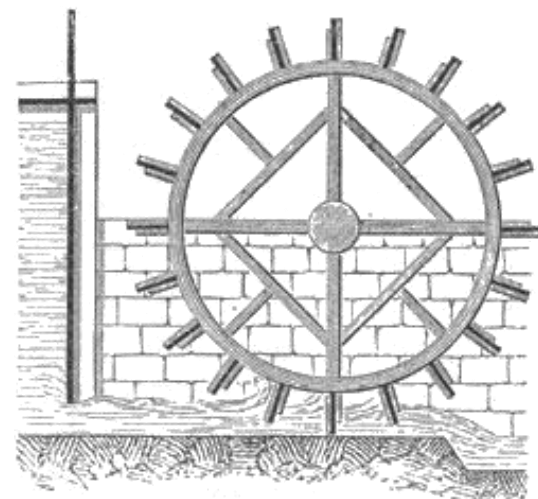
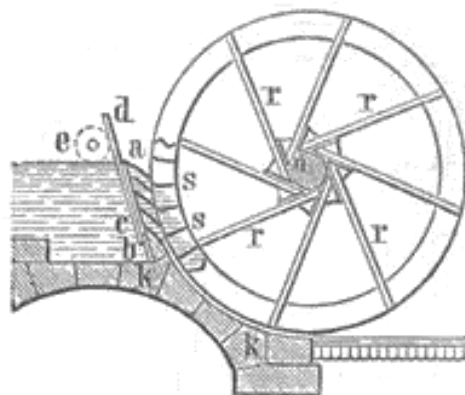
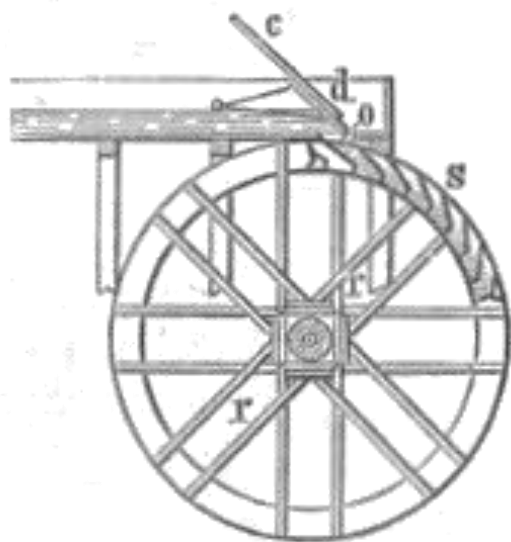


# KORIŠTENJE VODNIH SNAGA



UVOD

# Vodno kolo

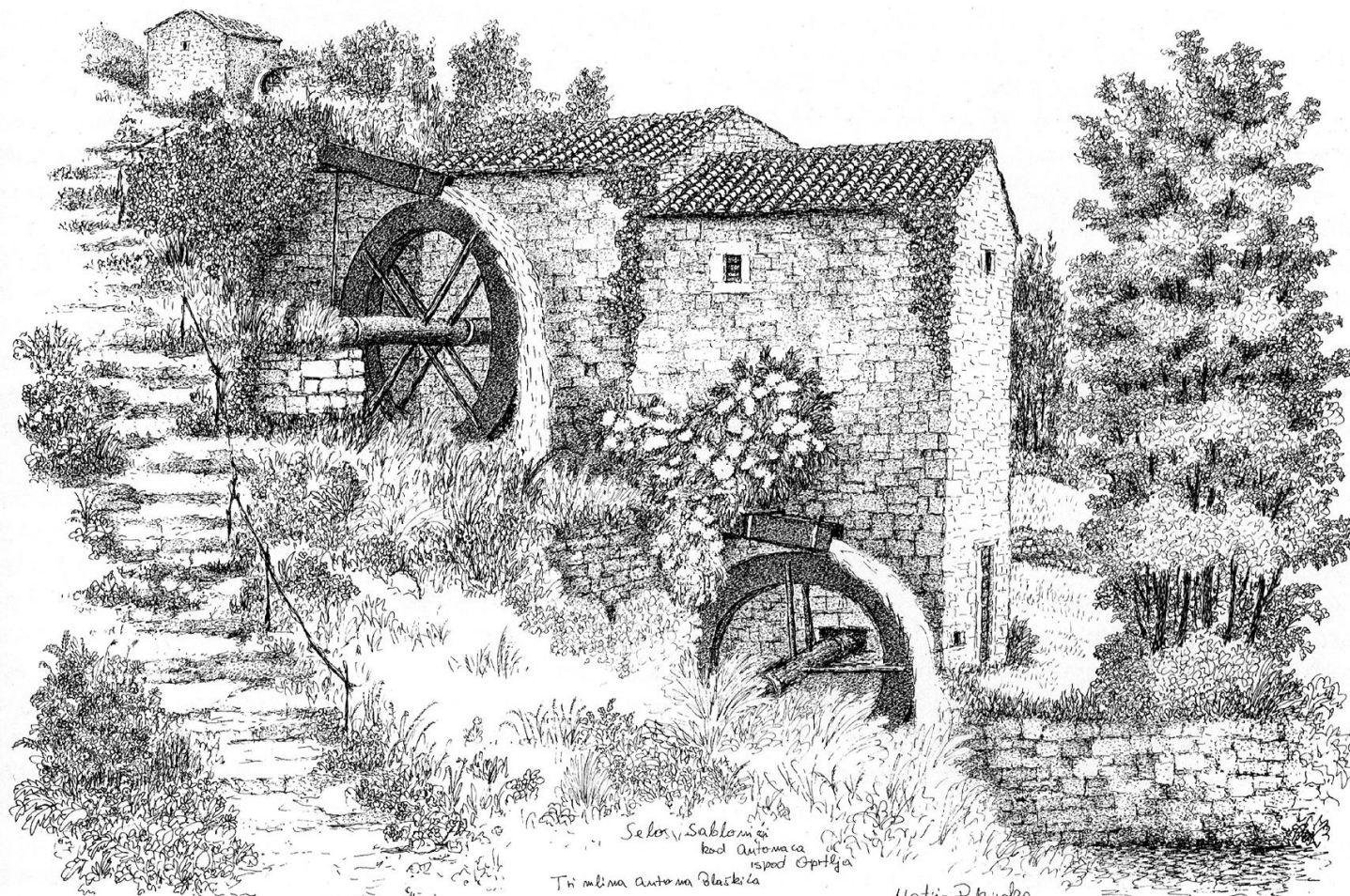


**Tjemeno vodno kolo**

**Bočno vodno kolo**

**Podnožno vodno kolo**

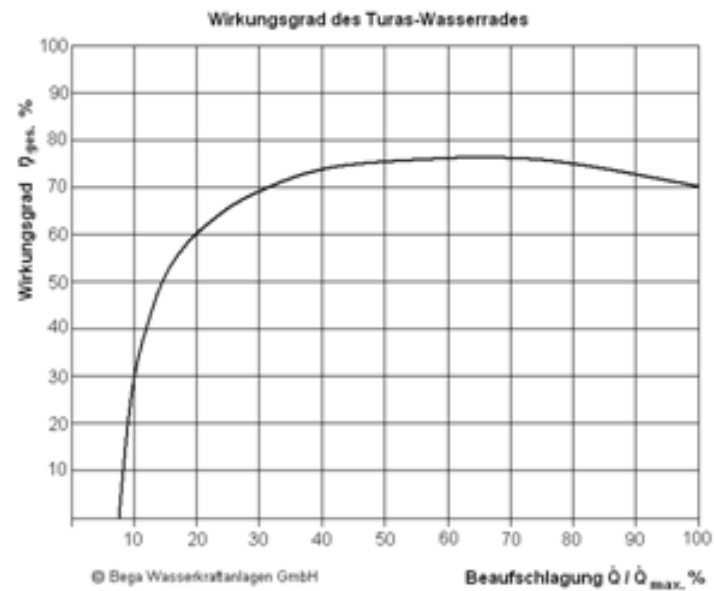
**Vodenica nadljevača u Oprtiju s dva kola**  
(M. Pokrivka, Mlinovi u Hrvata, Zagreb 2004., str. 187)





