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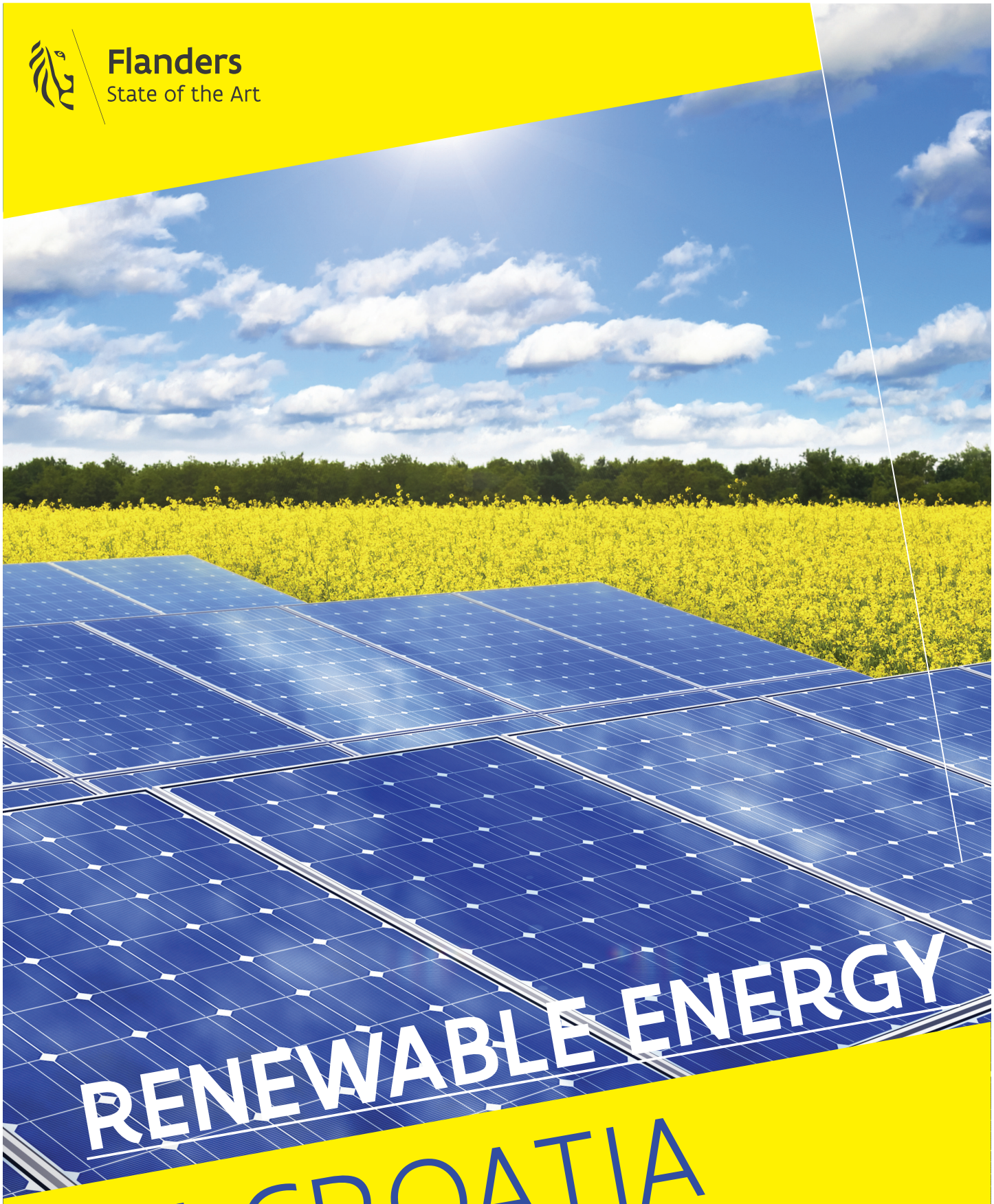

RENEWABLE ENERGY IN CROATIA

FLANDERS INVESTMENT & TRADE MARKET SURVEY

Renewable Energy in Croatia

December 2016

Alexis Soullard and Dora Bencetić
Interns at the Belgian Trade Office in Zagreb, Croatia

c/o Embassy of Belgium
Pantovcak 125d
HR - 1000 ZAGREB
Croatia
office@beltrade-croatia.com

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Introduction: Croatia in Figures

General data

Population	4,464,844 (July 2015 est.)
Main cities	Zagreb (Capital) Split Rijeka Osijek
National currency	Kuna
GDP GDP per capita	€ 43.921 billion (2015 est.) (source - HNB) € 10.364
GDP - composition, by sector of origin	agriculture: 4.3% industry: 26.7% services: 69.1% (2015 est.)
VAT	25%
Unemployment rate	16,3%
Major export countries	Bosnia and Herzegovina, Slovenia, Italy, Serbia

Political profile

Government	Parliamentary Democracy
Head of State	Kolinda Grabar-Kitarović
Membership of International Organisations	United Nations Organisation for Security and Co-operation in Europe Council of Europe Regional Cooperation Council International Monetary Fund World Bank World Trade Organisation European Bank for Reconstruction and Development, Partnership for Peace NATO
Accession to the European Union	1st July 2013 – 28th Member State

European Economic Forecast Spring 2016				
Forecasts for Croatia	**2014**	**2015**	**2016**	**2017**
GDP growth (%, yoy)	-0,4	1,6	1,8	2,1
Inflation (%, yoy)	0,2	-0,3	-0,6	0,7
Unemployment (%)	17,3	16,3	15,5	14,7
Public budget balance (% of GDP)	-5,5	-3,2	-2,7	-2,3
Gross public debt (% of GDP)	86,5	86,7	87,6	87,3
Current account balance (% of GDP)	1,1	5,1	4,4	4,0
Full forecasts for Croatia			3 May 2016 European Commission Institutional Papers 25 | 2016	

Source: http://ec.europa.eu/economy_finance/eu/countries/croatia_en.htm

Economic overview

Croatia borders Bosnia and Herzegovina, Hungary, Montenegro, Serbia, Slovenia and Italy (sea border), and has been an independent country since 1991. The country has a long and dramatic coastline with the Adriatic Sea, in which the country has over 1 000 islands and islets, of which just 48 are permanently inhabited.

The most important sectors of Croatia's economy in 2015 were wholesale and retail trade, transport, accommodation and food services (21.2%), industry (21.1%) and public administration, defense, education, human health and social work activities (15.4%).

Croatia's main export partners are Italy, Bosnia and Herzegovina and Slovenia while its main import partners are Germany, Italy and Slovenia.

In 2015, Croatia finally came out of its six-year long recession. Between 2008 and 2014, GDP shrunk by more than 12% in real terms and unemployment surged from below 9% to more than 17%. The situation started to improve at the end of 2014, and in the course of 2015 real GDP growth surpassed expectations. In 2015 economic activity was 1.6%. The external sector performed strongly, and Croatia recovered some of the lost market shares. Growth was however mainly driven by the rebound in consumption and – to some extent – investment.

The recovery is set to strengthen over the next couple of years, but risks remain. By 2017, GDP growth is forecast to attain 2.1% and unemployment to contract to below 14%, while the current account surplus should stabilize at around 4% of GDP. The external sector is expected to continue to contribute to this positive performance, but the main driver of growth will be internal demand. Investments, in particular, are set to start

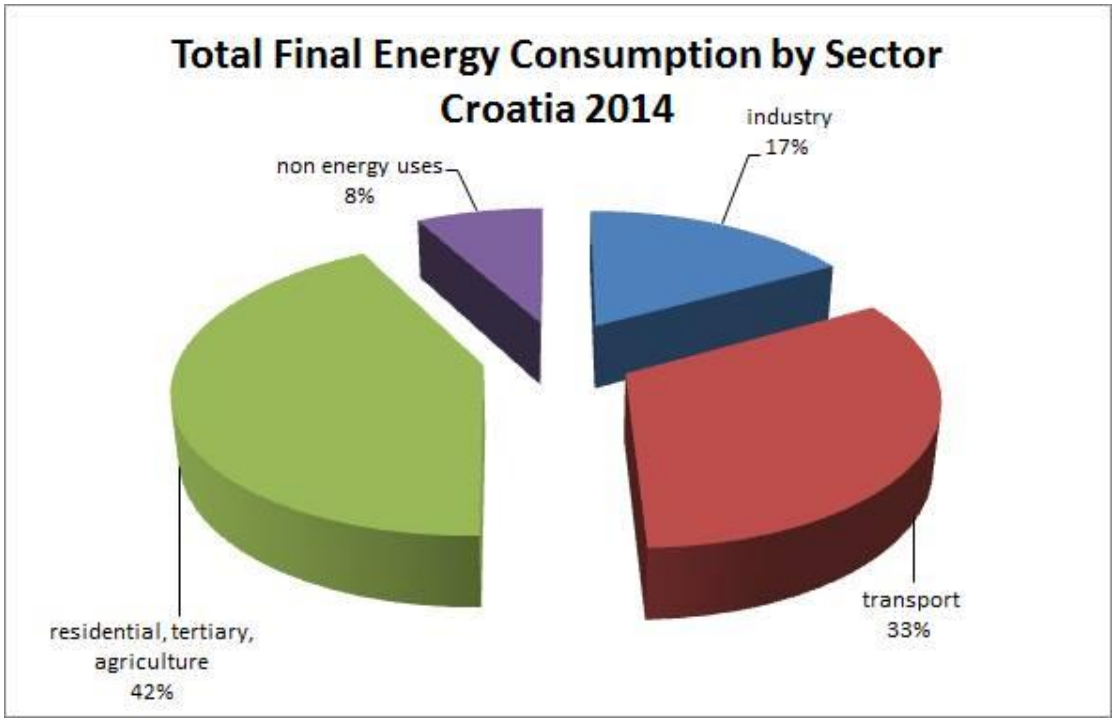
growing more robustly, on the back of an increased absorption of EU structural and investment funds.

Nevertheless, growth is projected to remain subdued for a catching up economy and it will take several years before output returns to pre-crisis levels. In a low inflation environment, high government and private debt, jointly representing more than 200% of GDP in 2014, public and private investment as well as household consumption will continue being constrained. Lifting potential growth requires sustained investments and deep structural reforms in labor and especially product markets in view of fostering full utilization of the labor force, while ensuring robust productivity growth.

Source: http://ec.europa.eu/europe2020/pdf/csr2016/cr2016_croatia_en.pdf

Energy profile

As most European countries, Croatia reported a distinct contraction in economic activity since the beginning of the economic and financial crisis. Its impact on Croatia's economy spurred negative business developments, trickling down to the primary energy sector, affecting the flow and scope of investments in renewable energy sources. Nonetheless, steady technological improvements, cost reductions and state-supported schemes still render electricity produced from renewables attractive. Renewable energy is gaining momentum in Europe; the continent has achieved the largest growth in energy produced from renewable sources (wind, solar, hydro etc.).



Source: www.enercee.net/countries/country-selection/croatia.html

Total energy consumption in Croatia

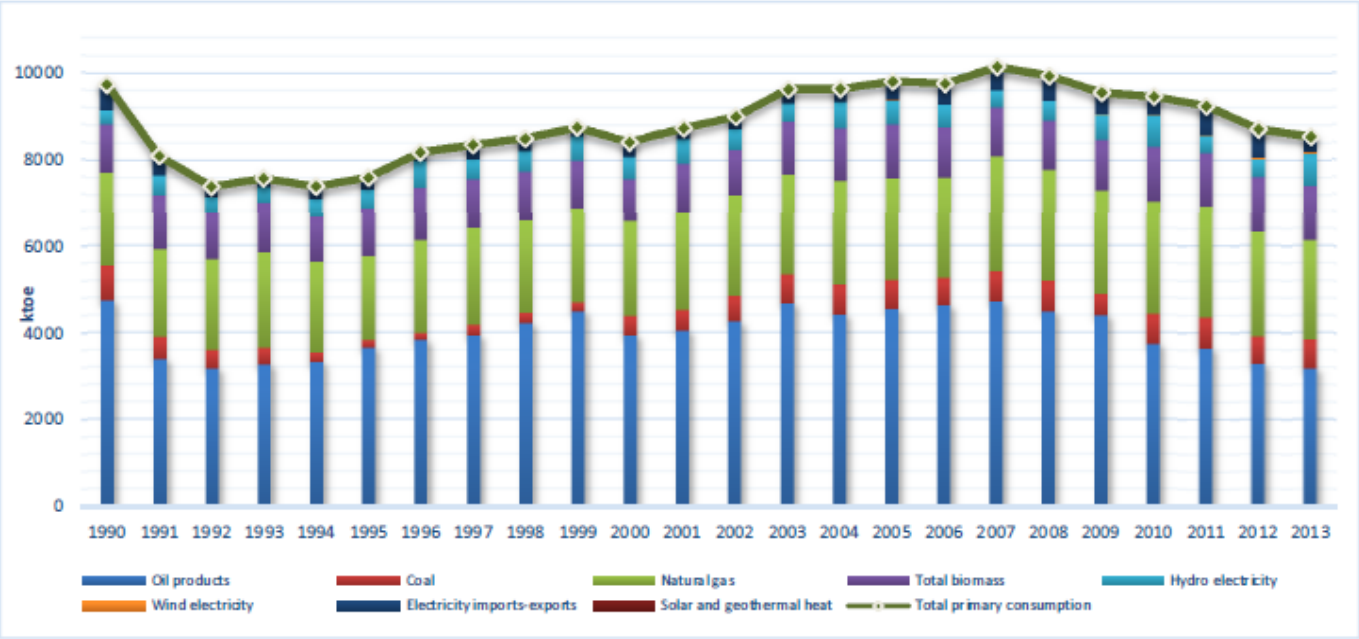


Table 1 : Growth rates in total energy consumption

%/year	00 - 05	05 - 08	08 - 10	10 - 13	00 - 13
Oil products	2,9	-0,4	-8,6	-5,4	-1,6
Coal	9,0	1,2	-1,6	-0,6	3,2
Natural gas	1,5	3,3	0,6	-4,7	0,3
Total biomass	4,5	-3,3	5,5	0,6	1,9
Hydro electricity	1,8	-6,1	25,8	1,1	3,1
Wind electricity		61,3	86,7	54,9	
Electricity imports-exports	5,0	8,8	-14,9	-6,7	-0,3
Solar and geothermal heat			29,5	9,9	
Total primary consumption	**3,1**	**0,4**	**-2,4**	**-3,4**	**0,1**

Source: www.odyssee-mure.eu/publications/national-reports/energy-efficiency-croatia.pdf

ELECTRICITY

GWh

Opskrba	Električna energija Electricity								Supply
	2014.				2015.				
	IX.	X.	XI.	XII.	IX.	X.	XI.	XII.	
Ukupna bruto proizvodnja	1 028	968	1 272	1 403	675	1 032	930	873	*Total gross production*
Hidroelektrane	811	665	869	945	309	542	446	442	*Hydro power plants*
Termoelektrane	170	252	336	387	275	392	431	389	*Thermal power plants*
Vjetroelektrane i ostali obnovljivi izvori	47	51	67	71	91	98	53	42	*Wind power plants and other renewable sources*
Ukupna neto proizvodnja	1 011	937	1 235	1 365	647	992	888	835	*Total net production*
Hidroelektrane	809	663	867	943	307	539	444	440	*Hydro power plants*
Termoelektrane	155	223	301	351	249	355	391	353	*Thermal power plants*
Vjetroelektrane i ostali obnovljivi izvori	47	51	67	71	91	98	53	42	*Wind power plants and other renewable sources*
Uvoz	768	555	522	514	871	722	632	803	*Imports*
Izvoz	414	100	332	300	139	315	99	99	*Exports*
Potrošeno iz mreže za crpke u reverzibilnim elektranama	7	12	16	26	18	9	22	27	*Energy absorbed by storage pumping*
Raspoloživo za tuzemnu potrošnju	1 358	1 380	1 409	1 553	1 361	1 390	1 399	1 512	*Available for inland market*

National Energy Strategy

The Republic of Croatia is endowed with a good potential in renewable energy resources. Renewable energies present several advantages, three of which stand out as most appealing:

- Renewable energy is drained from the exploitation of clean, domestic natural resources, thereby reducing energy dependency from third States;
- Their use as a means of improving security of energy supply boosts the development of domestic production of energy equipment and services;
- Finally, the development of renewable energy technologies is crucial towards to the achievement of internationally agreed, binding environmental objectives.

With EU membership, Croatia became party to the 2020 Climate and Energy Package, a set of binding legislation that aims to ensure that the EU meets its ambitious climate and energy targets for 2020. While Croatia is doing well on most of the targets, it needs to put more effort into scaling-up renewable energy resource (RER) and energy-efficiency (EE) programs to alleviate energy security concerns and improve access to reliable and affordable energy imports.

The objectives are to reduce CO2 emissions by 40%, to increase the renewable energy by 27% and to be energetically more efficient by 27%.

