



Serbia

Renewable
Energy
Sources

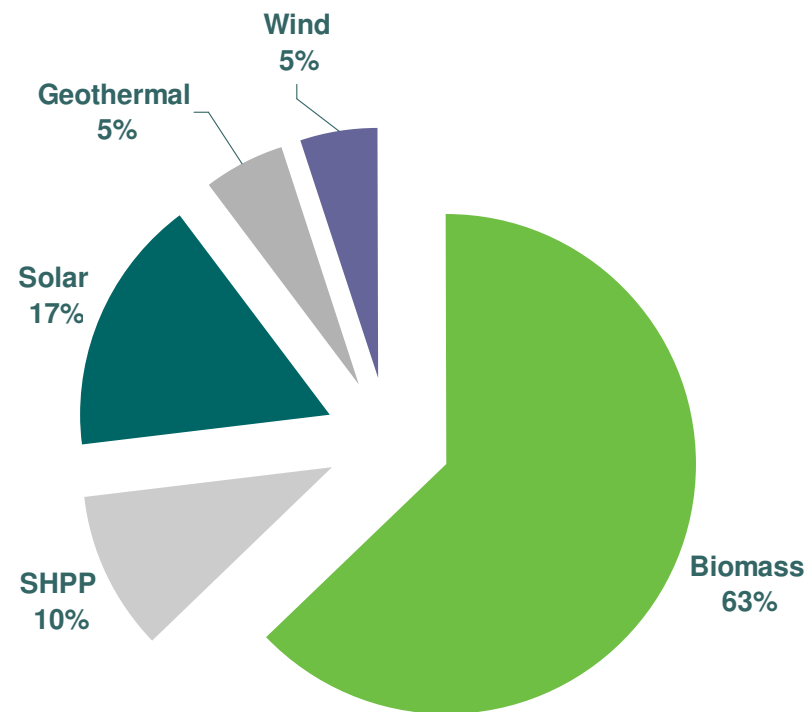
Country
Assessment

Belgrade, 11 December 2009.



RES Technical Potential

	Potentials (Mtoe)
<i>Biomass</i>	2.40
<i>SHPP</i>	0.40
<i>Solar</i>	0.64
<i>Geothermal</i>	0.20
<i>Wind</i>	0.19
TOTAL	3.83





Biomass

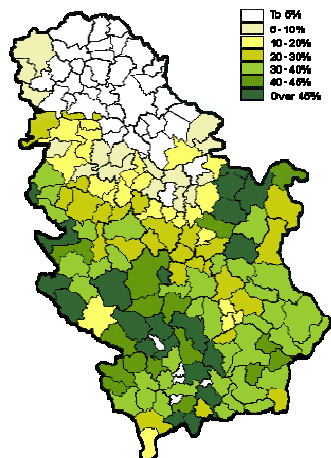
Crop farming residues 1/3 available for Energy Use		
	Total residues (1,000 tonnes)	Residues for Energy Use (1,000 tonnes)
Wheat	2,905	1,365
Barley	295	180
Rye	15.5	4.4
Corn	5,310	1,140
Sunflower	705	240
Soybean	320	130
Rapeseed	7.8	1.6
TOTAL	9,560	3,060

Fruit growing residues	
	Biomass residues (1,000 tonnes)
Plum	393.5
Apple	36.2
Cherries	55.0
Pear	14.0
Peach	35.1
Apricot	15.5
Walnuts	55.0
Grapes	515.0
TOTAL	1,119.3

Forest biomass	
	7 million m ³ unofficial
Fuel Wood	----- 1.6 million m ³ official (55% from State forest)
Wood residues	5 million m ³
TOTAL	12 million m³

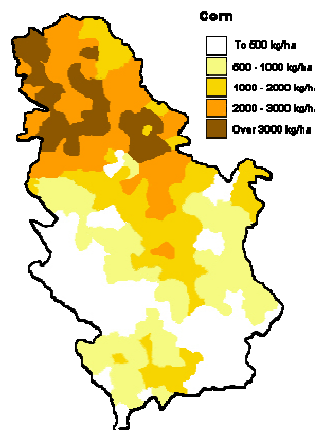
Most promising utilization options for biomass:

- Space heating in households and buildings using biomass pellets or briquettes
- Co-firing or total replacement in district heating plants firing heavy oil or coal in south Serbia, where natural gas is not available yet
- Production of electricity utilizing agricultural and wood wastes



Wood biomass
1 Mtoe

Federal Statistical Office, 2001



Agriculture biomass
1.4 Mtoe



Small Hydro Power Plants

SHPP Cadastre (1987)
856 locations
500 MW

>5 MW: 9 locations
2-5MW: 30 locations (average
3 MW)
<1 MW :largest number of
locations

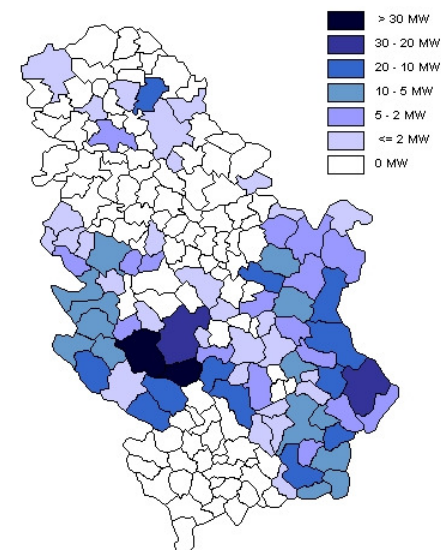
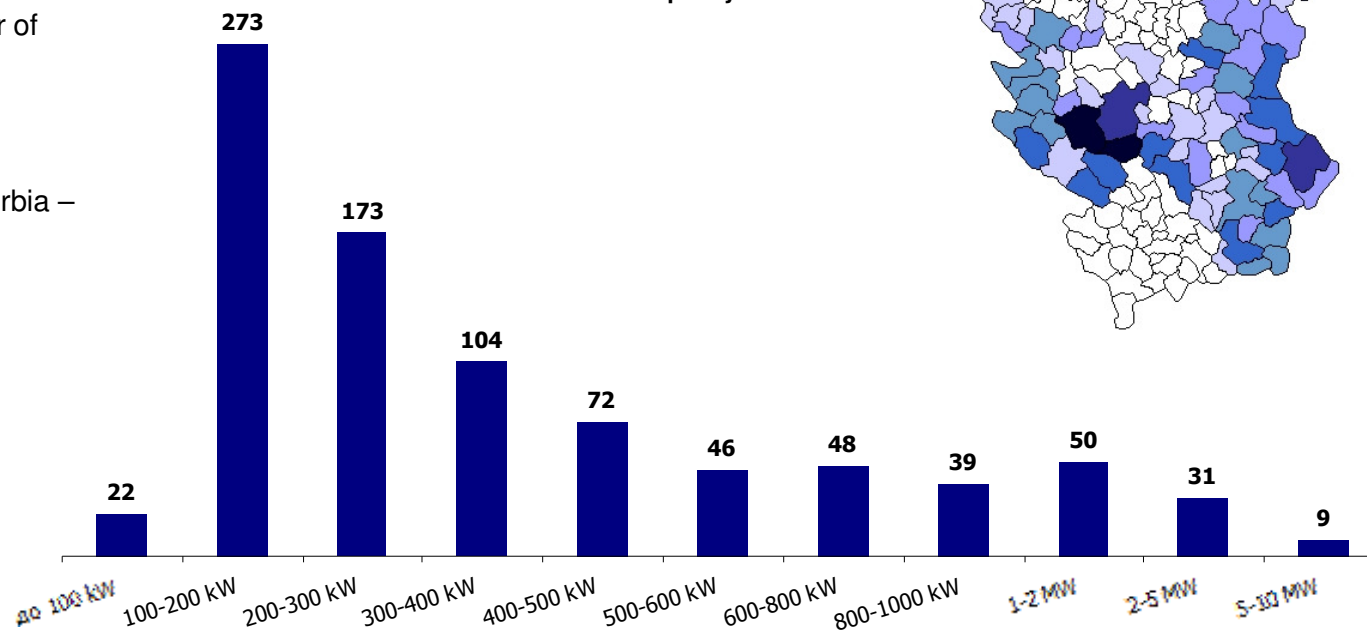
1,500 GWh/year

