

The Electric Power System

- Croatia -

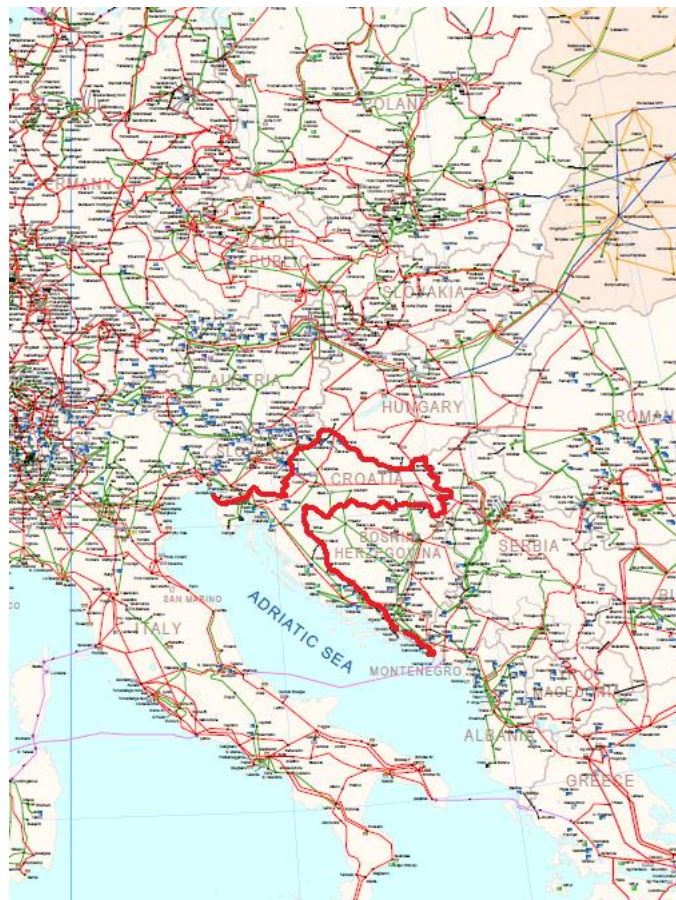
Basic facts

- ☐ Area: 56 594 km²
- ☐ Population: 4 284 889 (census 2011)
- ☐ Number of electricity consumers: *“There are more than 2.3 million electricity customers and/or metering points in Croatia.”* (www.hep.hr)
- ☐ Number of TSOs: 1
- ☐ Number of DSOs: 1 DSO (21 distribution area)
- ☐ Peak load: 3193 MW
- ☐ Average interruption of electricity (2017): 71.1 min/interruption

Global map of the grid and of its interconnections

Interconnectors with:

- Bosnia and Herzegovina;
- Slovenia;
- Serbia;
- Hungary.

