemija d.d. (2021). Godišnje izvješće Petrokemije d.d. za 2020. godinu (nekonsolidirano, nerevidirano): https://petrokemija.hr/Portals/0/Dokumenti_Kompanija/Financije/IzvjescePetrokemija2020G. pdf?ver=2021-02-24-111702-577

current 1.2 million tons per year to 900 thousand tons. In addition, at least 10 percent of ammonia would come from renewable sources.

Petrokemija also intends to become one of the five most energy efficient producers of mineral fertilizers in Europe.

4.6.1. Emissions of air pollutants

In the total air emission from the Petrokemija d.d. the most common are greenhouse gases: carbon dioxide (CO2) and nitrous oxide (N2O) with a total share of about 99%.

As for the emission of other characteristic pollution from technological processes of Petrokemija d.d. the most common were ammonia (NH3) and nitrogen oxides (NO2).

Total annual emission of pollutants in tons in year 2019 was 34.7% lower than the previous year. Individually, per tons of pollutants (also for year 2019), smaller amounts of NH3, NO2 and dust were emitted, and higher amounts of SO2 and F, while HCl emissions were at the same level compared to the previous year. The total emission factor for pollutants and dust was 40% lower than in the previous year. Viewed by individual pollutants, there was a decrease in emissions per unit of product for NH3, NO2, dust and an increase for SO2 and fluorides.

Regarding compliance with the prescribed emission limit values (ELV) according to the Decision on integrated environmental protection conditions in 2019, emission limit concentrations were exceeded at:

- 5 discharges for NH3 (4 outlets at the plant NPK 1, 1 outlet at MAP / NPK 2 plant),
- 3 dust discharges (1 outlet on the plant NPK 1, 1 outlet at MAP / NPK 2, 1 plant discharge at a clay production plant),
- 1 discharge for NO2 (Ammonia plant 2),
- 1 discharge for SO2 (SUKI plant).

To further improve the situation and reduce the harmful impact on the environment, harmonization with best available techniques (BAT) is carried out by implementing measures to harmonize existing plants with the provisions of legal regulations, which is contained in the Implementation Plan of Directive 2008/1 / EC adopted by the European Commission as well as in the Decision on integrated environmental protection conditions.

4.6.2. Air quality in the area of Kutina

Air quality monitoring is carried out through a measuring station within the state network for continuous air quality monitoring as well as measuring stations in the local network. According to the results of air quality monitoring at four measuring stations of the local network for 4 pollutants, the 1st category of air quality (clean or slightly polluted air) was determined at all stations.

According to unofficial measurement results, on the state measuring station DMP Kutina-1, it was determined the 1st category of air quality for all pollutants, except for PM10 particles for which the 2nd category was determined. Trend of long-term monitoring of concentration the pollutant is falling for all characteristic air pollutions.

4.6.3. Water management

In the period from 2015 to 2018, the trend of the degree of wastewater pollution, expressed through the pollution factor (k1) for current samples, is declining, but no official data for 2019 has yet been received in the moment of writing this report.

Nitrogen concentration in samples at measuring point Kanal Krč is below the limit value, as well concentration of other parameters whose measurement is prescribed by the Decision on integrated conditions of environmental protection.[69]

4.6.4. Waste management

During 2019 in Petrokemija d.d. 32 types of industrial waste were generated (12 types of hazardous and 20 types of non-hazardous waste). The amount of generated waste is 61% lower than in the previous year. All generated waste was temporarily stored at the time of delivery to authorized companies locations in the prescribed manner. 2 types of external hazardous waste were recovered in accordance with the valid permit at the NPK 1 plant. The amount of generated mixed municipal waste is about 11% less than in the previous year.[70]

[69] Ibid.

[70] Ibid.

4.7. Saponia d.d.

4.7.1. Reduction of energy consumption – EU projects

The purpose (goal) of the project "Reduction of energy consumption in a part of Saponia's production plant" is to achieve energy savings through the implementation of energy efficiency measures in the production plant of Saponia dd Project duration: 18 months.