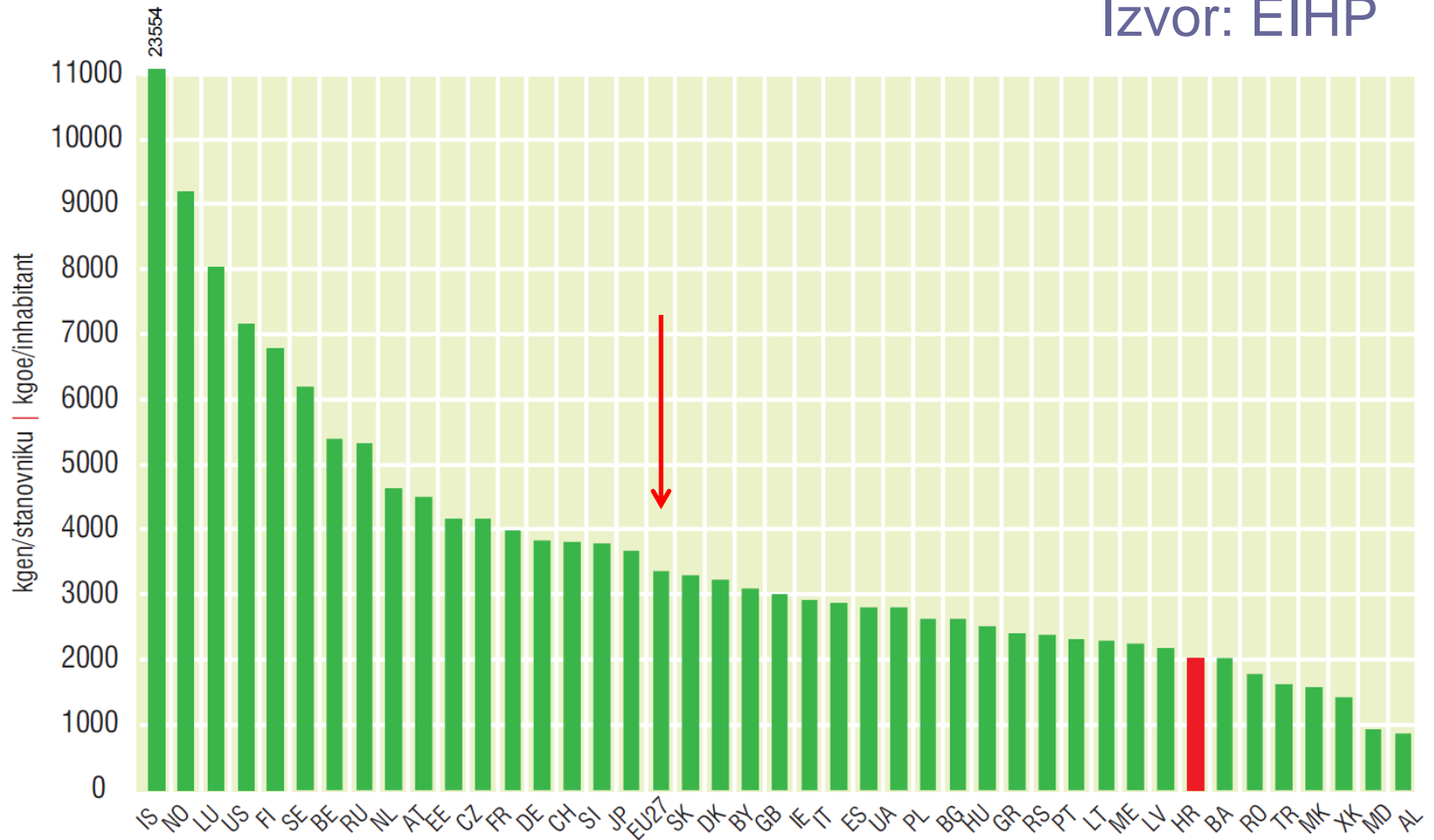


Vodno kolo u primjeni danas, mala hidroelektrana u Bavarskoj instalirane snage cca 40kW

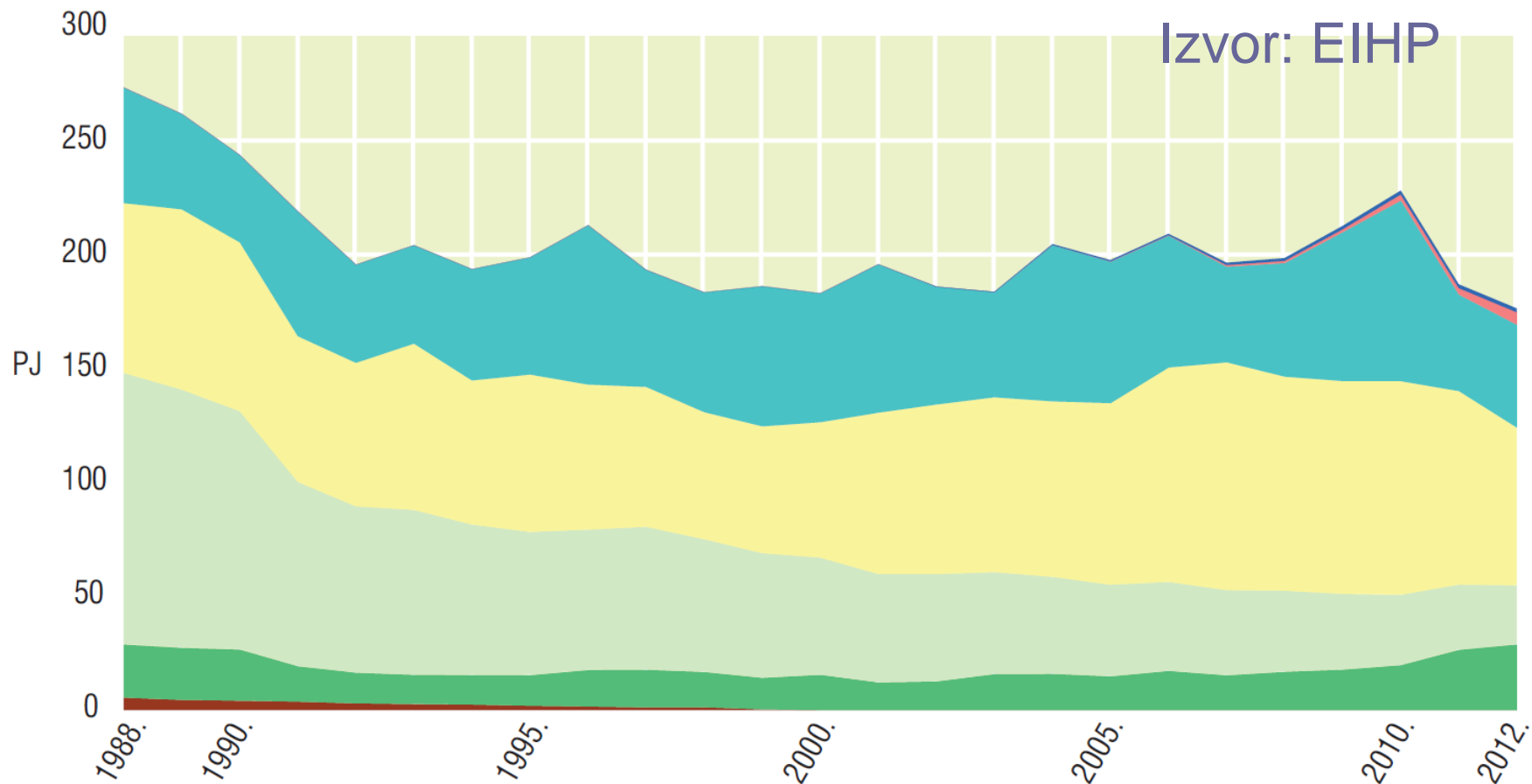


# Ukupna potrošnja energije po stanovniku, 2012. g

Izvor: EIHP



# Udio pojedinih oblika energije u ukupnoj proizvodnji energije u RH

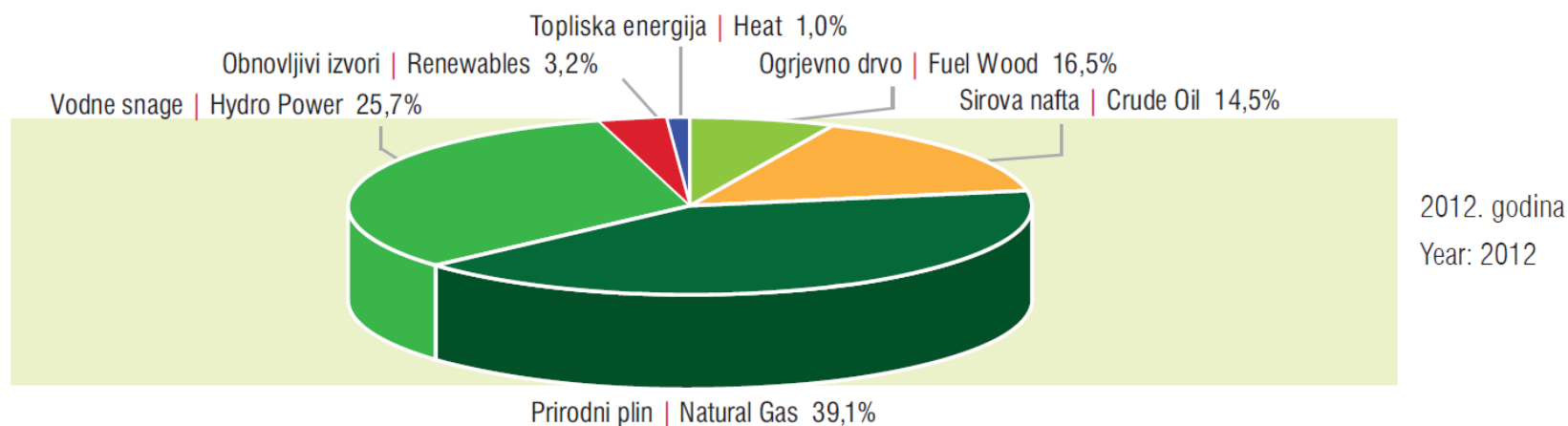
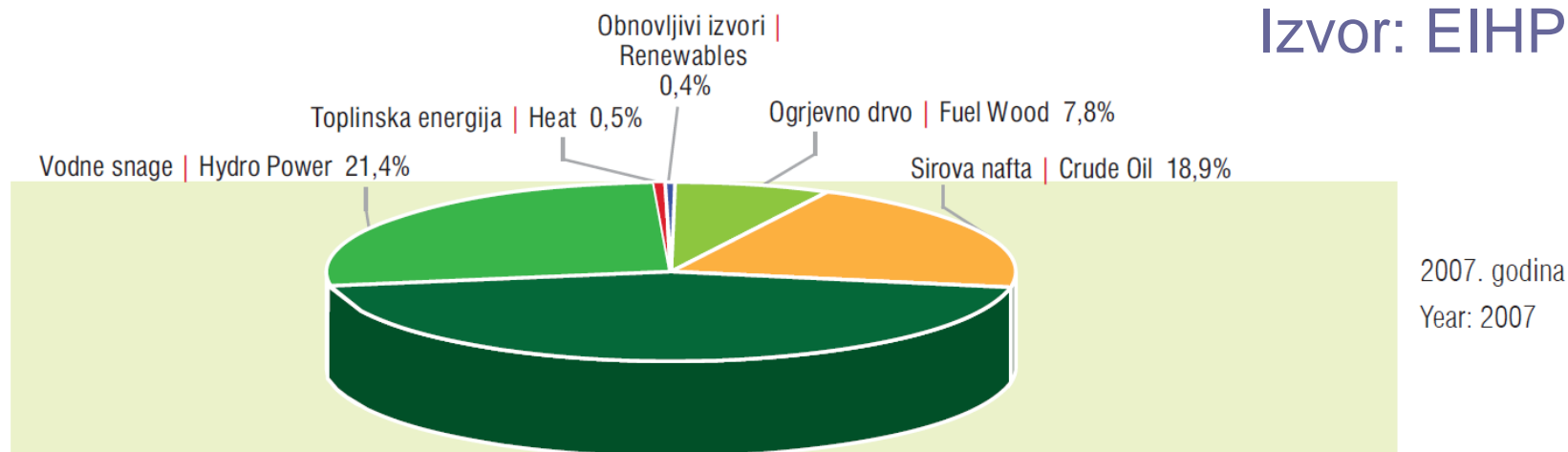


