

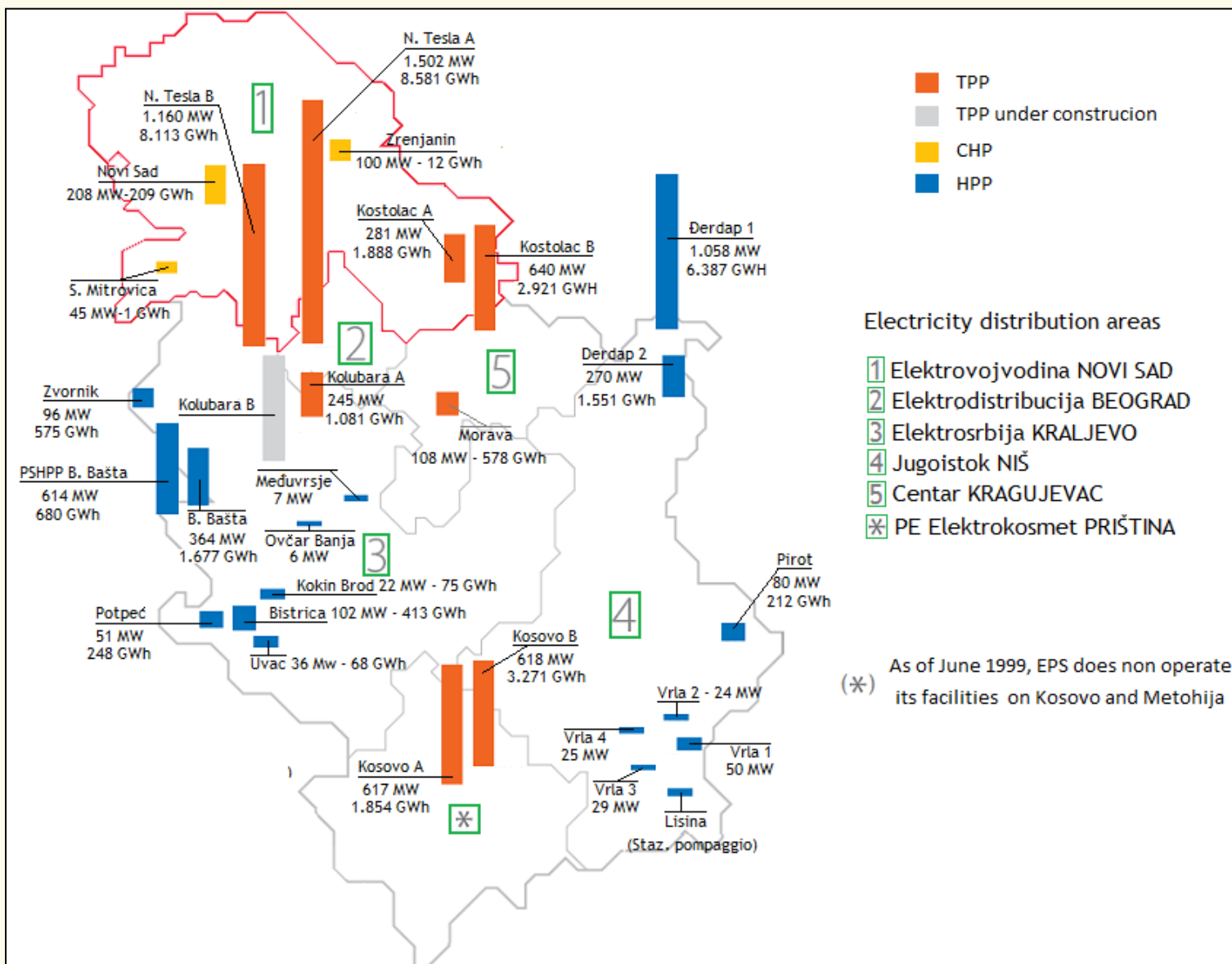


ENERBIO

*Renewable Energy & Biotechnologies between
Friuli Venezia Giulia and Vojvodina*

Pordenone – Trieste

April 11th - 12th 2012



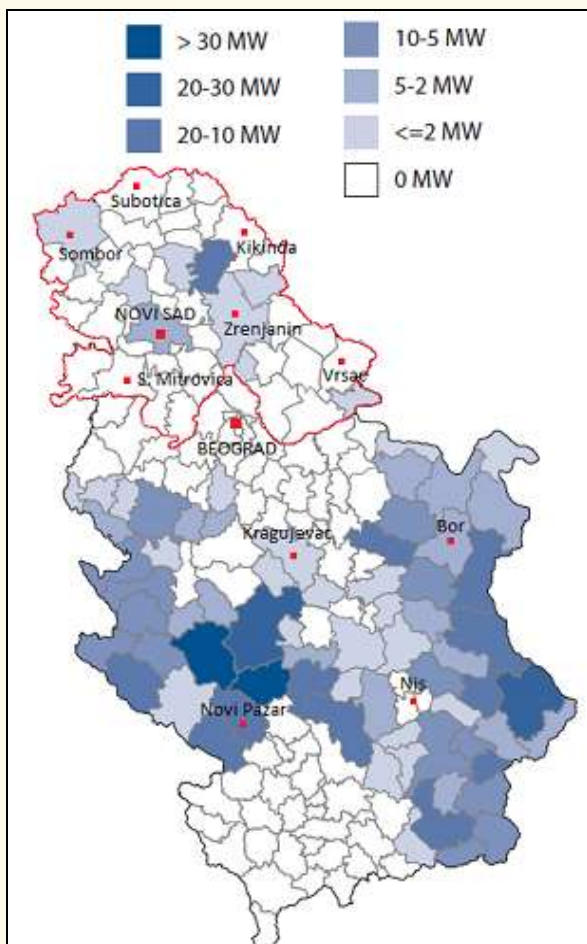


Hydroelectric plants

Hydro energy potentials of Vojvodina

- ❖ **Large Hydropower Plants:** hydropower plants on the Danube and the Sava rivers. The best location of water steps are at the Danube near Novi Sad (Begeč) and at the Sava (Obrež – Srem District).
- ❖ **Small Hydropower Plants:** hydropower plants which will be expanded along the existing water steps at the hydro system “Dunav-Tisa-Dunav” which have already been built.
- ❖ **Micro Hydropower Plants:** power plants which will be built on evacuation branches of accumulations in the Fruška Gora area (District of Srem).