Main elements of the project:

1. Replacement of the machine to produce PET bottles and related equipment,

2. Reconstruction of lighting, V Advertising and visibility, PM Project management and administration.

Results of the main elements of the project:

1. and 2. Achieved savings of delivered energy, ie achieved the same amount of results by using a smaller amount of input energy. The general public is informed about the project and the achieved results. Increased project visibility. Designed visual identity of the project. Printed promotional materials (200 leaflets, 3 information boards, 50 equipment labels), 2 press conferences held. Successfully implemented project activities and procurement procedures in accordance with the Ordinance for non-payers NOJN. Additionally strengthened the capacities of applicants with new experiences in the field of project management.[71]

4.7.1.1. CIRC-PACK

CIRK-PACK (Towards a Circular Economy in the Value Chain of Plastic Packaging) has created, tested and validated alternative biobased and recyclable (including biodegradable or compostable) plastic materials for the production of washers, bottles, coffee capsules, jars, films and pallets, and new types multilayer and multi-material packaging. The recycling rate in the automotive and hygiene products industry has improved, as has the amount of recycled materials in products such as auto parts, sanitary pads and diapers.

[71] Saponia, EU projekti: https://www.saponia.hr/eu-projekti

A consortium of 22 partners led by the Zaragoza-based Energy and Consumption Research Center (CIRCE) conducted three large-scale demonstrations through an eco-innovative approach involving actors across the value chain, including consumers, plastics suppliers, processors and traders, as well as those responsible for waste recovery.

The first demonstration focused on the production of biodegradable and compostable polyesters with improved properties using renewable sources instead of fossil raw materials.

The second has improved the recyclability of multilayer and multi-material packaging, which is known to be difficult to recycle. This has been achieved with smart eco-design that has taken advantage of new materials that make it easier to collect, separate and recycle waste, reducing environmental impact.

The third demonstration improved existing separation and recycling processes through new monitoring systems and technologies, increased the rate of return and ensured quality and reliability.

Awareness-raising activities targeted at consumers and other stakeholders have helped create a supportive regulatory environment and facilitate the acceptance and repeatability of developed solutions as well as new business models.

With this project, Saponia helped to develop bio-based and recycled plastic packaging that has the same properties as the one currently used, and multi-material boxes for powder detergents with barrier properties that are more environmentally friendly than boxes with barrier properties currently used in the detergent industry. With the further development of production capacities, the project partners will introduce the developed products into regular production and put them on the market in the foreseeable future.

4.7.1.2. FUNGUSCHAIN

FUNGUSCHAIN - valorization of mushrooms residues for obtaining high value products - Every year, the European Union produces about 90 million tons of food waste, 38% of which is directly generated by the food production sector. There are significant opportunities to convert these unwanted by-products into high-value products and this is the goal of the FUNGUSCHAIN project - complete valorization of these residues and conversion into bio-based functional additives and polymers, and demonstrating the industrial viability of such residue utilization.

Growing awareness of the impact of chemicals that come into contact with the skin on human health has encouraged consumers to turn to natural cosmetics, and in the same direction is the pressure of legislation on certain functional groups of products such as antioxidants, preservatives, etc. to replace more harmful ingredients with less harmful . Accordingly, market demands for the replacement of chemical antioxidants such as BTH or EDTA with those from nature for use in natural cosmetics are growing. SAPONIA in the FUNGUSCHAIN project tests the applicability of mushroom extracts as antioxidants to prevent oxidation of natural oils and other ingredients in cosmetic products. The secondary effect is a benefit for the skin itself given the positive effects of these extracts such as hydration, antioxidant, anti-inflammatory action, etc. After considering different application methods and market data and requirements, Saponia decided to incorporate samples into creams, milks, oils and soaps because antioxidants are rarely added to toiletries (shampoos, conditioners, liquid soaps) since the products themselves are of such composition that antioxidant no action is required. SAPONIA has tested glucans, proteins, chitosan / chitin and polyphenolic extracts, and the greatest potential so far shows an extract containing a high content of chitosan / chitin.