In Croatia, the share of energy from renewable sources in gross final consumption of energy in 2014 was 27.9%, as against 28.1% in 2013. In that way Croatia exceeded the 2020 target of 20% and reached the EU target for 2030, according to Eurostat's report. (target for 2020 is 20% / Target for 2030 is 27%)

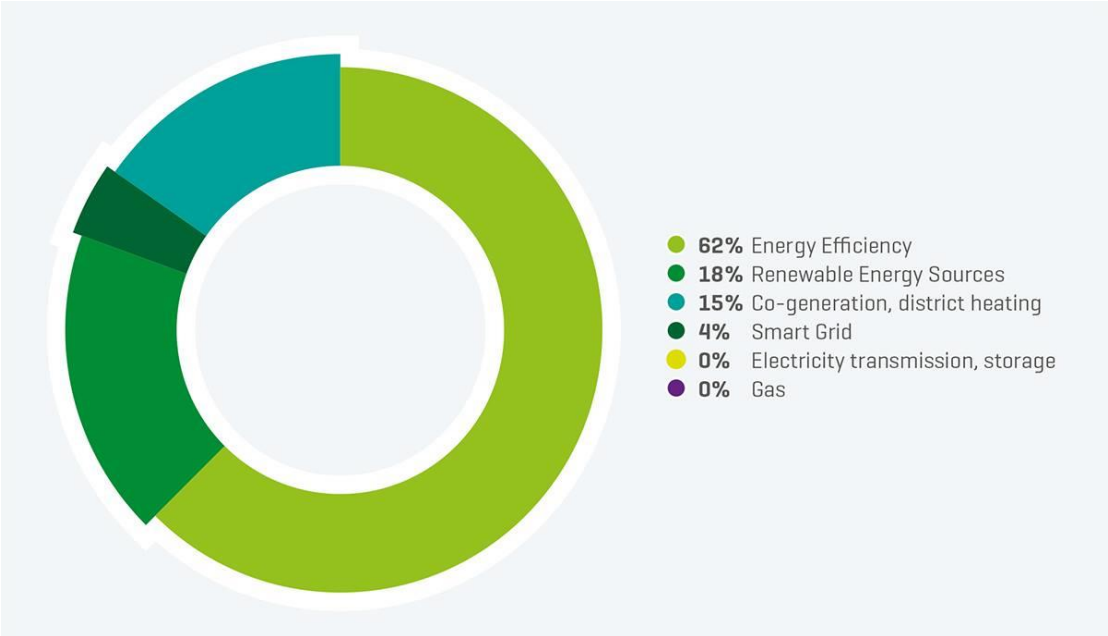
In 2014 Croatia met 43.8% of its energy needs with imports. In terms of dependency on energy imports in 2014, Croatia was alongside Slovenia and the United Kingdom, which recorded rates of 44.6 and 45.5% respectively.

Source: https://aboutcroatia.net/news/croatia/croatia-achieves-2020-target-share-renewables-energy-consumption-9766

PJ	Final energy consumption			
	2006	2010	2015	2020
Basic scenario	267.89	306.53	362.76	409.60
Sustainable scenario	267.89	299.84	345.17	386.85

Due to the economic and financial crisis, there was a drop of the gross domestic product (GDP). Instead of the projected GDP rise of 21.5% in the 2009–2012 period, a negative rate of - 9.0% was achieved, which is a 30.5% difference. The decrease of industrial production and the overall standard of living also reduced the need for energy. The scenarios featured in the Energy Strategy therefore had to be corrected and adjusted to the resulting situation and plans.

Graph: The different types of energy infrastructure investments in Croatia to be financed by EU funds 2014-2020



Source: http://bankwatch.org/news-media/blog/croatias-eu-funds-spending-plans-land-unfulfilled-clean-energy-potential

Structure of the Energy Market – State and Private Actors

Main state actors in the energy market of Croatia

The environmental Protection and Energy Efficiency Fund

www.fzoeu.hr

REPUBLIKA HRVATSKA
FOND ZA ZAŠTITU OKOLIŠA I ENERGETSKU UČINKOVITOST

FZOEU is one of the Croatian institutions managing all tenders and money transfers regarding energy efficiency and renewable energy projects. The Environmental Protection and Energy Efficiency Fund was established under the provisions of Article 60 Para.5 of the Environmental Protection Act (Official Gazette no. 82/94 and 128/99) and Article 11 of the Energy Act (Official Gazette no. 68/01). The Law on Environmental Protection and Energy Efficiency was published in the Official Gazette no.107/03, and applies since 1 January 2004. The Fund is a State institution.

The missions of this Fund include:

- Protecting, preserving and improving the quality of air, soil, water and seas;
- Mitigating the climate change protecting the ozone layer, remediating the landfill, encouraging avoidance and reduction of waste generation, waste treatment and utilization of valuable waste;
- Promoting cleaner production, and avoiding/reducing waste/emissions in the production process; protecting and conserving the biological and landscape diversity; implementing the national energy programs;
- Encouraging the use of renewable energy sources (sun, wind, biomass, etc.); encouraging sustainable construction;
- Promoting cleaner transport; promoting sustainable use of natural resources; promoting sustainable development of rural areas;
- Promoting sustainable economic activities and sustainable economic development;
- Improving the system of information on the state of environmental monitoring and assessment of the environment and the introduction of environmental management systems;
- Promoting education, research and development studies, programs, projects and other activities, including demonstration activities, the performance of the Fund.

The Fund may participate in co-financing other programs, projects and related activities in the field of environmental protection and energy efficiency, which are conducted on Croatian territory, when they are organized and financed by international organizations, financial institutions/bodies and other legal entities.

The Fund will not call new tenders when a party is directly involved in co-financing and implementation of programs, projects and related activities regulated by the Law on Environmental Protection and Energy Efficiency.

By-laws of the Fund shall determine the conditions that must be met by beneficiaries of the Fund, the conditions and manner of allocation of funds, criteria and benchmarks for evaluating requests for funds and the Fund's method of monitoring the use of earmarked funds and contractual obligations between the Fund and beneficiaries of its resources.

For the financing of these programs, projects and related activities of the Fund cooperates with banks and other financial institutions.

The Fund grants funds to enterprises and individuals to finance the programs, projects and other activities, determined in accordance with the provisions of the Law on Environmental Protection and Energy Efficiency, by:

- Loans,
- Subsidies,
- Financial assistance and donations.

Funds are awarded on the basis of a public tender.

Croatian Electricity Transmission and Distribution Operator (HEP Group)

www.hep.hr

HRVATSKA ELEKTROPRIVREDA

Hrvatska Elektroprivreda (HEP Group) is the national electricity company engaged in electricity production, transmission and distribution, and with heat supply and gas distribution. HEP Group is organized in the form of a holding company with a number of daughter companies. The parent company of the Group, HEP d.d., performs the function of HEP Group's corporate management and guarantees the conditions for a secure and reliable electricity supply to customers.

Croatian Distribution System Operator (HEP DSO)

www.hep.hr/ods/dp/default.aspx

HEP ODS d.o.o.

HEP DSO is responsible for delivering electricity to customers. With the distribution of electricity taken from the transmission and care for the reliable supply of customers, sales, measurement, calculation and billing for electricity supplied, HEP DSO is responsible for:

- Maintaining the distribution network and systems, replacement, reconstruction and development.
- Ensuring the distribution system's safety, reliability and efficient operation.
- Ensuring the impartiality of its users, including affiliated companies within HEP to provide information to network users which they need for efficient access to and use of the network.
- Providing network access to the regulated, transparent and equitable principles and care system losses and loss analysis.

HEP ODS shall submit annual reports to the Croatian Energy Regulatory Agency (HERA), which in case of need may require implementation of certain measures to ensure the principles of transparency and impartiality. With the prior approval of the Agency, HEP DSO adopts a development plan and construction of distribution networks, while taking into account energy efficiency, load management and distributed generation, which can delay the need for reinforcement of the distribution network during the planning.

ZelEn

http://zelen.hep.hr/home.aspx

The offer of HEP Supply, a leading national electricity supplier, also includes its unique ZelEn. The name ZelEn is a combination of words Zelena Energija (meaning Green Energy), which is basically the essential component of the product – electrical energy received solely from renewable sources

ZelEn is intended for HEP Supply customers, who have chosen socially responsible business, environmental care and using energy from renewable sources.

ZelEn costs 20 eurocents or about 1,5 kunas/MWh. For example, a company that has an annual consumption of 1.000.000 KWh will spend for Zelena Energija 1497 HRK more per year or about 125HRK a month.

Electricity used by ZelEn buyers is generated solely from HEP's hydro renewable sources, which is proven by retiring a sufficient number of guarantees of origin in the Registry of Guarantees of Origin managed by the Croatian Electricity Market Operator (HROTE).

Croatian implementing agency for energy efficiency programmes

HEP ESCO

www.hep.hr/esco

HEP ESCO provides services in energy project development and focuses specifically on energy efficiency projects. Projects include modernization, reconstruction and rehabilitation of existing plants and facilities.

The subsidiary promotes energy efficiency and the use of renewable energy sources in non-residential buildings. In this context, HEP ESCO participates in the Euopean Commission's Green Building voluntary program. Initiated in 2005, this programme provides guidelines to owners and users of non-residential buildings for the improvement of energy efficiency and use of renewable energy sources. In December 2007, a second phase of the project – GreenBuildingplus – began and for the continuation of the program, the Energy Institute Hrvoje Požar was appointed as one of ten partners and a national contact centre for GreenBuildingplus. The objective of the program is to:

- Improve the efficiency of energy use;
- Promote and use renewable energy sources;
- Reduce the use of fossil fuels:
- Protect the environment by reducing CO2 emissions, and;
- Increase the security of energy supply.

Any company or organization which will contribute to the objectives of GreenBuilding program can participate.

Croatian Energy Regulatory Agency (HERA)

www.hera.hr

HERA is an autonomous, independent and non-profit public institution. HERA's obligations and responsibilities are based on the **Act on the Regulation of Energy Activities**, the **Energy Act** and other acts regulating specific energy activities. The founder of HERA is the Republic of Croatia and the founding rights are exercised by the Government of the Republic of Croatia. HERA is responsible for its work to the Croatian Parliament.

HERA performs the following activities:

- Electricity market regulation
- Granting of the status of eligible electricity producer
- Providing opinion to the Ministry:
    - on the tariff system for the production of electric power from renewable energy sources and cogeneration,
    - on compensations when providing incentives for renewable sources and cogeneration and on compensation for stranded costs;
    - on the proposed amounts of compensation for the organization of the electric energy market;
    - on general conditions of energy supply;
    - on procedures and criteria for approval and construction of generating facilities.

Moreover, HERA supervises the application of all tariff systems and prescribed compensations, organizes and carries out tendering procedures for the construction of generating facilities; provides its opinion or consent to draft regulations in the energy sector for which it is authorized to, according to the **Act on the Regulation of Energy Activities** and other legislation regulating particular energy activities; supervises energy undertakings, pursuant to the provisions of The **Energy Act** and other legislation regulating particular energy activities; supervises the quality of services provided by energy undertakings; publishes information and data on energy efficiency and the use of energy; Participates in the energy policy design; cooperates with ministries and competent inspection services in accordance with special laws; collects and processes data related to the activities of energy operators; submits requests for misdemeanour offense proceedings; settles disputes related to carrying out of regulated energy activities, in particular with regards to the following;

- Rejection of connection to the transmission network/transport system;
- Determination of compensation for connection and usage of the transmission network/transport system.

Croatian Energy Market Operator – HROTE

www.hrote.hr

HROTE performs tasks necessary for the functioning of energy markets in the Republic of Croatia and monitors relationships between market participants. HROTE also plays an important role in stimulating the production of electricity from renewable energy sources and cogeneration systems, as well as in stimulating the production of biofuels

for transport. HROTE has been organizing the electricity and gas market as a public service, under the supervision of the Croatian Energy Regulatory Agency (HERA). The company's core activities are the promotion of electricity produced from renewable energy sources and cogeneration, and encourage the production of biofuels for transport.

The basic tasks of the electricity market are:

- Adoption of rules Electricity Market (Market Rules);
- Keeping records of entities in the electricity market;
- Recording of contractual obligations between entities in the electricity market;
- Calculating Croatia's energy balance;
- Analyzing the electricity market and proposing measures for its improvement.

Croatian Agency for the Environment and Nature

www.haop.hr

Croatian Agency for the Environment and Nature (HAOP) is an independent public institution established by decree of the Croatian Government in June 2015. The Agency is officially active since September 2015. HAOP was created by merging the Croatian Environmental Agency (http://www.azo.hr/English) and the State Institute for Nature Protection (http://www.dzzp.hr/eng/), and took over their duties to collect and consolidate data and information about the environment and nature in order to ensure and monitor the implementation of environmental policy and nature, sustainable development and other professional activities related to the protection of the environment and nature.

CROATIAN ENVIRONMENT AGENCY

Hrvatski okolišni portal
CroatianEnvironmental Portal

Before the merging, the Croatian Environment Agency was an independent public institution established by the Government of the Republic of Croatia to collect, integrate, and process environmental data.

The need to establish the Croatian Environment Agency as a focal institution into which all relevant environmental data will be channelled has been defined:

- In the basic strategic environmental protection document - the Environmental Protection Strategy of the Republic of Croatia, which dedicates a separate section to the need for establishment of an independent and specialised Agency and its objectives, defining it as a central professional body and a potential promoter of sustainable development;

- By Implementation Plan for the Stabilisation and Association Agreement between the European Community and its Member States and the Republic of Croatia (Article 81 on establishment of the Croatian Environment Agency);
- By the need to upgrade the infrastructure necessary for efficient enforcement of the environmental policy (Ministry, Agency, Fund);
- Through harmonisation of the Croatian legal and institutional environmental protection framework with that of the European Union.

The Croatian Environment Agency (CEA) had the obligation to analyse and interpret the environmental data collected and provide the information necessary to implement Croatia's environmental policy efficiently to the state administration, the Government and the Parliament.

In addition to these basic tasks, the Agency is active on a much wider scale as it takes a pro-active part in planning and developing new environmental protection forms and follow-up of environmental action plans and projects.

Some of its tasks include:

- harmonisation and co-ordination of data forms and information systems
- co-ordination and planning of all parts of the system:
  - defining the need for measurement of individual parameters (indicators),
  - method definition/review
  - planning – frequency, institutions, financing and the like
  - setting up the measurement and data processing Quality Assurance/Quality Control (QA/QC) System
  - information system levels of data submittal and exchange
  - legal background for data accessibility definition, data/information management co-ordination on different levels:
    - General public/scientific community/bodies comprising the information system /state and administrative bodies,
    - Development of neutral reports, not for any particular ministry, by individual topics (by themes, regions, indicator impacts, etc.).

The Croatian Environment Agency was the national focal point for collaboration with the European Environment Agency included in the European Environment Information and Observation Network.

The EIONET is a collaborative network of the EEA and its Member States which provides information for responsible decision-making on environment in Europe and implementation of efficient environmental policies. The Agency also co-operated with similar national institutions throughout Europe.

STATE INSTITUTE FOR NATURE PROTECTION

The State Institute for Nature Protection was established by virtue of a Regulation of the Government of the Republic of Croatia (OG 126/02), pursuant to the National Strategy and Action Plan for the Protection of Biological and Landscape Diversity of the Republic of Croatia (NSAP; OG 81/99) and the Implementation Plan for the Stabilization and Association Agreement, signed by Croatia and the European Union in 2001.

The Institute carried out expert tasks of nature protection for the Republic of Croatia, in particular: inventorying; monitoring and assessing the state of nature; preparing expert base proposals for the protection of natural values; conserving parts of nature; establishing the conditions for nature protection; managing protected areas and the use of natural resources; developing expert base proposals for the assessment of acceptability of interventions in nature; reporting on the state of nature; participation in the implementation of international agreements on nature protection and organizing and implementing educational and promotional activities in nature protection.

The Institute co-operated with numerous domestic and international institutions, and is an active member of the informal ENCA network (for the heads of European nature conservation agencies).

Energy Institute Hrvoje Požar

www.eihp.hr

The Energy Institute is a non-profit institution whose goals are to provide expert and scientific support to:

- the strategic development of the Croatian energy system and its sub-systems,
- the processes of legislative reform and development and
- the advancement of economic relations, and the development of relevant institutions.

The Institute's main tasks include:

- Expert and scientific research in the field of energy for state, regional and local administration and energy companies;
- Expertise and analyses for the Croatian Energy Regulatory Council;
- Management of National Energy Programmes and pilot projects ;
- Organisation of seminars, workshops and courses;
- Publication of editions, periodicals and other forms of communication with experts, scientists and the general public, especially via Internet.

The Institute carries out its mission in cooperation with numerous scientists and institutions from Croatia and abroad.

Investors, project developers and consultants in renewable energy

Adria Wind Power

www.adriawindpower.hr

Adria Wind Power is a wind power producer in Croatia since 1999. The company is an eligible producer who signed the Electricity Purchase Contract with HROTE. Her power plants are incentivized. Adria Wind Power planned capacity is 5 950 kW.

Vjetroelektrana TrTar-Krtolin

www.vjetroelektrane.com

VJETROELEKTRANA TrTar-Krtolin is a wind power producer in Croatia founded in 2002. The owner is WPD International GmbH, Enersys Gesellschaft für Regenerative Energien mbH. The company is an eligible producer who signed the Electricity Purchase Contract with HROTE. Her power plants are incentivized. Their planned capacity is 11,200 kW. The name of the power plant: VJETROELEKTRANA TrTar-Krtolin. The power plant has been working since 2006 and is located on the crest of the hill in TrTar-Krtolin (Šibenik).

Končar-Obnovljivi Izori

www.koncar.hr

Končar-Obnovljivi Izvori is a wind power company owned by Končar. The company was founded in 2008.

The company owns a wind power plant in Pometeno Brdo (near the town of Split) for a planned capacity of 1MW. The company is an eligible producer who signed the Electricity Purchase Contract with HROTE. Her power plants are incentivized.

Končar plans to add 15 more wind turbines in the same location for a total of 17,500 kW planned capacity. The Electricity Purchase Contract is signed with HROTE but the wind turbines are not connected to the grid and are not incentivized.