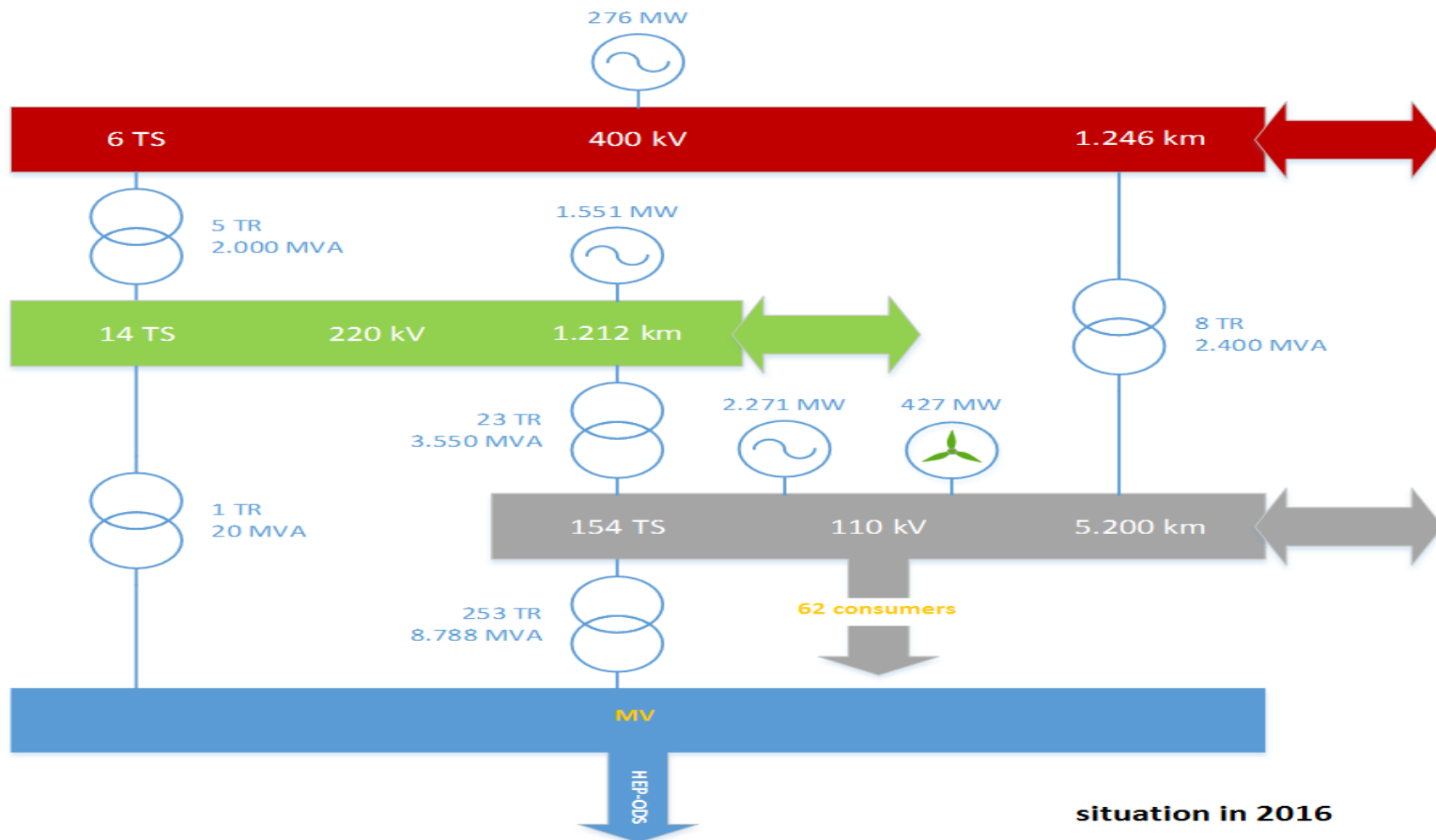


Grid facts and characteristics

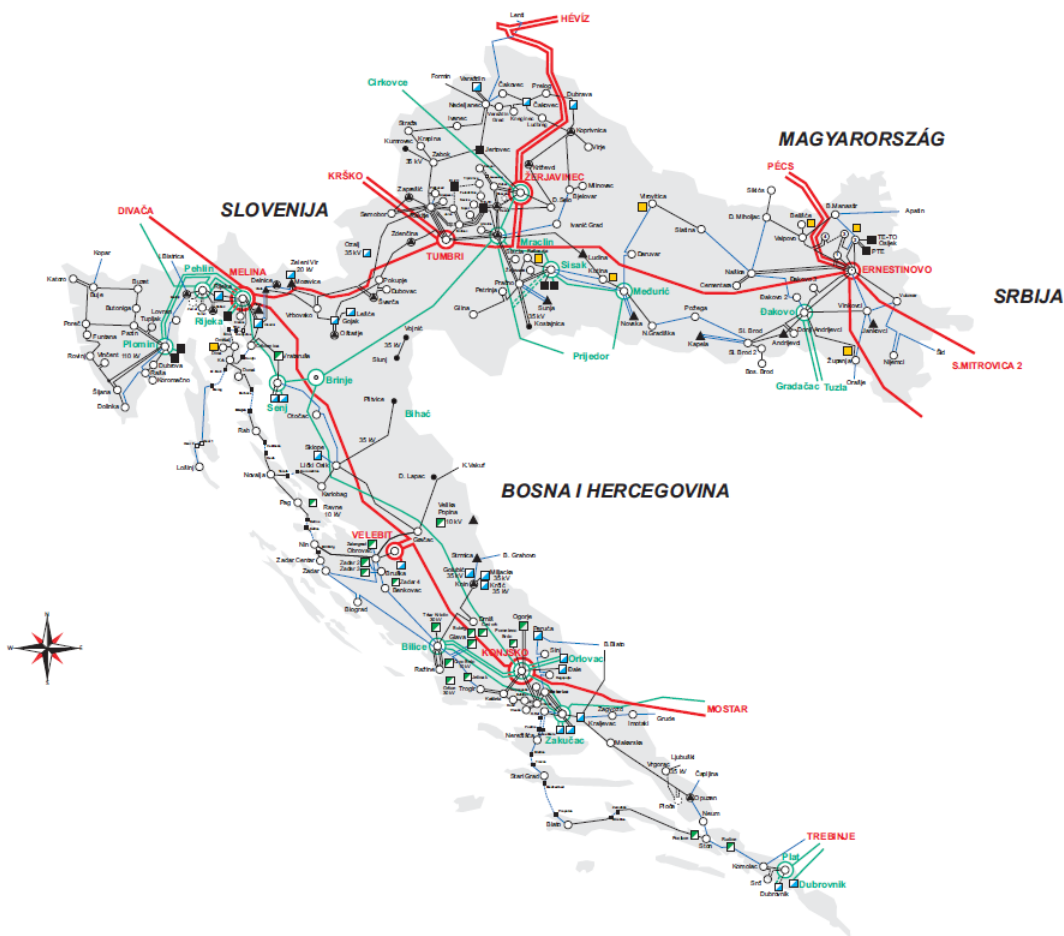
Substations		
Voltage level	Number	MVA
400/x kV	6	4.400
220/x kV	14	3.420
110/x kV	180	10.355
Total	129	18.175

Lines [km]	
Voltage	Total
400 kV	1.246
220 kV	1.212
110 kV	5.200
Medium Voltage	11
Total	7.669

Updated: 12.01.2018.



Map of the high voltage grid



Source: HOPS
(March 2016)

Information on TSO

- ☐ Name: Hrvatski operator prijenosnog sustava (HOPS)
- ☐ Network length 7669 km
- ☐ Served area 56 594 km²
- ☐ Annual transmitted energy (in 2017) 22.1 TWh
- ☐ website: <http://www.hops.hr>

Cooperation of TSO and DSOs

□ Transmission and distribution

Hrvatski operator prijenosnog sustava d.o.o. (HOPS - Croatian Transmission System Operator) and HEP Operator distribucijskog sustava d.o.o. (HEP ODS - Distribution System Operator) are providers of public services of electricity transmission and distribution, respectively, for the needs of participants in the Croatian market.

Scope of HOPS and HEP ODS cooperation is defined by a national legislative, and corresponding agreements and contracts between two system operators.