The project, with a budget of 11 million euros, is co-financed by the Bio Based Industries Joint Undertaking (BBI JU) under the Horizon 2020 research and innovation program of the European Union. BBI JU is a € 3.7 billion public-private partnership between the European Union and a consortium of biotechnology companies. Working under Horizon 2020, it is driven by the vision and agenda of Strategic Innovation and Research Agenda (SIRA) developed by the industry to boost the biotechnology-based economy. The consortium includes 16 partners from 10 different countries: 4 R&D institutes, 4 large industries and 8 SMEs. The project lasts 54 months, and the end is scheduled for April 2021.

4.7.1.3. EMBRACED

Modern absorbent hygiene products (AHP - baby diapers, incontinence products, women's pads) improve the quality of life, provide protection, and can improve the skin health of millions of people. Made of high quality non-woven materials, they contribute to comfort and good hygiene daily. They have become basic everyday products and their use has increased significantly. Like most consumer products, AHP ends up in municipal waste after use. Today AHP represents approx. 3-4% of all municipal waste is considered a non-recyclable fraction, which is usually incinerated or disposed of. Over the last 20 years, AHP manufacturers have made great strides in reducing the environmental impact of AHP, for

example, the average weight of baby diapers has been reduced by about 50%. However, to meet society's needs for sustainable consumption, additional innovations are needed:

Embraced is an EU-funded project involving 13 partners from industry, academia and research institutes within the public-private partnership BBI-JU and Horizon 2020. The goal of the EMBRACED project is to close the circular loop for AHP waste, reduce CO2 emissions and increase sustainability in Europe. To achieve this goal, it is planned to build an integrated bio-refinery in the Netherlands, with a capacity of 10,000 t / year, the first of its kind, based on the valorization of the cellulose fraction of AHP waste into bio-based precursors, polymers, and fertilizers. EMBRACED will work on the valorization of all fractions from the process to get marketable end products fully competitive in terms of cost, quality, and sustainability. It is important that the project follows the principles of the circular economy,

One of the expected fractions precursors are also to produce limonene, and the task of Saponia is to examine the usability of the limonene thus obtained as a substitute for limonene currently available on the market.

4.8. PHARMACEUTICAL INDUSTRY

In this chapter several companies from the pharmaceutical sector will be presented their plans and procedures in the direction of sustainable development.

4.8.1. Pliva Hrvatska d.o.o.

Pliva's largest markets are Croatia, the USA and Russia. They are followed by Poland, Ukraine, Bosnia and Herzegovina, the Czech Republic, the United Kingdom, Kazakhstan, and Hungary, where more than 80% of products are exported.

On October 25, 2006, Pliva was sold to US-based Barr Pharmaceuticals, Inc., which acquired a 92% stake in Pliva. On December 23, 2008, Teva acquired Barr Pharmaceuticals for, so Barr and Pliva (which Barr bought earlier) are part of Teva.

The last published report on sustainable development by Pliva is from 2016/2017. Teva's report refers to the global level, so it will not be presented in this report.

4.8.2. Belupo d.d. (Podravka group)

BELUPO, a pharmaceutical company within the Podravka Group, has three product groups in its product portfolio: prescription drugs, over-the-counter products, and enteral nutrition. The Podravka Group's report on sustainable development is available, but with a cumulative presentation of data from all members of the group. A special report for Belupo d.d. is not available.

4.8.3. JGL d.o.o.

The year 2019 was marked by the implementation of energy efficiency measures, i.e. the implementation of new solutions for better energy efficiency and resources with a focus on savings. JGL thus achieved 69% savings through four realized units within the project "JGL energy efficient society". These include the reconstruction of the roof, the replacement of the cooler, the application of a new hot water preparation system and the construction of a photovoltaic power plant. The contract is worth a

total of HRK 4,020,117.31, and part of it which is provided from the European Regional Development Fund is worth HRK 2,514,426.58.[72]

4.8.3.1. Environmental topics

In 2020, JGL launched the project "E3 - Energy efficiency of the JGL production complex" which was submitted to the tender of the European Regional Development Fund for the implementation of measures to increase energy efficiency and the use of renewable energy sources in manufacturing industries. The aim is to achieve a return on investment of approx. 69%. The planned savings that the company wants to realize relate to the following segments:

- Replacement of the non-sterile production cooler which will achieve energy savings of 32.7%;
- Replacement of lighting in the sterile solutions department, which will achieve 64% savings in electricity consumption.
- Replacement of the non-sterile DHW system bringing an alternative energy source through solar collectors and 66.1% energy savings.
- A centralized system of measuring electricity consumption at the location Svilno 1;
- A non-integrated photovoltaic power plant at Svilno 2.