Dalekovod

www.dalekovod.eu

Dalekovod is an eligible producer who signed the Electricity Purchase Contract with HROTE. Her power plants are incentivized. They are the owner of the wind farm Vjetroelektrana ZD6 for a planned capacity of 9 000 kW. It is the first wind farm project that is entirely completed without the help of foreign investors. The value of electrical works in this project amounts to approx. 1 billion Euro. The wind power plant is located near Gračac and consists of 4 wind turbines with a nominal power of 2.3 MW. The turbines that will be installed are manufactured by Siemens. The total installed power of the wind farm will amount to 9.2 MW, and it is expected to produce an average of 26.000.000 kWh a year. This is the first in a series of many projects dealing with renewable-energy sources currently in development at Dalekovod d.d.

EKO

www.eko-go.hr

EKO is a waste management company with headquarters in Zadar. Eko has diversified its activities by the acquisition two wind power plants in the region of Zadar for a total planned capacity of 36,000 kW.

They have signed the Electricity Purchase Contract with HROTE but the two power plants are not connected to the grid and are therefore not incentivized.

Solektra

www.solektra.hr

Solektra specialises in the design and construction of photovoltaic power plants. It has signed an Electricity Purchase Contract with HROTE. The planned activity of this company is about 29.95 kW. One of the power plants of this company is located in Križoptje (Croatia). Their pipeline also includes the construction of four additional power plants in Drag, Selo, Vukanovec (x2) and Križoptje.

Solvis

www.solvis.hr

Solvis is a manufacturing and engineering company based in Varaždin. Their main activities focus on the manufacture of photovoltaic modules using crystalline silicon technology. The company is an eligible producer that has signed an Electricity Purchase Contract with HROTE. However, some of its power plants have not been connected to the grid and they are not incentivized.

Univerzal

http://www.univerzal-vz.hr/-

Univerzal is another Varaždin-based company. The company specialises in the recycling of metal remains and sale of secondary raw materials, on top of collecting and storing non-hazardous and hazardous waste. In 2010, the company became an eligible producer and signed an Electricity Purchase Contract with HROTE. The facility's power plant is incentivized. Their main production comes from solid biomass. The power plant (Energana Varaždin) has a planned capacity of 2,740 kW.

Centre for energy sector investments

www.cei.hr

The Centre for Monitoring of the energy sector and investment (CEI) was founded in March 2012. Its goal is to provide transparent management, monitoring and implementation of the Croatian energy strategy and to implement a systematic way to monitor and support the conduct of state investments and state enterprises. Similar bodies exist in Australia, Italy, France and Germany, where the need to implement national energy strategy and investment control and water in one place has already been recognised.

HSUSE – Croatian Association for Solar Energy

www.hsuse.hr

The Croatian Association for Solar Energy (HSUSE) was created in 2004 and is located in Zagreb. Its main objectives include:

- The promotion of the use of solar energy at local, regional and global levels;
- The establishment of a data bank of all installed projects that use solar energy, with a particular emphasis placed on the ecological value;
- An active participation in all projects that use renewable energy sources.

To achieve the above objectives the Association pursues the following activities:

- Education and counselling on the use of solar energy by organizing courses, workshops, panel discussions, seminars, conferences and other meetings, and through the media,
- Cooperation with domestic and international institutions regarding the use of solar energy
- Link between business, research institutions, local communities, government bodies and other entities on projects that use solar energy,
- Promotion and use of other renewable energy sources, energy efficiency and rational use of energy and other technologies and measures that contribute to sustainable development and reducing environmental pollution.

The association will also use other media (internet sites, periodicals, newsletters, posters, etc.) in accordance with the regulations on public information and publishing activities.

Electricity Infrastructure

The Croatian power system comprises plants and facilities for electricity production, transmission and distribution in the territory of the Republic of Croatia. For the security reasons, quality of supply and exchange of electricity, the Croatian power system is interconnected with the systems of neighboring countries and together with them it is connected into the synchronous network of continental Europe. Customers in Croatia are supplied with electricity from power plants in Croatia, from power plants built in neighboring countries for Croatia's needs and with electricity procured from abroad.

By its size, the Croatian power system is one of the smallest power systems in Europe. Due to its geographical position and location of generating plants, electricity is transported for most of the year from the south to the north and vice versa, and from the north toward the east.

By putting into operation the newly constructed 400/220/110 kV Žerjavinec substation and the reconstructed 400/110 kV Ernestinovo substation, transmission capacity, security and reliability of the power system have significantly increased, especially in its northwestern and eastern parts.

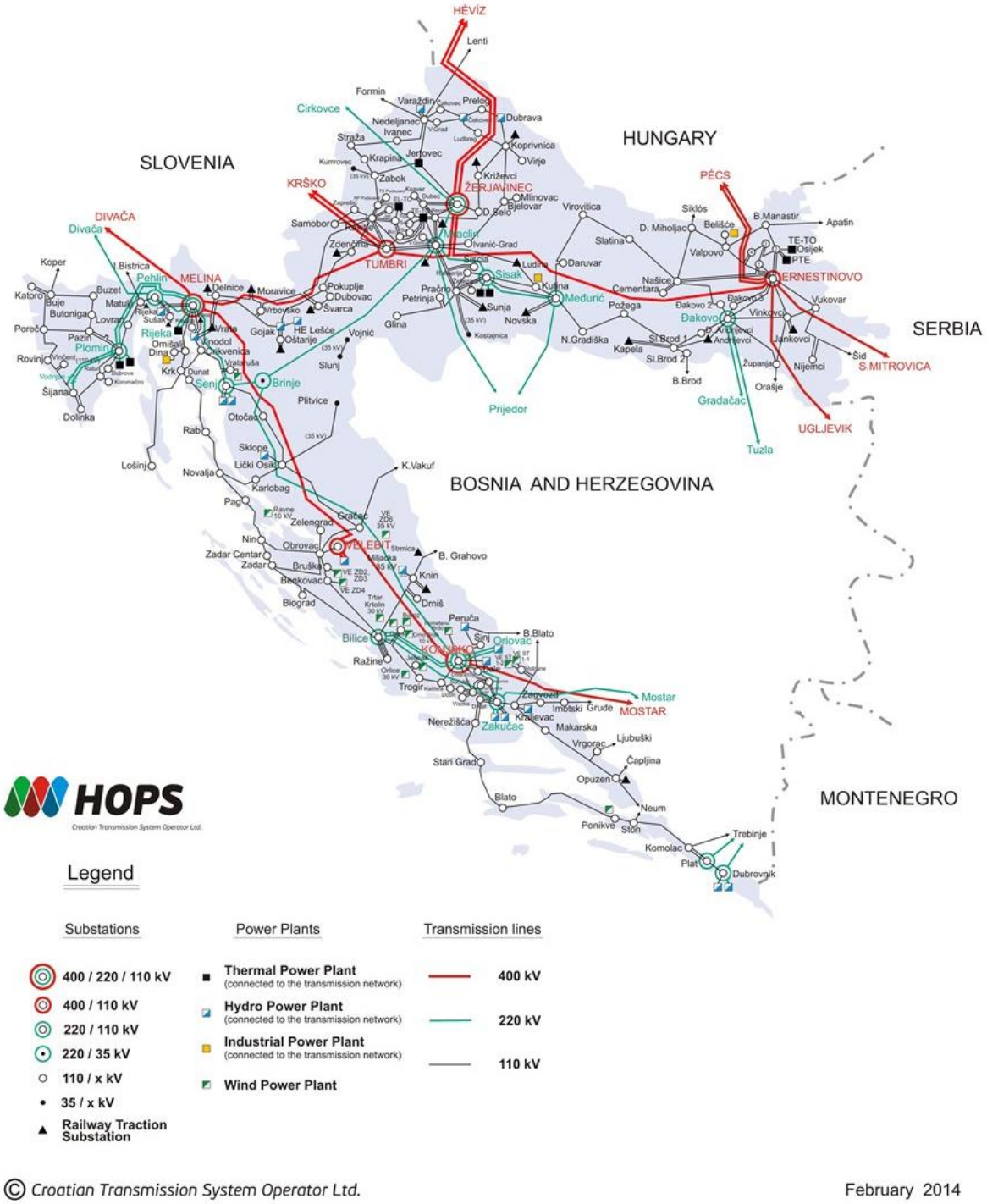
By reconnecting the UCTE synchronous zones 1 and 2, the Croatian power system has become a transit system again.

The Croatian power system is a control area by HOPS. Together with the Slovenian power system and the power system of Bosnia and Herzegovina it constitutes the control block SLO – HR – BIH within the ENTSO-E association.

The transmission network is a part of the Croatian power system and comprises transformer substations, switchyards, overhead lines and underground cables.

Electricity is transmitted through the network of 400, 220 and 100 kV voltage levels.

CROATIAN TRANSMISSION SYSTEM SCHEME



Conventional Electricity Market

Adoption of the Energy Act, the Act Amending the Energy Act, the Electricity Market Act and the Energy Activity Regulation Act created necessary conditions for gradual opening of the national electricity market.

There is only one electricity market in Croatia. In the initial phase of the market opening, the model of bilateral market has been chosen and the electricity trading has been carried out through bilateral contracts.

Electricity Market Rules regulate relations and activities in the electricity market, as well as determine obligations and duties of market participants in the process of electricity trading.

These Rules are binding for all electricity market participants.

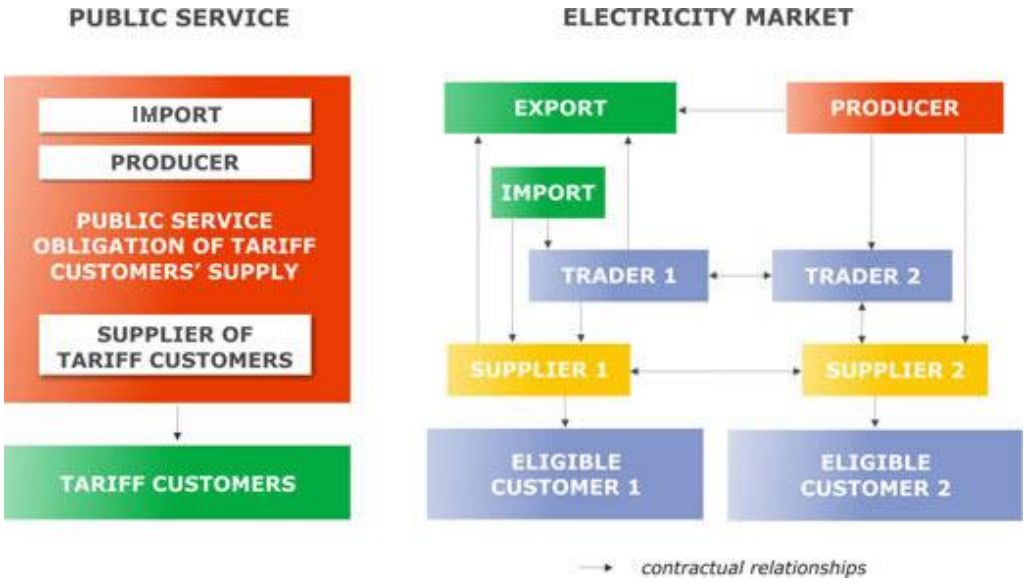
Market model

The framework for performing energy activities in the electricity market is established by energy related acts, while secondary legislation elaborates legal provisions.

In Croatia we distinguish:

- public service obligation of tariff customers' electricity supply,
- electricity market.

According to the Electricity Market Act, tariff customers are supplied by the energy entity having public service obligation of tariff customers' electricity supply. This task is performed by the HEP Group. Electricity prices for tariff customers are regulated by the Energy Act and the Tariff System for Energy Activities Performed as Public Services. The number of tariff customers shall decrease by gradual market opening.



Model of bilateral market, which is chosen in Croatia, is based on electricity trading through bilateral contracts. Contractual parties in the electricity supply contract are the

customer and the supplier. Bilateral contracts concerning electricity trade (purchase or sale) are concluded between the supplier, the trader or the producer. Besides the supply contract or the electricity trade contract, the eligible customer and producer shall conclude a contract for using the network with Croatian Transmission System Operator (CTSO) or with HEP-Operator Distribucijskog Sustava (Distribution Systems) (HEP-DSO) depending on the voltage level the eligible customer is connected to.

CTSO is in charge of procuring electricity necessary for system balancing. Each producer, supplier and trader is responsible to CTSO for deviations from its contractual schedule.

Market participants

A market participant in the Croatian electricity market is any producer, supplier, trader or eligible customer.

A producer, supplier and trader must have a license for performing energy activity, issued by the Croatian Energy Regulatory Agency.

The organization of the electricity market, electricity transmission and distribution are regulated activities performed as public services:

- HROTE is responsible for the organization of the electricity market,
- Croatian Transmission System Operator (CTSO) is responsible for electricity transmission, maintenance, development and construction of transmission system, and power system control,
- HEP-Operator distribucijskog sustava (HEP-DSO) is responsible for electricity distribution, maintenance, development and construction of distribution system.

Regulated energy activities performed as public services also include electricity production for tariff customers and electricity supply of tariff customers. Both activities are performed by HEP Group as a part of a common and integral task of the energy entity having public service obligation of tariff customers' electricity supply.

Source: www.hrote.hr/default.aspx?id=97

Ownership

The **Electricity Market Act** outlines the dynamics of electricity market liberalization. Two customer groups are identified in Croatia: **eligible and tariff customers**. However, since July 2008 all customers are deemed eligible customers and can choose a supplier on a free market and negotiate the electricity price. The Electricity Market Act also introduces the concept of a **privileged producer**, a status that can be obtained by a producer which simultaneously produces electricity and heat in an individual generation facility or utilises waste or renewable energy sources in an economic way while taking into account environmental protection measures.

However, the Croatian **energy sector is characterized by its monopolistic nature**, i.e. the State owns or is the majority shareholder for electricity production, transmission, distribution and operation. Nonetheless, specific energy sub-sectors, such as natural gas

distribution or retail sale of petroleum products, together with the distribution of LPGT, are still partially in the hands of private market actors.

In accordance with the energy legislation, **Hrvatska Elektroprivreda d.d. (HEP)** was transformed in 2002 into the **HEP Group**, a system of affiliated companies performing core electric activities and auxiliary activities. The HEP Group is a holding consisting of the parent company (HEP) and its subsidiary companies over which HEP exercises prevailing control: HEP Production, HEP Transmission, HEP Distribution, HEP Supply, HEP Gas, HEP District Heating, Sisak District Heating. The privatization of HEP has been performed in accordance with the HEP Privatization Act.

T.E. Plomin d.o.o. is a joint venture between RWE Power AG and HEP, is privately-owned and financed, and is responsible for electricity generation at **Plomin 1 & 2 thermal power plants**[1].

Competition

The competition in power generation was introduced by the **Law on Electricity Market,** which was first introduced in 2001. The Electricity Market Act defines the role of the distributions system operator, the transmission system operator, the market operator and the provider. The energy activities are performed as market activities (generation of electricity for privileged buyers, supply of electricity to privileged buyers, and marketing, intermediation and representation on the electricity market) and as regulated activities which are performed as public services (generation of electricity for tariff buyers, transmission of electricity, distribution of electricity, management of the electricity market, and supply of electricity for tariff buyers).

As part of the process of harmonisation of the Croatian legal framework with the Third Energy Package, on 22 February 2013 a new Electricity Market Act was adopted and, immediately after that, the new Gas Market Act.

Due to the process of harmonisation with EU rules, the new Energy Efficiency Act and the new Heat Energy Market Act were adopted. In addition, changes in bylaws concerning Feed-in Tariffs and licensing of electricity market participants occurred as well.

In 2015, a new act was introduced. According to the proposed amendments, the act introduces an obligation by system operators to adopt business plans (annual, 3-year and 10-year) that are to be submitted to the Croatian Energy Regulatory Agency (HERA).

Regarding the procurement of goods, works, and services related to the construction and maintenance of their energy networks that are financed from connection fees, the act stipulates that the transmission system operator or distribution system operator is obliged to act in accordance with the provisions of the Public Procurement Act.

[1] Source: www.reegle.info/policy-and-regulatory-overviews/HR#ownership

The transmission or distribution system operator is determined to be responsible for any change in energy suppliers. It stipulates that the contract with the former supplier is terminated on the date that the contract with the new supplier takes effect. This will allow the transition process between suppliers to run more smoothly and with less legal obstacles.

In order to balance the energy market, the act stipulates that the transmission system operator buys and sells electricity from participants in the electricity market according to measured economic priorities.

The act increases consumer rights in the area of resolving complaints. The supplier shall efficiently resolve consumer complaints, including out-of-court settlements, and is required to provide an annual report on these activities to the HERA.

In June 2013, two new power retailers entered the market offering electricity to customers connected to the distribution network. The response of small customers and households at first seemed high, although the actual switching rate is unclear. This development is significant given that the price for household customers remains fully regulated. Recently the competition for customers gained momentum. Operators launched advertising campaigns, promising savings on energy bills of 30%. Though the Croatian regulator issued 15 electrical energy supply licences, the two companies leading the campaign for swapping suppliers are Slovenia's GEN-I and Germany's RWE. In practice, supplier switching rules are yet to be developed.[2]

However, the HEP Group still has a factual monopoly in transmission, distribution and sale of electricity, as only members of the HEP Group have been granted permits for the performance of activities of transmission of electricity, distribution of electricity, managing of electro-energetic systems, and organisation of electricity market[3].

Electricity Generation in Croatia

Electricity generation capacities

The installed electricity generating capacities in the Republic of Croatia include hydro and thermal power plants owned by the HEP Group (Croatian Power Company), a certain number of industrial power plants and a few privately owned power plants (wind power plants, small hydro power plants).

HEP's electricity generation capacities

Electricity generation capacities within the HEP Group consist of 16 locations with hydro power plants, 7 locations with thermal power plants and one half of the installed capacities of the nuclear power plant Krško (located in the territory of Slovenia). Thermal power plants are gas-fired, coal fired and fuel oil fired. The majority owner of the generation capacities in the Republic of Croatia is HEP d.d.

