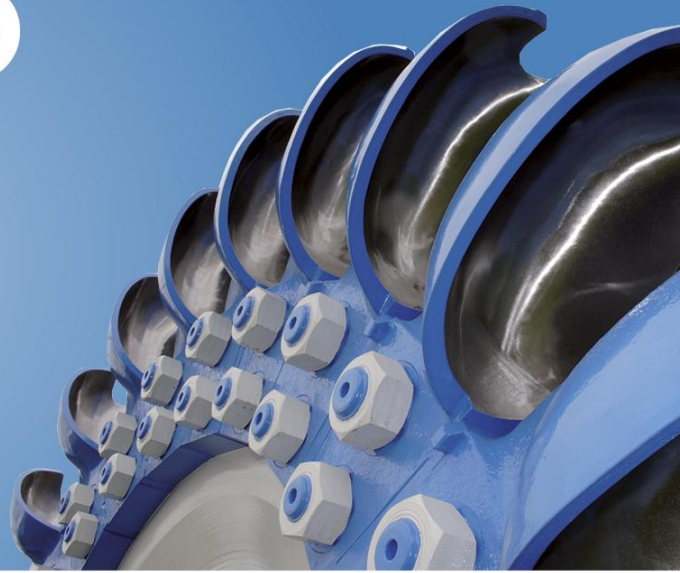
RENEXPO INTERHYDRO

28th–29th November 2019

Europäische Wasserkraftmesse mit Kongress
European hydropower trade fair
with conference



3rd Eastern Europe Hydropower Forum

Concept

Session I: Overview of the region and country reports
(UNIDO Report, Czech Republic, Slovakia and Macedonia)

Session II: Experiences and best practice in hydropower development within the region: challenges, tasks and investment opportunities
(erection & rehabilitation contracts, hidden hydropower potential)

Session III: Plenary Discussion
The future for Hydropower in Eastern and South Eastern Europe
(existing potential and new opportunities
following from national climate & energy policies)

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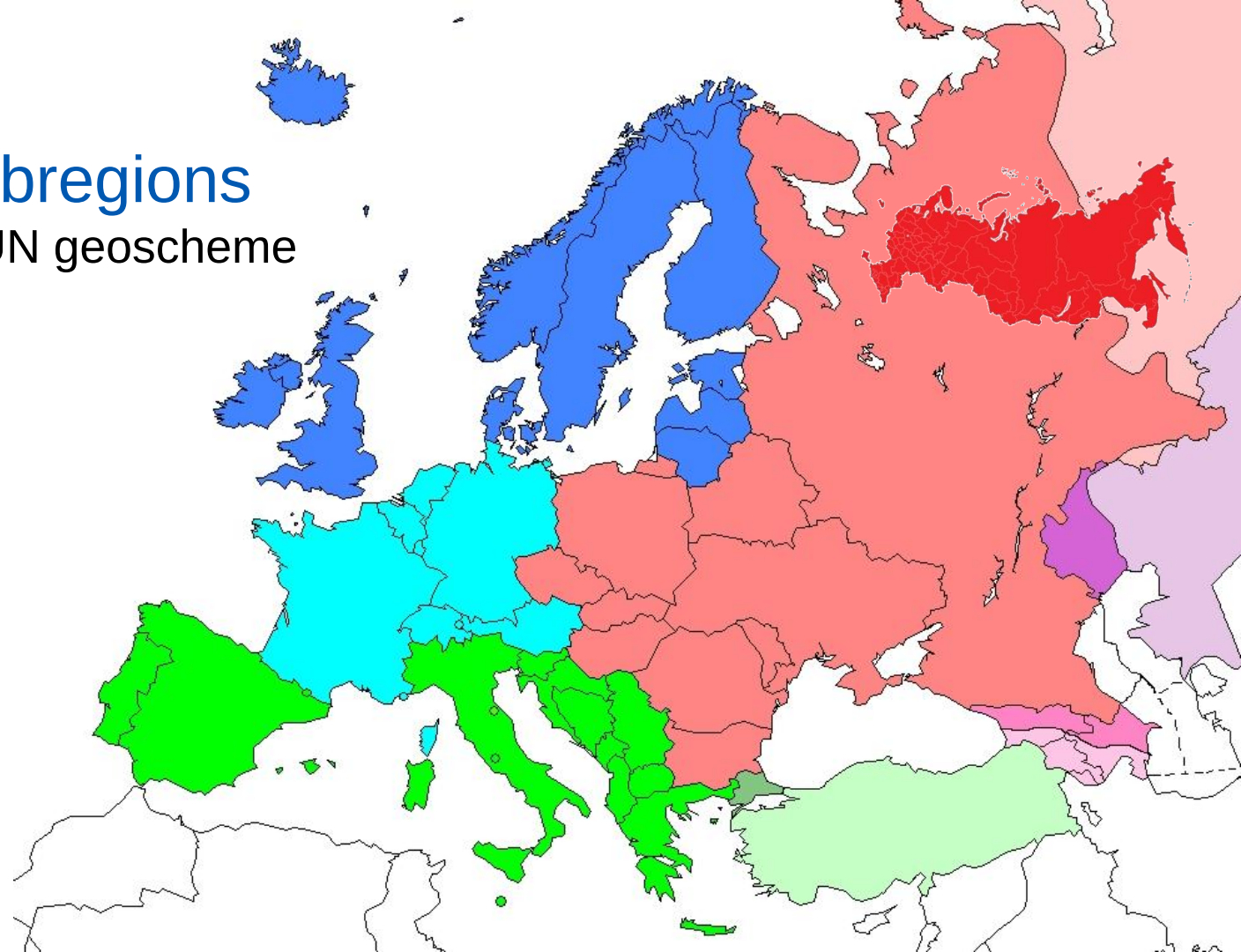
European subregions

according to the UN geoscheme

United Nations



Eastern Europe
in the Salzburger Hydropower Debate

Subregions

EE9: Belarus, Bulgaria, Czech Republic, Hungary, Moldova, Poland, Romania, Slovakia, Ukraine

EE10 = EE9 + Russian Federation

Baltic States
Estonia, Latvia, Lithuania

Western Balkans
Albania, Greece, Bosnia&Herzegovina, Croatia, Kosovo, Montenegro, Northern Macedonia, Serbia