The latter is also the most important part as the construction of a photovoltaic power station for own use reduces the dependency on the energy supplied from the main power grid. The non-integrated photovoltaic power plant is planned for an annual production of 0.137 MWh of energy. The construction of the new plant is expected to save 1.6% in relation to the total needs of all locations.

The key goals of the "E3 - Energy efficiency of the JGL production complex" project are:

- Reduce energy consumption in the designed units from the current 456.7 MWh to 271.7 MWh;
- Save 185 MWh or 40.51% in energy supplied;
- Reduce CO2 by 106.5 t/year.

At the very beginning of the year, the system of remote monitoring of energy consumption was implemented with own funds at the location Svilno 2, and at the end of the year, at the location Svilno

[72] Izvješće o održivom razvoju JGL grupe: https://uploads.jgl.hr/uploads/2020/08/IOR_report_190x240_8.pdf

1. Further investments in the control and monitoring of consumption through co-financing by the Fund will create a single system of control over energy consumption. In addition to enabling a more systematic analysis of consumption, the system will also have a networked alarm in case of increased consumption, enabling us to react promptly and undertake corrective actions to resolve the problem.

4.8.3.2. Energy

Management approach disclosures – explanation of the material topic and its boundary

To increase competitiveness, in the segment of investing in energy efficiency of the facilities, JGL has successfully managed the energy aspect through the "ISO 50001:2018 energy management system". The 2020 recertification has confirmed the success of the implementation.

The topic of "Energy" is material for the JGL Group due to significant ecological and economic impacts related to energy and the shareholders' reasonable expectations and interests in the company's systematic care about the following:

- Control over energy losses in development, production, and distribution through the implementation of preventive methods for network maintenance and investments in the entire system.
- Ensuring the availability of information and data, continuous improvement of methods for the analysis of data on energy source consumption (electricity, water, fuel, gas), and recognizing opportunities and implementing activities for the improvement of energy performance.
- Permanently raising awareness on the importance of energy efficiency among all users.
- Procurement of energy-efficient machines, devices and vehicles, and energy services.
- Energy efficiency when designing, upgrading and modernizing the company's systems.
- Continuous improvements of the energy management system in accordance with the requirements of the ISO 50001 standard.
- Permanent harmonization and intention of surpassing legal and other requirements in the field of energy management, and in all other areas applicable to the business.[73]

[73] Ibid.

Energy consumption within the organization

The main energy sources used within JGL are electricity and extra light fuel oil (ELFO). By encouraging sustainable economic growth within the environment, JGL continues to use only electricity produced from renewable sources. ELFO is a relatively new energy source that has been in use since the opening of the new production plant within the Pharma Valley complex. Seeing as JGL is not in the position to use a more environmentally friendly energy source due to the remote location of the facility, it will continue to use ELFO for now. In the long run, a facility that uses ELFO as fuel is also prepared to use natural gas as an energy source and the transition is planned as soon as possible.

Energy intensity

In 2020, the trend of reducing energy consumption continued with an increase in production, i.e. the number of products produced. This trend is planned to continue, with optimization and continuous monitoring of energy sources and increased production. Energy input includes electricity and ELFO.

Reduction of energy consumption

The Company reduces the consumption of electrical energy by using solar energy for heating water, and through its own production of electrical energy from a photovoltaic power station. In accordance with the ISO 50001:2018 standard for energy management systems, all segments of energy are constantly monitored and in the last five years, noticeable savings in energy consumption have been achieved, and consequently lower emission of harmful substances released into the environment. In addition to good management and investments in equipment, the following measures to reduce energy consumption were implemented:

- Replacement of existing lighting with LED lights
- Temperature regulation of processes, and operational, storage and office spaces
- Partial use of wasted heat
- Solar preheating of hot water and water softening (preventing limescale deposits on the heating elements)

- System for remote monitoring of the consumption of all energy sources (electrical energy, water and ELFO)[74]

4.8.3.3. Water

Management approach disclosures - explanation of the material topic and its boundary

There are significant environmental impacts related to water and due to stakeholders' expectations and interest in the company's systematic care about:

- Introducing advanced washing and cleaning processes.
- Effective preparation of purified water for industrial needs.
- Use of wastewater and collection of rainwater from roofs for the irrigation of green areas.
- Controlled water discharge and treatment of water through biological purifiers before its discharge into municipal systems.