- Ugljen | Coal
- Drvo i biomasa | Biomass
- Sirova nafta | Crude Oil
- Toplinska energija | Heat
- Prirodni plin | Natural Gas
- Vodne snage | Hydro Power
- Obnovljivi izvori | Renewables

1PJ = 277 778 MWh

# Udio pojedinih oblika energije u ukupnoj proizvodnji energije u RH

Izvor: EIHP



# Ukupna raspoloživa snaga elektrana u sastavu HEP grupe

- Hidroelektrane u RH ukupna instalirana snaga = **2,14GW**.

Kapaciteti za proizvodnju električne energije Electricity generation capacity	Raspoloživa snaga Available power (MW)	Udio Share (%)	Proizvedena električna energija u 2012. Electricity produced in 2012 (GWh)
Hidroelektrane (HE) Hydro power plants (HPP)	2 136,76	51,3	4 709
Termoelektrane (TE) Thermal power plants (TPP)	1 489	35,7	3 128
TE Plomin d.o.o. (B) TE Plomin Ltd.	192	4,6	1 372
<b>Ukupno u Republici Hrvatskoj Total in the Republic of Croatia</b>	<b>3 817,76</b>	<b>91,6</b>	<b>9 209</b>
Nuklearna elektrana Krško (NE Krško) – 50% Nuclear power plant Krško (NPP Krško) – 50%	348	8,4	2 621
<b>UKUPNO TOTAL</b>	<b>4 165,76</b>	<b>100</b>	<b>11 830</b>

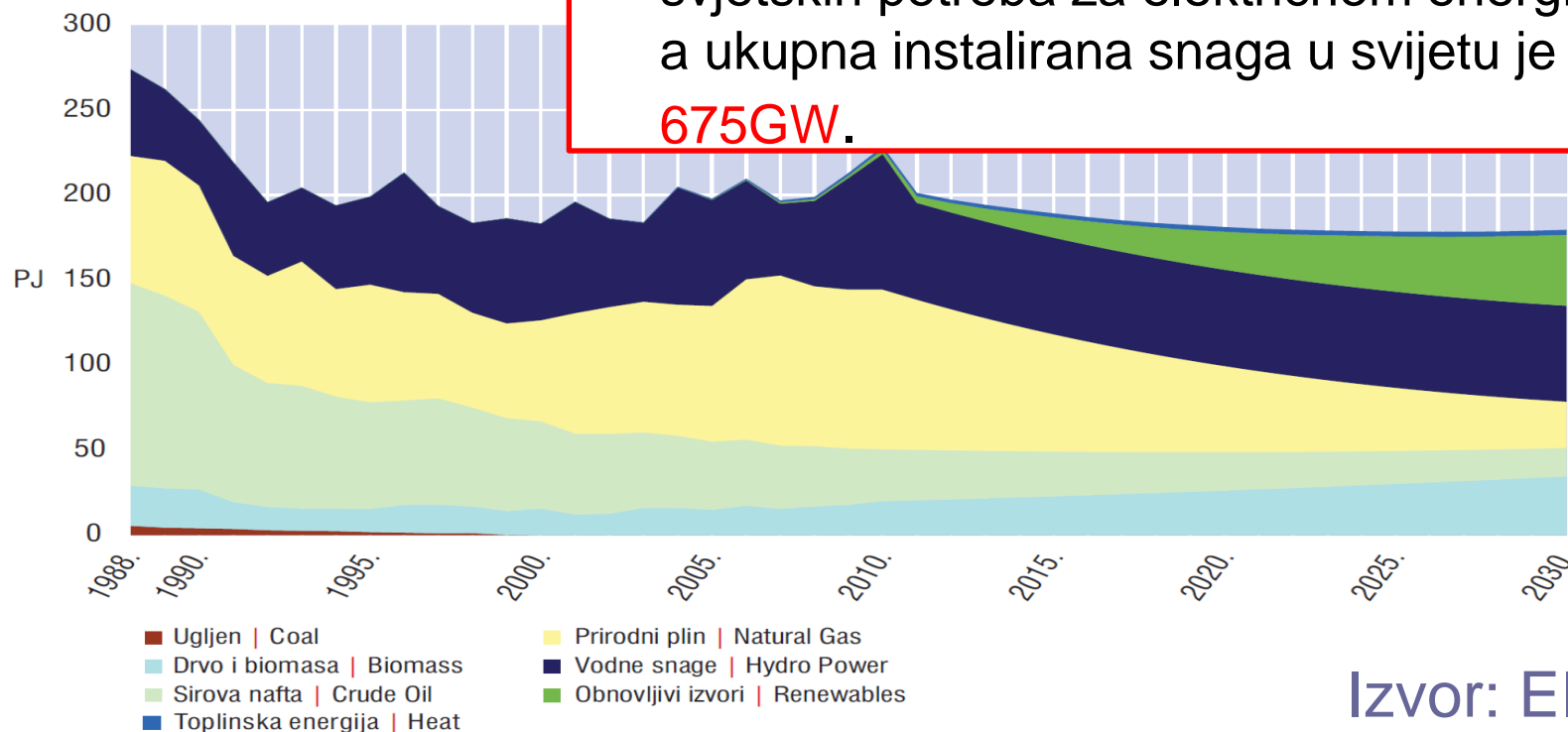
Izvor | Source: EIHP, HEP

- Instalirani kapaciteti za proizvodnju električne energije u Republici Hrvatskoj obuhvaćaju hidro i termoelektrane u sastavu HEP grupe (oko 95% kapaciteta), određeni broj industrijskih termoelektrana i nekoliko elektrana na obnovljive izvore energije u privatnom vlasništvu.



# Udio pojedinih oblika energije u ukupnoj proizvodnji energije u RH s projekcijom razvoja do 2030.

□ Hidroelektrane danas proizvode oko **24%** svjetskih potreba za električnom energijom, a ukupna instalirana snaga u svijetu je **675GW**.



Izvor: EIHP

- Prema *Strategiji energetskeg razvoja Republike Hrvatske* udio električne energije iz obnovljivih izvora energije uključivo velike HE u ukupnoj potrošnji električne energije iznosit će 35%.
- Pri tome je za male hidroelektrane cilj izgradnja barem 100MW malih hidroelektrana do 2020.