Hydroelectric plants

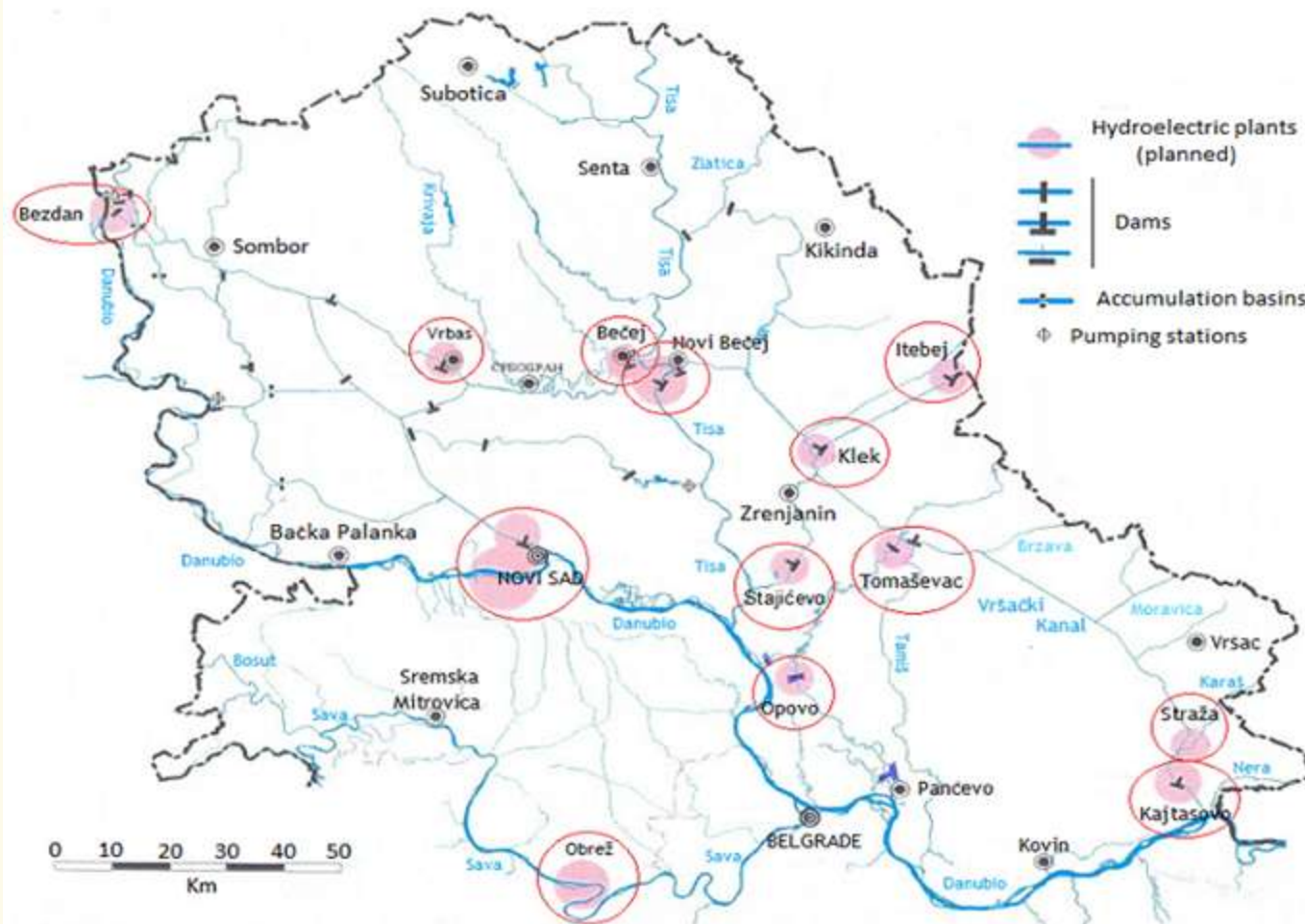


Potential hydroelectric plants in Vojvodina

Location of Hydroplants	Water flow (m ³ /s)	Range of falls		Installed capacity (kW)	Annual production (MWh)
		Min.	Max.		
Bezdan (Sombor - West Bačka)	40	1.5	5.0	1 650	2 200
Novi Sad (South Bačka)	60	1.5	7.0	3 000	13 700
Kucura (Vrbas - South Bačka)	20	1.5	2.1	250	1 800
Vrbas (South Bačka)	18	4.0	5.8	850	4 700
Bečej (Middle Banat)	20	1.5	4.2	620	2 270
Itebej (Žitište - Middle Banat)	30	1.5	2.5	600	2 600
Klek (Zrenjanin - Middle Banat)	30	1.5	3.6	850	3 400
Stajićevo (Zrenjanin - Middle Banat)	30	1.5	3.6	850	2 600
Tomaševac (Zrenjanin - Middle Banat)	10	1.5	2.5	240	750
Opovo (South Banat)	10	2.0	3.5	280	900
Straža (Vršac - South Banat)	6,6	1.5	4.8	240	1 220
Kajtasovo (Bela Crvka - South Banat)	40	3.0	4.0	1 220	8 190
Novi Bečej (Middle Banat)	525	1.5	6.5	14 800	50 700
TOTAL				25 450	95 030