The management approach and its components

The goal and purpose of the approach to wastewater management are to systematically monitor the quality of wastewater daily through own efforts, as well as to analyze the quality of discharges of authorized partners based on water permits. The obligation to manage wastewater is based on compliance with legal regulations and, where possible, even stricter own measures. Water discharge is controlled, and water is treated in biological purifiers before being discharged into municipal systems. At all JGL manufacturing sites, there are a total of three biological purifiers which are continually refurbished according to new technologies. The systems for collecting rainwater from roofs and water from the production process of purified water at the new production facility Svilno 2 greatly contributes to the reduction of water consumption for irrigation of green areas. The mud residue, or the sludge from the purified water, is collected and ecologically disposed of by authorized external partners.

[74] Ibid.

Evaluation of the management approach

Mechanisms for monitoring the effectiveness of the management approach include water authority inspections, monitoring of waste water quality through authorized laboratories, and own daily discharge analysis. The processes arising from the above are:

- documentation and data management,
- management of non-compliance and corrective measures,
- resource management,
- analysis and improvement (monitoring, quality review, process performance),
- risk management and management of opportunities

Water withdrawal by source

JGL is supplied with water from the local water supply network and there are no surface flows within the production sites. The implementation of a consumption monitoring system resulted in direct savings and reduced consumption.

A sharp increase in water consumption was recorded in 2015 due to the opening of a new production site and testing of different systems. By optimizing consumption and through continuous remote monitoring of the entire water supply system of the plant, uncontrolled leaks have been greatly reduced. The trend of growth of production stimulated the growth of water consumption, but it remained within the same values in relation to the number of units produced. It is worth pointing out that the discharged water from the clean water production system and rainwater from the roof surfaces is accumulated in the collection pool and used for watering green areas.

Water recycled and reused

JGL is undertaking numerous measures for the reduction of water consumption:

- Introducing advanced washing and cleaning processes;
- Effective preparation of purified water for technological needs - less waste water;
- Use of waste water for watering green areas.[75]

[75] Ibid.

4.8.3.4. Emissions

Reduction of greenhouse gas emissions

Managing gas emissions, i.e. the release of gases into the environment, is one of the biggest priorities for JGL when it comes to caring for the environment. Through the green way of thinking, own production of eco-energy, and the introduction of the ISO 50001:2018 standard, a high degree of environmental consciousness and care was achieved. The Company regularly monitors and reports on releases into the atmosphere from stationary sources in accordance with legal obligations. The chemical composition of the coolant used in the air-conditioning systems, just like in the majority of all existing systems, is not harmful to the ozone layer. JGL pays particular attention to the monitoring and servicing of this equipment to prevent failures and irregularities that can lead to an unwanted release of harmful gas into the environment. Servicing and repairs are performed exclusively by our authorised partners. In accordance with trends and company needs, the design and execution of new systems are performed using an eco-friendly coolant. New technology coolants which are planned to be used in the near future are: R32, R134A, R513A, R449A, whereas R22 and R404A are planned to be replaced with environmentally friendly equivalents.

4.8.3.5. Effluents and waste

Explanation of the material topic and its boundary

This topic was chosen as material because JGL, through its regular operations and activities, generates hazardous and non-hazardous waste, as well as technological wastewater. Information related to the above is of significant interest to key stakeholders.