[2] https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_croatia.pdf
[3] Source: www.reegle.info/policy-and-regulatory-overviews/HR#competition

The facilities that are not fully owned by HEP d.d. are the following:

- NE Krško d.o.o. (Nuclear power plant Krško Ltd.) is under the joint ownership of the HEP d.d. (50%) and the Slovenian company ELES GEN d.o.o. (50%)
- TE Plomin d.o.o. (Thermal power plant Plomin Ltd.) is under the joint ownership of the HEP d.d. (50%) and the German company RWE Power (50%). HEP Proizvodnja d.o.o. (HEP Generation Ltd.) won a management, operations and maintenance contract for the thermal power plant Plomin.

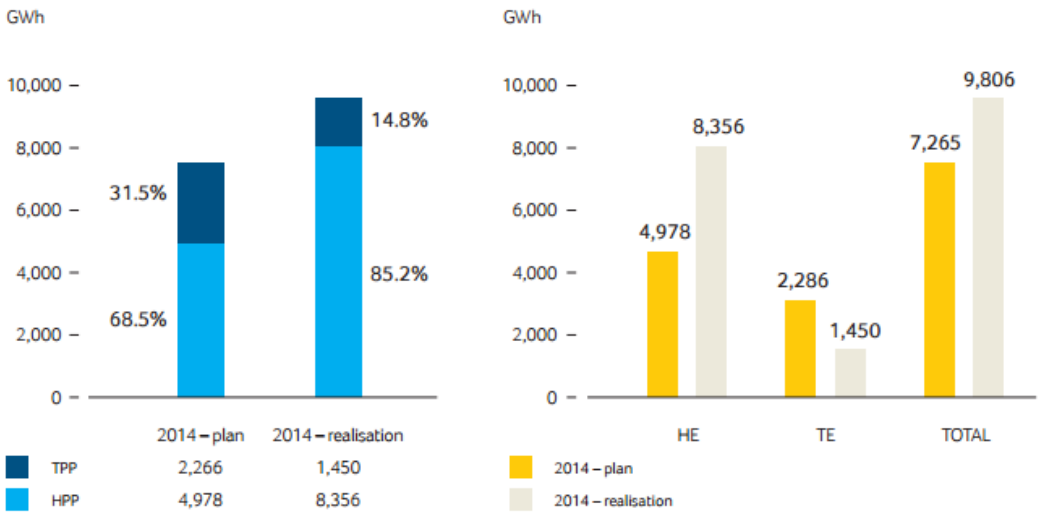
Total available capacities of all HEP's power plants in the Republic of Croatia amount to 3 653.22 MW (including TPP Plomin and excluding NPP Krško)

- Total capacities serving the needs of the Croatian electric power system amount to 4 001.22 MW (with 50% of Krško capacities).
- Out of this amount:
    - 1 565 MW is placed in thermal power plants (including TPP Plomin and excluding NPP Krško);
    - 2 088.22 MW in hydro power plants;
    - 348 MW in the nuclear unit Krško (50% of total available capacity).

These capacities do not include generating units in other countries from which the Croatian electric power system has the right to withdraw electricity on the basis of capacity lease and share-ownership arrangements.

Total electricity production capacities in HEP Group ownership

In 2014, HEP Generation power plants produced the total of 9,805.6 GWh of electricity. Hydro and thermal generation accounted for 8,355.8 GWh or 85.2% and 1,449.8 GWh or 14.8%, respectively. Compared to the 2014 planned generation, total recorded generation was 35% higher including 68% higher hydro and 37% lower thermal generation.



In 2014, total electricity turnover (sale domestically and abroad) amounted to 19 TWh, of which 14.3 TWh was generated in power plants fully or partially owned by HEP Group, while the remaining portion was procured on the market. 16.9 TWh was allocated for the needs of domestic customers and cove- ring the network losses, while 2.1 TWh was sold on neighbouring markets. Gross domestic electricity consumption was reduced by 2.2%.

Type of the plant	Eligible producers No. of power plants:	Project holders No. of power plants:
Wind power plants	18	11
Solar power plants	1213	16
Hydro power plants	8	10
Biomass power plants	10	54
Biogas power plants	18	29
Cogeneration power plants	5	0
Geothermal power plants	0	1
Landfill gas power plants	1	0
Sewage gas power plants	1	0
Total	**1274**	**121**

Type of the plant	Eligible producers Installed capacity (kW)	Project holders Installed capacity (kW)
Wind power plants	383.750	360.200
Solar power plants	43.985	10.995
Hydro power plants	2.987	4.932
Biomass power plants	24.585	93.758
Biogas power plants	20.934	28.034
Cogeneration power plants	13.293	0
Geothermal power plants	0	10.000
Landfill gas power plants	3.000	0
Sewage gas power plants	2.500	0
Total	**495.034,00**	**507.919,00**

Type of the plant	Production (kWh)
Wind power plants	52.907.441
Solar power plants	2.397.998
Hydro power plants	1.108.748
Biomass power plants	12.920.044
Biogas power plants	16.288.881
Cogeneration power plants	347.988
Geothermal power plants	0
Landfill gas power plants	1.166.720
Sewage gas power plants	17.070
Total	**87.154.890**

Source: www.hrote.hr/default.aspx?id=128

Hydro power plants	Available capacity (MW) / (-MW pumping regime)	Hydro power plants	Available capacity (MW)
Storage		Run-of-river	
HE Zakučac	522*	HE Varaždin	92.46
RHE Velebit	276 (-240)	HE Dubrava	79.78
HE Orlovac	237	HE Čakovec	77.44
HE Senj	216	HE Gojak	55.5
HE Dubrovnik	108+120	HE Rijeka	36.8
HE Vinodol	90	HE Miljacka	24
HE Peruća	61.2	HE Jaruga	7.2
HE Kraljevac	46.4	HE Golubić	6.54
HE Đale	40.8	HE Ozalj	5.5
HE Sklope	22.5	HE Krčić	0.34
CS Buško blato	7.5/4.2/(-10.2/-4.8)	HE Lešće	41.2
CHE Fužine	4.6/(-5.7)	HE Lešće ABM	1.09
HE Zavrelje	2		
RHE Lepenica	0.8 (-1.2)		
HE Zeleni vir	1.7		

CS: pumping station CHE: pumped storage RHE: reversible pump turbine

* The capacity following the Unit A revitalization has still not been confirmed by acceptance testings.

** During revitalization of HE Dubrovnik, shared 50%-50% generation was agreed

Thermal power plants	Net available capacity (MW,MWT,T/H)	Fuel
TE Sisak	396 / 0 / 96	oil/natural gas
TE-TO Zagreb	422 / 743 / 360	oil/natural gas
TE Rijeka	303	oil
TE Plomin (A)	105	coal
EL-TO Zagreb	88.8 / 347 / 377	oil/natural gas
TE-TO Osijek	90 / 139 / 150	oil / natural gas/extra light oil
KTE Jertovec	74	natural gas/extra light oil
TE PLOMIN (B)*	192	coal

* Owned by TE Plomin d.o.o. (HEP : RWE Power - 50% : 50%); HEP-Proizvodnja d.o.o. – O&M contract

Renewable Energy Market

Regulatory framework

On September 1st, 2015 the Croatian Government initiated an urgent legislative procedure before the Croatian Parliament for the adoption of the Act on Renewable Energy Sources and High Efficient Cogeneration ("Act"). The Act has been adopted at the extraordinary session of the Croatian Parliament on September 10th, 2015 and on September 19th, 2015 it has been published in the Croatian Official Gazette nr. 100/2015.

The new Act aims to:

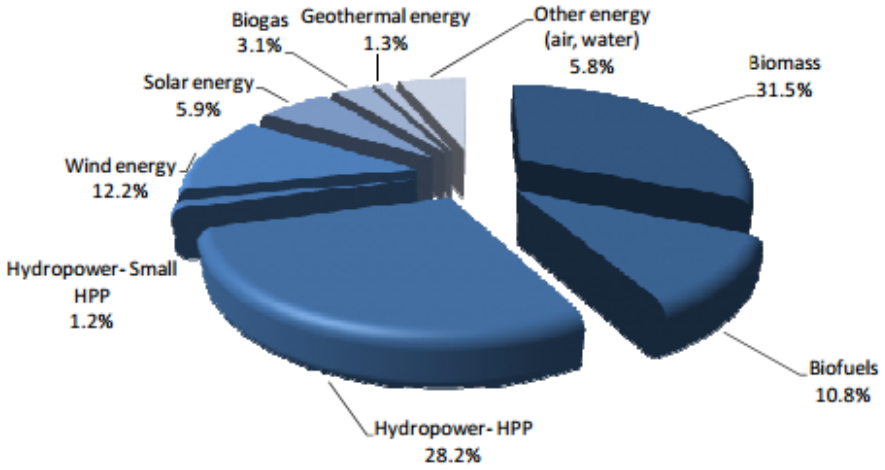
- incentivize production and consumption of electric energy produced in renewable energy power plants;
- determine electricity production improvement measures;
- define possibilities of construction of electricity production facilities on the state property;
- regulate the management of a register of projects, project developers and preferential producers;
- stimulate international cooperation in the field of renewable energy.

Regarding the issue of feed-in tariffs (FIT), the incentive price was judged to be relatively high, and for some technologies even higher than in other European countries. The act introduced changing the model of incentives. Instead of the present feed-in tariff system, a new concept of market premium model is introduced.

The new Act foresees that the Croatian Government will determine the quota for incentivizing electrical energy production from renewable energy and cogeneration for the 2016 – 2020 year period.

Source: www.zuric-i-partneri.hr/news.aspx?newsID=275&pageID=17

FORECAST OF THE RENEWABLE ENERGY SOURCES STRUCTURE TO 2020



Share of energy from renewable sources in gross final consumption of energy, %

		2011	2012	2013	2014	2011-2012 average	2013-2014 average	S_{2005}	2011-2012	indicative 2013-2014	trajectory 2015-2016	2017-2018	2020 target	
EU-28	EU-28	13.1	14.3	15.0	16.0	13.7	15.5	:	:	:	:	:	20	EU-28
BE	Belgium	6.2	7.2	7.5	8.0	6.7	7.8	2.2	4.4	5.4	7.1	9.2	13	BE
BG	Bulgaria	14.3	16.0	19.0	18.0	15.2	18.5	9.4	10.7	11.4	12.4	13.7	16	BG
CZ	Czech Republic	9.5	11.4	12.4	13.4	10.5	12.9	6.1	7.5	8.2	9.2	10.6	13	CZ
DK	Denmark	23.5	25.6	27.3	29.2	24.6	28.2	17.0	19.6	20.9	22.9	25.5	30	DK
DE	Germany	11.4	12.1	12.4	13.8	11.8	13.1	5.8	8.2	9.5	11.3	13.7	18	DE
EE	Estonia	25.5	25.8	25.6	26.5	25.7	26.0	18.0	19.4	20.1	21.2	22.6	25	EE
IE	Ireland	6.6	7.1	7.7	8.6	6.9	8.2	3.1	5.7	7.0	8.9	11.5	16	IE
EL	Greece	10.9	13.4	15.0	15.3	12.2	15.2	6.9	9.1	10.2	11.9	14.1	18	EL
ES	Spain	13.2	14.3	15.3	16.2	13.8	15.8	8.7	11.0	12.1	13.8	16.0	20	ES
FR	France	11.1	13.4	14.0	14.3	12.3	14.2	10.3	12.8	14.1	16.0	18.6	23	FR
HR	Croatia	25.4	26.8	28.1	27.9	26.1	28.0	12.6	14.1	14.8	15.9	17.4	20	HR

Share of electricity from renewable sources in gross electricity consumption (%)

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EU-28	EU-28	14.4	14.9	15.4	16.1	17.0	19.0	19.7	21.7	23.5	25.4	27.5
BE	Belgium	1.7	2.4	3.1	3.6	4.6	6.2	7.1	9.1	11.3	12.4	13.4
BG	Bulgaria	9.1	9.3	9.3	9.4	10.0	11.3	12.7	12.9	16.1	18.9	18.9
CZ	Czech Republic	3.6	3.7	4.0	4.6	5.2	6.4	7.5	10.6	11.6	12.8	13.9
DK	Denmark	23.8	24.6	24.0	25.0	25.9	28.3	32.7	35.9	38.7	43.1	48.5
DE	Germany	9.4	10.5	11.8	13.6	15.1	17.4	18.1	20.9	23.6	25.3	28.2
EE	Estonia	0.6	1.1	1.5	1.5	2.1	6.1	10.4	12.3	15.8	13.0	14.6
IE	Ireland	6.0	7.2	8.7	10.4	11.2	13.4	14.5	17.2	19.5	20.8	22.7
EL	Greece	7.8	8.2	8.9	9.3	9.6	11.0	12.3	13.8	16.4	21.2	21.9
ES	Spain	19.0	19.1	20.0	21.7	23.7	27.8	29.8	31.6	33.5	36.7	37.8
FR	France	13.8	13.7	14.1	14.3	14.4	15.1	14.8	16.3	16.4	16.8	18.3
HR	Croatia	35.5	35.8	35.2	34.0	33.8	35.9	37.6	37.6	38.8	42.2	45.3

Source: Eurostat

Economic actors

Business interests can be a motor for RES development as companies may lobby the government for better RES policy. Technical capacities also play a role, especially given the "national component" of the Croatian legislation. The *Renewable Energy Association of the Chamber of Economy* is an independent national organization of business entities established in 2003 and current membership is made up of 132 companies. The main aim of the association is to promote RES utilisation in Croatia, which is a sign for the interest of business in RES. There are several companies active in the field of RE technology. Končar, one of the main Croatian electro-technical companies, developed a wind turbine with 1 MW capacity.

Končar is currently investing in its own wind park in order to get references for further business undertakings. It is also developing a PV system. The business community recognizes that RES open the development for small investments and that this sector has a significant business potential.

Three producers of PV modules exist in Croatia, two of them founded after 2000.

The traditional energy monopolies are still existent in Croatia and, due to their inherent organization and tradition, a very centralized approach is still applied. They are still very close to government and thus an influential lobby. The market is not yet fully liberalized and in the field of electricity, the Croatian electricity provider HEP is still the majority player.

The strongest lobby in the RES sector are wind companies. The wind lobby was for example very much involved in the formulation of the secondary legislation. Foreign investors, coming mainly from Germany, are playing an important role and are one of the main driving forces for RES development in Croatia.

Installed capacity

At the beginning of August 2015, in Croatia there were 1,207 power plants which use renewable energy sources, while the total capacity of these plants was 430.88 MW, reported by the Croatian Energy Association. The Association conducted its research based on data released by the Croatian Energy Market Operator.

Compared to the last report of the Croatian Energy Association published at the end of January 2015, it is an increase of 137 power plants and 18.28 MW. The energy system now has 130 new solar power plants, one hydroelectric plant, three plants which use biomass and three biogas power plants.

As far as installed capacity is concerned, the top spot belongs to 16 wind power plants with a total of 339.25 MW, while the second place is reserved for 1,115 solar power plants with a total of 40.39 MW. Compared to the last report, the third place, which was firmly held by cogeneration plants, has now been taken over by biogas power plants with a total installed capacity of 15.93 MW.

By installed capacity, the biggest single plant which uses renewable energy sources is the "Wind Farm Velika Glava, Bubrig i Crni Vrh", with the installed capacity of 43 MW. It is

projected that soon another 138 plants with total power of 502.61 MW will start to operate.

The Croatian Energy Association warned that National Action Plan for Renewable Energy 2020 sends a very clear message to investors that the incentives for the construction of plants using renewable energy sources are almost spent. According to the document, quotas for wind power and solar power have been completely used up, and there are just a small number of biogas plants, geothermal plants and biomass power plants which can be built using government incentives.

The Association believes that this should not discourage investors from continuing to develop renewable energy in the context of technical or market constraints. The produced energy can be used for their own use or for sale at the average market prices. The Association expects that soon a new law on renewable energy sources and efficient cogeneration will be passed, which should open a way for further development of this sector in Croatia.

Source: www.total-croatia-news.com/business/524-renewable-energy-on-the-rise-in-croatia

Croatia Renewable Capacity over a 5 year period					
Year	Installed MW	Added MW	Final MW	Growth %	% Total
2007	1,821	-22	1,799	-1.21%	46.06%
2008	1,799	1	1,800	0.06%	46.05%
2009	1,800	5	1,805	0.27%	46%
2010	1,805	41	1,846	2.25%	46.47%
2011	1,846	75	1,921	4.07%	47.39%

Growth % = Year on Year Growth | % Total = % Total Capacity.