Number of SHPP in Serbia –
60
(50% out of operation)

Revitalization

Construction

Number of locations for the construction of
SHPP according to potential
installed capacity





Small Hydro Power Plants

No of SHPP locations	Potential power installed (kW)	Potential Annual Generation (MWh)	Municipality
64	34,300	121,203	Ivanjica
35	33,284	109,692	Raška
40	25,925	94,026	Pirot
40	23,458	78,394	Kraljevo
47	18,800	73,971	Prijepolje
9	17,576	60,210	Zaječar
22	17,045	72,212	Crna Trava
20	15,825	55,100	Novi Pazar
8	15,690	58,850	Bela Palanka
8	11,216	25,850	Despotovac
30	10,974	45,391	Brus
19	10,706	30,180	Đa
32	10,185	38,438	Vranje
22	10,141	38,985	Kuršumlija
16	9,875	35,318	Priboj
30	9,800	36,099	Trgovište
13	9,785	30,937	Valjevo
10	9,305	27,419	Tutin
16	8,945	24,380	Žagubica
17	8,675	34,553	Bosilegrad

No of SHPP locations	Potential power installed (kW)	Potential Annual Generation (MWh)	Municipality
19	8,625	32,877	Čajetina
17	8,320	29,720	Leskovac
21	8,310	36,832	Nova Varoš
27	8,170	32,543	Surdulica
13	7,990	28,262	Vlasotince
19	7,640	27,395	Bajina Bašta
12	7,070	27,500	Niš
8	6,740	20,050	Boljevac
12	5,346	17,928	Užice
15	5,325	19,862	Ljubovija
7	4,730	10,230	Negotin
11	4,690	16,578	Vladičin Han
6	4,655	20,283	Arilje
14	4,515	19,459	Babušnica
1	3,000	13,700	Novi Sad
1	850	4,700	Vrbas
1	620	2,270	Bečej
1	1,220	8,190	Bela Crkva



Solar

AVERAGE DAILY SOLAR IRRADIANCE ON HORIZONTAL SURFACE IN kWh/m²

	MONTH												Total Year	Average Daily
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
Beograd	1.40	2.20	3.35	4.85	6.00	6.45	6.75	6.00	4.65	3.05	1.60	1.15	1,446.80	3.96
Vršac	1.00	2.00	3.35	4.40	6.00	6.40	6.55	6.85	4.60	3.00	1.55	1.00	1,424.75	3.90
Palić	1.30	2.10	3.45	5.00	6.15	6.25	6.35	5.85	4.30	2.85	1.40	1.15	1,407.40	3.80
Novi Sad	1.45	2.35	3.20	4.65	5.80	6.20	6.35	5.75	4.40	2.90	1.45	1.20	1,392.65	3.82
Niš	1.75	2.60	3.45	5.00	6.10	6.35	6.70	6.15	5.35	3.45	1.85	1.50	1,531.40	4.20
Kuršumlja	2.15	3.00	3.60	5.05	5.85	6.05	6.55	6.10	5.30	3.50	2.00	1.75	1,550.50	4.25
Peć	1.85	2.95	3.70	4.85	5.95	6.15	6.75	6.15	4.90	3.65	2.25	1.60	1,546.25	4.24
Priština	1.85	2.90	3.70	5.25	6.30	6.60	6.95	6.30	5.10	3.35	1.90	1.60	1,578.25	4.32
Vranje	1.70	2.70	3.65	5.15	6.15	6.40	6.50	6.35	5.25	3.45	1.85	1.50	1,543.40	4.23
Loznica	1.50	2.30	3.05	4.35	5.30	5.75	6.15	5.60	4.30	2.80	1.45	1.20	1,333.50	3.65
Kragujevac	1.50	2.40	3.35	4.80	5.85	6.10	6.45	5.90	4.85	3.30	1.70	1.30	1,447.85	3.97
Negotin	1.35	2.05	3.25	4.85	6.05	6.60	6.95	6.25	4.75	2.90	1.45	1.20	1,453.35	3.98
Zlatibor	1.50	2.30	3.10	4.35	5.10	5.85	5.90	5.35	4.30	2.75	1.60	1.30	1,316.40	3.61