Water discharge by quality and destination

JGL has three discharge points of technological wastewater. At the Pulac site, there is a discharge point for wastewater from the research and development laboratory. At the Svilno 1 site, there is a discharge point for wastewater from the production plant as well as from the quality control laboratory and at the Svilno 2 site, there is a discharge point for wastewater from the production plant located at the location. At all three locations, technological wastewater is treated in the treatment plants before being discharged into the public sewerage system. At the Svilno site, there are two biological treatment plants, one for each micro-location, while at the Pulac site there is a chemical wastewater treatment plant. The

analysis of wastewater samples collected at discharge points is carried out in authorized laboratories, periodically every six months, in accordance with legal regulations. Water is analyzed for parameters determined by valid water permits for each location. Analyses of wastewater samples show that all parameters, which the company is obliged to test in accordance with water permits, are below the prescribed limit values.

Waste by type and disposal method

JGL produces hazardous and non-hazardous waste. To dispose of the generated waste in a legal and environmentally friendly manner, JGL cooperates with several authorized waste disposal companies in the Republic of Croatia. The partners have all the prescribed permits for performing the required activities, i.e. all permits for hazardous and non-hazardous waste management. The permits were issued by the Administrative Department for Physical Planning, Construction and Environmental Protection of the Primorje-Gorski Kotar County, as well as by the Ministry of Environmental Protection and Energy.

JGL's priority in terms of waste management is to reuse the waste as raw material through recycling and recovery. For this purpose, JGL educates its employees on proper waste separation, and there is a special space intended for the separation of large quantities of waste at the Svilno site. The separated non-hazardous waste (paper, cardboard, plastic, glass, aluminum…) is collected by authorized partners for disposal, who forward it for processing where the waste is treated in appropriate ways and largely becomes a raw material again. Hazardous waste is given to authorized hazardous waste disposal partners who transfer the majority of it to incineration plants in Europe (primarily Austria) for its disposal following the highest European Union standards that ensure minimal impact of the disposal process on the environment. A small part of specific hazardous waste is used as fuel, i.e. as a source of energy.

In 2020, JGL d.d. produced a total of 416,421.50 kg of waste, of which 395,970.00 kg is non-hazardous waste and 20,451.50 kg hazardous waste. [76]

[76] Ibid.

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6. APPENDIX – BRIEFING DOCUMENT

Draft

Project Green@Work - **questions for the research institutions**

Preliminary remark:

This draft proposes a series of questions to be put to the scientific institutes in Germany, Italy and Croatia and the EU (Brussels).

It should be taken into account that different accesses to data and information must be found for the different sets of questions:

1: Access to statistical material (official, company-related).

2: Access to documents (annual reports, programmes, etc.) of state institutions, companies, consumer associations, etc. and to the knowledge of these institutions and associations by means of expert interviews.

Finally, it must be decided whether differentiations should be dispensed with for reasons of feasibility.

1. Figures and data on the structure of the chemical, pharmaceutical and energy industries

1.1 Chemical industry

1.1.01. How has production in the chemical industry developed up to 2020?
1.1.02. How are imports and exports of the chemical industry to be quantified in 2020?
1.1.03. How has the corporate structure in the chemical industry developed?
1.1.04. How has the number of enterprises in the chemical industry developed from 1990 to 2020?
1.1.05. How has the number of employees developed in the chemical industry from 1990 to 2020?
1.1.06. How have turnover and investments developed in the chemical industry from 1990 to 2020?
1.1.07. How has the European chemical market developed?
1.1.08. How has the innovation dynamic developed in the chemical industry from 2006 to 2020?
1.1.09. How did electricity consumption develop in the chemical industry from 2006 to 2020?
1.1.10. How have emissions developed in the chemical industry from 2006 to 2020?
1.1.11. (...)[77]

1.2 Pharmaceutical industry

1.2.01. How has the production of the pharmaceutical industry developed until 2020?
1.2.02. How are imports and exports of the pharmaceutical industry to be quantified in 2020?
1.2.03. How has the corporate structure in the pharmaceutical industry developed?