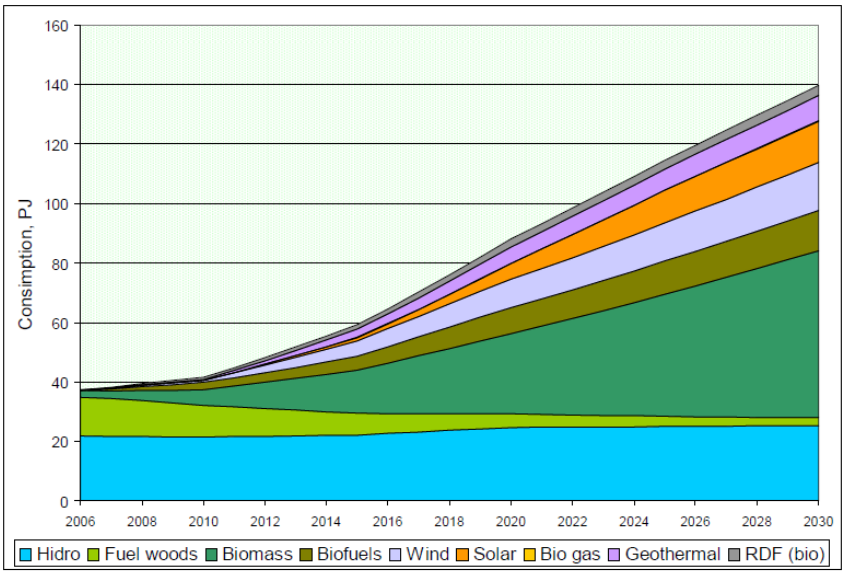
		2010.	2020.	2030.
Biomass	[PJ]	18,14	36,27	68,72
Biofuel	[PJ]	2,50	9,55	14,35
Wind energy	[PJ]	1,02	9,50	15,84
Hydro power – small HEPP	[PJ]	0,40	0,97	1,55
Hydro power – Large HEPP	[PJ]	21,06	23,76	23,76
Geothermal energy	[PJ]	0,15	5,51	8,54
Solar energy	[PJ]	0,51	5,27	13,87
TOTAL	[PJ]	43,78	88,42	146,63
	[t_{oe}]	1 042 000	2 105 000	3 491 000

F

Forecast of RES structure to 2020 (with a view to 2030)

Source: Green Book. *Upgrade of the Energy Strategy and of the implementation programme of the Republic of Croatia*. Ministry of Economy, Labour and Entrepreneurship, and UNDP.

Structure of renewable energy sources to 2020 (with a view to 2030)



Biomass

In the time of increasing price of fossil fuels more and more countries are turning to the renewable resources of energy, especially to biomass, for production of heat and electricity. Biomass fuels used in the production of heat and electricity are wheat, oat, and barley straw corn stover and wood chips from forest residual and wood industry. The estimated potential of biomass relates to the use of wood biomass and biomass from agriculture as well as the possibility of cultivating wood biomass.

Wood biomass which is obtained from wood falling during maintenance of waterways and electricity complexes (waterways, protected transmission corridors and electricity distribution lines) as well as protected road corridors and finally possible agricultural residue are considered.

Conversely, agricultural residue can only be partially used (not more than 30%), because residue must be returned to agricultural fields to ensure a balance in minerals. Agricultural residue is complex and includes residue from orchard and vineyard pruning as well as olive pips, sunflower seed shells, hay, etc.

In accordance with the goals of the Strategy of Waste Management, waste potential of biological origin for the energy production has been particularly valuated.

Croatia belongs among the countries of large biomass potential.

It is possible to use available biomass with various techniques to transform it into electricity and/or internal energy (heat) or to refine it for commercially acceptable forms of energy (pellets, briquettes and wood coal). Part of biomass could be used for production of biofuels of the second generation.

Source: ENERGY STRATEGY OF THE REPUBLIC OF CROATIA

Wood pellet is an environmentally acceptable product and its production significantly contributes to rural development and sustainable approach to the management of timber resources, but at the same time this important energy source is neglected in strategic planning and energy policies.

Croatian wood pellets producers with a potential production of 260, 000 tonnes so far have been forced to export. In 2014, 92% of total Croatian wood pellet production was export to foreign markets. The main reason for this market situation is that Croatian market (public institutions and private persons) is not yet enough informed about scope of wood pellet usage and it advances in the contacts of ecology and green economy.

Source: http://bib.irb.hr/prikazi-rad?rad=781426

No.	Sort of biomass	Volume	Density	Mass	Net calorific value	Energy
		m^3/ year	kg/m^3	t/year.	kWh/kg	PJ
1	Cord wood	1.889.551	730	1.379.372	4,90	24,33
2	Wood residue	700.928	700	490.650	4,90	8,65
3	Abbaino	207.306	550	114.018	4,90	2,01
4	Wood industry residue	1.389.000	730	1.013.970	4,90	17,89
5	Water management, Roads and HEP	400.000	680	272.000	4,90	4,80
6	Agro residue	2.888.000	450	1.299.600	4,90	22,93
7	Total	7.474.785	-	4.569.610	-	80,62
8	Energy forests	1.000.000	730	730.000	4,90	12,88
9	Total	8.474.785	-	5.299.610	-	93,49

The following table shows the total estimated potential of wood biomass from forestry, industry and agriculture.

Even with the most favourable incentive measures it cannot be expected that all theoretically available biomass can be exploited. A portion of biomass will be used to produce second generation biofuel. Croatia's national energy strategy marks a clear objective:

- From the total available biomass potential described above, 72% will be exploited for energy purposes and the use of biomass will as of today, continue to grow to reach this rate in 2030.
- As the application of any new technology requires a period of "a running start", before any major thrust is made on the market it is assumed that it would be up to 40% by 2020 (without accounting for energy forests).

It is possible to use available biomass with various techniques to transform it into electricity and/or internal energy (heating) or to refine it for commercially acceptable forms of energy (pallets, briquettes and wood coal).

With the current incentive measures, and taking into account a further removal of institutional barriers, the total amount of power to be produced in several biomass fired power plants could amount to about 140 MW. After 2020 it will be necessary to balance

energy available from energy forests and in 2030 the installed power in biomass fired power plants could present amount to 420 MW.

The following objectives are defined with the presumptions that can be included into incentive measures in government industrial, agricultural and energy policies in the following period:

- Motivate development of the Croatian wood processing industry by creating favourable conditions for private investment into this branch with the aim of reducing exports of trunks from Croatia and instead exporting products of a higher degree of manufacturing;
- Develop forestry and facilitate all forest residues to be utilized as is the case in EU countries.
- Without proper organization in the forestry industry, forest residue will only partially be utilized and will rot at the detriment of forests themselves and the surrounding environment (CH4 emissions);
- Motivate forest cultivation and energy forest cultivation on retarded forest areas; and
- Motivating biomass fired cogeneration plants for heat and electricity production.

Evolution of renewable energy in Croatia				
Years	2011	2012	2013	2014
Total renewable energy (MW)	2286	2343	2439	2546
Total hydropower (MW)	2141	2141	2141	2141
Total wind energy (MW)	131	147	147	147
Total bioenergy (MW)	14	18	24	25

http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Capacity_Statistics_2015.pdf

Biofuels

Biofuel essentially relates to biodiesel and bioethanol. Biodiesel is made out of oil plants while ethanol is obtained from cultures rich with sugar and carbon. The most important sources of biodiesel production are: rapeseed, sunflower, soya, palm oil, waste edible oil, beef lard, etc. Below is an analysis of production potential of bioethanol from corn, wheat and barley as well as biodiesel from oil rape, Soya and residue edible oil. This next table shows possible production of biofuel in Croatia dependent on the size of cultivated areas and the yields realized on these areas.

Possible production of biofuel in Croatia from corn, wheat, barley, oil rape and Soya

	Variant 1	Variant 2	Variant 3	Variant 4
Biodiesel [t]	3 682	9 225	21 901	32 353
Bioethanol [t]	110 518	13 302	249 327	307 878
Total [t]	**114 200**	**22 527**	**271 228**	**340 231**
Total [PJ]	**3,09**	**0,69**	**7,47**	**9,41**

One other important source to produce biofuel and biodiesel could also come from edible oil. In Croatia, the average consumer produces about 2 litres of waste edible fuel per annum. The analysis of potential accounted for cities with a population of more than 20,000 residents which accounts for around 2.2 million people. The estimated potential from residue edible oil amounts to 4.4 million litres which can annually produce around 3,800 tonnes of biodiesel.

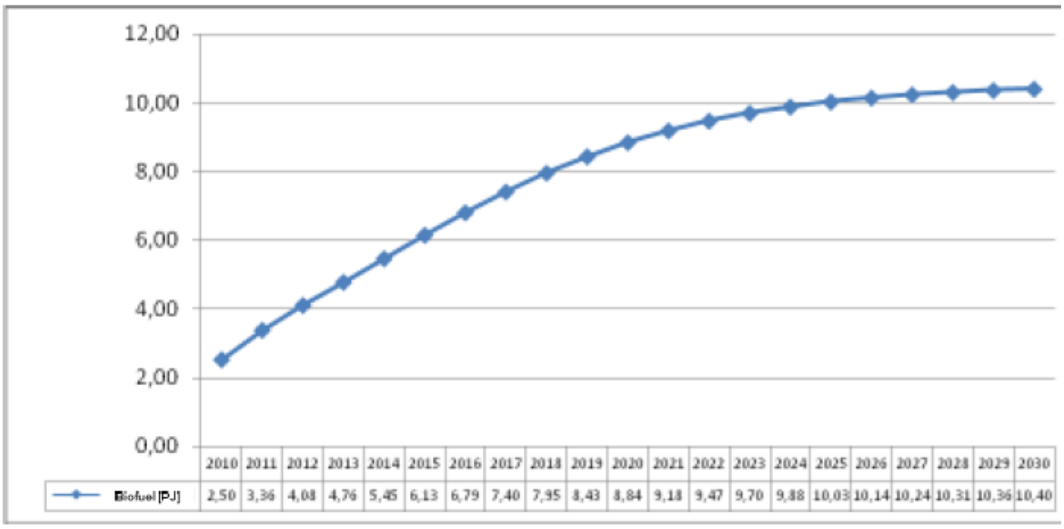
Croatia's strategic direction defined in the National Energy Strategy is to develop the renewable energy sector which comprises the rational use of renewable energy sources. Seeing that all the production variants to produce biofuel were estimated respecting the principle of primary use of agricultural to produce food and the sustainable exploitation of the soil, the objective adopted by the Strategy is to realize an annual domestic production of biofuel from grain amounting to 340,231 tonnes and an additional 3,800 tonnes obtained from waste edible oil by 2020.

After 2020 increased production of biofuel will depend on demand for that type of energy and it is expected that this will continually reach new heights due to a "growing awareness" of citizens, government incentives and/or the high price of oil derivatives. The following table and graph show the dynamics of the growing production of biofuel in Croatia to 2030.

Dynamics of the growing production of biofuel in Croatia to 2030

	2010.	2020.	2030.
Production of biofuels [t]	**90.060**	**344.031**	**380.055**
Production of biofuels [PJ]	**2,5**	**8,91**	**10,55**

Dynamics of the growing production of biofuel in Croatia to 2030



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biofuel [PJ]	2,50	3,36	4,08	4,76	5,45	6,13	6,79	7,40	7,95	8,43	8,84	9,18	9,47	9,70	9,88	10,03	10,14	10,24	10,31	10,36	10,40

Technological advances in producing second generation biofuel need to be especially pointed out. Consideration should be made of the fact that it is not possible to exploit all the available crude oil. Namely, of the total biomass that is created in fields, 40% must be returned to the soil, 30% used for fodder and on farms and the remaining 30% may be used to produce biofuel. Biomass that is produced in the fields as residue has a significant energy value. The quantity of biofuel that can be obtained from that depends on the efficiency of the technology applied to produce second generation biofuel.

In order to achieve the defined objective, it is necessary to increase the production of the observed grains in agriculture in the following combination:

- Increasing cultivated areas; and
- Intensifying production on current and new cultivated areas.

Croatia possesses a considerably larger area of arable land than the portion that is cultivated today. Therefore, it can be expected that part of this arable land could be utilized to produce corn, wheat, barley and oil rape. Nevertheless, the best quality arable land has been left to production and these areas will require significant resources to be invested (clearing scrub, cleaning water canals, clearing roads, etc.).

Measures taken by government should also motivate land owners to activate these areas by including them in direct subsidies and offering higher prices for crops. The current high price of grain can itself stimulate sowing on greater areas. However, such a situation could affect the sowing of oil plants, sugar rape, etc. The current law on agricultural land facilitates these policies, but here again provisions concerning "land taxes" on uncultivated land are currently not being implemented. It is therefore necessary to implement currently existing legislative provisions.

Considering the above and in addition to relevant policies in import/export prices, no later than 2020, Croatia could certainly produce sufficient quantities of grain and oil plants to satisfy its need to produce the estimated quantities of biofuel required.

In order to achieve this objective it is vital to increase investments into agricultural products and above all for:

- further mergers of agricultural farms; and
- to exploit productive areas primarily through change of ownership or through leasing private agricultural land.

Significant resources must be tied to compulsory reserves of vital products in order to regulate prices on the domestic market which is one of the government's functions. Equipping with modern mechanization should be facilitated under favourable conditions with expert assistance from agencies and advisory bodies, faculties, etc. Current activities to facilitate the introduction of irrigation would also contribute to accelerating increased agricultural production.

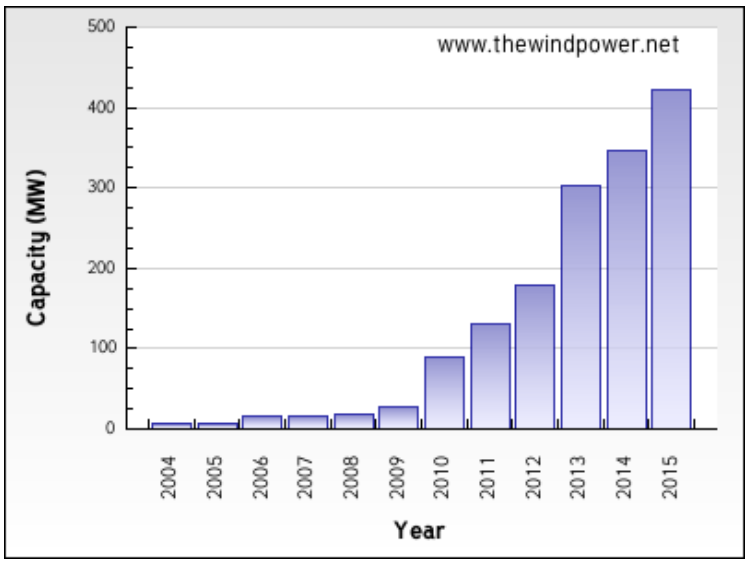
Wind power

The estimated land potential of wind power plants is presumed with the proportion of energy while the power of installed power plants is calculated so that the forecasted energy is divided by an average of 2,200 operational hours per annum.

- The natural potential of Wind Power Plants (WPP) on land in Croatia (56,542 km^2) is estimated at 120 TWh electricity per annum, which is the equivalent to 54.5 GW installed energy in wind power plants;
- Technically, land potential of WPP in Croatia is estimated to nearly 10 TWh of electricity which is equivalent to 4.54 GW of installed power in WPP;
- The presumed economic potential of wind energy in central and southern Dalmatia is estimated at 0.36 – 0.79 TWh/annum with units of 250-750 kW18. Unofficial estimates with larger units are around 1.5 to 4 TWh where the larger amount accounts for possible trading with electricity balanced out with surrounding power systems.

Production capacities

- End 2012: 180 MW (+37.5%)
- End 2013: 302 MW (+67.8%)
- End 2014: 347 MW (+15%)
- End 2015: 423 MW (+22%)



Estimated sea potential of wind power plants:

- The natural potential of WPP on the Croatian sea (territorial waters and internal waters: 61,067 km^2) is estimated at around 150 TWh electricity per annum;
- Technically, sea potential in WPP in Croatia are estimated at nearly 12 TWh of electricity per year. That is 12 times less than the average in Italy (150 TWh/annum) and around eight times less that that estimated for Greece (100 TWh/annum) which has 4 to 6 times more sea than Croatia with relatively similar meteorological conditions.

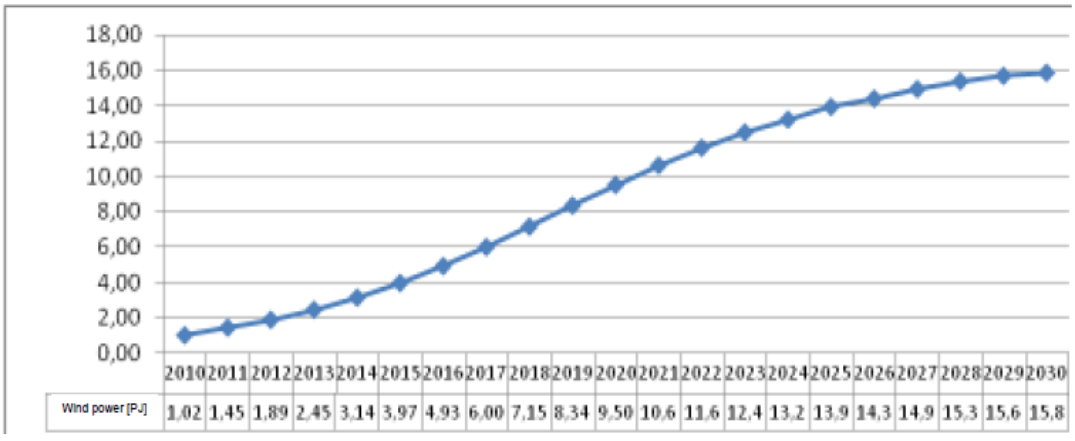
By 2020 Croatia should with its estimated 1,200 MW of installed energy per installed power in wind power plants for each 1,000 population head be close to Spain's current level of (348 kW/1000 per population head).

By 2030, Croatia should have 450 kW of installed power in WPP per 1,000 population head which is a total of 2,000 MW of installed power. It is assumed that energy balances will be achieved by trading on the open market with neighbouring power systems. Total numbers for the years observed are shown in the following table, while the growth dynamics are shown in the accompanying graph. Calculations presume that WPP will have an average of 2,200 working hours per year.

Growth dynamics of installed capacities to produce electricity in wind power plants to 2020 (with a view to 2030)

	2010.	2020.	2030.
Installed power[MW]	129	1200	2000
Production of electricity [TWh]	0,28	2,64	4,40
Production of electricity [PJ]	1,02	9,50	15,84

Growth dynamics of electricity produced in wind farms to 2020



Wind power plants are the most important RES to produce electricity in Croatia (not counting potential in existing large hydropower plants). There is great interest shown by investors which is greatly facilitated by favourable legislation and guaranteed sales prices (feed-in tariffs).