Average yearly insolation in Serbia
about 1,400 kWh/m²

Average daily value
about 3.8 kWh/m²



Solar

Most promising utilization options

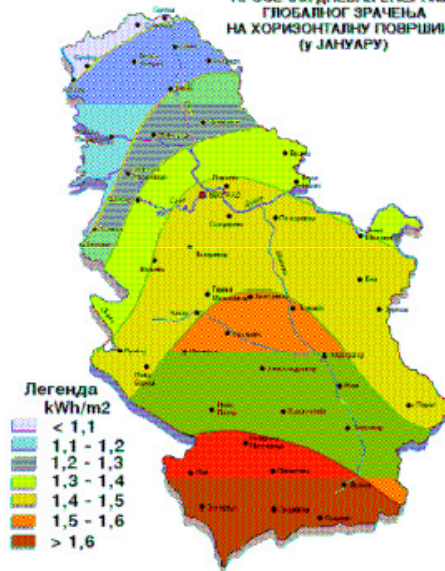
- Sanitary water heating
- Space heating

If each housing unit (2.65 million units) would install average 4 m² of collectors

Equivalent to some saving potential of 7,420 GWh

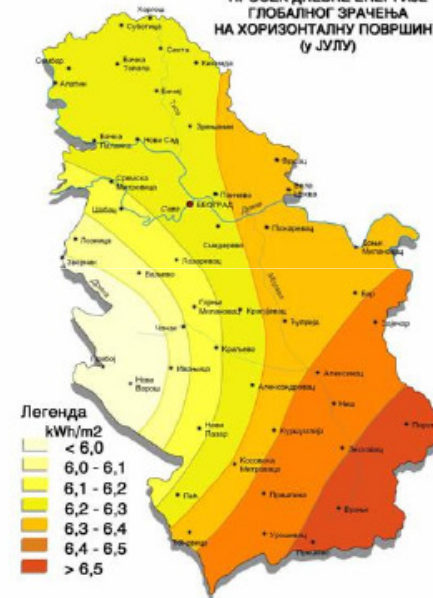
January

ПРОСЕЧНА ДНЕВНА ЕНЕРГИЈА ГЛОБАЛНОГ ЗРАЧЕЊА НА ХОРИЗОНТАЛНУ ПОВРШИНУ (у ЈАНУАРУ)



July

ПРОСЕК ДНЕВНЕ ЕНЕРГИЈЕ ГЛОБАЛНОГ ЗРАЧЕЊА НА ХОРИЗОНТАЛНУ ПОВРШИНУ (у ЈУЛУ)





Geothermal

Average geothermal flow density in Serbia is higher than 60 mW/m³

There are 160 natural resources of geothermal waters (excluding Panonian basin) with temperature above 15°C