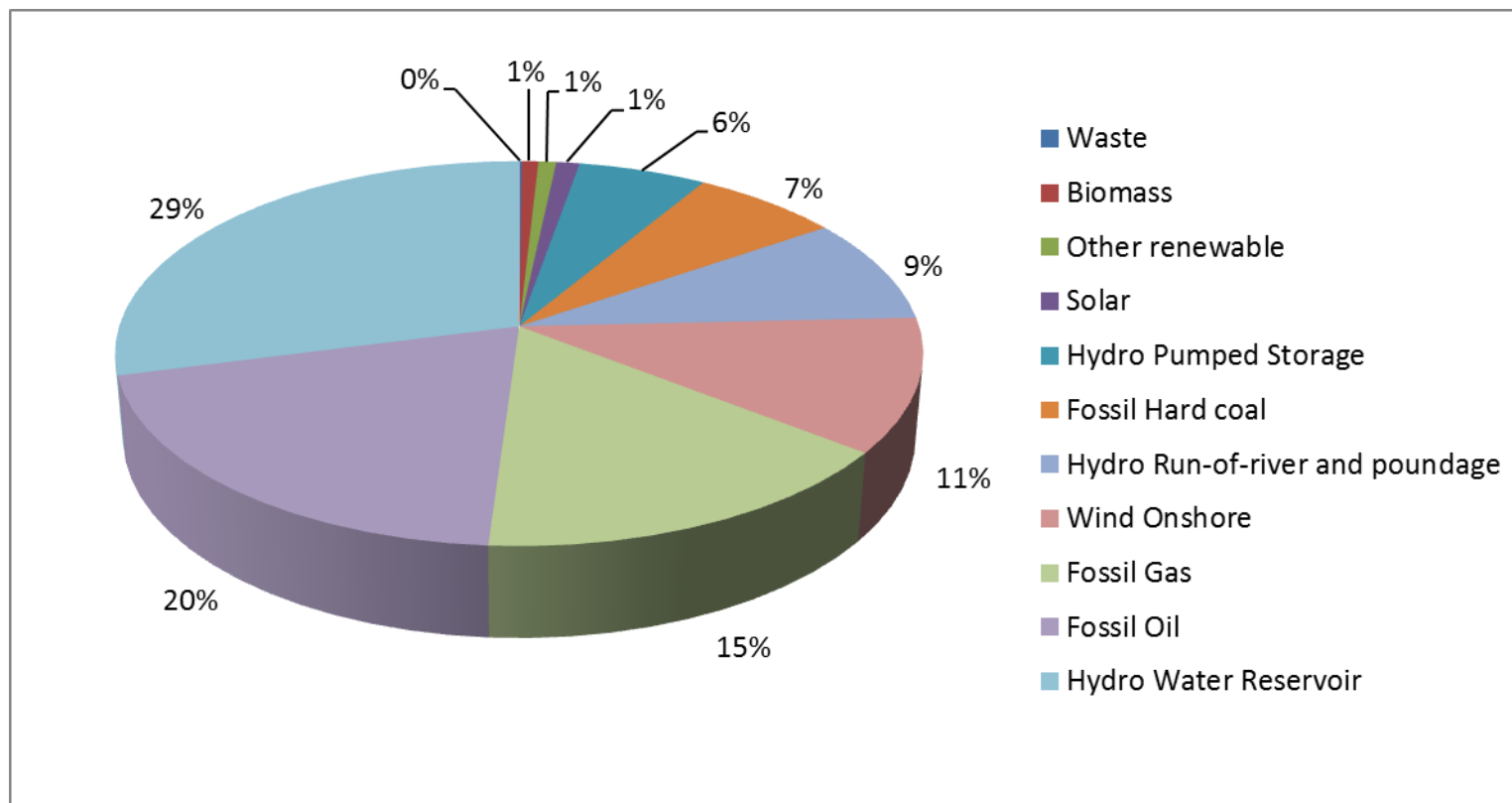
Responsibilities of TSO

- ☐ Transmission of electricity generated in power plants connected to transmission grid or imported from adjacent power systems, at least cost while maintaining electricity quality standards and safety of the power system at the highest possible level,
- ☐ Control, maintenance and development of high voltage grid.

Responsibilities of DSO

- ☐ Distribution of electricity generated in power plants connected to distribution grid or delivered from transmission grid, at least cost while maintaining electricity quality standards and safety of the power system at the highest possible level,
- ☐ Control, maintenance and development of medium and low voltage grids.