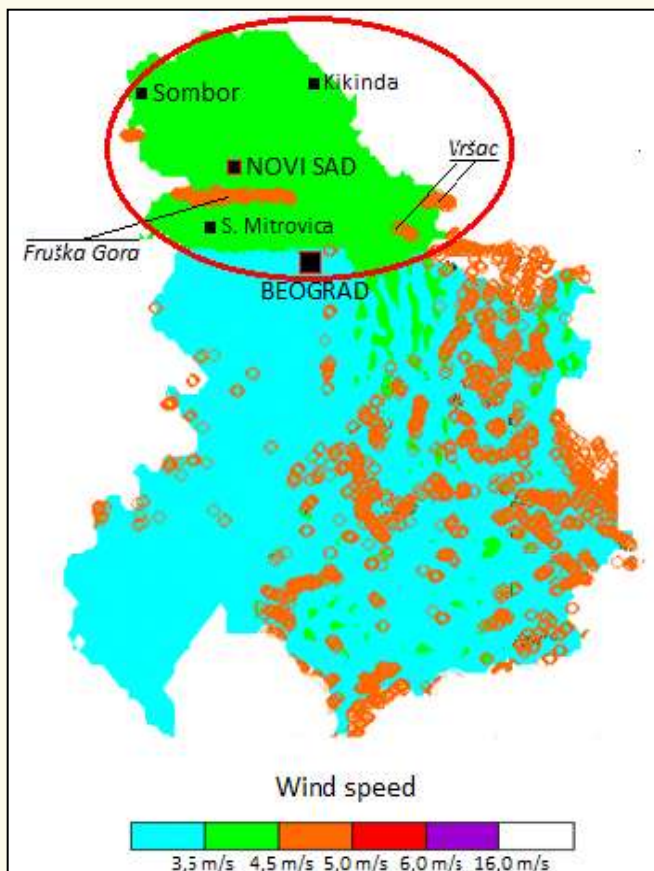
Hydroelectric plants

Potential locations of hydroelectric plants in Vojvodina



Source: Provincial Secretariat for Energy and Mineral Resources

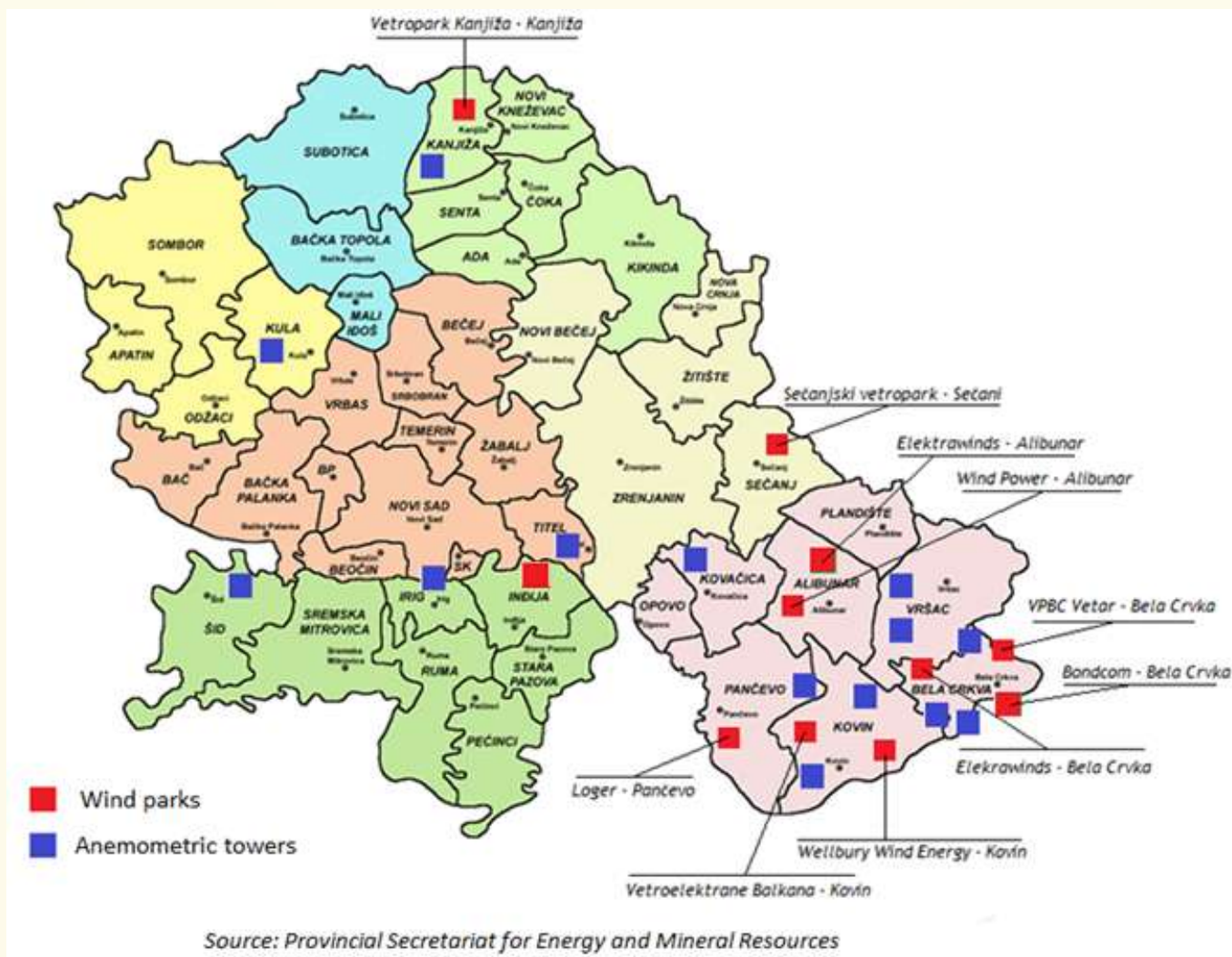
Wind energy



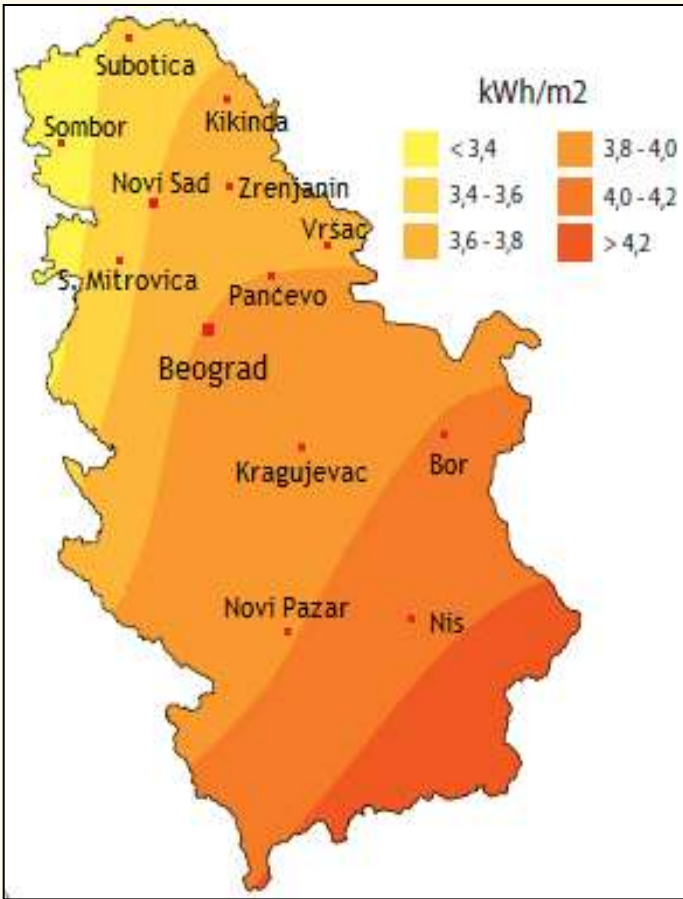
Wind park projects in Vojvodina		
Developer	Wind park	Location
VPBC Vetar d.o.o. - Bela Crkva	“Vracev gaj” 187,5 MW	Bela Crkva - Vracev gaj
Wellbury Wind Energy d.o.o. - Beograd	“Bavanistansko polje” 188 MW	Kovin Municipality (Bavaniste, Deliblato, Mramorak and Dolovo)
Windtim d.o.o. - Beograd	“Susara” 60 MW	Vršac Municipality and Bela Crkva
Energowind d.o.o. - Vršac	“Vršac - Alibunar - Plandiste” 400 MW	Vršac, Alibunar and Plandiste Municipalities
Vetroelektrane Balkana d.o.o. - Beograd	“Cibuk” 300 MW	Kovin Municipality (Bavaniste)
Zad MK - Fintel Wind a.d. - Beograd	“Kosava” 117 MW	Vršac Municipality (Uljma, Izbiste, Zagajica and Parta)
Zad MK - Fintel Wind a.d. - Beograd	“La Piccolina” 5 MW	Vršac Municipality
Vetropark Indjia d.o.o. - Indjia	“Indjia” 20 MW	Indjia Municipality