List of the 18 wind farms present in the database:

1. Danilo (43,700 kW, 19 turbines)
2. Jelinak (60,000 kW, 40 turbines)
3. Ogorje (42,000 kW, 14 turbines)
4. Orlice (9,600 kW, 11 turbines)
5. Pag (5,950 kW, 7 turbines)
6. Pometeno Brdo (17,500 kW, 16 turbines)
7. Ponikve (36,800 kW, 16 turbines)
8. Raven 1 (5,950 kW, 7 turbines)
9. Ravne Adria (11,900 kW)
10. Rudine (34,200 kW, 12 turbines)
11. Senj (42,000 kW, 14 turbines)
12. Sibenik-Knin (13,800 kW, 6 turbines)
13. ST1-1-ST1-2 (42,000 kW, 14 turbines)
14. Trtar-Krtolin (11,200 kW, 14 turbines)
15. ZD2 (18,400 kW, 8 turbines)
16. ZD3 (18,400 kW, 8 turbines)
17. ZD4 (9,200 kW, 4 turbines)
18. ZD6 (9,200 kW, 4 turbines)

Source: www.thewindpower.net/country_windfarms_en_45_croatia.php

Hydropower (small hydropower plants – SHPPs)

Small hydro power plants in Croatia refer to those with installed capacity up to 10 MW. When first researches on small hydro power plants potential began, the term small hydro power plant referred to plants with installed capacity up to 5 MW.

All data are based on 20-30 years old researches that took into account only technically exploitable potential without considering environmental constraints, economic feasibility, biological minimum, etc.

The total gross (i.e. natural) hydro potential in Croatia is around 21.7 TWh and technically exploitable (i.e. net) hydro potential is around 12.8 TWh.

Target according to National Action Plan: plants that are in operation and those that have a signed contract on the purchase of electricity with HROTE (Energy Market Operator), but are not yet in operation.

Target until 2020	Plants in operation	Projects with PPA contract
100 MW	1,482 MW	3,468 MW

PPA: Power Purchase Agreement

The incentive price for small hydro power plants according to the Tariff System ("Official Gazette", No. 133/2013)

	Plants with installed capacity up to 300 kW	Plants with installed capacity exceeding 300 kW up to 2 MW	Plants with installed capacity exceeding 2 MW up to and including 5 MW	Plants with installed capacity exceeding 5 MW up to and including 10 MW
Small hydro power plants	1,07 kn/kWh ~139 EUR / MWh	0,93 kn/kWh ~121 EUR / MWh	0,88 kn/kWh ~114 EUR / MWh	(RC) 0,53 kn/kWh ~69 EUR / MWh

Researches on the potential of small watercourses in Croatia began in the early 1980s (installed capacity up to 5 MW. A total of 130 watercourses were analysed and two major groups were defined:

- Watercourses with specific power greater than 50 kW/km
- Watercourses with modest possibilities for energy use.

The first group counts 63 watercourses that were further analysed which resulted in the estimation of their net energy potential.

Potential locations for construction of small HPPs were determined for each watercourse, as well as the corresponding potential of each location. A total of 699 potential locations were defined which resulted in a detailed spatial distribution of the gross potential of small hydro power plants. Total gross (natural) capacity of all locations on 63 analysed watercourses amounts 134.5 MW, with the corresponding gross energy potential of 1180 GWh.

Research of the potential of small water courses in Croatia was conducted through a cadastre for small water courses "Katastar malih vodnih snaga" (KMVS), which encompassed 130 water courses indicating the possible energy that could be exploited. The total gross potential of the water courses inspected was around 1,310 GWh per annum. Among these, around 1,180 GWh falls off on water courses at the defined exploitation sites and 130 GWh on water courses without defined exploitation sites. It is important to stress that locations inspected were for possible small hydropower plants (SHPPs) with powers of up to 5 MW.

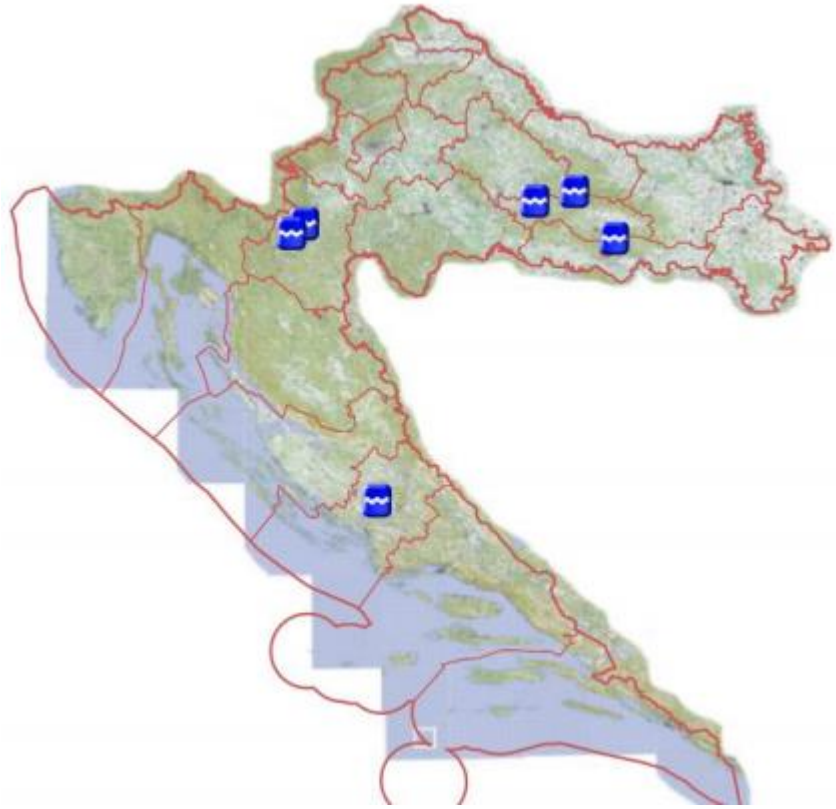
Technically exploitable potential at 699 locations inspected on 63 water courses amounted to around 570 GWh, while the installed power on a little less than 50% of these locations was estimated at less than 100 kW. Based on the KMVS, a cadastre for small hydropower plants "Katastar malih hidroelektrana" (KMHE) was prepared which signals out 67 potential exploitation locations for SHPPs along the following water courses: Boljunčica, Bijela, Bregana, Brzaja, Butišnica, Čabranka, Čučkov jarak, Jadova, Jadro, Krupa, Kupčina, Kupica, Ljuta, Orljava, Ovrlja, Ruda Velika, Rumin Veliki, Slapnica, Vitunjčica, Voćinka and Žrnovnica. The investigation determined an annual possible

production from these 67 locations at around 100 GWh. However, further analysis of the feasibility of construction as well as conditions to adapt the small hydropower plants into the local surroundings, protection of cultural-historical heritage and environmental protection significantly reduced the number of potential locations which left a total of only 6 water courses with a possible 18 exploitable locations.

The installed power of all 18 SHPPs was a little less than 2 MW, while the estimated average annual electricity generation amounted to 8.3 GWh. However, it is necessary to investigate a further 622 locations which surely offer the possibility for additional potential with regard to SHPPs.

In order to estimate the total potential in SHPPs it is necessary to estimate the potential power of SHPPs with 5 – 10 MW power. According to available data the construction of these SHPPs is foreseen with a total power of around 125 MW. Based on the use of existing SHPPs and HPPs that amounts to 0.34 of the total production of these SHPPs, it is safe to make a conservative estimate of around 300 GWh per annum. As further investigation is necessary to satisfy limiting factors and we can expect that this figure will be significantly reduced.

Projects in operation, January 2015



SHPP not belonging to HEP Group

Projects registered for development, January 2015

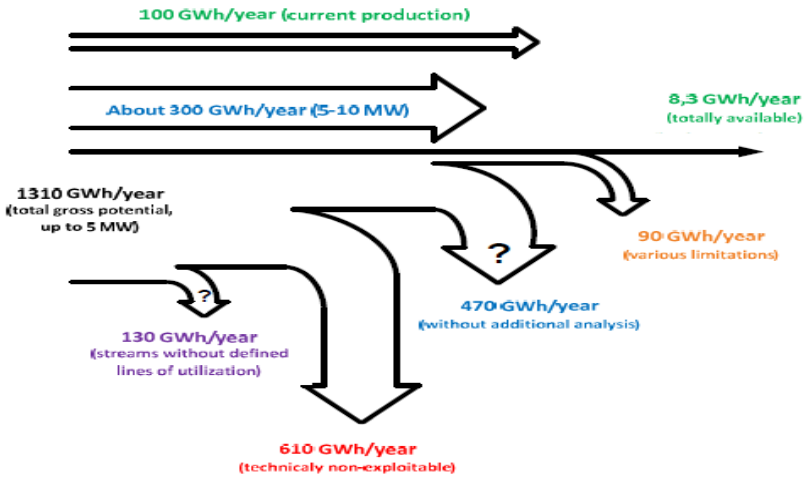
SHPP not belonging to HEP Group

Hydro power plants in the Republic of Croatia (HEP Group ownership)

Hidroelektrane Hydro power plants			
	Raspoloživa snaga Available power (MW)		Raspoloživa snaga Available power (MW)
Akumulacijske hidroelektrane Storage plants		**Protočne hidroelektrane Run-of-river plants**	
HE Zakučac	522	HE Varaždin	92,5
RHE Velebit	276/(-240)	HE Čakovec	77,44
HE Orlovac	237	HE Dubrava	79,8
HE Senj	216	HE Gojak	55,5
HE Dubrovnik	228	HE Rijeka	36,8
HE Vinodol	90	HE Miljacka	24
HE Kraljevac	46,4	HE Lešće	41,2
HE Peruća	61,2	**Male protočne hidroelektrane | Small run-of-river plants**	
HE Đale	40,8	HE Jaruga	7,2
HE Sklope	22,5	HE Lešće ABM	1,1
RHE Buško Blato	11,7/(-15)	HE Golubić	6,5
Male akumulacijske hidroelektrane | Small storage plants		HE Ozalj	5,5
		HE Krčić	0,3
RHE Fužina	4,6/(-5,7)	**Ukupno protočne Total run-of-river**	427,08
HE Zavrelje	2	**Ukupno male HE Total small HPP**	29,7
RHE* Lepenica	0,8/(-1,2)		
HE Zeleni Vir	1,7		
Ukupno akumulacijske HE Total storage HPP	1 760,70		
***RHE – reverzibilna HE | reversible HPP**		**Ukupno HE Total HPP**	2 188,5

Izvor | Source: HEP – Godišnje izvješće 2014. | HEP – Annual Report for 2014

Balance of potential in SHPPs



The remaining technically exploitable potential in small hydropower plants is less than 5 MW and amounts to 500 GHz, while the power of larger plants of 5 MW is around 300 MHz per annum, therefore a total of 800 GHz per annum.

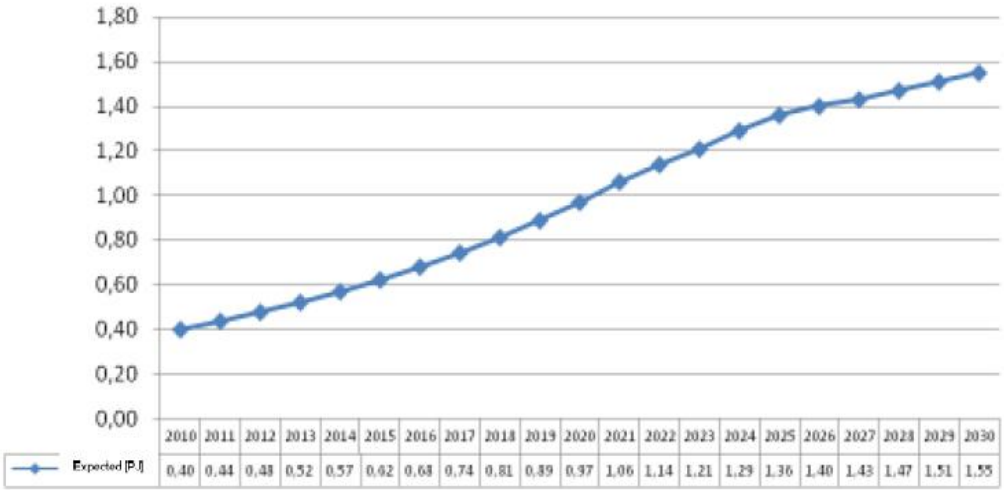
Future electricity production from small hydropower plants will depend on the factor of technically exploitable potential. There are three different cases:

- With the presumption that the factor of technically exploitable potential is equal to the presumed lower limit of 10%, additional production from new SHPPs is estimated at around 80 GHz. The total production of SHPPs is estimated at around 190 GHz in 2020;
- With the presumption that the factor of technically exploitable potential is around 20%, additional production from new SHPPs is estimated at around 160 GHz. The total production of SHPPs is estimated at around 270 GHz in 2020. That increase is supported by the fact that amongst the newly investigated sites there will not be as many that run along border regions which is a realistic assumption. This scenario is included in the Strategy;
- With the presumption that the factor of technically exploitable potential is around 40%, additional production from new SHPPs is estimated at around 320 GHz. The total production of SHPPs is estimated at around 430 GHz in 2020. This increase assumes that newly investigated sites will not be within protected regions and a greater interest of investors is presumed virtually for all the SHPPs with a power of up to 5 MW.

As such, the portion of production by SHPPs will be around 2 – 7%. Croatia's national energy strategy sets the objective of 270 GHz of electricity produced in small hydropower plants in 2020, or 430 GHz in 2030. With regard to the development of the use of energy from small water courses after 2020, if a total production of 430 GHz was to be achieved by 2020, that value would be retained in the following period due to the exploitability of available potential. If that increase is not achieved then measures should be taken to realize this object by 2030.

Growth in the exploitation of energy from small water courses in SHPPs in Croatia to 2030

	2010.	2020.	2030.
Electricity production [GWh]	110	270	430
Electricity production [PJ]	0,40	0,97	1,55



Geothermal energy

Geothermal sources are contained in the Earth's interior and are extracted via internal water energy or steam to the surface and exploited for energy purposes. Geothermal energy from natural resources for medical purposes and bathing is already in use in Croatia, and the country has a long tradition in this field. Geothermal waters in mineral springs are created by natural flows. Today in addition to natural springs, geothermal waters are exploited from shallow bores.

Exploration of oil and gas and techniques and technology to obtain geothermal energy from deep bores is well developed in Croatia. The purpose of initial exploration was to process data obtained in exploration bores with the aim of finding oil and gas reserves. This entailed certain exploration bores to be drilled in order to confirm the data obtained. Of the numerous locations explored only the following few need be mentioned, Bizovac near Valpovo, then the region between Koprivnica, Ludbreg and Legrad and the south-western outskirts of Zagreb.

The possible power of thermal power plants to transform internal hot water energy into electricity at a medium temperature in already drilled bores amounts to 11 MW, and with complete utilization of the basin, 48 MW. Low temperature potential (water at 65 - 96°C) in already drilled bores amounts to 26MJ/s (with the use of heating energy with water at 50°C) or 48MJ/s (with the use of heating energy with water at 25°C). In case of complete utilization of the basin that potential is 74MJ/s or 130MJ/s. Geothermal energy from these basins can be used for heating, hot water use and for recreation.

Potential springs at extremely low temperatures (to 65°C) in already drilled bores amounts to 9MJ/s (with the use of heating energy with water at 50°C) or 53MJ/s (with the use of heating energy with water at 25°C). This group of springs belongs to geothermal springs that are used for medical and recreational purposes as are a large number of mineral spring baths and recreational complexes. These include springs in Daruvar (Daruvarske Toplice), Ivanić Grad (Naftalan Hospital), Krapinske Toplice, Lipik (Lipičke toplice), Livade (Istarske toplice), Samobor (Šmidhen SRC), Stubičke Toplice, Sveta Jana (Sveta Jana RC), Topusko (toplice Topusko), Tuhelj (Tuheljske toplice), Varaždinske Toplice, Velika (Toplice RC), Zagreb (INA-Consulting), Zelina (Zelina RC) and Zlatar (Sutinske toplice).

The aims of this Strategy with regard to the exploitation of geothermal energy are:

- Exploiting medium temperature basins to develop business zones where geothermal power stations would be the central business complex,
- Constructing a total of 3 geothermal power plants with business zone by 2020,
- Tripling the use of internal geothermal water energy for consumer heating needs by 2020.

The exploitation of geothermal energy in Croatia will in the future be tied to complete exploitation of existing geothermal bores that were drilled on the main part to obtain oil and gas with economically feasible boring techniques.

Projects are currently being prepared regarding electricity produced using geothermal energy at the Lunjkovec-Kutnjak and Velika Ciglena bores. These are multi-purpose projects with a fundamental objective to develop business zones where the thermal power plant will be in a situation to stimulate electricity prices and as such be in a position to offer businesses in the zone a favourable price for residue heating energy and in that way attract potential investors (hot houses for horticulture, tourist-recreational contents, and fisheries).

In addition to producing electricity, geothermal energy should continue to be used for traditional purposes (i.e. tourism and recreational purposes), but also for heating, hot water, agricultural production, industrial manufacturing, fish farms, drying cement beams, etc.

The following table shows a forecast of the use of geothermal energy in Croatia. The table shows consumption for heating energy without showing consumption for recreational purposes.