# Instalirani kapaciteti za proizvodnju električne energije iz obnovljivih izvora u RH

Izvor: EIHP

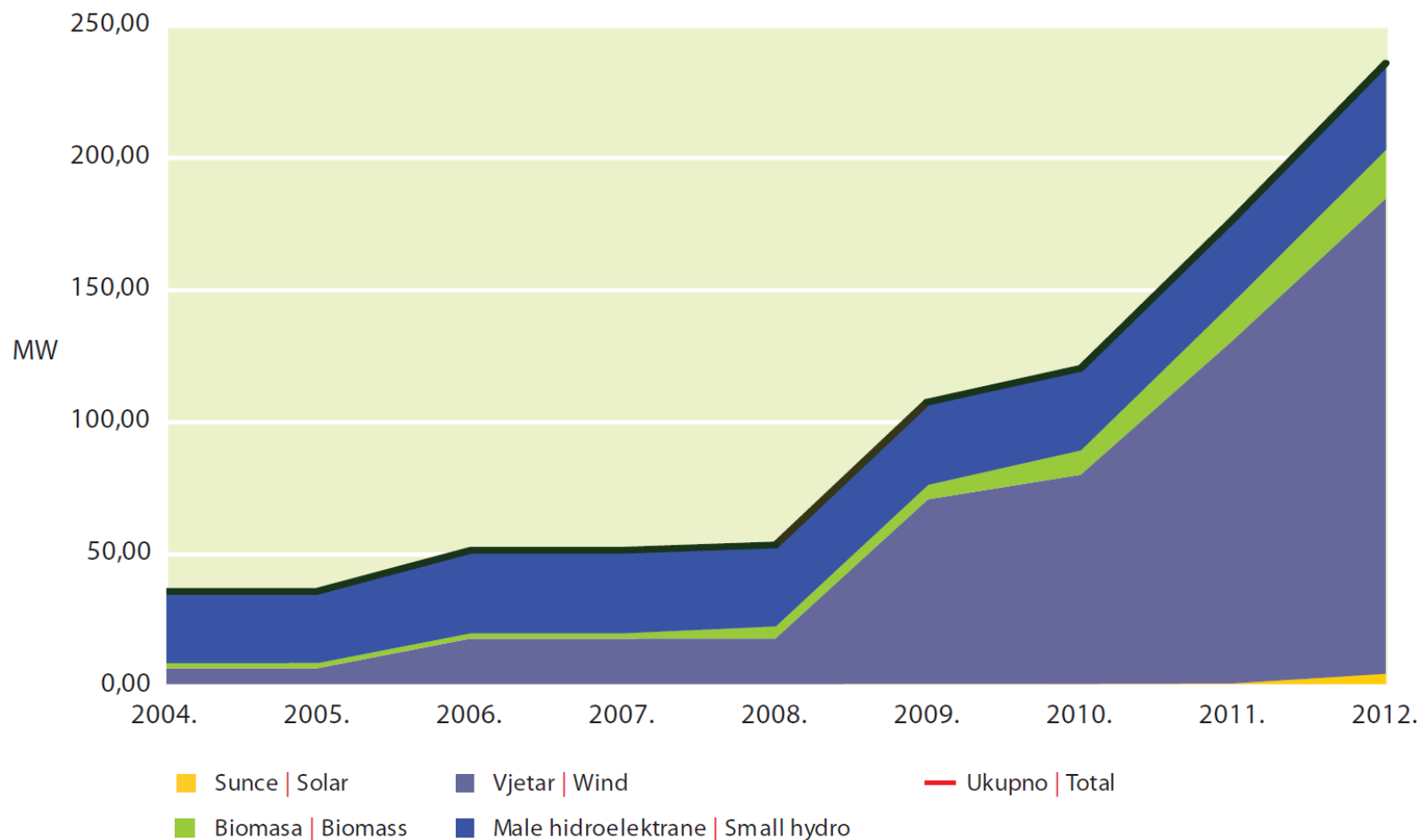
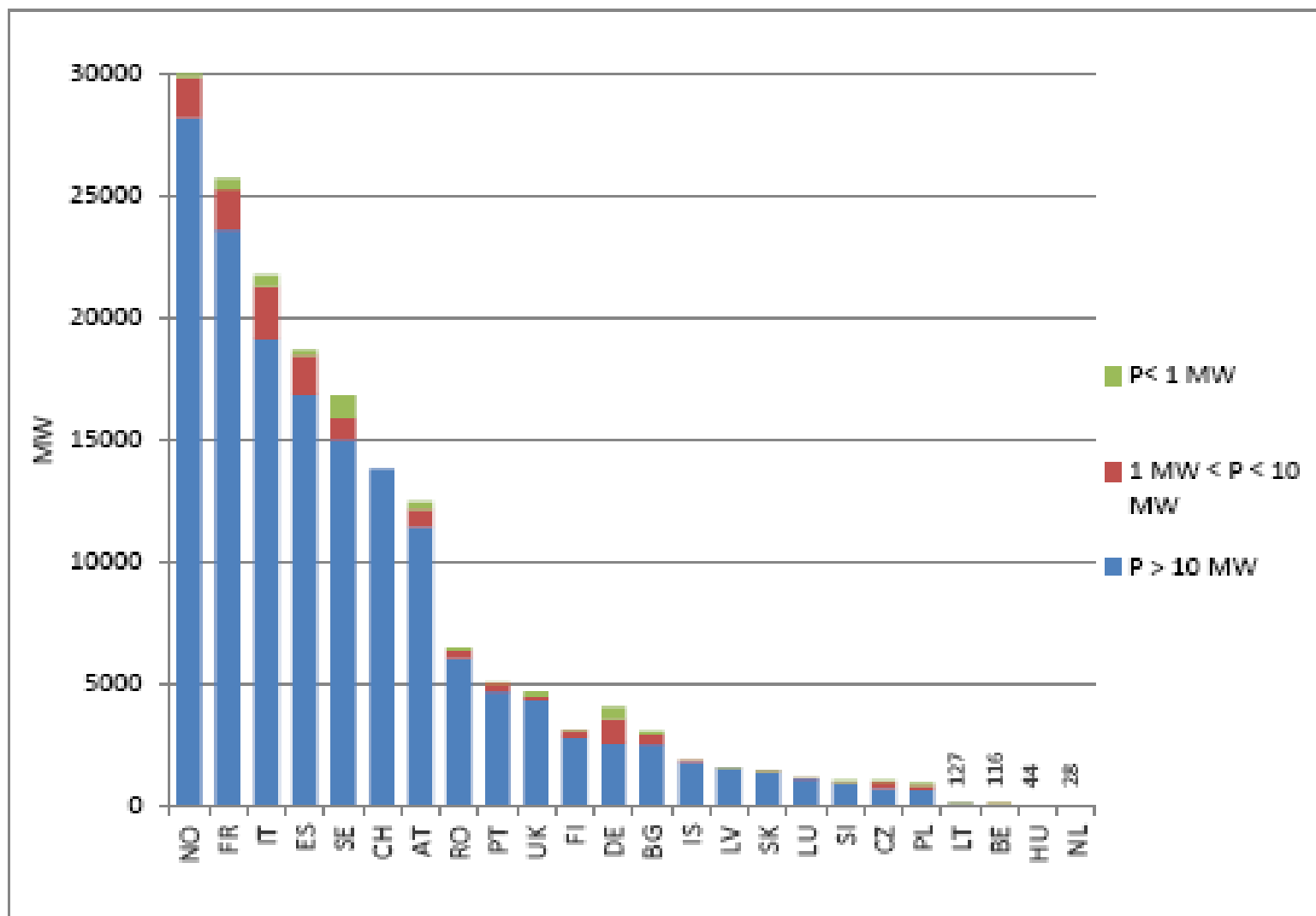
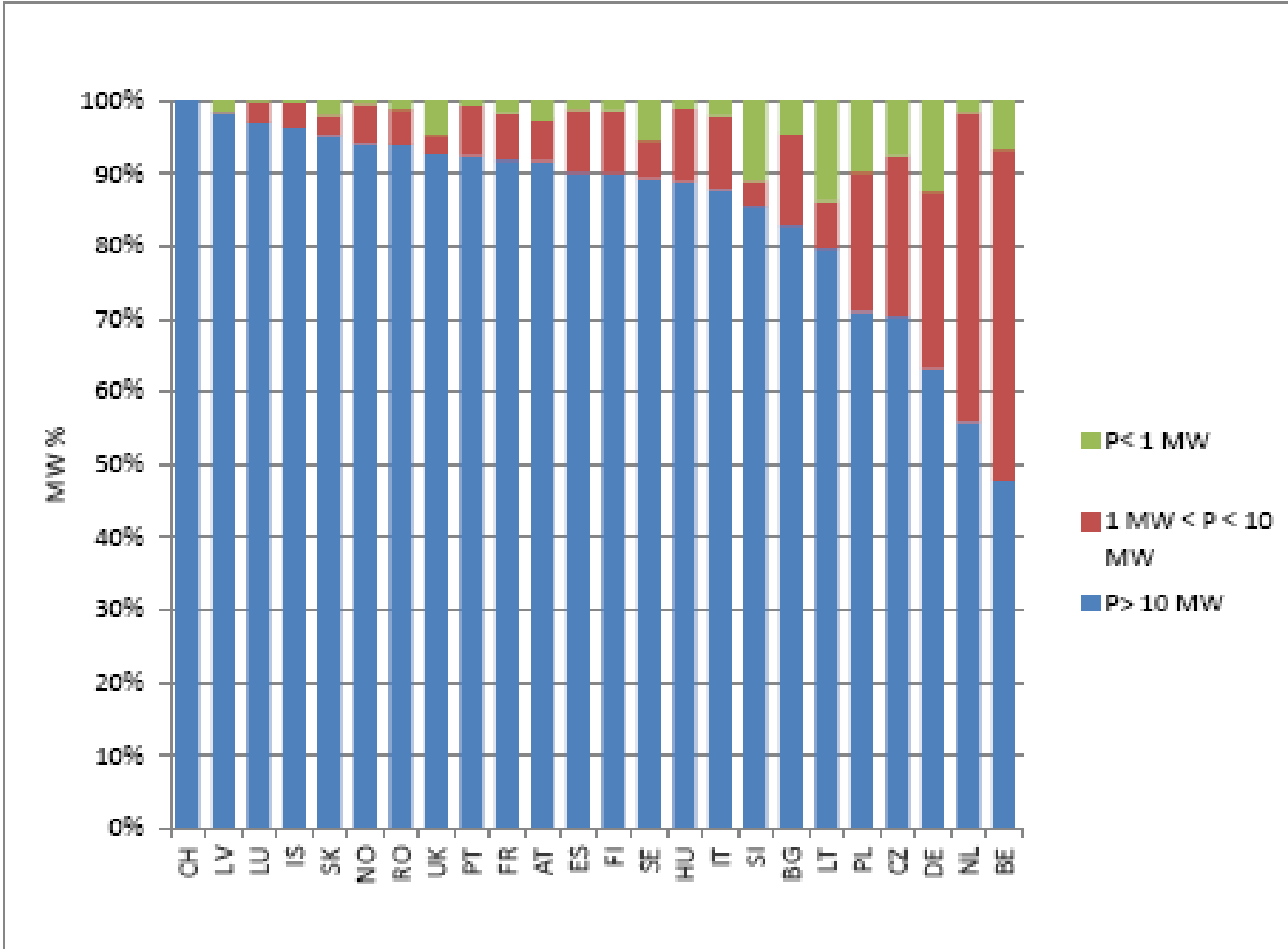