Highest temperatures recorded

Vranjska spa - 96°C

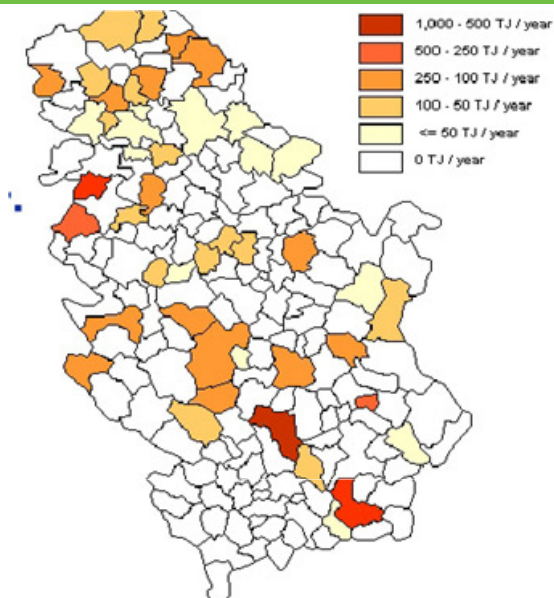
Jošanička spa - 78°C

Sijarinska spa - 72°C

Total flow rate of geothermal water resources is 4000 l/sec

60 locations are in the water reservoirs up to 3000 m depth

	Installed thermal power (MWt)	Produced heat (TJ/year)
Residential and commercial areas	18.5	575
Spas and recreation	36.0	1,150
Gain drying	0.7	22
Greenhouses	8.4	256
Fishing and cattle breeding	6.4	211
Industrial processes	3.9	121
Heat pump heating	12.0	80
Total	86.0	2,415



Use of geothermal potential is mainly for balneological purposes, sports and recreation

Prospects for expanding geothermal energy for agricultural heat and water heating are reasonably good

Potential for larger scale geothermal electricity is limited - requires water temperatures above 100°C.