Caucasus Republics
Armenia, Azerbaijan, Georgia

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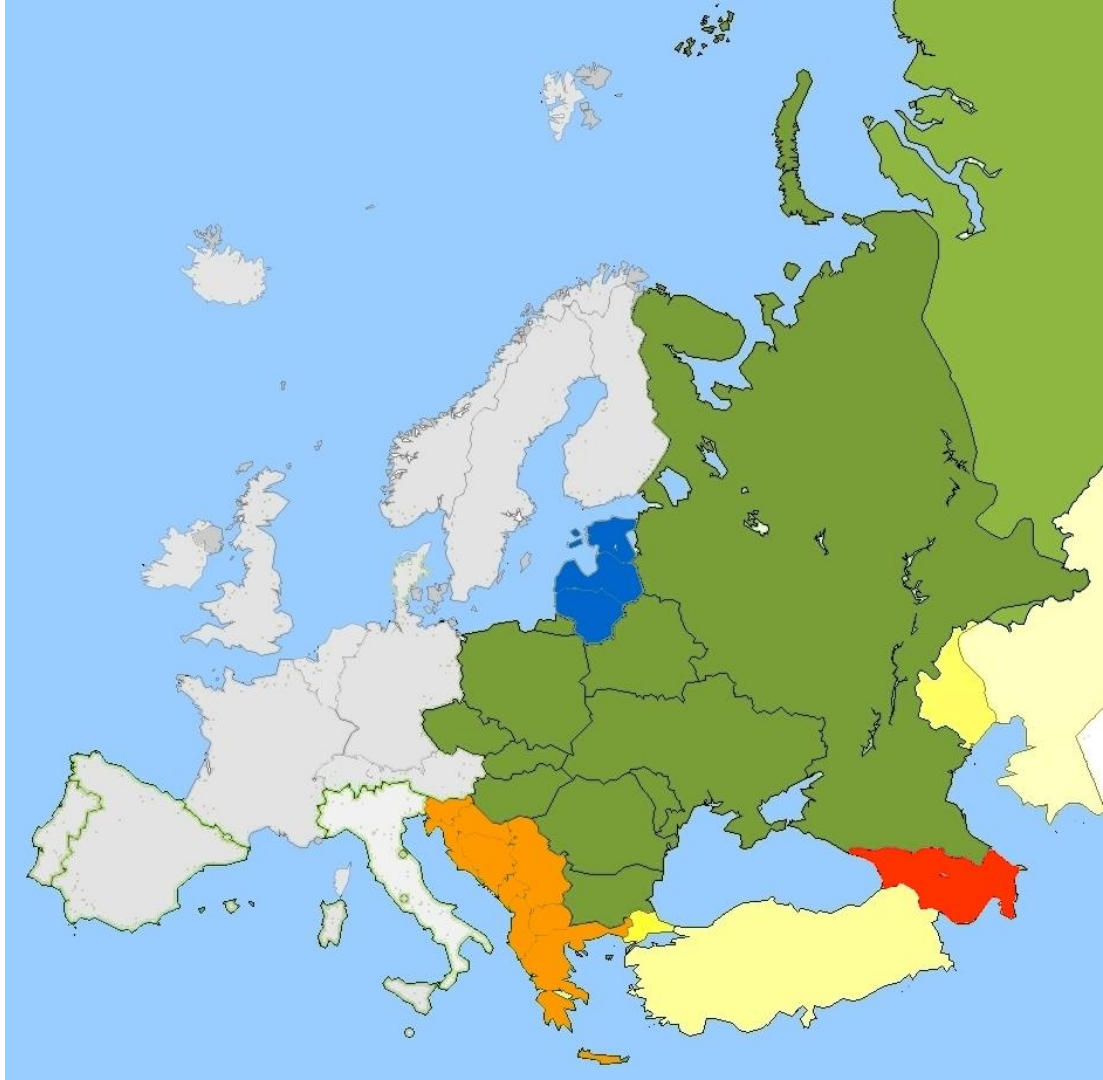


Topography & rivers

Danube
(technical potential 43 TWh/a)

Volga
(economic potential 42 TWh/a)

Dnieper

Pechora, Northern Dvina, Kama, Terek and Sulak

Daugava (Western Dvina), Nemunas

Vistula, Oder and Elbe

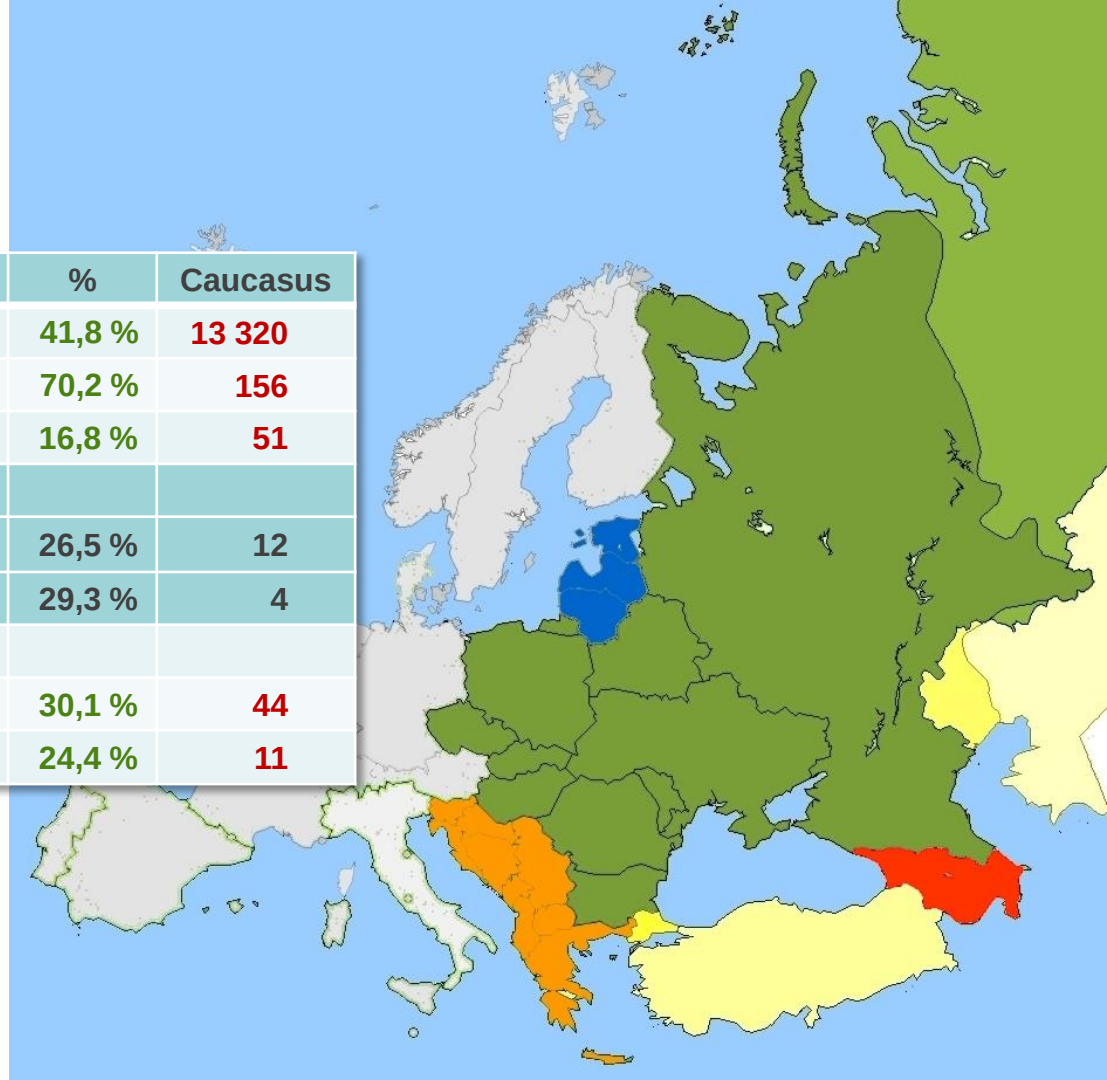
Vah, Sava

Prut and Dniester

Eastern Europe

in the Salzburger Hydropower Debate

Item	EE 21	Europe	%	Caucasus
Population, mln	310 014	710 491	41,8 %	13 320
Surf. area, thousand km^2	6 292	8 897	70,2 %	156
GDP, billion €	3 307	19 672	16,8 %	51
Installed power, TW				
Total	368	1 386	26,5 %	12
Hydropower	65	221	29,3 %	4
Generation, TWh				
Total	1 445	4 684	30,1 %	44
Hydropower	156	638	24,4 %	11



Note:
The GDP data have been taken
for the whole territory of Russian Federation.

Subregion	Area	Population	GDP	Electricity generation
	10^3 km^2	thousand	M€	TWh
Eastern Europe-9	1 701	146 397	1 362 692	617,2
RF – European Part *)	4 000	109 200	1 467 593	635,7
Eastern Europe-10	5 201	255 597	2 830 285	1 252,9
Baltic States	175,1	6 081	100 451	33,3
Western Balkans	415,9	35 016	376 532	158,5
Total	**6 292,0**	**296 694**	**3 307 268**	**1 444,8**
Caucasus Republics	186,0	16 310	61 065	43,6