Power structure of the country

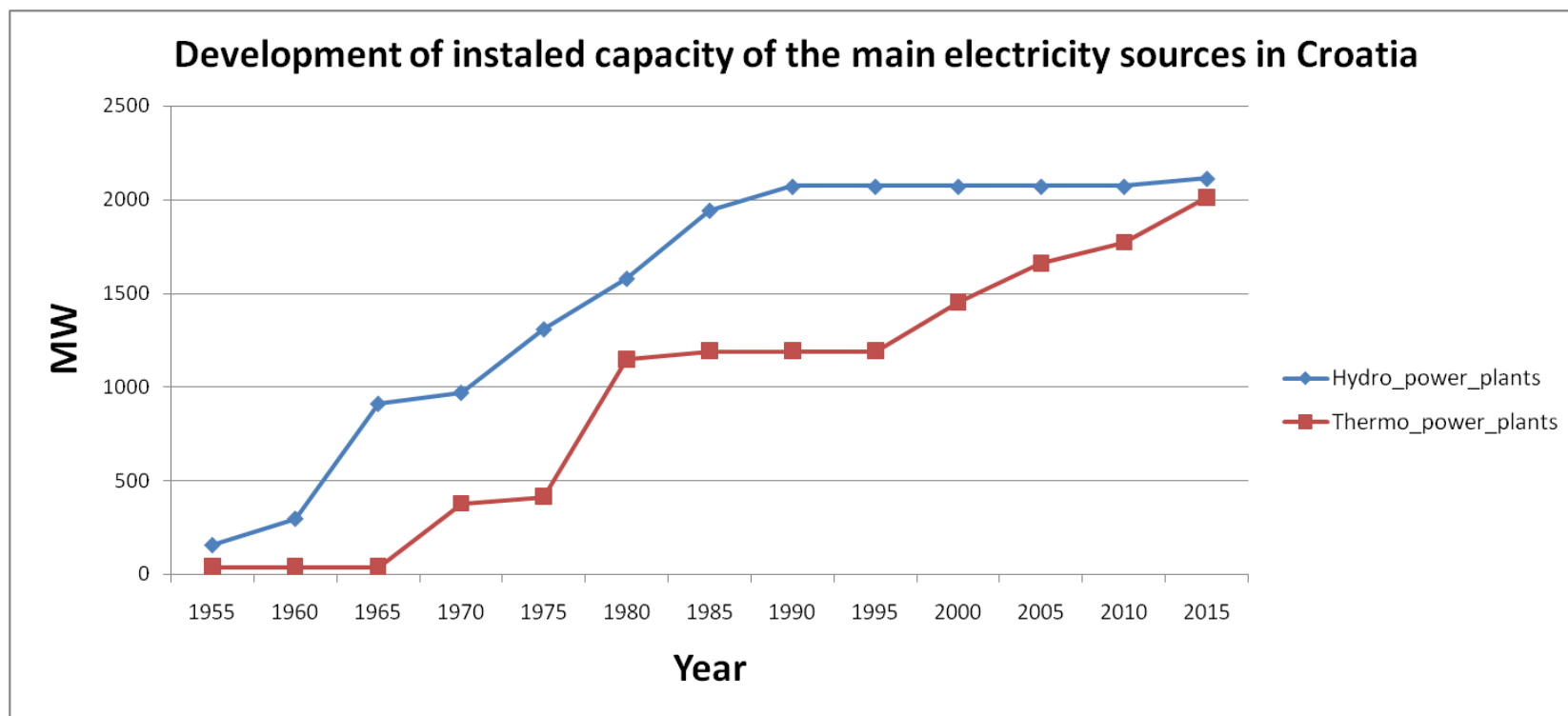


Energy production with reference to primary resources

Electricity generated (TWh), year 2017

Nr.	Primary Source	Installed capacity (GW)	Electricity generated (TWh)
1.	Waste	0.006	0
2.	Biomass	0.036	0.126
3.	Other renewable	0.039	0.069
4.	Solar	0.051	0.062
5.	Hydro Pumped Storage	0.281	0.569
6.	Fossil Hard coal	0.325	2.351
7.	Hydro Run-of-river and poundage	0.421	1.845
8.	Wind Onshore	0.537	1.006
9.	Fossil Gas	0.743	1.312
10.	Fossil Oil	0.95	0
11.	Hydro Water Reservoir	1.388	3.716
12.	Total	4.777	11.056

Development of generation capacity since 1955



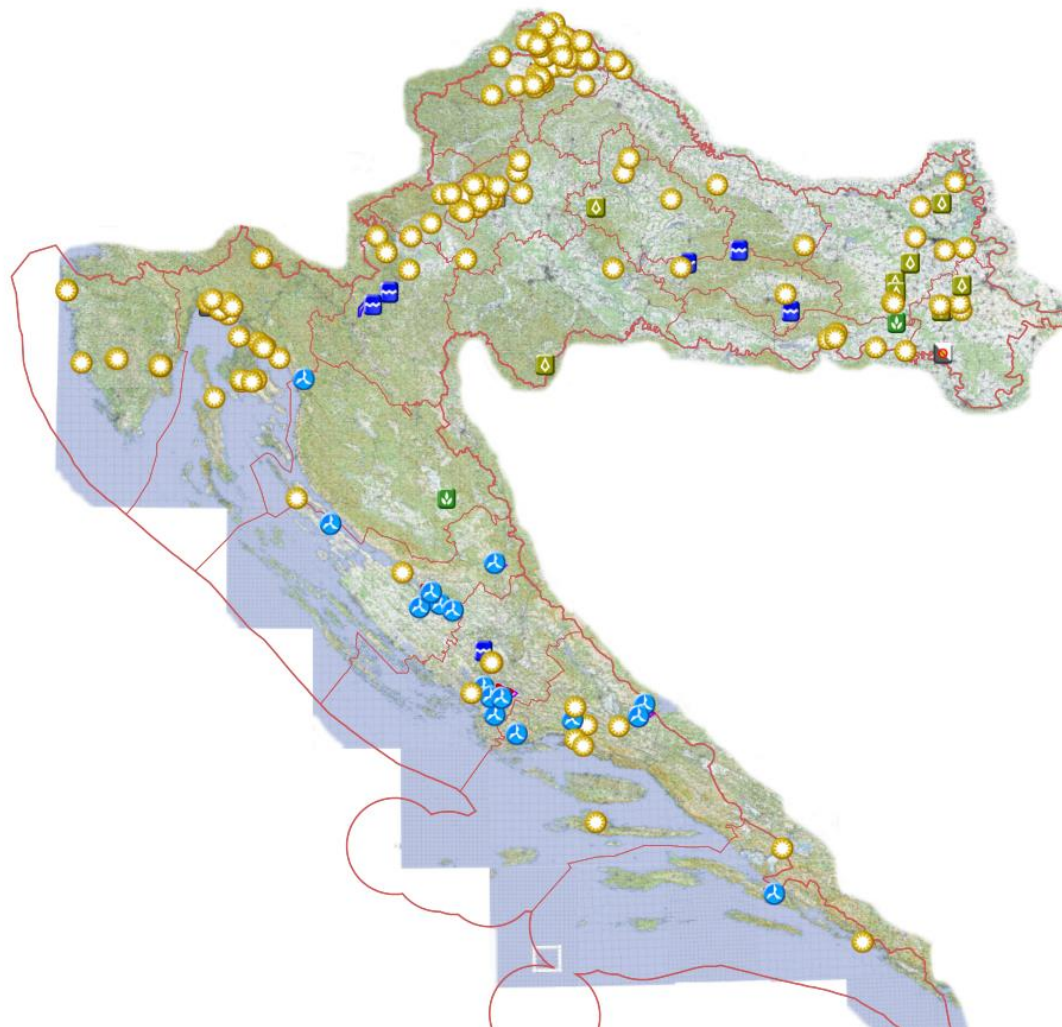
Consumption per customer groups

- Electricity consumption classes and indicative peak power for the consumers from the category "Entrepreneurship" in accordance with EUROSTAT