Wind

Wind data
based on 10 metre heights
extrapolated to 50 metre heights

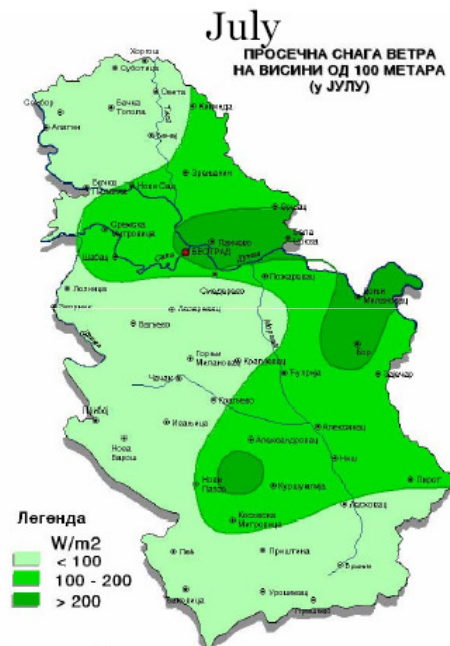
2,300 GWh

1,300 MW of capacity

at sites with minimal average
wind speeds of 5 m/s

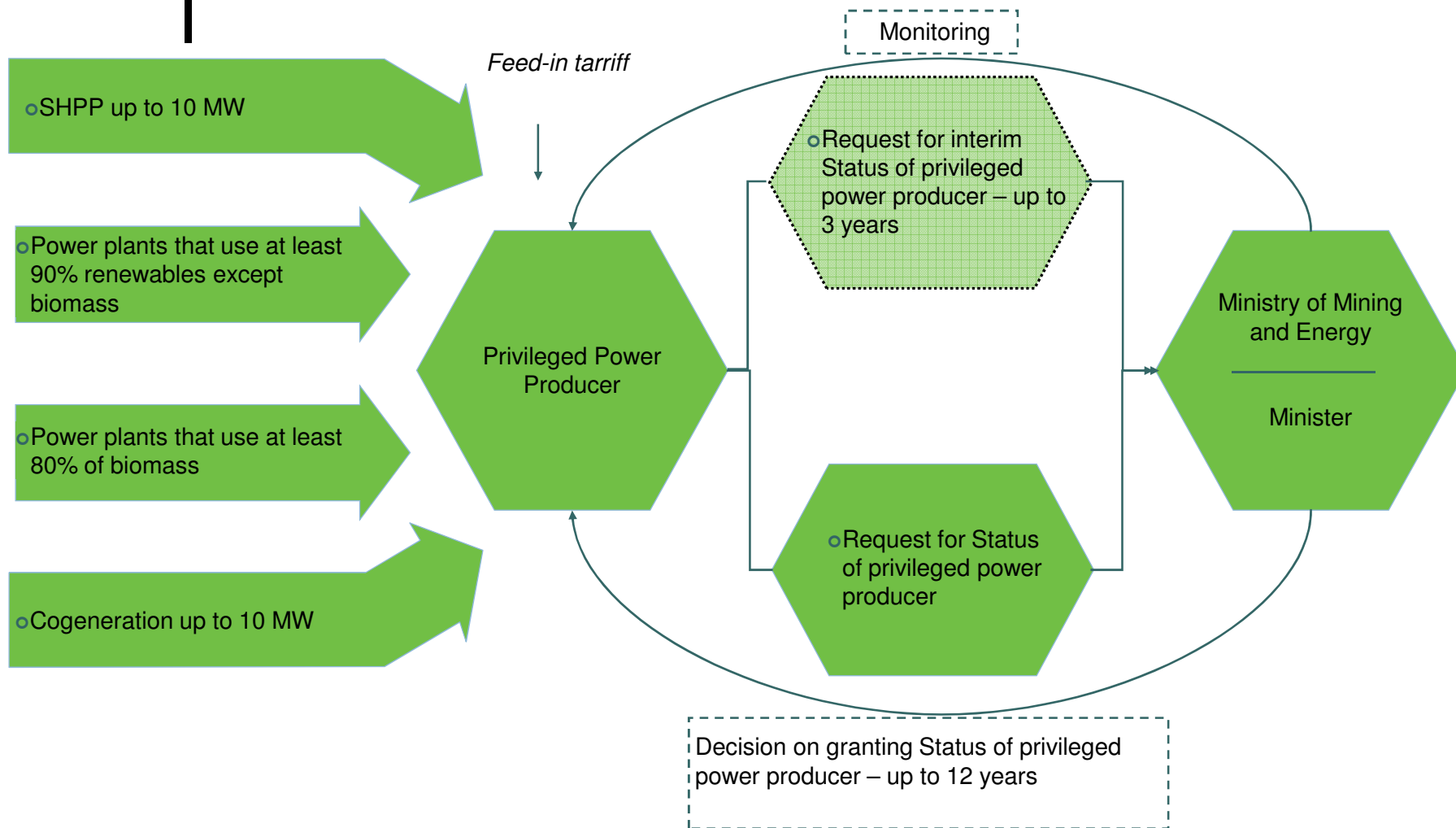
Best locations in Serbia (extrapolated)

Midzor	7.66 m/s
Suva Mt.	6.46 m/s
Vrsacki breg	6.27 m/s
Tupiznica	6.25 m/s
Krepoljin	6.18 m/s
Deli Jovan	6.13 m/s