Wind energy

Location of wind park projects in Voivodina



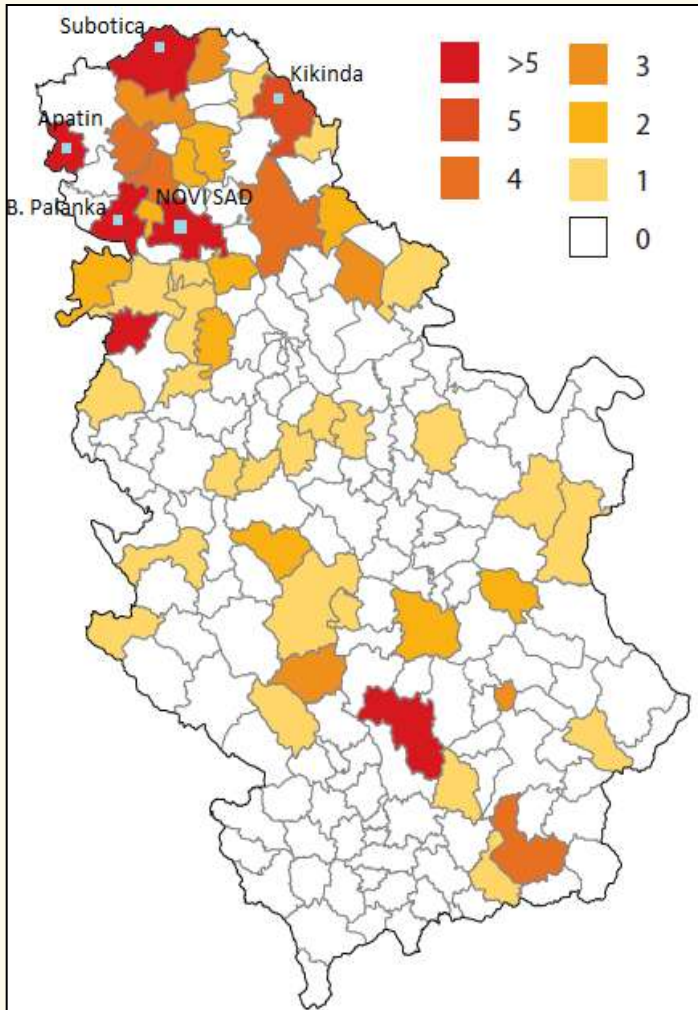
Solar photo-voltage systems



Solar irradiation in Vojvodina

(kWh/m ²)	Month		Total year	Daily average
	Min.	Max.		
Novi Sad	1,20 (Dec.)	6,35 (July)	1.392,65	3,82
Vršac	1,00 (Dec.)	6,85 (Aug.)	1.424,75	3,90
Palić	1,15 (Dec.)	6,35 (July)	1.407,40	3,80
			1.400,00 (Av. Serbia)	3,80 (Av. Serbia)