Nr.	Electricity consumption class	Minimal consumption [MWh/year]	Maximal consumption [MWh/year]	Lowest value [kW]	Highest value [kW]	Entrepreneurship - Total values	
						Consumption (%)	Number (%)
1.	la	–	<20	5	20	9.7	79.4
2.	lb	20	<500	10	350	29.5	19.3
3.	lc	500	<2 000	200	1 500	11.6	0.7
4.	ld	2 000	<20 000	800	10 000	21.7	0.5
5.	le	20 000	<70 000	5 000	25 000	20.7	0.1
6.	lf	70 000	<=150 000	15 000	50 000	6.8	0.0
Source: HEP-ODS and HOPS							

Location of renewable energy sources

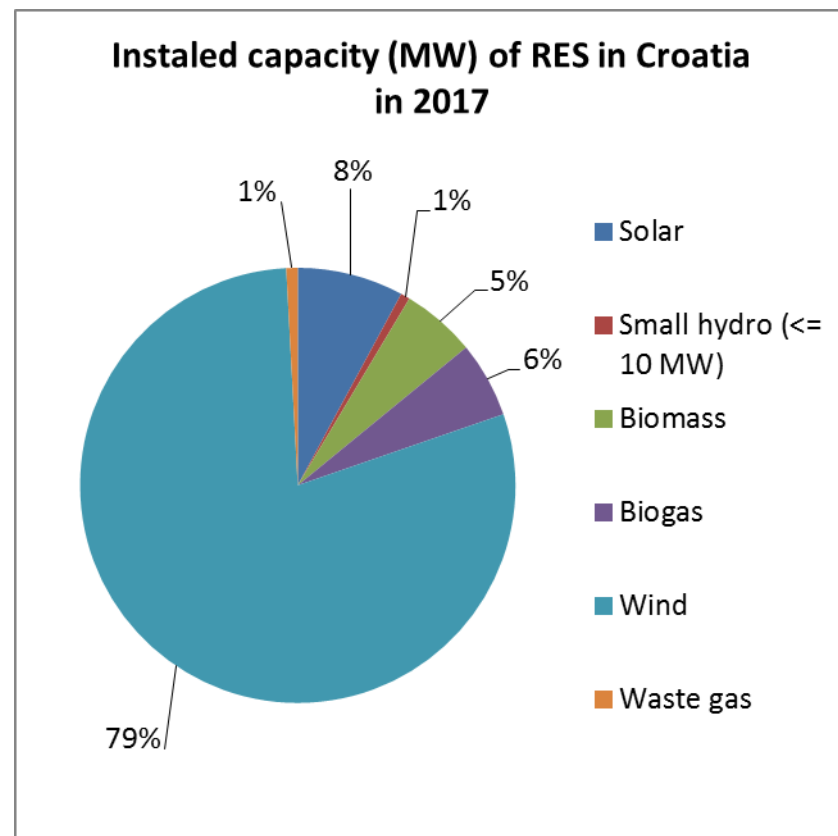
Solar power plant		
Hydro power plant		
Wind power plant		
Biomass power plant		
Geothermal power plant		
Biogas powerplant		
Liquid biofuel power plants		
Landfill gas power plant and gas from the plant wastewater treatment		
Cogenerations		
Other		



Source: Ministry of economy

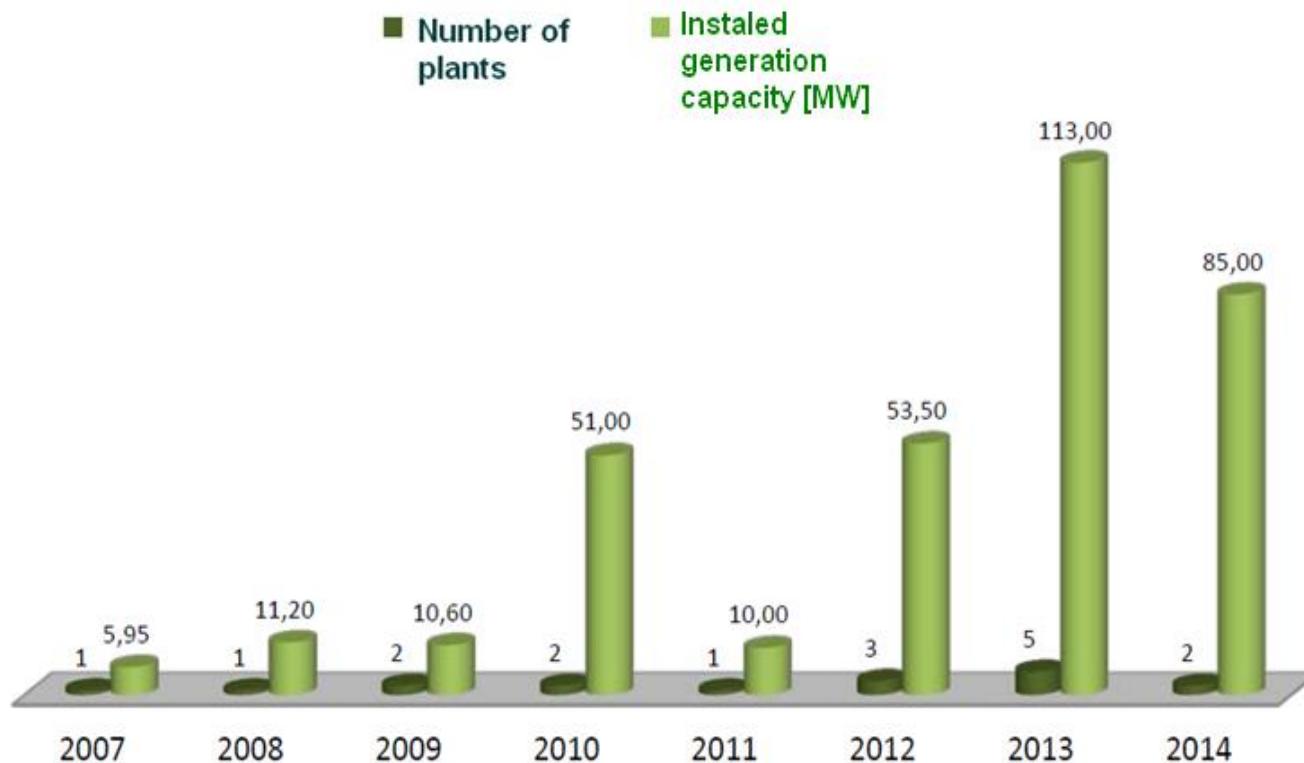
Data about renewable energy sources

Nr.	Technology	Number of plants	Installed power (MW)
1.	Solar	1223	51.49
2.	Small hydro (≤ 10 MW)	12	4.48
3.	Biomass	17	35.95
4.	Biogas	32	36.73
5.	Wind	21	519.00
6.	Waste gas	2	5.50
7.	Cogeneration	6	113.29
8.	Total	1313	766.44