Figure 7: Total installed hydropower capacity for different HP plant sizes (MW)



Note: 1) Data for P < 1 MW and 1 MW < P < 10 MW was not available for CH. 2) The indicated amounts of installed capacity stand in relation to the total hydropower capacity for the different HP plant sizes.

Figure 8: Percentage of total installed hydropower capacity for different HP plant sizes (%)



Note: 1) Data for P < 1 MW and 1 MW < P < 10 MW was not available for CH.

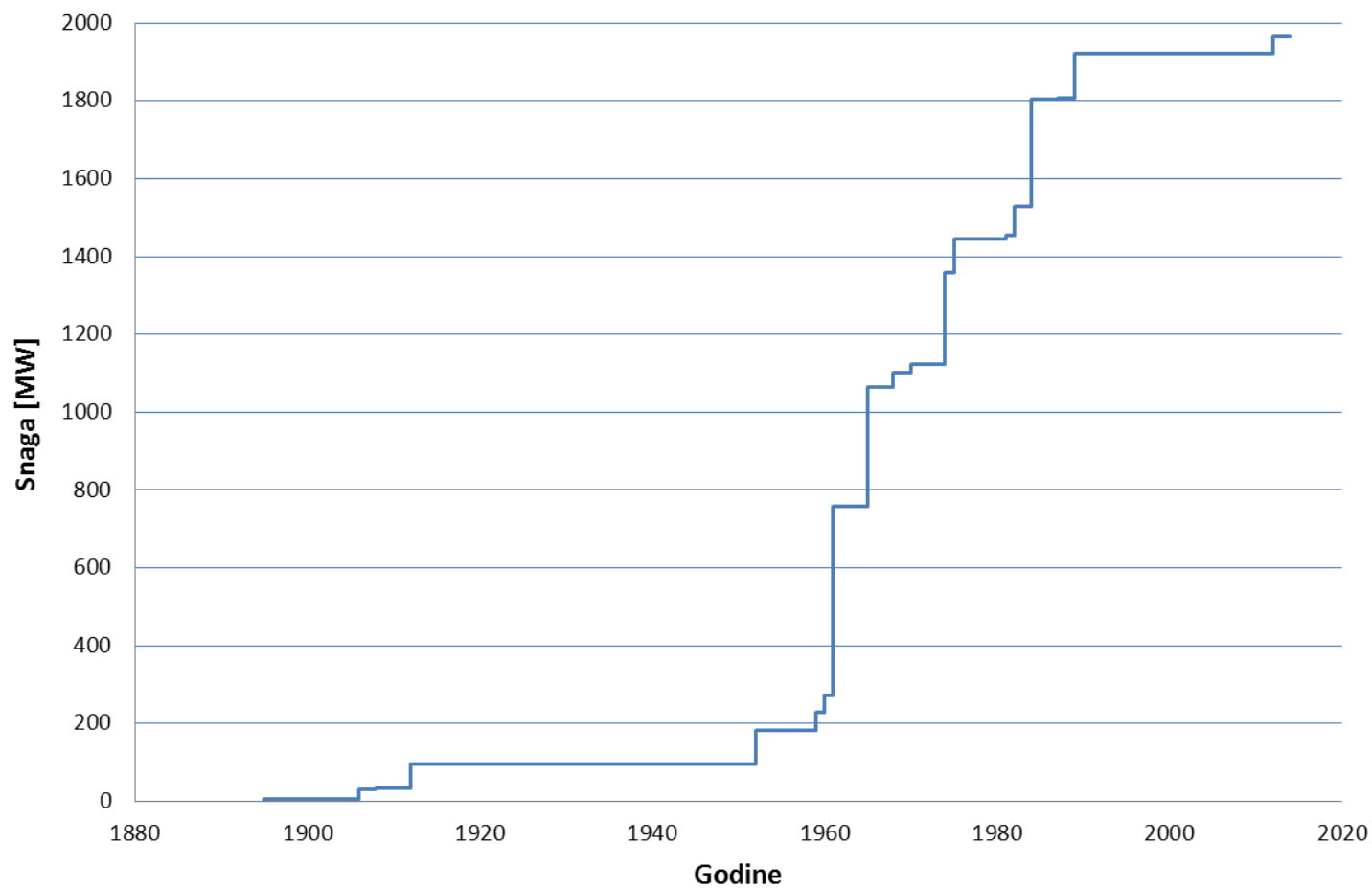
# HE u Hrvatskoj

		Instalirana snaga $P_i$ [MW]	Prosječna godišnja proizvodnja [GWh]	Godina puštanja u pogon
<b>HE NA RIJECI DRAVI</b> (slika 6)				
1.	HE VARAŽDIN	86,0	476	1975
2.	HE ČAKOVEC	75,9	400	1982
3.	HE DUBRAVA	75,0	385	1989
<b>HE U SLIVU RIJEKE KUPE</b>				
4.	HE OZALJ	5,5	23,9	1908/1952
5.	HE GOJAK (ak. Sabljaci, ak. Bukovnik)	48	195,4	1959
	HE LEŠĆE	42,3	98	2012
6.	HE ZELENI VIR	1,8		1921
<b>HE SUSTAV VINODOL, SLIV RIJEKE LOKVARKE I LIČANKE</b> (slika 7)				
7.	HE VINODOL (ak. Lokvarka, ak. Bajer, ak. Potkoš)	84	148	1952
8.	CHE FUŽINE		6,57	1957
9.	CHE LEPENICA	1,14	2,73	1987
<b>HE NA RIJEČINI</b>				
10.	HE RIJEKA	36,8	97,9	1968
<b>HE SUSTAV SENJ, SLIV RIJEKE LIKE I GACKE</b> (slika 8)				
11.	HE SENJ (ak. Kruščica, k.b. Gusić polje)	216	972	1965
12.	HE SKLOPE	22,5	85	1970
<b>GRAČAČKA VISORAVAN</b>				
13.	RHE VELEBIT	276	430	1984
<b>HE SLIVA RIJEKE KRKE</b> (slika 9)				
14.	HE GOLUBIĆ	7,5	28,5	1981
15.	MHE KRČIĆ	0,350	2,0	1988
16.	HE MILJACKA	24	116	<del>1906/1956</del>
17.	HE JARUGA	5,4	35	1895/1903
<b>HE SUSTAV U SLIVU RIJEKE CETINE</b> (slika 10)				
18.	HE PERUĆA	41,6	120	1960
19.	HE ORLOVAC	237	440	1974
20.	HE ĐALE	40,8	157	1989
21.	HE ZAKUČAC	486	1640	1961/1980
22.	HE KRALJEVAC	59,2	40	1912/1932
<b>HE SLIVA RIJEKE TREBIŠNJICE</b>				
23.	HE DUBROVNIK	90,0	216	1965
24.	HE ZAVRELJE	1,9	4,5	1952
Na popisu su navedene samo HE instalirane snage veće od 1MW				