Geothermal



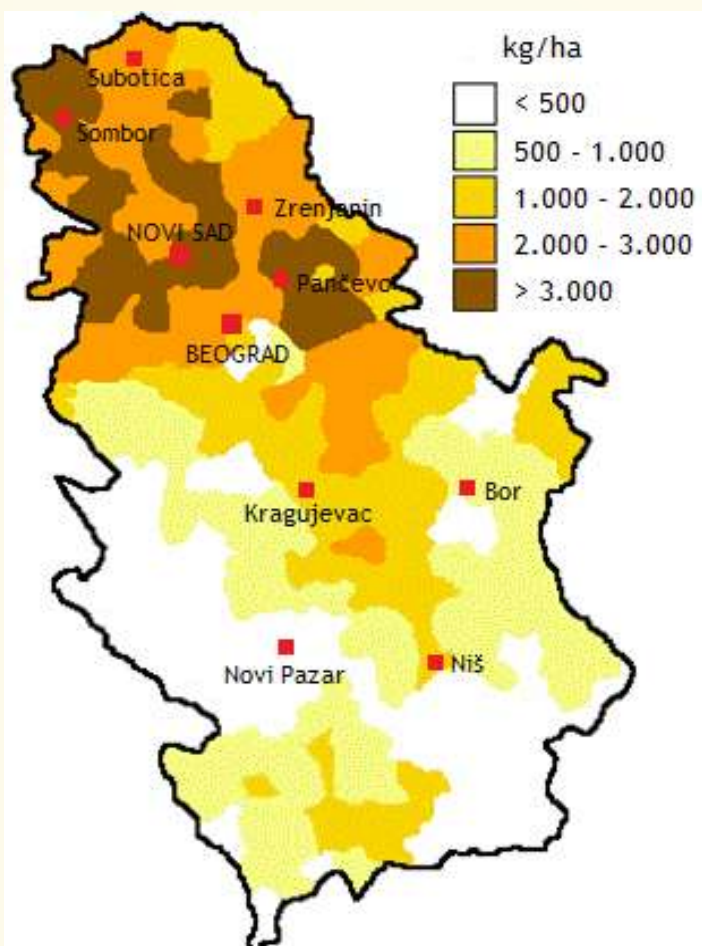
Relevant Characteristics of Geothermal Waters in Vojvodina			
self-outflow water profusion		10-20 l/s	
Most frequent outflow temperature		40-60 C°	
Geothermal gradients		4.5-7.5 C°/100 m	
Almost all waters contain quantities of gases		Mostly methane	
Waters contain dissolved minerals		0.42-13.94 g/l	
73 hydrothermal drills		Positive: 65 drills	
Deepest:	2,520 m	Vrbica, North Banat	82 C° at depths (1,749-1,854) m
Shallowest:	305.5 m	Novi Sad	25 C°

Geothermal

Operating geothermal wells

Location	Year	Depth (in m.)	Water profusion (in l/sec)	Water temperature (in °C)	Nominal capacity (in MWt)	Management
1 - Alibunar	1986	600.0	7.4	24	n.d.	Turistička organizacija (Devojački Bunar)
2 - Bačko Karadordevo	1978	1 059.0	2.17	34	n.d.	Vojska Srbije i Crne Gore
3 - Banatsko Veliko Selo	1987	925.0	11.2	43	0.75	DP "Kozara"
4 - Bečej	1988	1 020.0	17.2	65	4.50	OSC "Mladost" DZ P. "Hadnađev" Hotel "Bela Lađa"
5 - Bački Petrovac	1987	800.0	6.5	64	0.94	Institut za hmelj
6 - Kanjiža	1981	1 147.0	1.8	41	0.19	"Banja Kanjiža"
7 - Kanjiža	1986	1.123.0	9.3	65	1.95	"Banja Kanjiža"
8 - Kanjiža	1999	1 140,0	12.5	70	2.36	"Banja Kanjiža"
9 - Kula	1984	787.4	5.6	53	0.85	Fabrika kože "Eterna"
10 - Melenci	1985	1 300.0	6.9	33	0.34	"Banja Rusanda"
11 - Mokrin	1984	950.0	7.0	51	1.46	DP "Mokrin"
12 - Palić	1984	701.0	5.5	48	1.17	JP "Palić - Ludoš"
13 - Palić	1989	750.0	6.3	48	0.53	"Elite - Palić"
14 - Prigrevica	1984	701.7	11.8	53	2.26	"Banja Junaković"
15 - Temerin	1987	914.0	14.9	40	1.34	JP "Komunalac"

Agricultural biomass



	Surface (ha)	Yield (tonn./ha)	Mass of relations (t/t)	Yield of straw (t/ha)	Mass of straw (t/y)
Corn	636 728	5.165	1:1	5.165	3 288 447
Wheat	297 403	3.766	1:1	3.766	1 120 074
Sunflower	171 489	1.985	1:2	3.970	680 714
Soybean	127 856	2.426	1:2	4.852	620 358
Barley	47 921	3.234	1:1	3.234	154 964
Oats	5 179	2.344	1:1	2.344	12 140
Tobacco	4 221	1.475	1:0.35	0.516	2 230
Oilseed rape	4 204	2.090	1:2	4.180	17 572
Rye	1 474	2.547	1:1.2	3.056	4 505
TOTAL (other species included)					6 003 112