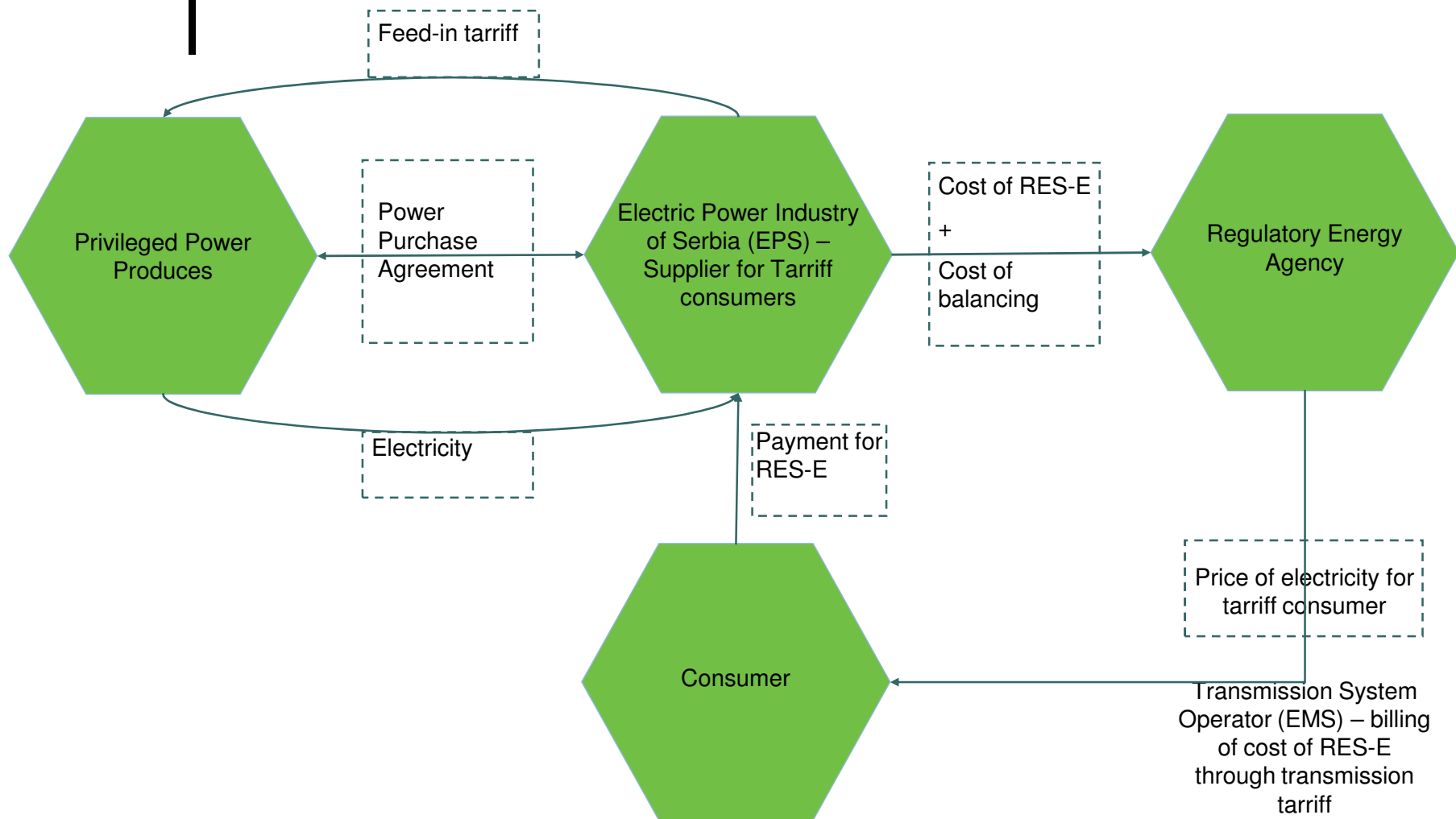


Legal Regulation: Decree on conditions for acquiring status of Privileged Power Producer





Legal Regulation: Decree on Market Model for Privileged Power Producers





Feed in tariffs

Type of generation facility	Installed power (MW)	Price (c€/kWh)
Hydro	up to 0,5 MW	9,7
	0,5 MW to 2 MW	10,316 – 1,233*P
	2 MW to 10 MW	7,85
	On existing infrastructure	
	up to 2 MW	7,35
	2 MW to 10 MW	5,9
Biomass	up to 500 kW	13,6
	500 kW to 5 MW	13,845 – 0,489*P
	above 5 MW	11,4



Feed in tariffs

Type of generation facility	Installed power (MW)	Price (c€/kWh)
Biogas	up to 0,2 MW	16,0
	0,2 MW to 2 MW	16,444 – 2,222*P
	2 MW to 10 MW	12,0
Biogas – from sewage or landfill		6,7
Wind farms		9,5
Solar		23
Geothermal		7,5



Feed in tariffs

Type of generation facility	Installed power (MW)	Price (c€/kWh)
Cofiring	up to 0,2 MW	10,4
	0,2 MW to 2 MW	10,667 – 1,333*P
	2 MW to 10 MW	8,2
	On existing infrastructure up to 10 MW	7,6
Municipal waste	up to 1 MW	9,2
	1 MW to 10 MW	8,5



THANK YOU FOR YOUR ATTENTION!