*) GDP value of the whole Russian Federation

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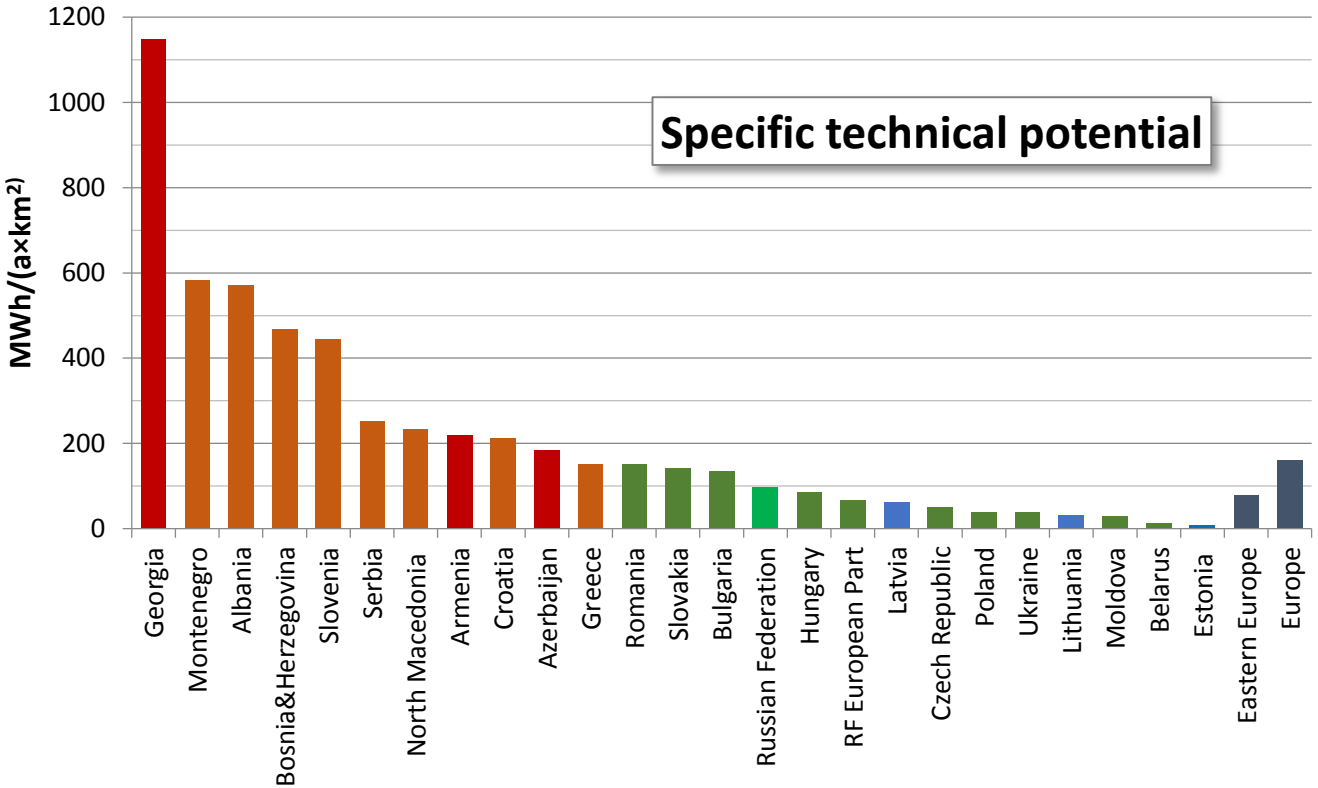
Subregion	Techn. potential	Specific potential	Norm. generation	Total capacity	Potential use
	TWh/a	MWh/(a×km$^{2)}$	GWh/a	MW	%
Belarus	2,5	12,0	309	95	12,4
Bulgaria	15,1	135,6	4 078	3 208	27,1
Czech Republic	4,0	50,7	2 233	2 268	55,8
Poland	12,0	38,4	2 350	2 365	19,6
Romania	36,0	151,0	17 174	6 759	47,7
Slovakia	7,0	142,8	4 537	2 548	64,8
Ukraine	22,0	38,2	14 051	6 162	63,9
Eastern Europe-9, EE9	**107,6**	**63,2**	**45 305**	**23 525**	**42,1**
RF - Total	1670,0	97,3	179 861	51 815	10,8
RF – European Part	229,0	65,4	61 589	21 070	26,9
Eastern Europe-10, EE10	**336,6**	**64,7**	**106 592**	**44 595**	**31,8**
Latvia	4,0	61,9	3 113	1 563	77,8
Baltic States	**6,4**	**36,5**	**3 718**	2 597	**58,1**
Greece	20,0	151,6	6 340	4 109	31,7
Serbia	19,5	251,7	10 792	3 018	55,6
Western Balkans	**114,5**	**275,4**	**45 557**	16 717	**39,8**
Total, EE21	**598,0**	**79,0**	**156 169**	**63 909**	**34,1**
Caucasus Republics	**161,0**	**550,9**	**13 155**	**5 234**	**12,8**

Specific technical potential



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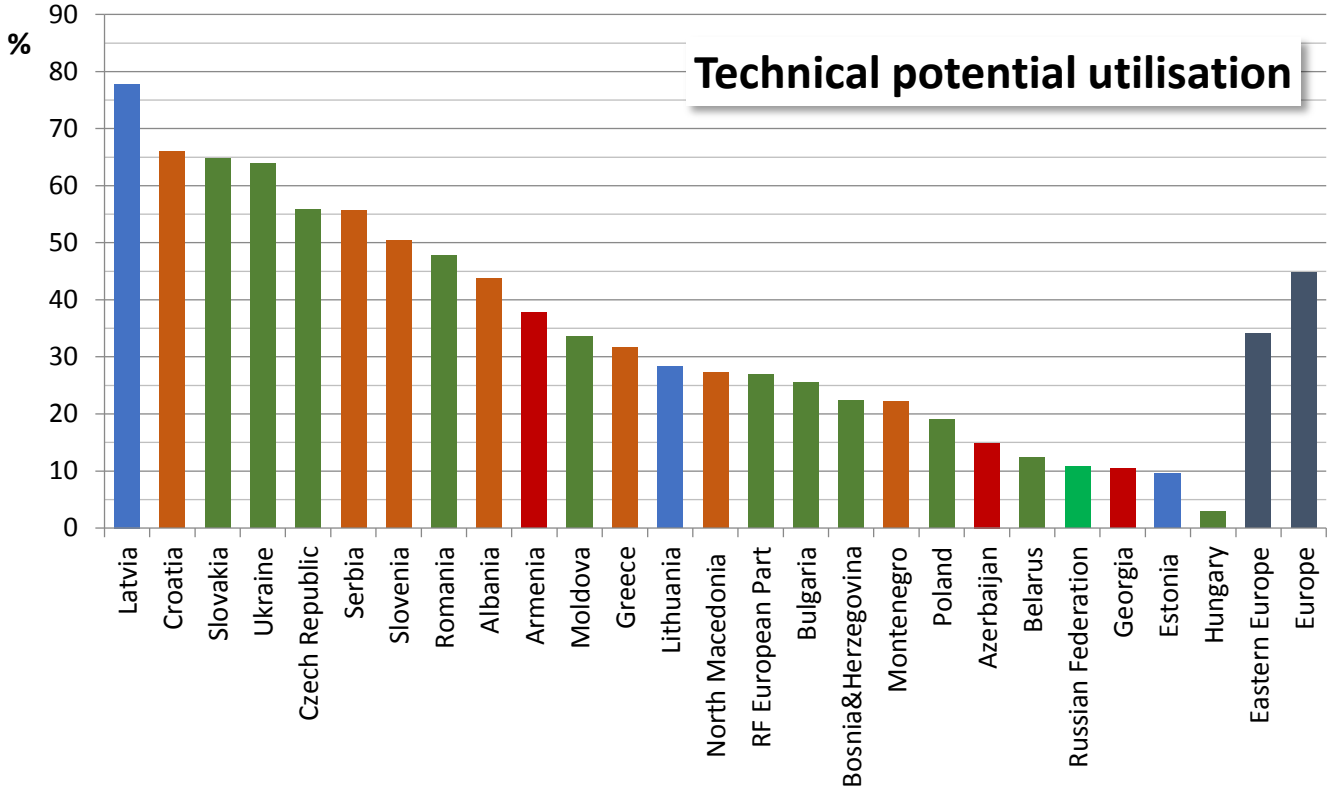
Potential utilisation