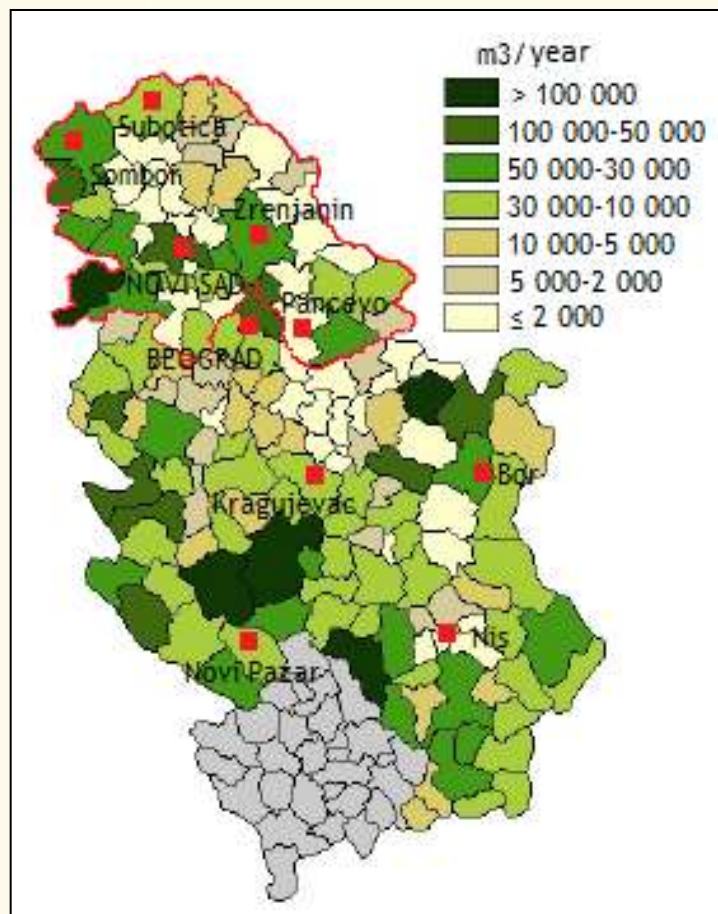
Agricultural biomass

	Surface (ha)	Yield (tonn./ha)	Mass of relations (t/t)	Yield of straw (t/ha)	Mass of straw (t/y)
Fruit tree	18 402	10.450	1:0.325	3.399	62 548
Grape	10 793	6.556	1:0.457	3.020	32 595
TOTAL					95 143

	N. heads	Mass of head (Kg/capo)	N. of head corrected (*)	Manure (kg/head-day)	Relation of mass (kg/kg)	Mass of manure (t/y)
Cattles	266.500	389	207.337	26	1:18.98	1 967 628
Pigs	1.581.000	59,2	187.190	22	1:16.06	1 503 136
Sheeps	224.500	38	17.062	26	1:18.98	161 918
Goats	49.000	35	3.420	26	1:18.98	32 551
Horses	7.500	400	6.000	26	1:18.98	56 940
Poultry	6.424.500	1,5	192.735	26	1:18.98	182 906
TOTAL						3 905 079

(*) 1 CN= 500 KG

Wood biomass



	Surface covered by forests (ha)		
	Total Serbia	Vojvodina	Vojvodina share
TOTAL	1 978 112	114 890	5,8 %
Broadleaved	1 223 325	62 818	5,1 %
Conifers	194 506	2 225	1,1 %
Mixture	560 281	49 847	8,9 %

Wood biomass

	Cutoff trees		Forestry residue		Process residue		Total residue	
	m ³	t (*)	m ³	t (**)	m ³	t (**)	m ³	t
Broadleaved	455 356	341 517	-	-	-	-	-	-
Conifers	40 481	30 361	-	-	-	-	-	-
Mixture	5 604	4 203	-	-	-	-	-	-
TOTAL	501 441	376 081	585 980	292 900	157 488	59 058	743 468	352 048

(*) 1 m³=750 kg (***) 1 m³=375 kg