# HE u Hrvatskoj

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# HE Jaruga

- 1895. – 600kW
- 1904. – 5,4MW





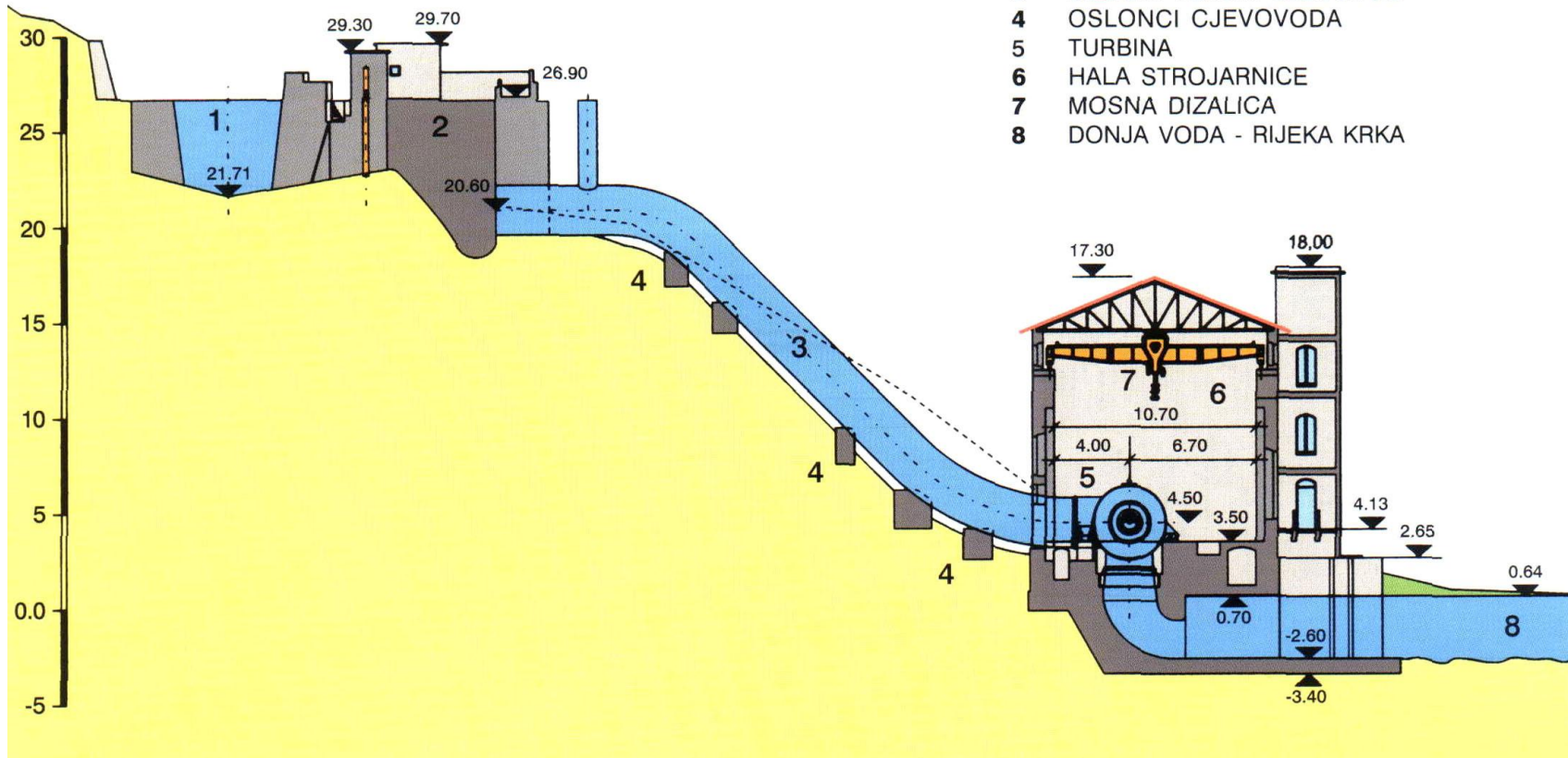
# HE Jaruga

- 1895. – 600kW
- 1904. – 5,4MW



# HE Jaruga

- 1895. – 600kW
- 1904. – 5,4MW



# HE na rijeci Dravi

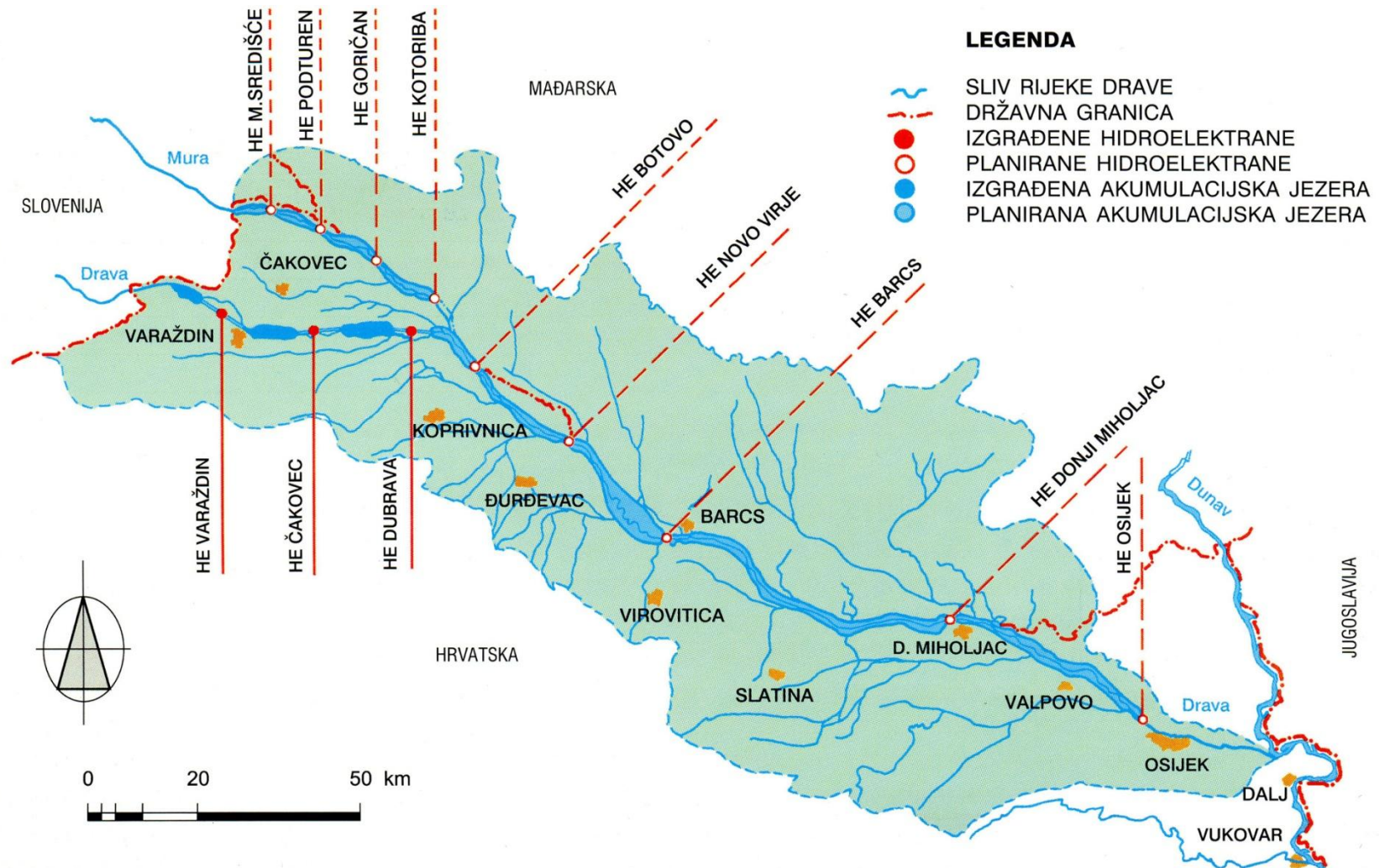
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- Korištenje vodnih snaga
- Opskrba vodom
- Obrana od poplava
- Zaštita zemljišta od erozije
- Navodnjavanje
- Odvodnja
- Rekreacija

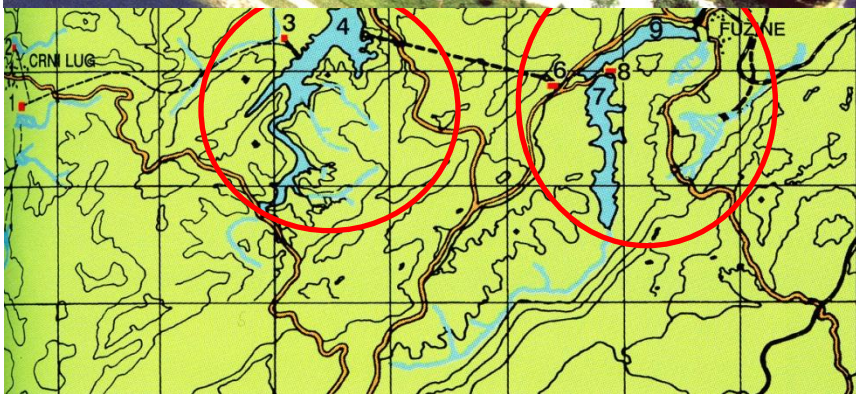
- HE Varaždin – 86MW, 1975.g.
- HE Čakovec – 76MW, 1982.g.
- HE Dubrava – 75MW, 1989.g.