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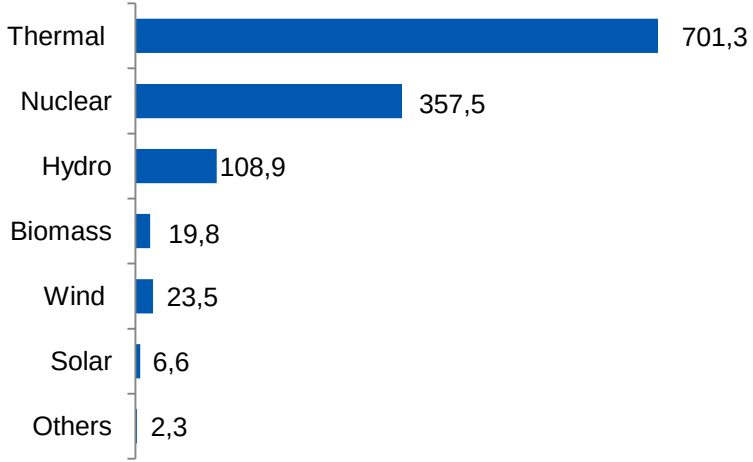
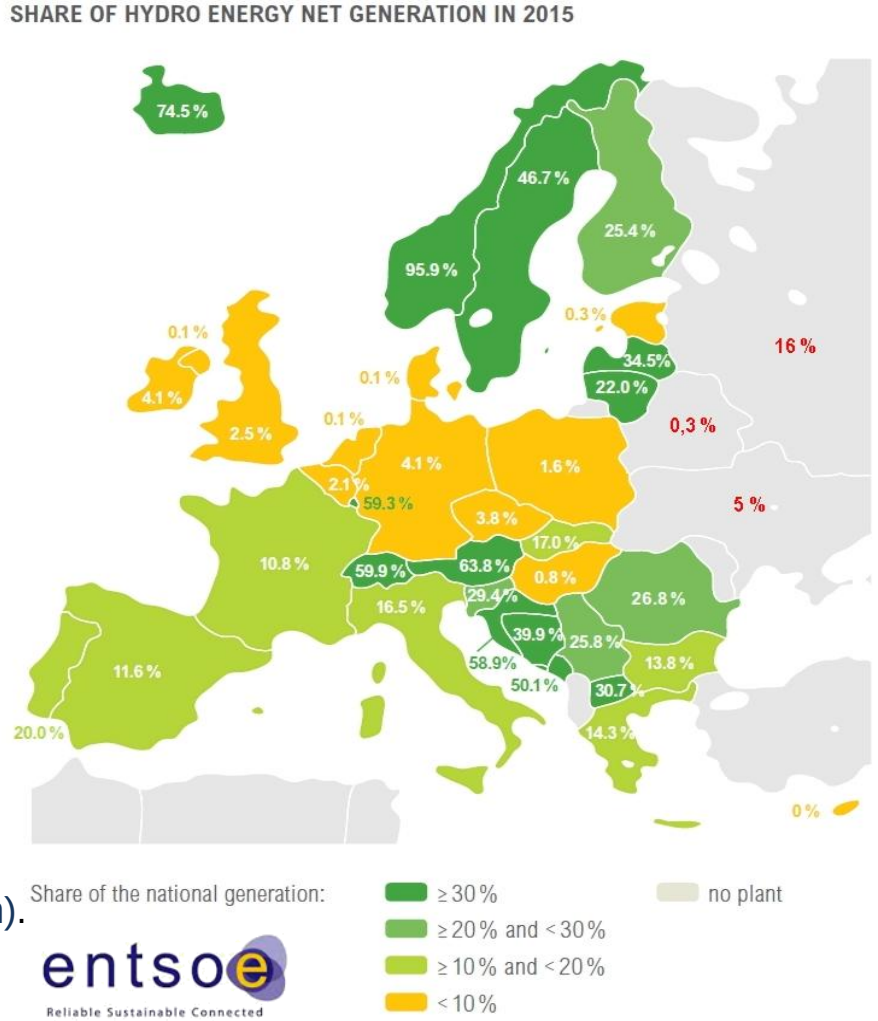
HYDRO IN THE ENERGY MIX

Highly differentiated hydropower situation within the region

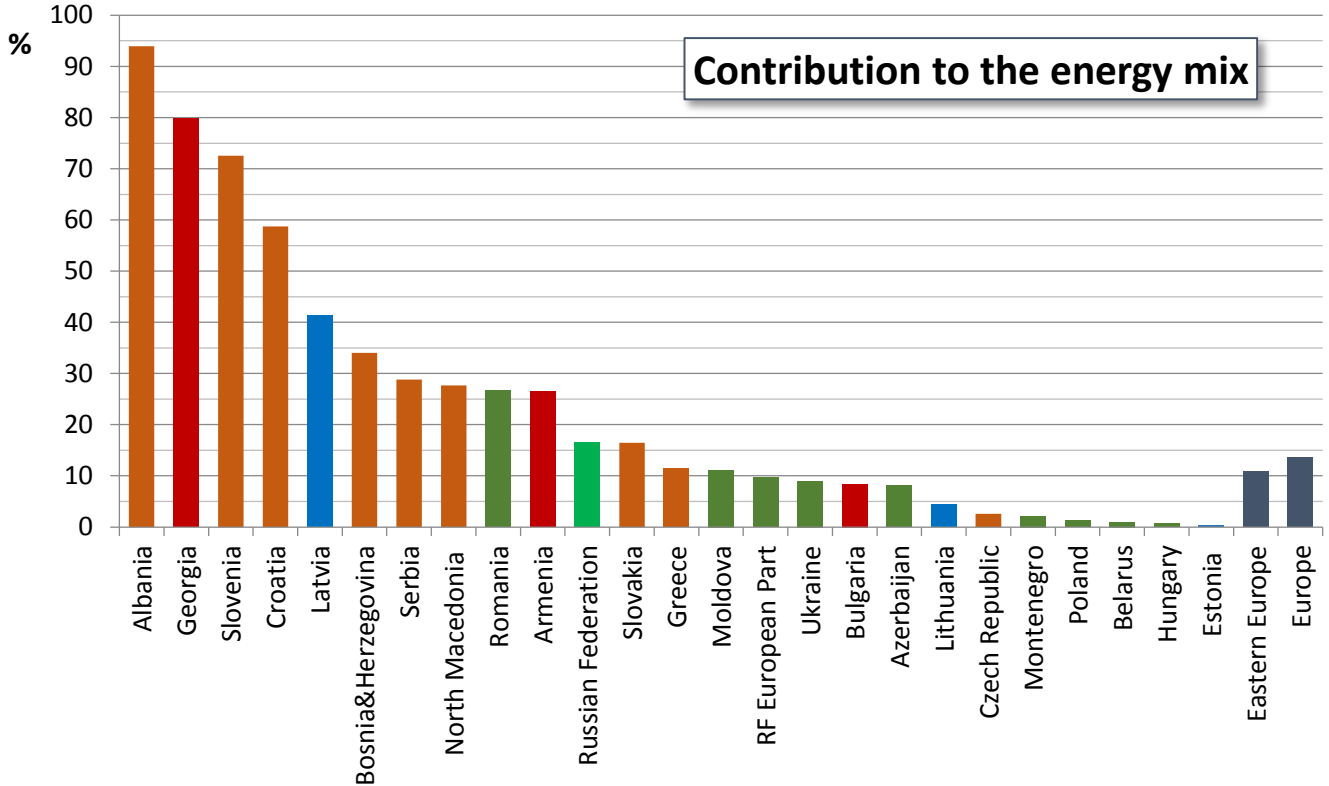


Contribution of various electricity generation technologies and energy carriers to the East European (EE10) **electricity mix** (TWh/annum).