Forecasted use of geothermal energy in Croatia

Structure of geothermal energy consumption	2006	2010	2015	2020	2030	2006	2010	2020	2030	2006-2020	2006-2030
	PJ	PJ	PJ	PJ	PJ	%	%	%	%	%	%
Total	**0,14**	**0,15**	**2,77**	**5,51**	**8,54**	100,0	100,0	100,0	100,0	30,3	22,5
Electricity	0,00	0,00	2,49	4,98	7,47	0,0	0,0	90,3	87,5	-	-
Households, services and other	0,14	0,15	0,28	0,53	1,07	100,0	100,0	9,7	12,5	10,3	10,4

	MWt	TJ/year
individual space heating	31.99	291.79
District heating	13.77	8.61
greenhouse	7.53	169.49
bathing and swimming	22.15	172.1
geothermal heat pumps	4.5	42.5

Total thermal installed capacity in MWt	79.94
Direct use in TJ/year	684.49
Direct use in GWh/year	190.15
Capacity factor	0.27

Source: www.geothermal-energy.org/direct_uses/croatia.html

Solar Energy

Estimates of the potential of solar energy, on the largest parts along the Croatian coastline were conducted by the National Energy Programme - SUNEN21 in 1998 for Croatia on the whole with a Solar Handbook written in 2007.

The natural potential of solar energy in continental regions of Croatia, with an average insulation of 3.6 kWh/m^2, amounts to around 74,300 TWh/annum (267.500 PJ/annum.), which is over 800 times more than the consumption of primary energy in Croatia in 2000.

The installed solar PV capacity in Croatia hit 30.3 Mw in 2015, with most of that figure being composed of rooftop projects in the range of 10–30 kW.

That number represents a big increase over earlier years because it possessd only 89.72 kilowatts of solar PV capacity at the end of 2012, but is still exponentially lower than the growth rate seen in the country's wind energy sector. This disparity is largely down to differences in investment, development funds, and incentives.

Recent months have seen slightly larger rooftop solar projects enter development. These still aren't utility-scale plants, though, being mostly in the 200 to 300 kW size range.

Croatia's current solar energy goals entail that it will install at least 52 MW of solar PV capacity by the year 2020 – this is in contrast to the country's goal of installing at least 1.2 GW (1,200 MW) of wind energy capacity by the same year.

A significant difference in goals, and an especially interesting difference when you consider that the European country actually is quite well suited to solar energy exploitation.

Based on the policies of the government there, these trends seem unlikely to change, as the feed-in tariffs there is unmistakably geared towards the development of household-scale systems, nothing larger.

The technical potential of solar energy on 1% of the continental part of Croatia is estimated at 830 TWh/annum (3,000 PJ/annum) or close to 10 times the daily consumption of primary energy in Croatia.

With the presumption that 60% of that energy is used to produce heating power and 40% to produce electricity, we can conclude the following:

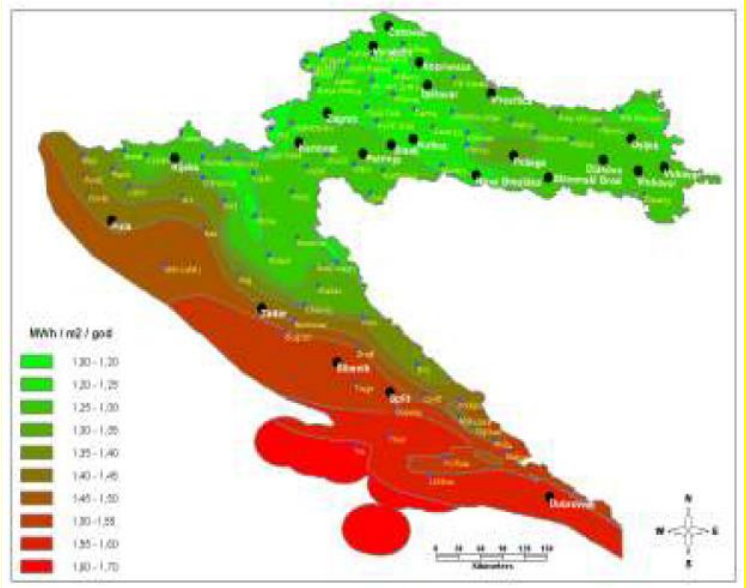
- The technical potential to produce heating power from solar collectors and the use of passive solar energy (solar architecture) amounts to 175 TWh/annum. (630 PJ/annum);
- The technical potential to produce electricity from photovoltaic (PV) systems and solar thermal power plants amounts to around 33 TWh/annum.

The economic potential of solar energy in Croatia is estimated as follows:

- Heating energy amounting to around 50% of low temperature heat in 2000 in Croatia, or nearly 12 TWh/annum (43.2 PJ/annum.), the production of heating energy from solar collectors and passive use of solar energy (solar architecture). That makes up for about 7% of the technical potential of solar energy for heating in Croatia.
- Electricity produced from solar energy in photovoltaic systems and solar thermal power plants could become economically viable around 2020. With the use of a little less than 1% of the technical potential, the economic potential to produce solar electricity would amount to around 0.3 TWh/annum, which is the equivalent of around 200 MWe electricity power.

The scope of radiation in Croatia is shown in the following figure, with data for specific regions in Croatia and Europe shown the next table.

Solar radiation in Croatia



Comparison of radiated solar energy on an optimally slanted sheet in various selected areas in Croatia and Europe

Location	Yearly average of emitted energy (kWh/m^2d)
Croatia, south Adriatic coast	5,0 – 5,2
Croatia, north Adriatic coast	4,2 – 4,6
Croatia, continental part	3,4 – 4,2
Central Europe	3,2 – 3,3
North Europe	2,8 – 3,0
South Europe	4,4 – 5,6

Two objectives have been set in the Strategy with reference to the exploitation of solar energy:

- The situation with regard to solar heating systems in Croatia by 2020 must be equal to the level in Germany and Greece en par to the population ratio (objective of 0.225 m^2 per head);
- The situation in Croatia with regard to the state photovoltaic power by 2020 must be equal to the situation in Spain today (11.71 W per head), and Germany by 2030 (over 45 W per head).

It is also presumed that the growth rate in exploiting photovoltaic systems will be around 68% per annum to 2020 and by 2030 this rate should be around 20% per annum. The total number of controlled years is shown in the following table and the dynamics of growth is shown in the accompanying graph.

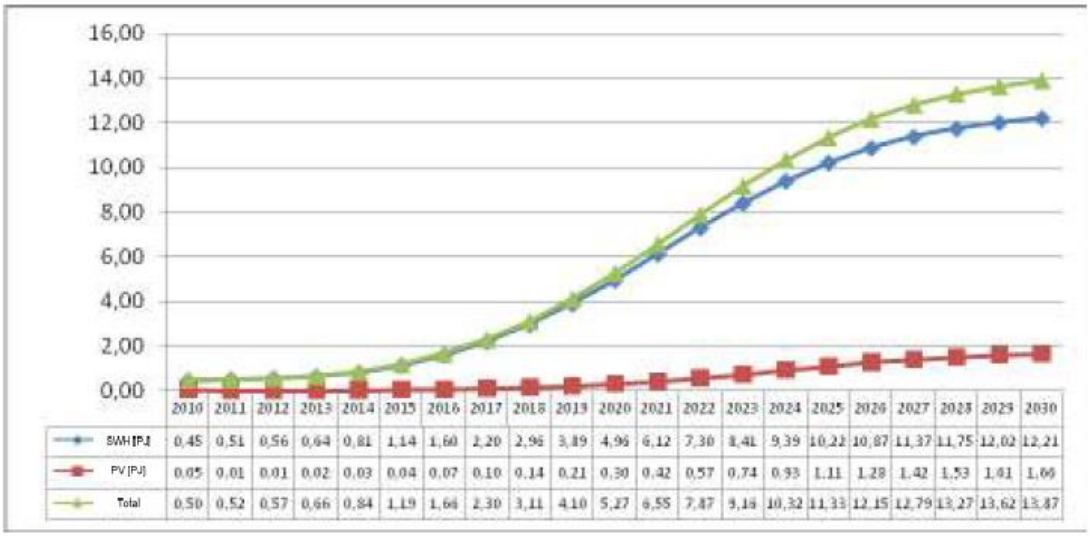
Estimates accounted for the average insulation in Croatia equal to 1.37 MWh/m^2/annum. It is estimated that solar PTV is 1.5 m^2 of solar collectors per head who use these systems and 1,825 hours of peak power in photovoltaic systems per annum (maximum radiation at an average of 5 hours per day all year round).

Greenpeace estimated that the solar power will become the cheapest energy source in Croatia in the coming years, with the biggest potential and opportunity for a massive upscale of investments. Cumulative savings of € 4 to 5 billion a year in energy imports alone could be achieved through a transition to 100% renewable energy. Proposed projects would create up to 3,600 jobs in construction of power plants and 8,000 permanent jobs in operation and maintenance annually by 2050. Installing PV on all schools would require a one-off investment of around € 60 million, yet it would produce annual savings of over € 7 million.

Growth in exploitation of energy in Croatia to 2030

	2010	2020	2030
Solar energy – hot water preparation [PJ]	**0,5**	**4,96**	**12,21**
Inhabitants using solar hot water system (1,5 m^2 collector / inhabitant)	67.691	660.000	1.653.017
Average m^2 per 1000 inhabitants	23,8	225,00	563,53
Solar Energy – PV [PJ]	**0,01**	**0,3**	**1,66**
Installed capacity [MW$_p$]	1,52	45,66	252,66
Average W per inhabitant	0,34	10,38	57,42
Solar energy – Total [PJ]	**0,51**	**5,27**	**13,87**

Dynamics of growth in exploitation of solar energy in Croatia to 2030



Passive use of solar energy in Croatia, particularly in coastal regions, mostly in tourist – catering and the accommodation sector will mean huge energy savings in heating. It is estimated that savings could be as high as 50 – 75% compared to current consumption. By 2030, all hotel, catering and accommodation units, and in particular those to be built along the coast after 2010 will be required to be built using modern technology,

primarily through high energy efficiency, using passive solar systems while at the same time all available active solar systems will be used for heating, air-conditioning and lighting. The total energy needs of all new buildings will not be allowed to be over 80 kWh/m^2.

In the first phase of implementation of this Strategy, activities need to be directed towards stimulating the use of solar heating systems. It is imperative that solar collectors be constructed to obtain heating energy (low temperature heating and hot water use) in all new construction both inland and along the coast. Croatia is geographically positioned allowing high energy efficiency in solar energy.

Installations with two circular knots should not be ignored which facilitate very hot water that can be used for low temperature heating via thermal regulators. As such, not one system is excluded and installation should be made possible for individual housing units and collective buildings.

The objective need not be 100% coverage of heating to heat hot water but rather to contribute to heating hot water which reduces the need for electricity or other energy sources for this purpose.

Long-term incentives to use solar heating systems and photovoltaic systems will have a positive effect to developing domestic industry and so this segment should be included in government incentive policies.

The implementation phase for growing solar energy use is divided into two time segments:

• 2010 – 2020

- Achieving the set indicators – 300,000 residents with at least 1.5 m^2 solar collectors installed to satisfy their own heating requirements;
- Achieving the set indicators – 11.71 W/per head of installed power in photovoltaic systems.

• 2020 – 2030

- Accomplishing 15% of buildings with some form of solar sours participating in their own energy balance;
- Accomplishing 50% of newly constructed buildings with some form of solar energy source satisfying their own energy balance;
- Achieving more than 45 W/per head of photovoltaic power;
- Reaching 4^{th} place in Europe with regard to MWth of solar heating systems per head.

Energy efficiency in public buildings

The building sector accounts for around 40% of the total energy consumption, so energy efficiency of buildings, which means providing minimum energy consumption in order to achieve the optimum comfort of living and use of the building, is very important.

Energy consumption of a building depends on its characteristics (shape and structural materials), installed energy systems (heating system, cooling system, ventilation, electrical devices and lighting used), as well as climatic conditions of the region where it is located.

In general, buildings in Croatia were built before 1987 and as such they do not have adequate thermal protection. As many as 83% of the buildings do not satisfy even the 1987 technical regulations, they have high heat losses with the average energy consumption ranging from 150 to 200 kWh/m^2, which classifies them in energy efficiency class E.

Increased energy consumption implies higher emissions of CO_2 in the atmosphere and it is, therefore, essential to implement the required measures in order to reduce excessive consumption and streamline the utilisation of available energy generating products.

Energy performance of buildings comprises a number of different options for saving thermal energy and electricity, with more rational use of fossil fuels and application of renewable energy sources (RES) in buildings, wherever it is functionally feasible and economically justified. Thermal protection of buildings is one of the key aspects because of its high energy savings potential.

By improving thermal insulation of the building, it is possible to reduce the total heat losses of the building from 30% to 60% on average.

Energy efficiency measures in the building sector:

- Energy audit of the building and energy performance certificate (EPC) which shows the energy efficiency class of the whole building or part of the building;
- Increasing thermal protection of the building (installing heat insulation and energy efficient windows and doors);
- Increasing performance of the heating, cooling and ventilation systems;
- Increasing performance of the lighting systems and electrical equipment;
- Use of renewable energy sources.

The implementation of the measures for increasing energy efficiency in the building sector results in lower energy consumption of the building and, at the same time, better comfort of living and performance of the building. The preference of measures depends on the energy performance and type of building, its purpose and location, and the best option would be to implement several measures ensuring their synergistic effect and to achieve more notable energy savings.

The Environmental Protection and Energy Efficiency Fund is implementing **energy retrofit programmes** that were adopted by the Government of the Republic of Croatia, and it is co-financing energy efficiency measures in buildings, with a view to reducing the consumption of energy at national level and reducing CO_2 emissions.

Building retrofit (renovation) programmes were adopted for different types of buildings, and they are implemented accordingly:

- Programme of energy renovation of family houses
- Programme of energy renovation of multi-residential buildings
- Programme of energy renovation of non-residential commercial buildings
- Programmes of energy renovation of public buildings.

Measures aimed to achieve energy savings in households represent one of significant guidelines of both European and Croatian energy policy, in accordance with the Energy Development Strategy of the Republic of Croatia, and the current Third National Energy Efficiency Action Plan. Apart from energy retrofit of family homes and multi-residential buildings, the Fund is also implementing the Programme of co-financing the purchase of A+++ electrical home appliances, which is open to citizens.

Source: www.fzoeu.hr/en/energy_efficiency/building_sector/

Retrofitting Programme for public sector buildings 2012 – 2013

Due to the ever more present energy crisis and the growing environmental impacts of energy consumption, the EU has developed documents setting guidelines for the development of its energy policy. In 2007, the European Council adopted a bi-annual action plan (2007-2009) for the creation of a joint energy policy supplemented by new energy measures for the period until 2014. This resulted in the adoption of an energy and climate package which evolved into the EU 20-20-20 goals which included:

- 20% cut in greenhouse gas emissions by 2020
- 20% increase in the share of renewables
- 20% improvement in energy efficiency.

However, presently these targets are different, and the goals extended to 2030:

- 40% reduction in greenhouse gas emissions
- 27% improvement in energy efficiency
- 27% of renewable energy in the energy mix.

Source: http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm

To support the achievement of these objectives an entire set of activities is required at international, EU and national level. One of the initiatives made for catalysing progress is the so-called **Resource-efficient Europe**, aimed at separating economic growth from the use of resources, supporting transition to low-carbon economy, increasing use of renewables, modernising the transport sector and promoting energy efficiency.

As the 28th EU Member State, Republic of Croatia is obliged to accept the European energy policy guidelines. In order to ensure the achievement of these objectives, Ministry of Construction and Physical Planning launched the Retrofitting Programme for Public Sector Buildings 2012 – 2013 (hereinafter referred to as the Programme).

The model applied in the Programme implementation was the ESCO model, implying type of business operation where energy service provider (ESCO Company) offered measures for the improvement of energy efficiency according to its own solutions, which would then result in provable savings in energy consumption.

Since the implementation of such a model in Croatia was limited, this Programme sets preconditions for development of an ESCO market.

The added value of the Programme is in the fact that this particular investment method helped to develop the energy service market, introduced the energy efficiency principles introduced into public procurement and set up an information system for monitoring energy consumption.

Location of the Program	Throughout Croatia
Period of the program	04/2012 – 12/2013
Implementation partners	Ministry of construction and physical planning, Centre for Monitoring Business Activities in the Energy Sector and Investments, national, regional and local authorities and other public sector actors
Partners of the program	Croatian Bank for Reconstruction and Development (HBOR), United Nation Development Program (UNDP), Croatian Fund for Environmental Protection and Energy Efficiency
Budget (2012)	5.000.000kn (around 675.000 €) (Budget of the Ministry of construction and physical planning, for the development of public buildings Terms of Reference)
Major sources of funding	Ministry of construction and physical planning, UNDP, Croatian Fund for Environmental Protection and Physical Planning, HBOR (Credit line – loans)
Target groups	Public sector buildings
Final Beneficiaries	Owners, users and managers of public buildings; service providers (consultant, engineering, ESCO services); financial institutions; architects and constructors; business and NGO sector; media

Related information	www.mgipu.hr

Programme Objectives

The overall objective of the programme resides in the implementation of economically feasible, energy efficient technologies and measures in public sectors building in Croatia by creating local expert capacities, implementing continuous and systematic energy management, introducing strategic energy planning and sustainable energy and other resource management at the national, regional and local level throughout Croatia.

The Program aimed to use the investment potential of public sector buildings, when the volume of the investment is smaller than the expected benefits of energy saving measures in the future.

Specific objectives of the Programme were:

- The reduction of total energy costs of publicly owned buildings by 30-60%, through the application of energy efficiency improvement measures
- The increase of the share of renewable energy sources
- The implementation of advanced methods of energy consumption measuring, via a system of continuous monitoring and centralised cost analysis
- A contribution towards achieving sustainable development goals
- Boosting local economic development by creating new jobs in the public and private sector.