# HE na rijeci Dravi





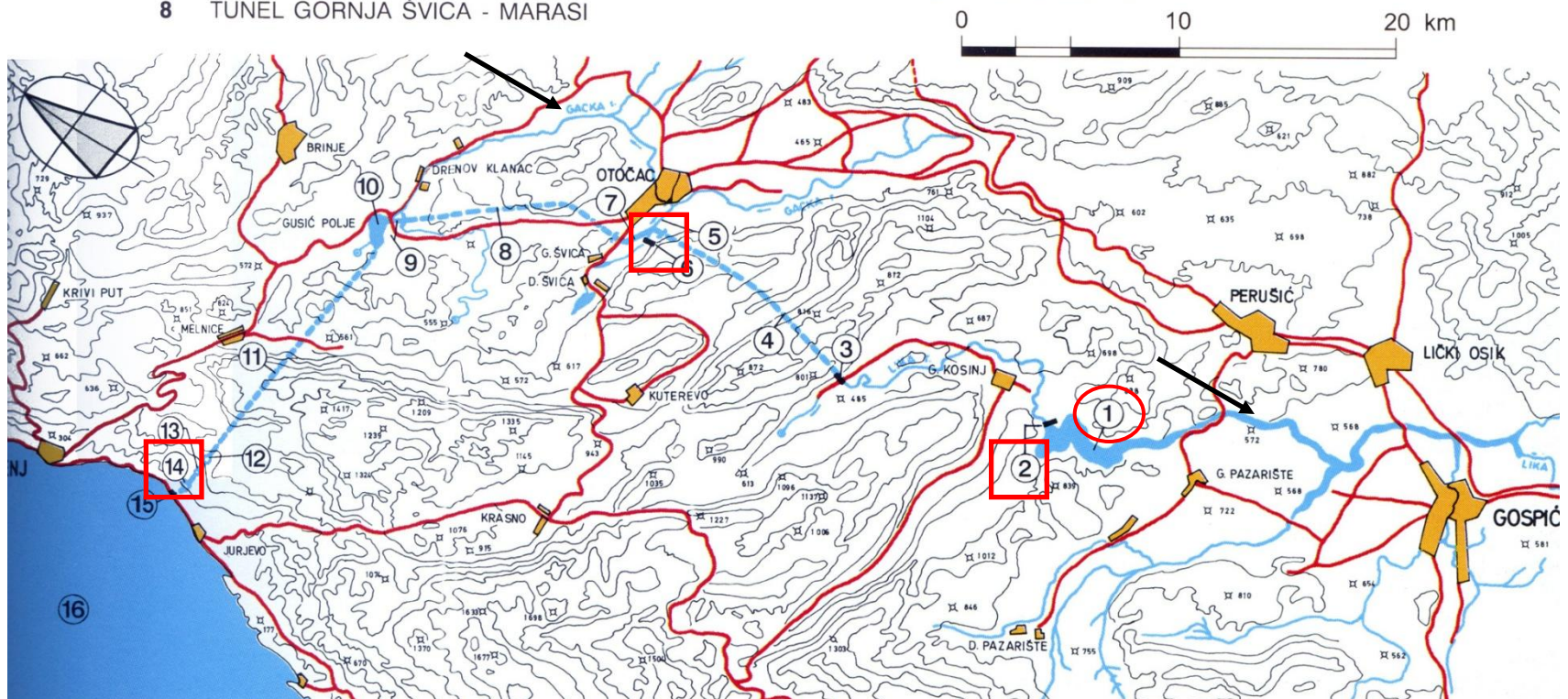




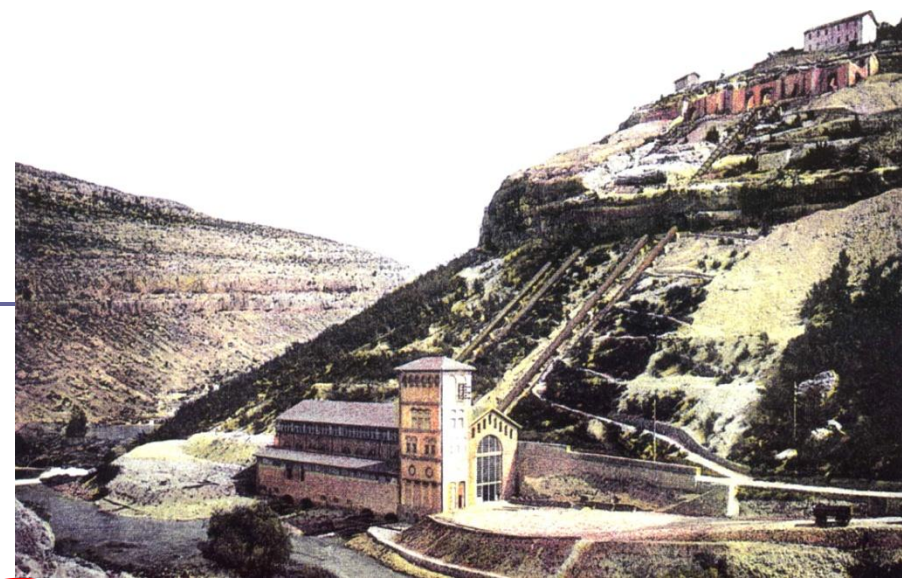
# HE sliva rijeke Like i Gacke

## LEGENDA

- |   |                                  |    |                                   |
|---|----------------------------------|----|-----------------------------------|
| 1 | AKUMULACIJSKO JEZERO KRUŠČICA    | 9  | KANAL MARASI - GUSIĆ POLJE        |
| 2 | BRANA I HE SKLOPE                | 10 | KOMPENZACIJSKI BAZEN GUSIĆ POLJE  |
| 3 | BRANA I ULAZNA GRAĐEVINA SELIŠTE | 11 | TUNEL GUSIĆ POLJE - HRMOTINE      |
| 4 | TUNEL LIKA - GACKA               | 12 | VODNA KOČMORA                     |
| 5 | REGULIRANO KORITO GACKE          | 13 | ZASUNSKA KOMORA I TLAČNI CJEVOVOD |
| 6 | BRANA ŠUMEČICA                   | 14 | HIDROELEKTRANA SENJ               |
| 7 | KANAL ŠUMEČICA - GORNJA ŠVICA    | 15 | ODVODNI TUNEL I IZLAZNA GRAĐEVINA |
| 8 | TUNEL GORNJA ŠVICA - MARASI      | 16 | JADRANSKO MORE                    |