Source: EUROSTAT[9], UES[6] and WSHPRD 2019[1]



Contribution to the energy mix



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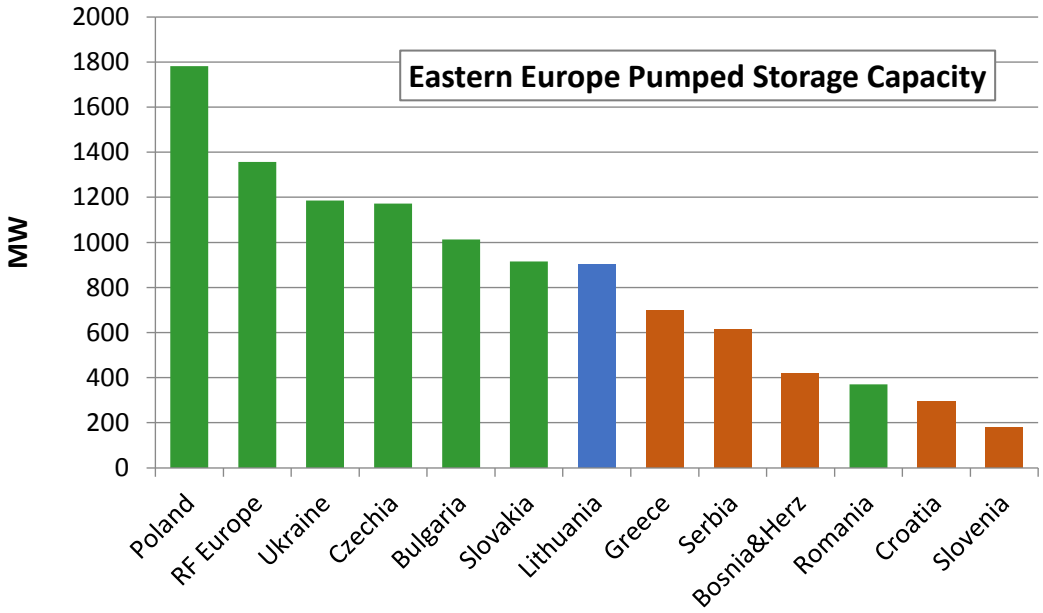
Pumped storage



Total pumped storage capacity

within the region: 11 930 MW

in Europe: 58 980 MW

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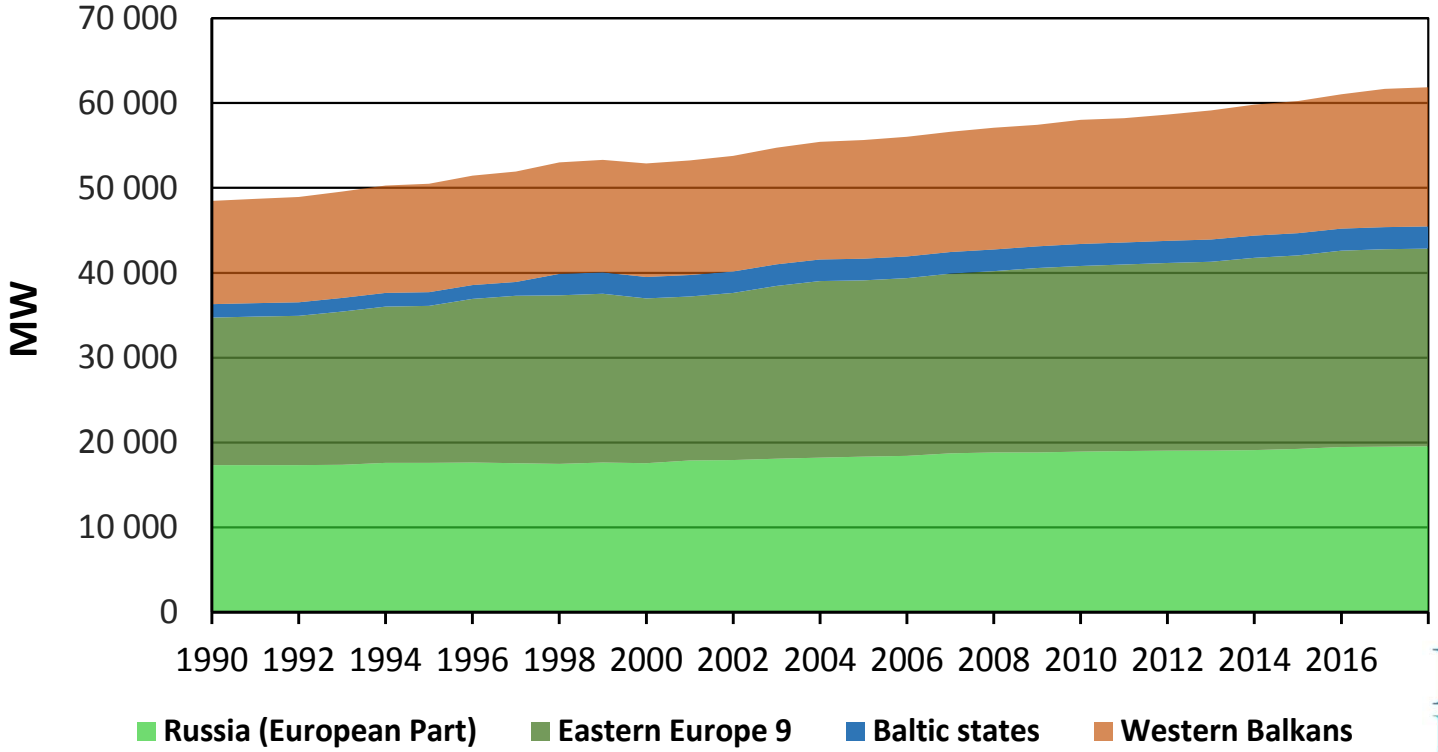
Sector growth



Assets & trends

steady growth
of 0.8 %/annum
(400 MW/year)

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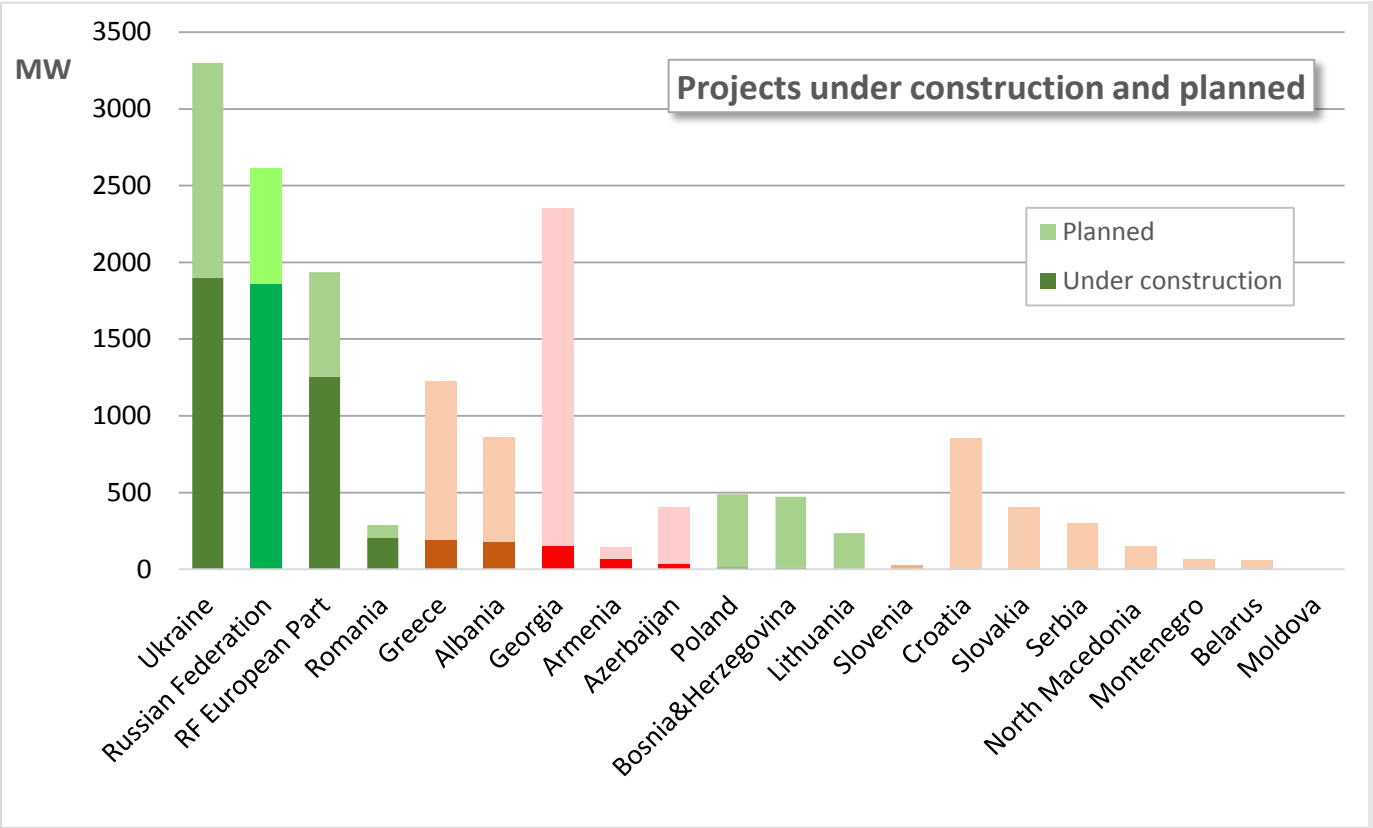
Sector growth