Data source: HROTE

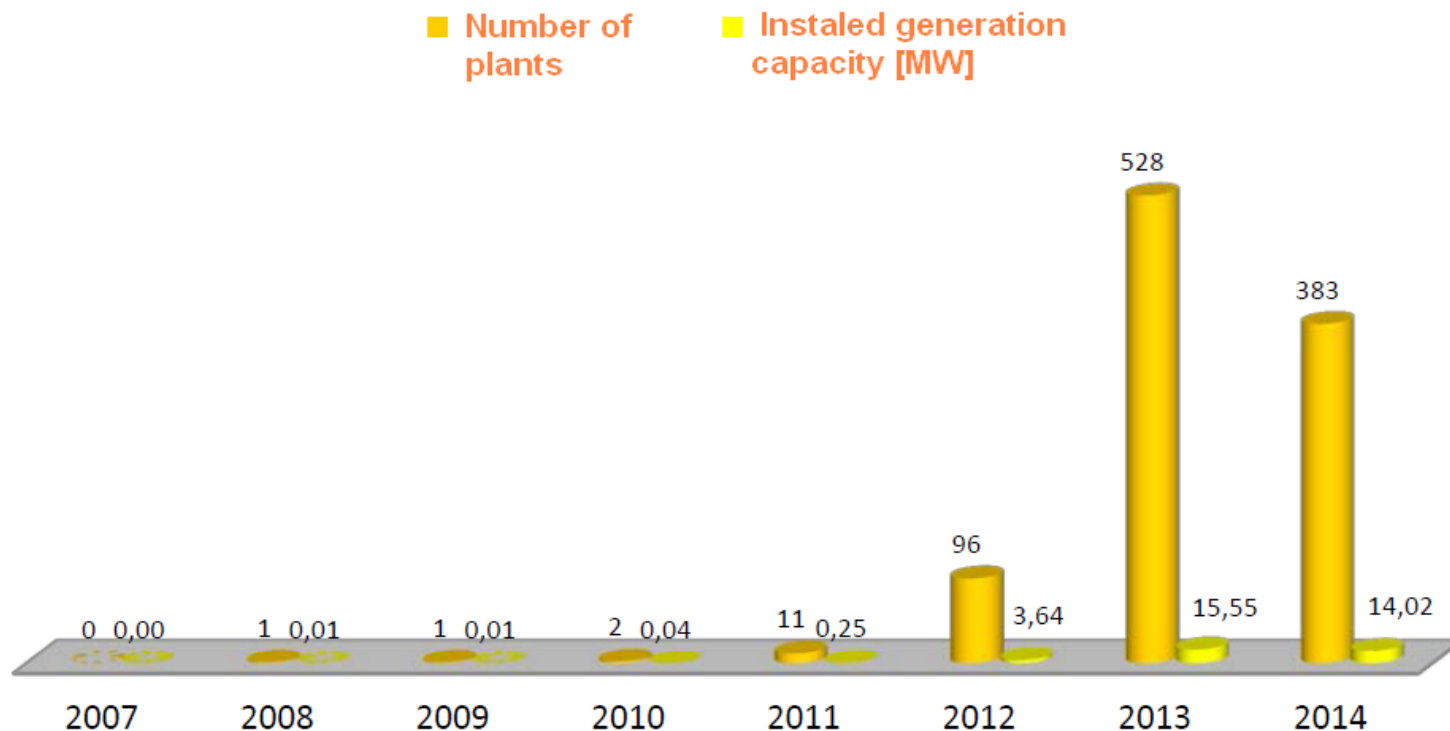
Development of wind power



Number of plants and installed generation capacity of wind power plants in particular year

Source: HROTE

Development of photovoltaic power



Number of plants and installed generation capacity of solar power plants in particular year

Source: HROTE

RES production 2017

□ Energy produced by particular technologies in 2017 (Source: HROTE)

Nr.	Technology	Production in 2017 (kWh)
1.	Wind	1.203.884.518
2.	Solar	73.991.764
3.	Small hydro	15.866.622
4.	Biomass	186.010.625
5.	Biogass	265.051.632
6.	Cogeneration	544.496.954
7.	Geothermal	0
8.	Waste gas from the dump	13.609.660
9.	Gas from the plants for waste water treatment	78.155
10.	Total	2.302.989.930



Price development for households and industry consumers (“entrepreneurship”)

Average electricity prices for terminal consumers (kn/ kWh) (exchange rate: 1 € ≈ 7.5 kn)

Category of terminal consumer	Year						
	2008	2009	2010	2011	2012	2013	2014
Consumers at medium voltage	0.49	0.58	0.58	0.58	0.61	0.60	0.58
Consumers at low voltage (Entrepreneurship)	0.64	0.72	0.74	0.73	0.79	0.78	0.75
Consumers at low voltage (Households)	0.64	0.70	0.70	0.70	0.78	0.82	0.79

Source: HEP-ODS

Electricity market organisation (part 1)