# HE sliva rijeke Krke



## LEGENDA

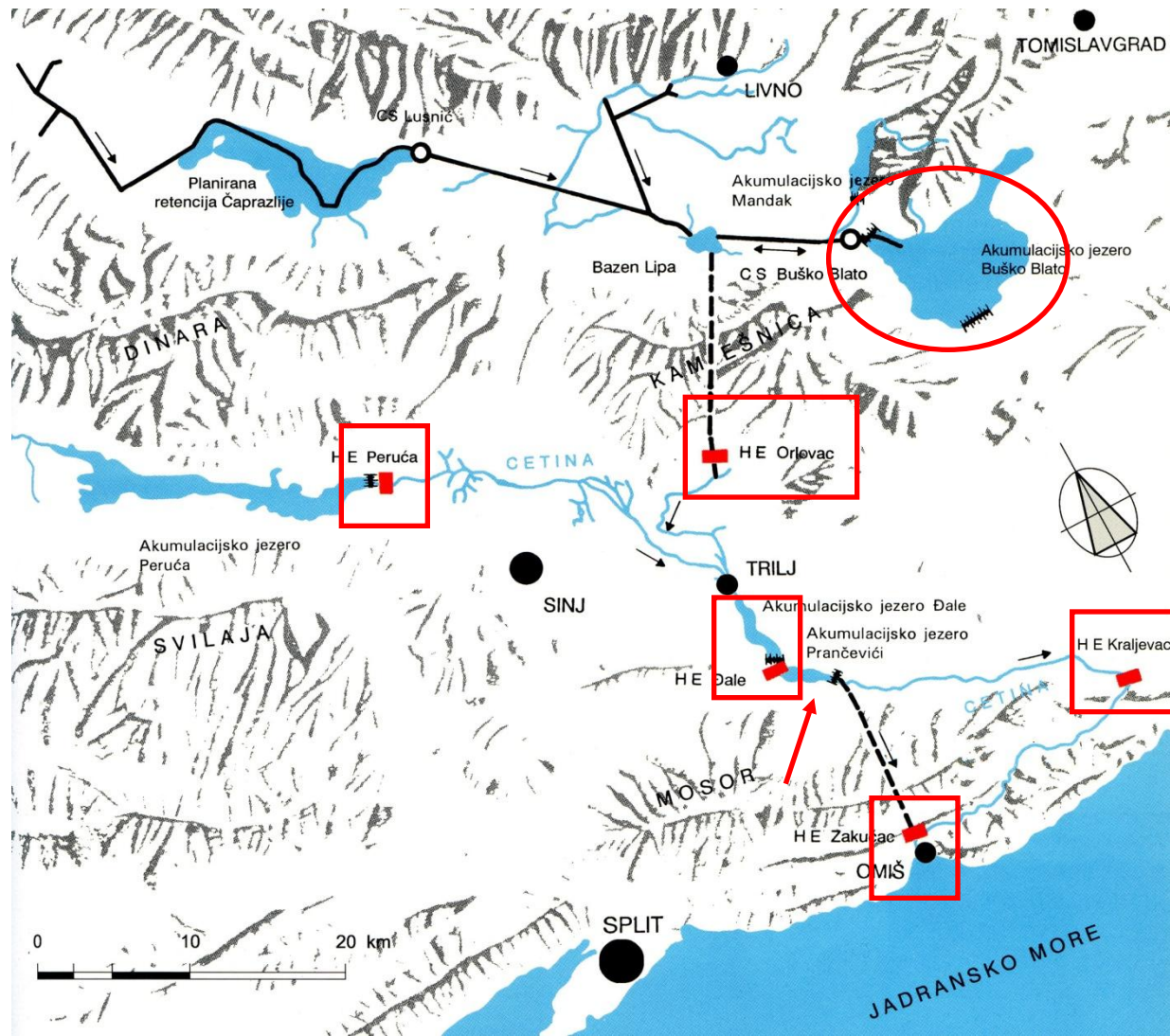
- 1 HE GOLUBIĆ
- 2 MHE KRČIĆ
- 3 HE MILJACKA
- 4 HE ROŠKI SLAP
- 5 HE JARUGA



HIDROENERGETSKI  
OBJEKTI NA RIJECI KRKI

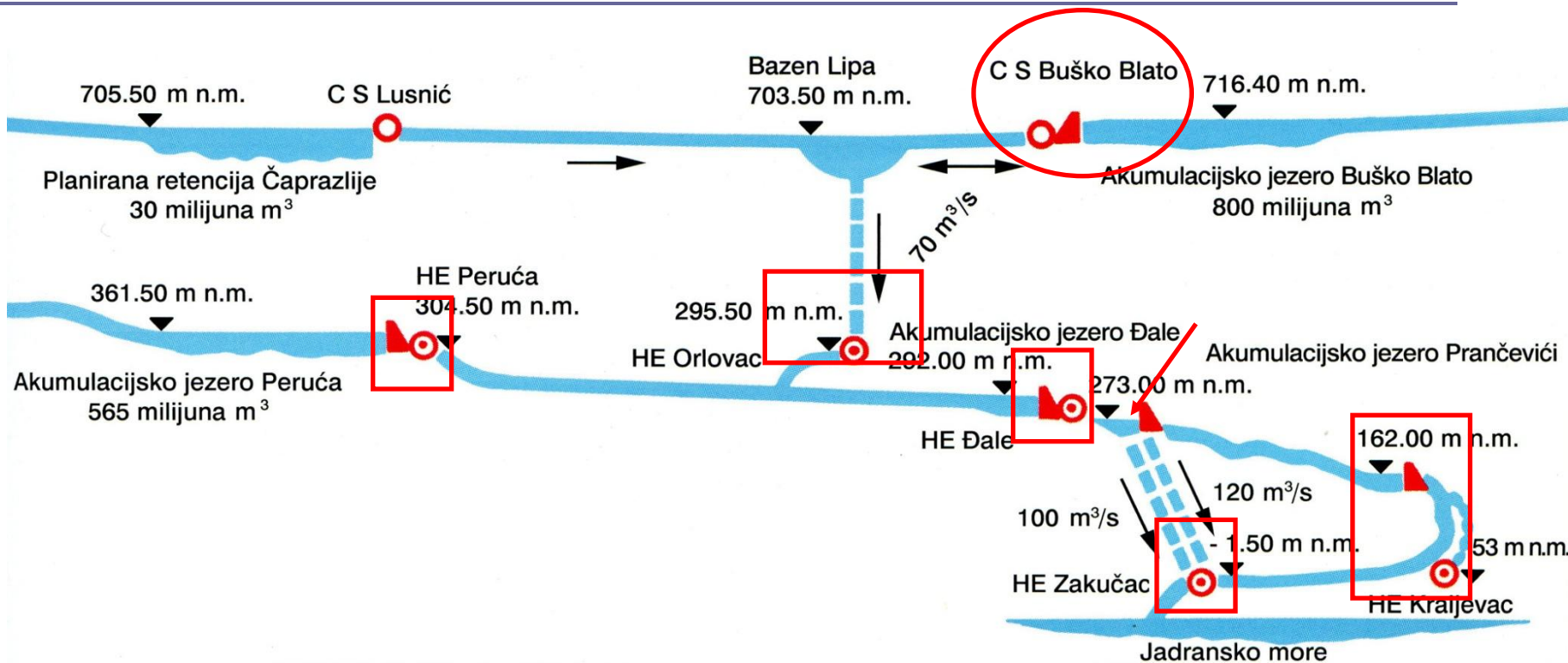


# HE sustav sliva rijeke Cetine





# HE sustav sliva rijeke Cetine



# Buduće korištenje vodnih snaga Hrvatske

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- Preostali hidroenergetski potencijal u Hrvatskoj
  - Oko 60 HE – instalirane snage 1400MW, prosječne god. proizvodnje 5950GWh
    - Dio na graničnim rijekama
    - Prema nekim proračunima RH: 1027,5MW – 4614GWh
  
- Značajnije planirane HE
  - HE Novo Virje na Dravi – 114MW
  - HE Podsused, HE Prečko, HE Zagreb, HE Drenje na Savi – ukupno 140MW
  - HE Senj 2 – 350MW
  - HE Ombla (izvor Ombla na Rijeci Dubrovačkoj)– 68,5MW

# Velike HE u svijetu – prema instaliranoj snazi

---

## □ Three Gorges Dam, Kina

- 22.5GW, 80.8 TWh/god

## □ Itaipu, Brazil / Paragvaj

- 14.0GW, 94.7TWh/god



## □ Guri, Venezuela

- 10.2GW, 53.41TWh/god

Hrvatska:

- 1.HE Zakučac: 486MW – 1640GWh
- 2.HE Senj: 216MW – 972GWh
- 3.HE Orlovac: 237MW - 440GWh



# Three Gorges Dam



November 7, 2006



# Velike HE u svijetu – prema padu

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## □ Reisseck, Austria

■ 1772 m

## □ Grand Dixence, Švicarska

■ 1748 m

## □ Portillon, Francuska

■ 1420 m

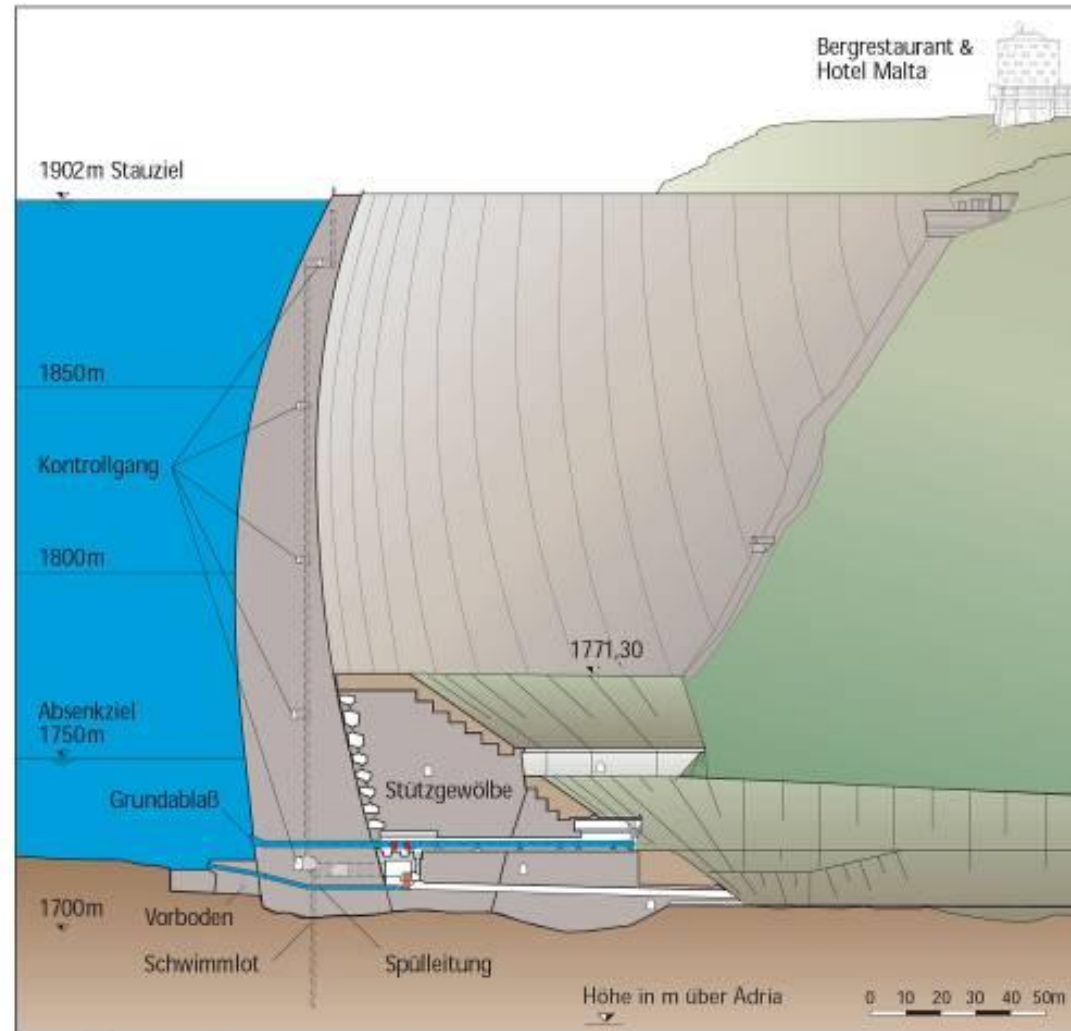
Hrvatska:

1.HE Vinodol: 660m

2.HE Velebit: 550m

3.HE Senj: 437m





Sperrstausee Kölnbrein, Querschnitt





Najviša gravitacijska  
brana - 285m