Europe

Projects under construction:
8 060 MW

Projects planned
14 370 MW

Eastern Europe

Projects under construction
3 760 MW (47 %)

Projects planned
6 910 MW (48 %)

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Ukraine: Major ongoing projects

Dniester Pumped Storage Power Plant

7 x 324/421 MW = **2268** / **2947** MW
currently 3 units in operation (972 / 1263 MW)
commissioning of the 4th unit envisaged for 2020

Tashlyk Pumped Storage Power Plant

6 x 151 MW = **906** MW (generating mode)

currently 2 units in operation

commissioning of the 3rd unit (151/211 MW)
envisaged for 2020

Source: Landau I., Kraynik V., Levitsky M.: Prospects for the development of hydropower of Ukraine, considering the strategy of development of energy systems of Ukraine and the EU Polish Hydropower Conference HYDROFORUM 2019, Polanczyk/Solina, October 9-10th, 2019

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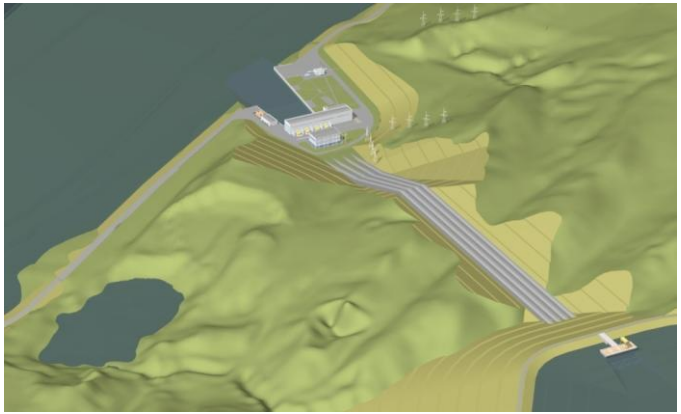
Ukraine: Major planned projects



Kaniv Pumped Storage Power Plant

4 x 250/260 MW = **1 000** / **1040** MW

preparatory work underway

Kakhovka 2 Hydropower Plant

250 MW currently 2 units in operation

preparatory work underway

Source: Landau I., Kraynik V., Levitsky M.: Prospects for the development of hydropower of Ukraine, considering the strategy of development of energy systems of Ukraine and the EU Polish Hydropower Conference HYDROFORUM 2019, Polanczyk/Solina, October 9-10th, 2019

Russia : rescue works at a major pumped storage project

Zagorskaya 2 PSPP under construction

4 x 210/250 MW = 840 / 1000 MW

After destabilisation and flooding (2013) levellizing of the powerhouse building will start in 2020 according to the Hydroproject Moscow technology.

Source: Rushydro website, Andrei Trofimov, https://russos.livejournal.com/1462750.html

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Balkan states and Caucasus Republics: Some opportunities and ongoing projects

Romania: 6 projects (208 MW) on rivers Olt, Jiu, Basca Mare under construction
further 4 projects of 80 MW in planning.

Greece: 2 projects under construction (161,6 MW + 29 MW);

2 classic projects (126 MW + 160 MW) in the redesign phase;

Pyrgos (220 MW) and Agios Georgios (460 MW) PSPPs in planning.

Albania: The Moglice HPP (183 MW) to be commissioned in 2020
as the second stage of Devoll Cascade.

Georgia: Shuakhevi (178 MW) to be recomimissioned this November;

In planning: Khudoni on Enguri (702 MW), Namakhvani Cascade, Nenskra HPP (280 MW) and Tskhenistskali Casccade (192,5 MW).

Numerous refurbishment activities and further plans in Croatia, Serbia and Montenegro.

Source: 2019 World Atlas & Industry Guide, The International Journal on Hydropower & Dams, Aqua Media 2019

Central-Eastern Europe: Opportunities and ongoing projects - inland navigation routes

ECE/TRANS/120/Rev.4

ECONOMIC COMMISSION FOR EUROPE
INLAND TRANSPORT COMMITTEE

EUROPEAN AGREEMENT ON MAIN INLAND WATERWAYS OF INTERNATIONAL IMPORTANCE (AGN)

DONE AT GENEVA ON 19 JANUARY 1996

ACCORD EUROPÉEN SUR LES GRANDES VOIES NAVIGABLES D'IMPORTANCE INTERNATIONALE (AGN)

EN DATE, À GENÈVE, DU 19 JANVIER 1996

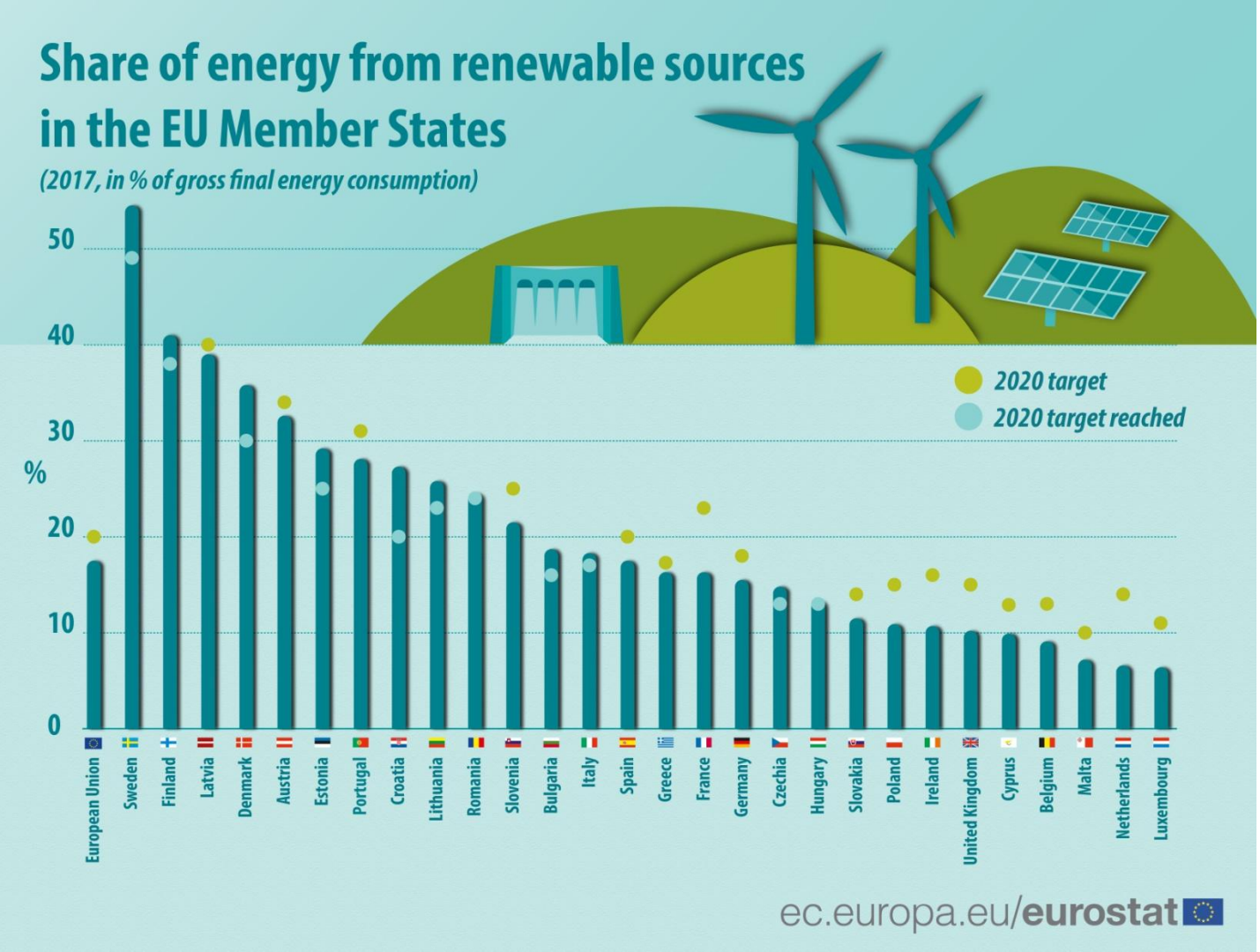
ЕВРОПЕЙСКОЕ СОГЛАШЕНИЕ О ВАЖНЕЙШИХ ВНУТРЕННИХ ВОДНЫХ ПУТЯХ МЕЖДУНАРОДНОГО ЗНАЧЕНИЯ (СМВП)

СОВЕРШЕНО В ЖЕНЕВЕ 19 ЯНВАРЯ 1996 ГОДА

Poland joined the agreement in 2017.