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

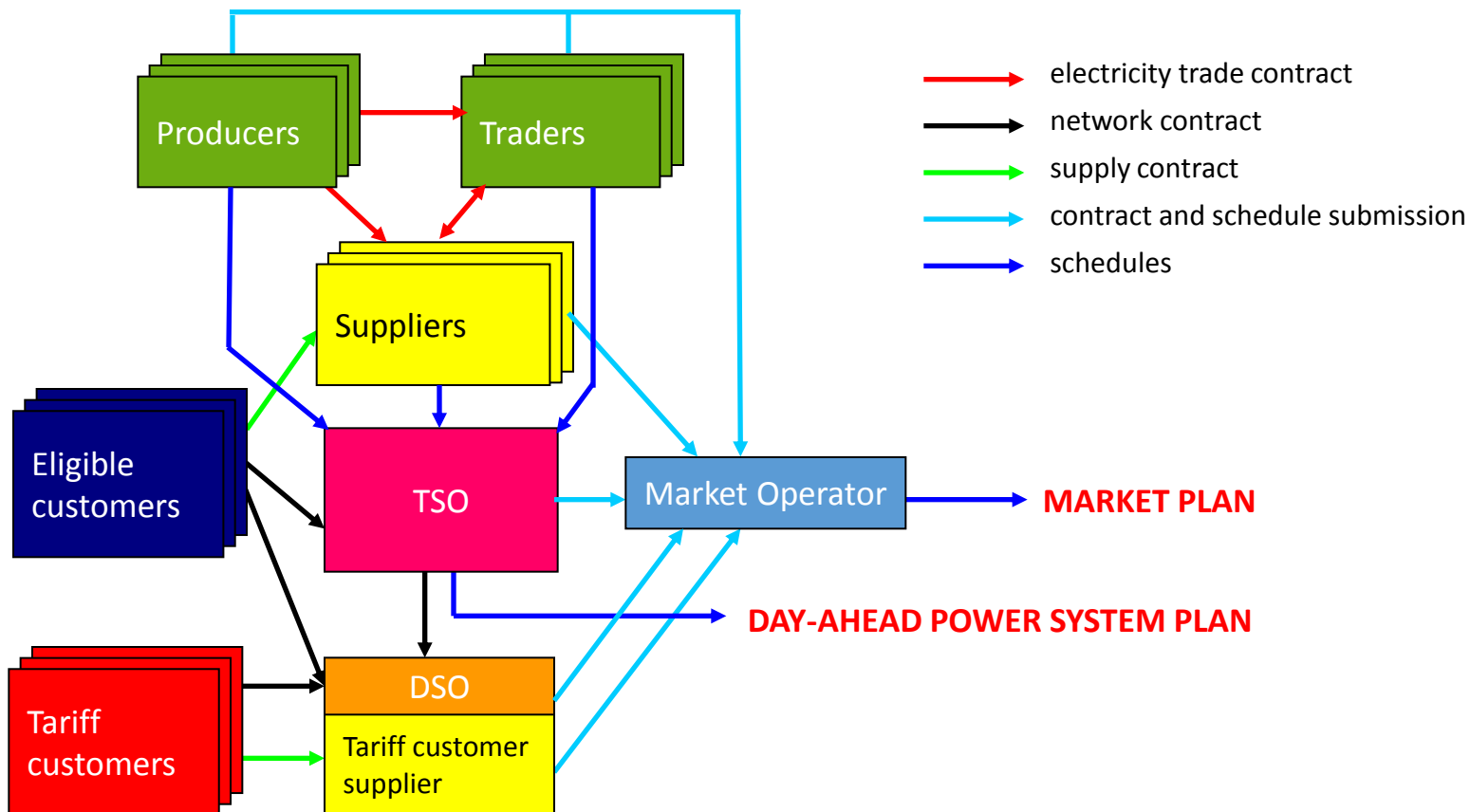
In Croatia we distinguish:

1° public service obligation of tariff customers' electricity supply,
2° 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 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.

(Source: HROTE)

Electricity market organisation (part 2)