The importance of this programme was its direction towards demand-side market transformation and the development of an energy efficiency segment in the market related to the availability of energy efficiency products and the development of local capacity for energy efficiency services, including new "green" jobs.

The main problems during the implementation were:[4]

- Lack of well-prepared projects
  - The database of public buildings is incomplete
- Problems with property rights and ownership issues with public buildings
- Insufficient number of energy service providers
  - Problem: energy service providers must ensure energy saving guarantees
  - Energy service providers don't like to take over the risks for behaviour of consumers
- Financing of the project is on the owner/user of buildings through project financing (establishment of SPV)
  - Problem: project financing is not developed in Croatia
- Verification of energy savings is not solved

[4] www.unece.org/fileadmin/DAM/energy/se/pp/adhoc/EE21_19_GE_April_13/6_Croatia_Juric_EIHP.pdf

Program for Energy Renewal of Buildings in Public Sector 2014-2015

Country members of EU made a commitment, starting from 01 January 2014, to renew 3% of total floor area heated and/or cooled buildings owned and used by central government each year. In case when these commitments aren't fulfilled EU commission can begin formal proceedings for violation of EC law.

Program goals for period 2014-2015

- To contract and completely renew 200 public sector buildings - approximately 420.000 $m^2$of heated area
- To decrease energy consumption in refurbished buildings for 30 - 60% (approximately 150 kWh/m^2 per year)
- To decrease CO2 emission for approximately 20.500 t per year
- To start investments in the amount of about 400 mil. Kunas (€ 53 mil.)
- To start energy services market

Program participants

Croatian Government	Accepted Program
Ministry of Construction and Physical Planning	Developed Program and supervise implementation
Agency for Transactions and Mediation in Immovable Properties	Program implementation and signing Contracts for energy efficiency
Environmental Protection and Energy Efficiency Fund	Ensures co-financing funds
Croatian Bank for Reconstruction and Development	Approves credit to ESP in accordance with credit program
Croatian Agency for SMEs and Investments	Ensures all needed guarantees ESP needs, in favor of creditor
Energy Service Client (ESC)	Owner/User of the building applies building into Program
Energy Service Provider (ESP)	Implements energy renewal

Conclusion

Despite adverse economic conditions and structural problems which still underpin the development of renewable energy in Croatia, the country has made good progress to attain a significant amount of electricity produced from renewable energy sources.

The efforts to develop renewable energy in the country allowed it to reach the target before the deadline (2020). Furthermore, Croatia already achieved the target fixed by the EU for 2030, which is at least 27% share of renewable energy in the energy mix.

Notwithstanding this situation, Croatia's accession to the EU improved the development of renewable energy projects. The country's hydroelectric and geothermal potential is very significant and has already been developed over the last decades. However, more efforts are needed in the development of wind and solar energy, for which Croatia has good natural endowments (see annex).

While the development of renewable energy projects were given impetus by the facilitation of business and commercial projects surrounding wind and solar energy with Croatia's accession to the EU, other infrastructural problems will have to be resolved. A main problem is the country's grid infrastructure, which momentarily cannot support an overload of electricity fed into the network by additional solar and wind energy power plants. To resolve this, Croatia's transmission and distribution system operator will have to invest heavily in the refurbishing of its existing grid. Belgian and European companies active in renewable energy project development could play an important role in this segment of the market. Moreover, it should be reminded (in the case of Belgian companies) that traditional European commercial partners active in Croatia stem mostly from Italy, Austria and Germany. It is therefore important for Belgian - and other European companies to explore the market for renewable energy as thoroughly as possible, and to seek Croatian partners to establish a presence in the country. Smart grids and meters, better wind and more effective wind turbines, solar panels and other renewable energy technological advances will be sought from Croatia's engineering bureaus and companies, who are eager to cooperate on projects in the country.

To conclude, it is important to understand that the Croatian energy sector is very eager to further develop renewable energy, but authorities in the country will only to do at a socially and environmentally acceptable cost. The same logic applies to energy efficiency in buildings, where the Croatian government is making a genuine effort to issue public tenders and to include the participation of a majority of actors, Croatian and foreign.

Annexes

Contact information – Industrial Power Plants

Plant name & location	Fuel usage	Installed capacity	Contact details
Belisce, d.d., Belisce	Natural gas/wood	32 MW	Tel: +385 31 516 202 Trg A. Starčevića 1 31 551 Belišæe, Hrvatska Web: www.belisce.hr
Viro d.o.o., Virovitica	Natural gas	8 MW	Tel: +386 1 759 14 01 E-mail: damjan@viro.si Web: www.viro.si
INA Rafinerija nafte, Rijeka	Fuel oil	40.5 MW	Avenija Većeslava Holjevca 10 p.p. 555 10 002 Zagreb Hrvatska Tel: +385 1 6450 000 E-mail: ina-besplatni.telefon@ina.hr Web: www.ina.hr
Pliva d.d., Savski Marof	Natural gas	4.8 MW	PLIVA HRVATSKA d.o.o. Prilaz baruna Filipovića 25 10000 Zagreb Tel: +385 1 37 20 000 Fax: + 385 1 37 20 111 E-mail: info@pliva.hr Web: www.pliva.com/
Plant name & location	**Fuel usage**	**Installed capacity**	**Contact details**
INA Rafinerija nafte, Sisak	Fuel oil/ refinery gas/ petroleum coke	30MW	Avenija Većeslava Holjevca 10 p.p. 555 10 002 Zagreb Hrvatska Tel: +385 1 6450 000 E-mail: ina-besplatni.telefon@ina.hr Web: www.ina.hr
Gavrilovic d.d., Petrinja	Natural gas	1.6 MW	Gavrilovic doo Gavrilović Square, 1 HR-44 250 Petrinja Tel: +385 44 811 111 Web: www.gavrilovic.hr/hr
Kandit premijer,	Natural	18.5 MW	Krste Frankopana 99,

d.o.o. (Tvornica Secera Osijek)	gas/fuel oil/ coal		31000 Osijek, Croatia Tel: +385 31 512 512 Fax: +385 31 512 527 kandit@kandit.hr Web: www.kandit.hr
INA d.d. Naftaplin CPS Molve, Durdevac	Natural gas	11.1MW	Avenija Većeslava Holjevca 10 p.p. 555 10 002 Zagreb Hrvatska Tel: +385 1 6450 000 E-mail: ina-besplatni.telefon@ina.hr Web: www.ina.hr
INA d.d. Naftaplin pogon Etan, Ivanic Grad	Natural gas	5.6 MW	Avenija Većeslava Holjevca 10 p.p. 555 10 002 Zagreb Hrvatska Tel: +385 1 6450 000 E-mail: ina-besplatni.telefon@ina.hr Web: www.ina.hr
Plant name & location	Fuel usage	Installed capacity	Contact details
INA d.d. Maziva Rijeka	Natural gas, fuel oil	3 MW	Avenija Većeslava Holjevca 10 p.p. 555 10 002 Zagreb Hrvatska Tel: +385 1 6450 000 E-mail: ina-besplatni.telefon@ina.hr Web: www.ina.hr
Petrokemija d.d., Kutina	Natural gas	35 MW	PETROKEMIJA, Plc. Ferilizer Company Aleja Vukovar 4, 44320 Kutina, Croatia E-mail: uprava@petrokemija.hr Tel: +385 44-647269 Fax: +385 44-680882 E-mail: josip.jagust@petrokemija.hr

Current energy investments in Croatia

HPP Kosinj - hydro power project on the rivers Lika and Gacka

The Hydro power project consists of a rehabilitation of hydro power plants Sklope and Senj, construction of new hydro power plants Senj 2 and Kosinj:

Power plant KOSINJ

- Installed capacity: 52 MW
- Electricity production: 48 GWh

Power plant SKLOPE

- Installed capacity: 27 MW
- Electricity production: 68 GWh

Power plant SENJ

- Installed capacity: 240 MW
- Electricity production: 576 GWh

Power plant SENJ 2

- Installed capacity: 360 MW
- Electricity production: 864 GWh
- Total planned electricity production is 1,6 TWh.
- The system is flexible, enabling mainly production in peak hours.
- HEP is interested in loan financing of the project.

HPP Kosinj – Current Status

- Project documentation completed;
- Strategic assessment of environmental impact is in process
- Development of the Environmental impact Assessment Study and preliminary design for the location permit, preparation of property-legal affairs
- Estimated construction period – 6 years

CCGT EL-TO Zagreb

- Basic characteristics:
    - Co-generation of gas-fired power station and heating plant of the installed power of 110 MW of electric and 120 MW of thermal power;
    - anticipated annual generation of 700GWh of electric + 400GWh of thermal power;

- anticipated investment value € 120 million.
- The project of combined gas-fired cogeneration plant on the location EL-TO Zagreb is anticipated as a replacement block for the existing plants that are at the expiration of the lifetime.

Status of the project:

- The location permit was issued in July 2014
- Financial closing of the project is under preparation, relying on the provision of the EBRD loan
- Location permit obtained, tender published for the construction, equipment supply and a long-term maintenance contract
- Construction period estimated from 2017 to 2020

Multipurpose solution for the regulation and use of the Sava River in the Zagreb area

Main goals and benefits

- Flooding hazard protection for more than 3000 ha of Sava banks;
- Desired water level insurance;
- Regulation of water-bed and river-bank aquifer;
- Drinking water supply for Zagreb and region;
- Improvement and protection of well fields;
- Defining Croatian-Slovenian water convention;
- Hydro energy usage for supply of electrical energy
- Technical solution consists out of 4 main electricity production objects: Installed capacity of total 120 MW:
  - Podsused 41 MW,
  - Prečko 23 MW,
  - Zagreb 19 MW,
  - Drenje 39 MW.
- Annually provides about 610 GWh, which makes about 23% of Zagreb energy consumption.
- Stakeholders: Zagreb County, City of Zagreb, Croatian waters, HEP;
- Looking for potential investors – whole project worth over 0,8 billion €

Current status

- Update of the project necessary; new environment impact assessment needed because the area is now embraced with Natura 2000
- Estimated project development time – 2 years

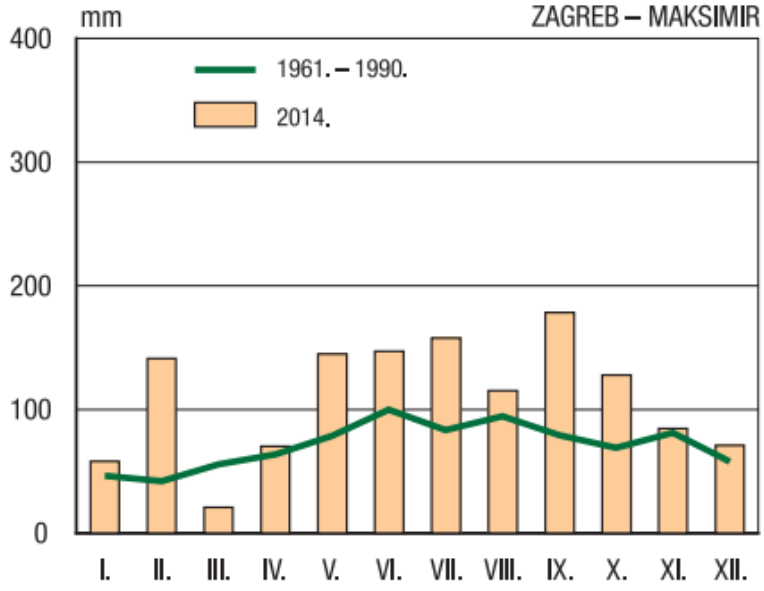
- Estimated construction time 5 – 9 years, depending on the construction model (phases or parallel)
- PPP possible

BE-TO OSIJEK AND SISAK CHP

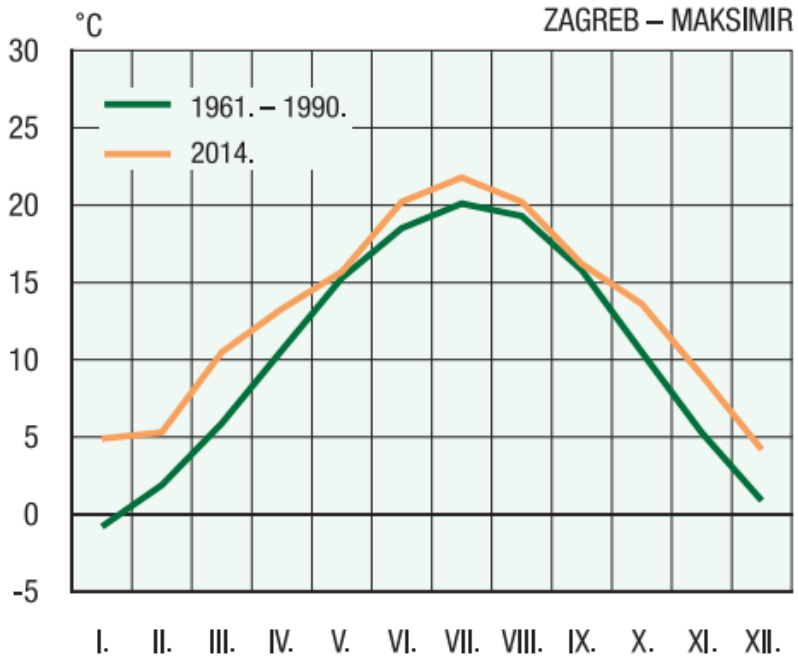
- HEP prepared the construction of two biomass fired cogeneration plants projects, BE-TO Osijek CHP 3 Me/10 MT and BE-TO Sisak CHP 3 Me/10 MT
- The energy market operator will purchase the generated electricity from both power plants in accordance with the incentive tariff
- Operation of such plants contributes to the fulfilment of the national goals harmonized with the EU directives related to the renewable sources and energy efficiency generation.
- The consortium for construction of both EUR 35 million worth projects is Đuro Đaković holding with the partner HOST B.V. from the Netherlands. Investment assets are insured by the KfW bank credit.
- Forest biomass is the energy source for both power plants and its provision is insured by the signed long-term contracts
- The construction site is opened in December 2015 and construction of both plants will be finalized in 2016. Trial operation is foreseen to commence in the first half of 2017.

Climate Indicators

Annual precipitation change, 2014 and 1961-1990



Annual air temperature change, 2014 and 1961-1990



Source: www.dzs.hr/Hrv_Eng/ljetopis/2015/sljh2015.pdf - Weather averages for Croatia[5]

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARS	# CITIES
Average Temperature (C)	12.5	3.8	4.6	8	11.5	16.1	19.8	22.2	21.8	18.4	13.8	8	4.4	27	39
Average High Temperature (C)	16.6	6.5	8	11.9	15.6	20.3	24.2	27.1	26.6	22.8	17.6	11	7.9	21	37
Average Low Temperature (C)	8.7	0.9	1.4	4.1	7.3	11.7	15.2	17.3	17	13.6	9.8	4.8	2	22	37
Average Precipitation (mm)	1040.9	80.7	67.7	77.5	80.2	83.3	73.5	54.9	68.8	90.3	112.6	119.4	106.7	39	30

* Years is the average number of years used to compute the average. # Cities is the total number of locations used to compute the average.

[5] www.weatherbase.com/weather/city.php3?c=HR&set=metric

Weather averages for the city of Split

Average Length of Day — Years on Record: 30

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Hours	12.7	9.9	11	12.5	14	15.3	16	15.6	14.4	13	11.5	10.2	9.5

Average Number of Days Above 90F/32C — Years on Record: 20

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Days	15	---	---	---	---	---	1	7	7	---	---	---	---

Average Number of Days Below 32F/0C — Years on Record: 20

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Days	17	7	5	2	---	---	---	---	---	---	---	1	3

Average Number of Rainy Days — Years on Record: 19

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Days	128	12	11	12	13	12	10	5	7	8	12	13	13

Average Number of Days With Snow — Years on Record: 19

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Days	2	1	1	---	---	---	---	---	---	---	---	---	---

Average Morning Relative Humidity — Years on Record: 20

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
%	69	70	67	72	70	69	63	58	62	73	76	73	72

Average Evening Relative Humidity — Years on Record: 20

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
%	53	58	54	55	54	54	49	42	44	51	59	60	60

Average Daily Sunshine — Years on Record: 30

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Hours	9.1	5	7	8	10	12	12	13	13	10	8	6	5

Average Wind Speed — Years on Record: 20

	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
km/h	9	9	9	14	14	12	8	8	8	8	8	8	8

References and Links

The Energy Act:
https://ec.europa.eu/energy/en/topics/energy-strategy

The Electricity Market Act
Electricity Market Rules:

www.hera.hr
www.hera.hr/en/html/eu_lex.html

The Act on the regulation of Energy Activities:
The Act on the amendments to the Act on the regulation of Energy Activities:
www.hera.hr/english/docs/OG_2007_2400.pdf

Grid Code:
http://files.hrote.hr/files/PDFen/Documents/Secondary%20legislation/Grid_Code.pdf

Ordinance on acquiring the Status of Eligible Electricity Producer:
http://files.hrote.hr/files/PDFen/Documents/Secondary%20legislation/Ordinance_Acquiring_EEP_Status.pdf

Tariff System for the Production of Electricity from Renewable Energy Sources and Cogeneration:
www.hrote.hr/default.aspx?id=227

General Conditions for Electricity Supply:
http://files.hrote.hr/files/PDFen/Documents/Secondary%20legislation/General_Conditions_for_Electricity_Supply.pdf

Renewable energy legislation and energy efficiency labelling:
https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

List of electricity and energy acts:
www.hrote.hr/default.aspx?id=142

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