UNITED NATIONS NATIONS UNIES
ОРГАНИЗАЦИЯ ОБЪЕДИНЕННЫХ НАЦИЙ

EU RES Policy



European Commission

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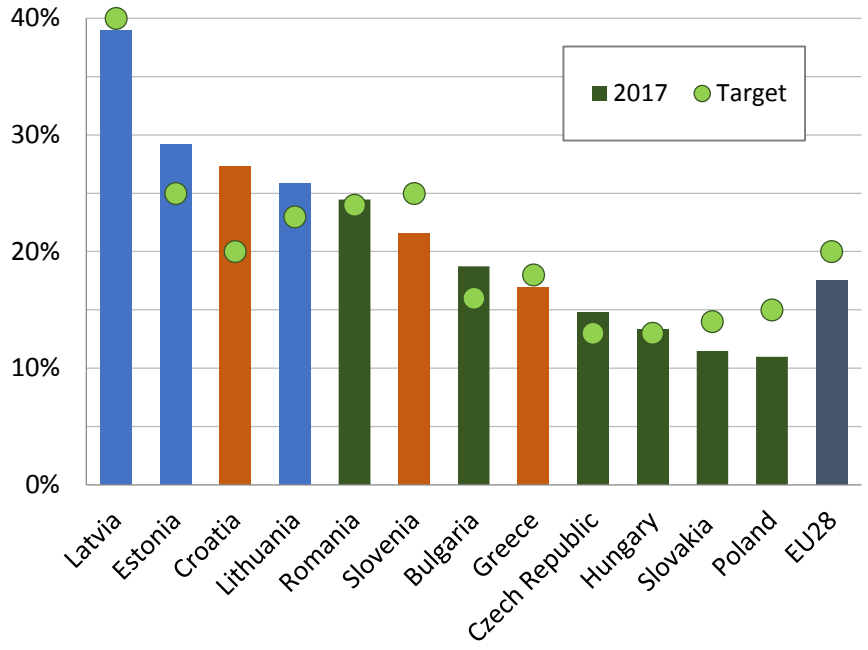
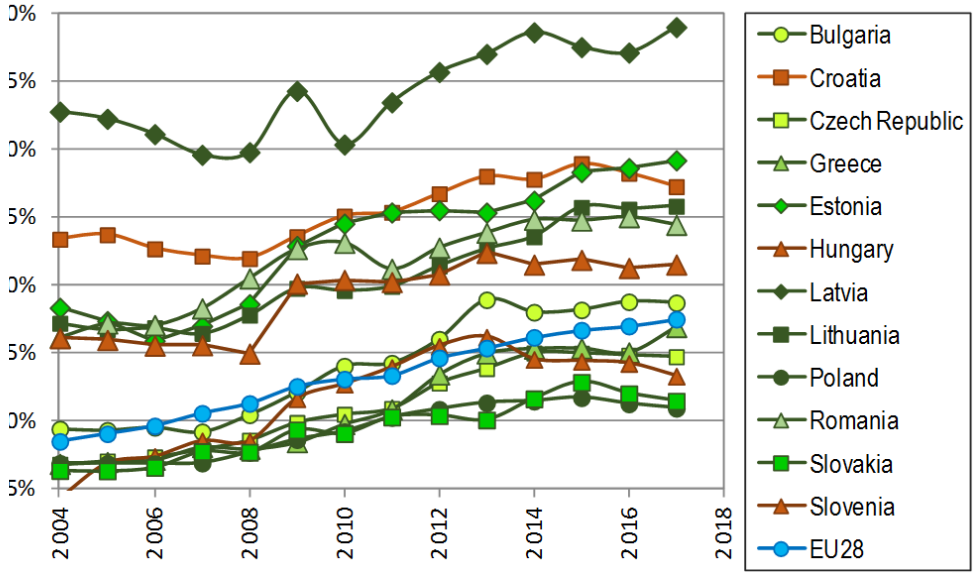
EU RES Policy
– share of energy from renewable sources





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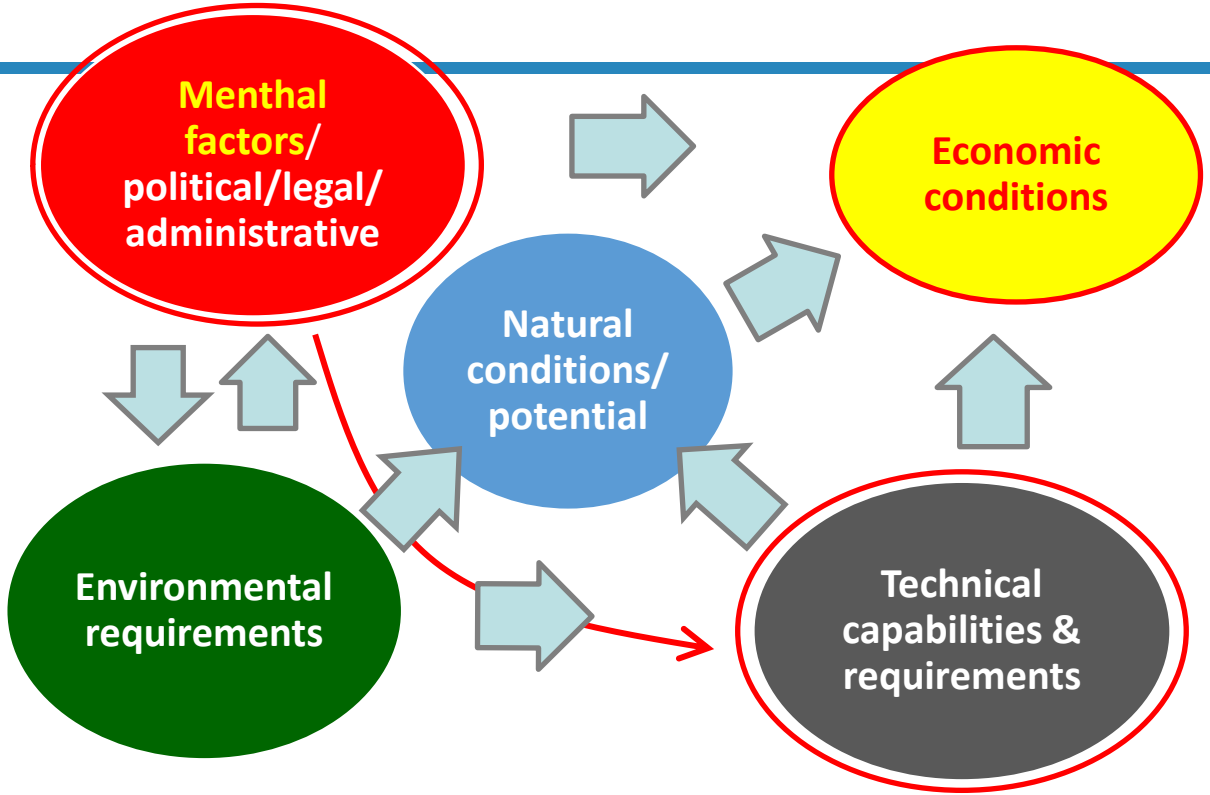
Development barriers in categories