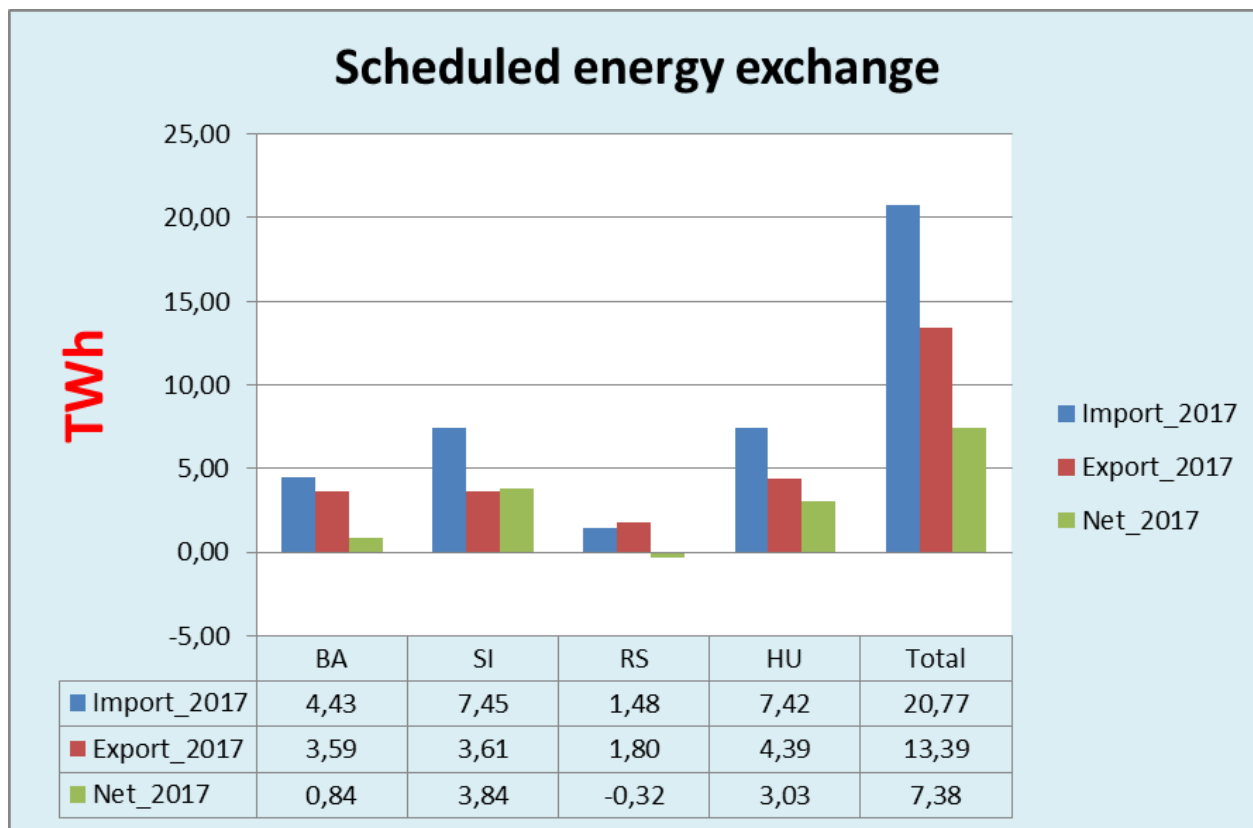
Power balance in 2017

- ☐ Generation (TWh)
- ☐ Consumption (TWh)
- ☐ Imports (TWh)
- ☐ Exports (TWh)
- ☐ Losses (TWh)

Nr.	Electricity balance	Energy (GWh)
1.	Generation	9 941
2.	Import	12 157
3.	Total input (1. + 2.)	22 098
4.	Export	4 778
5.	Total consumption (3. - 4.)	17 320
6.	Consumers at high voltage	1 078
7.	Consumption of pump	284
8.	Other consumption	7
9.	Losses	417
10.	Net delivery to distribution	15 818
11.	Transit (min (2. , 4.))	4 778

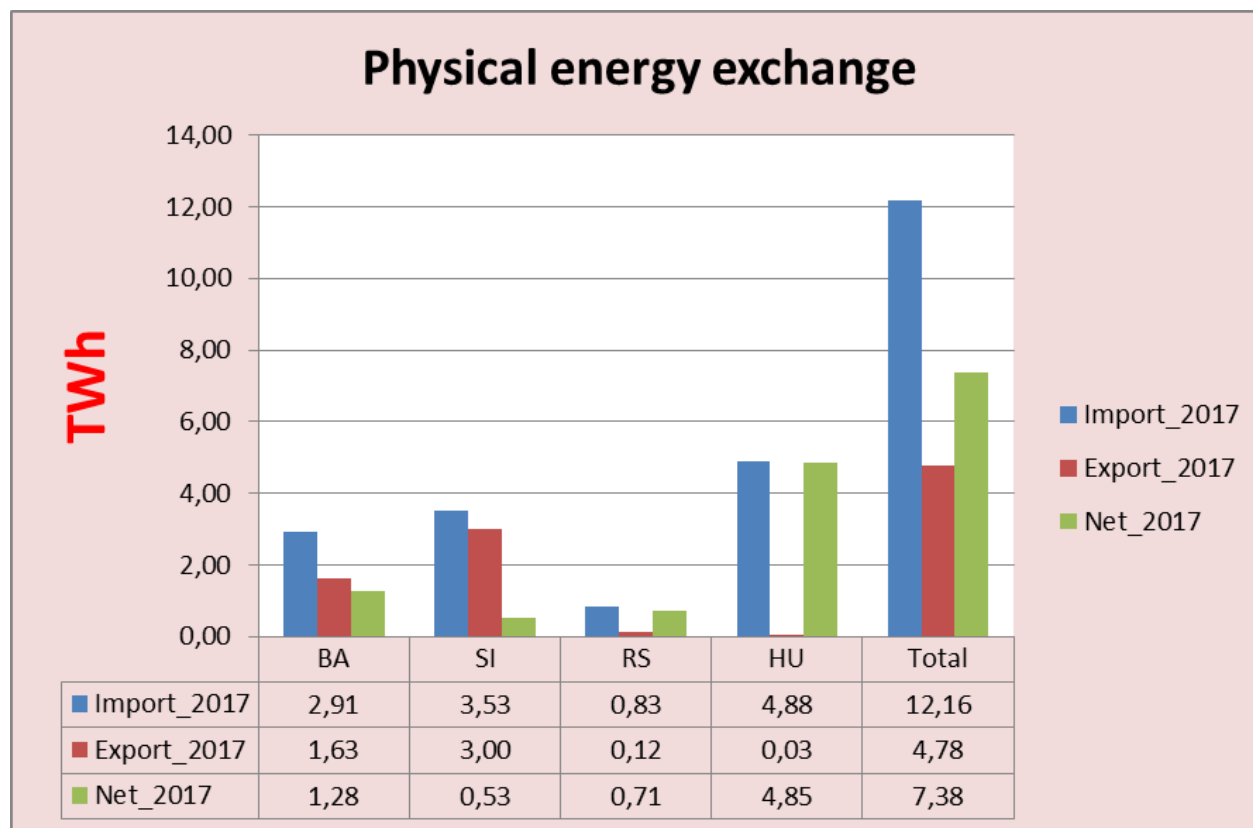
Energy exchanges in 2017

Commercial flows



Energy exchanges in 2017

Physical flows



Specific aspects of the electricity market

- ❑ Bilateral Day-ahead and Intraday Market
- ❑ Coordinated Cross-border capacity allocation:
 - HR-SI, HR-RS and HR-HU border: JAO (Joint Allocation Office) Luxembourg
 - HR-BA: SEE CAO (South East Europe Coordinated Auction Office) Podgorica, Montenegro
- ❑ Power exchange CROPEX operational since February 2016.,
- ❑ Market coupling successfully implemented on HR-SI border from 20.06.2018. – Croatian day-ahead market coupled with European MRC market