[77] If necessary, expand to include specifics on the chemical industry

1.2.04. How has the number of enterprises in the pharmaceutical industry developed from 1990 to 2020?
1.2.05. How has the number of employees developed in the pharmaceutical industry from 1990 to 2020?
1.2.06. How have turnover and investments developed in the pharmaceutical industry from 1990 to 2020?
1.2.07. How has the European pharmaceutical market developed?
1.2.08. How has the innovation dynamic developed in the pharmaceutical industry from 2006 to 2020?
1.2.09. How did electricity consumption develop in the pharmaceutical industry from 2006 to 2020?
1.2.10. How have emissions developed in the pharmaceutical industry from 2006 to 2020?
1.2.11. (...)[78]

1.3 Energy industry

Preliminary remark:

Overview of the different forms of energy

- Primary E.: Coal, crude oil, natural gas, nuclear fuels, renewable energies, solar energy, wind energy, biomass, geothermal energy

- Secondary E.: coal briquettes, processed natural gas, petroleum products, petrol, diesel, heating oil, liquefied petroleum gas, electricity, district heating, wood products

- Tertiary E.: Heat / cold, light, mechanical work, sound

1.3.01. How did primary energy production and consumption develop from 1990 to 2020?
1.3.02. What is the percentage growth rate for renewable energies from 1990 to 2020?
1.3.03. What is the share of energy carriers in primary energy consumption?
1.3.04. How are imports and exports of primary energy sources to be quantified in 2019?
1.3.05. How have electricity prices developed for industry and private consumers?
1.3.06. How has the corporate structure of energy supply developed?
1.3.07. How has the number of enterprises in industrial supply developed from 1990 to 2020?
1.3.08. How has the number of employees in industrial supply developed from 1990 to 2020?
1.3.09. How have turnover and investments developed from 1990 to 2020 in electricity supply?
1.3.10. How has the European Energy Union developed from 1990 to 2020?
1.3.11. How has innovation intensity developed in energy supply from 2006 to 2020?
1.3.12. How has electricity consumption developed in the energy supply sector from 2006 to 2020?
1.3.13. How have emissions developed in the energy supply sector from 2006 to 2020?

[78] If necessary, expand to include specifics on the pharmaceutical industry

2. Green deal / master plan[79] - challenges for the sectors

Preliminary remark:

According to the climate protection goals of the Green Deal, greenhouse gas emissions are to be reduced by 50 - 55 % by 2030 and greenhouse gas neutrality is to be achieved by 2050. These are ecologically sensible, but also ambitious goals. They require a more stringent and speedy approach from Germany, Italy and Croatia. For the chemical and energy industries, the preservation of existing value chains and the future security of jobs for industrial employees are a particular challenge

The following questions for companies in the chemical, pharmaceutical and energy industries (C), government institutions (G) and consumer associations (CA) result from the Master Plan:

2.1 What measures does the development of markets for climate-neutral products of the circular economy require?
2.1.1 How can the demand for and competitiveness of climate-neutral, circular economy solutions be promoted through demand-side measures? (C, CA)
2.1.2 What alternative or complementary options for carbon pricing mechanisms can be developed at EU level, taking into account their impact on emissions, markets and investments? (C,G)
2.1.3 How can customers and consumers be empowered for the transition to carbon neutrality? (CA)

2.2 What measures does the development of climate-neutral solutions require? What measures are required for the development of climate-neutral solutions? [80]
2.2.1 Is it beneficial to develop industrial demonstrators for key breakthrough technologies (by 2030)?
2.2.1.1 If yes, how should this be done? (C,G)
2.2.2 How can the establishment of larger R&D&I programmes be realised to bring solutions closer to the market and achieve better integration with national programmes? [81] (C,G)
2.2.3 How can access to private capital be facilitated at reasonable cost? [82] (C,G)

2.3 Resources and development[83]
2.3.1 How can access to and availability of climate-neutral energy at globally competitive prices be ensured? (C,G)
2.3.2 How can access to alternative sources of raw materials be ensured by promoting the use of renewable and (carbon-based) valuable materials beyond energy production? (C,G)
2.3.3 How can energy and non-energy infrastructure and supply be mapped? (G)

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[79] Master plan for a Competitive Transformation of EU Energy-intensive Industries Enabling a Climate-neutral Circular Economy by 2050, Luxemburg 2019
[80] See master plan (2019,25)
[81] It is about "establishing larger R&D&I programmes at all technology maturity levels (TRL) with a focus on bringing solutions closer to the market and achieving better integration with national programmes adequately supported by coherent state aid rules".
[82] Also through de-risking instruments
[83] See master plan (2019,39)

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