Eastern Europe

in the Salzburger Hydropower Debate

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Eastern Europe

in the Salzburger Hydropower Debate

2017

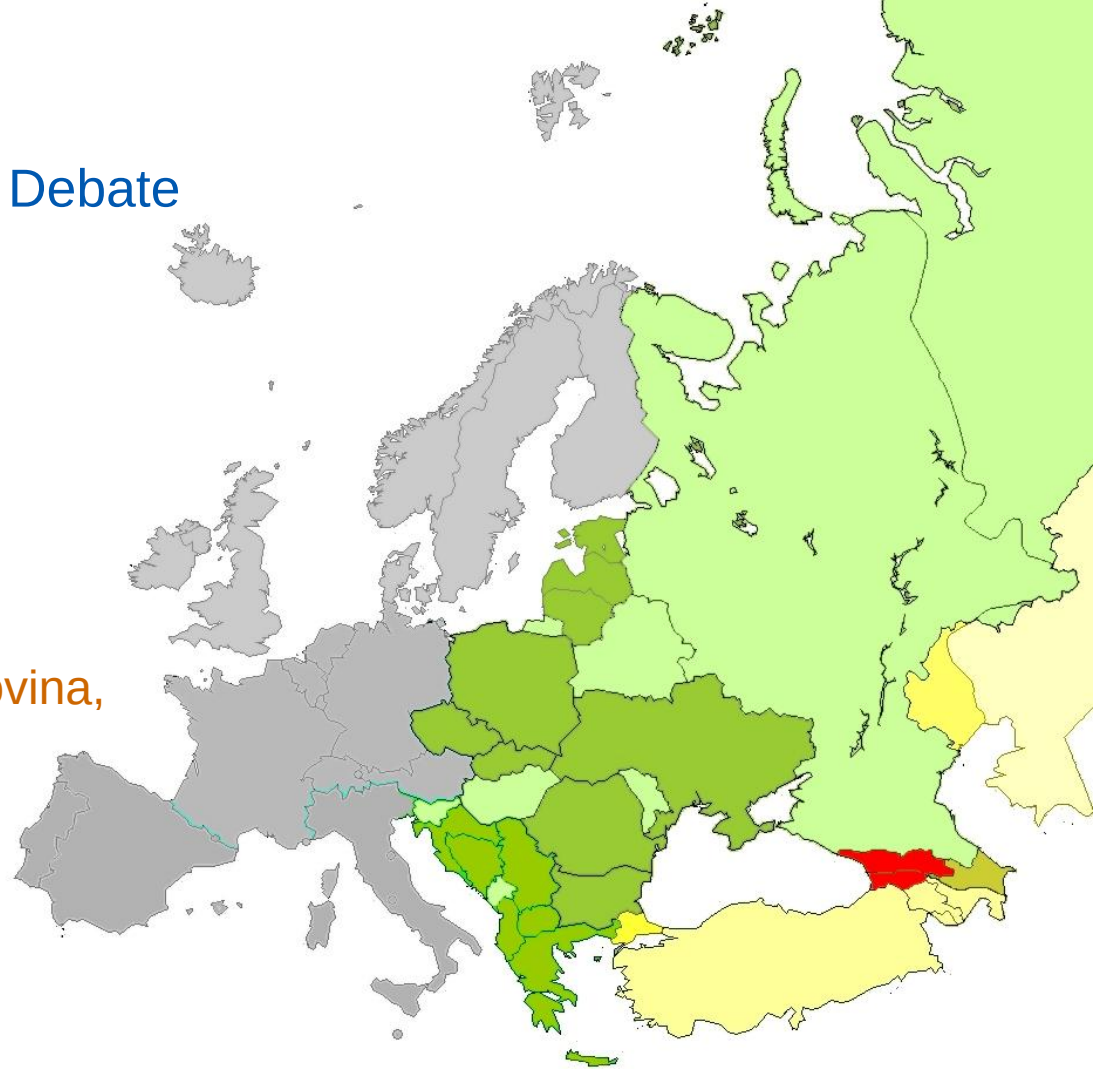
Bulgaria, Poland, Ukraine,
Lithuania, Bosnia&Herzegovina

2018

Romania, Baltic States,
Albania, Greece,Bosnia&Herzegovina,
Serbia, Georgia

2019

Czech Republic, Slovakia,
Northern Macedonia

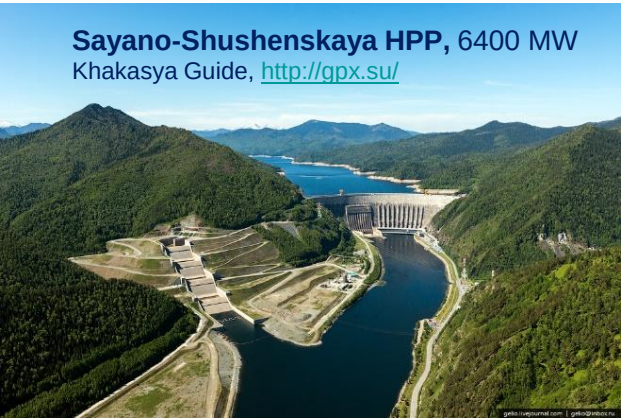


Russian Federation: essential hydropower sector characteristics

Parameter	RF Europe abs. values	RF Europe re RF whole, %	RF Europe re EE21, %	RF whole	Eastern Europe 21
Total system capacity, MW	**147 115**	*58,8*	*40,0*	250 400	367 830
Annual generation, TWh	**636**	*58,2*	*44,0*	1 091,7	1 444,8
Hydropower sector					
Technical potential, TWh/a	**229**	*13,7*	*50,1*	1 670	457,5
Hydropower capacity, MW	**21 070**	*40,7*	*33,0*	51 815	63 909
Annual generation, TWh	**61 539**	34,2	39,4	179 861	156 169
Use of technical potential, %	***26,9***	×	×	*10,8*	*34,1*
Contribution to the energy mix, %	***9,7***	×	×	*16,5*	*10,8*


Russian Federation
Усть-Среднеканская
Колымская
Усть-Хантайская
Курейская
Загорская ГАЭС
Нижегородская
Чебоксарская
1
2
Камская
Жигулёвская
Саратовская
Волжская
Вилюйская
Богучанская
Зейская
Усть-Илимская
Красноярская
Братская
Бурейская
Чиркейская
Новосибирская
Майнская
Иркутская
Нижне-Бурейская
Саяно-Шушенская

Russia: hydropower installations ≥ 1 GW



No	Power Plant	MW	Commissioning	Owner	River
1	Sayano-Shushenskaya	6 400	1978—1985 2011 - 2013	Rushydro	Yenisei
2	Krasnoyarskaya	6 000	1967—1971	EvroSibEnergo	Yenisei
3	Bratskaya	4 500	1961—1966	EvroSibEnergo	Angara
4	Ust'-Ilymskaya	3 840	1974—1979	EvroSibEnergo	Angara
5	Boguchanskaya	2 997	2012—2014	Rushydro/RUSAL	Angara
6	Volzhskaya	2 671	1958—1961	Rushydro	Volga
7	Zhigulyovskaya	2 488	1955—1957	Rushydro	Volga
8	Bureyskaya	2 010	2003—2007	Rushydro	Bureya
9	Saratovskaya	1 415	1967—1970	Rushydro	Volga
10	Cheboksarskaya	1 370	1980—1986	Rushydro	Volga
11	Zeiskaya	1 330	1975—1980	Rushydro	Kheya
12	Nizhnekamskaya	1 205	1979—1987	Rushydro	Kama
13	Votkinskaya	1 065	1961—1963	Rushydro	Kama
14	Chirkeskaya	1 000	1974—1976	Rushydro	Sulak
	Total	38 291			

Major projects developed, planned, under consideration

Under development

- Zagorskaya PSPP, 840 MW
- Ust’ Srednekanskaya, 570 MW (third phase, adding 260 MW to current 310 MW)
- Irkutskaya, uprating from 662 to 822 MW
- Small hydro (< 30 MW) projects

Planned

- Small hydropower (<30 MW) development, 750 MW till 2025

Further opportunities

- In Europe: harnessing the Northern Caucasus rivers, small hydro development
- In Asia: harnessing Siberian rivers of Upper Ob., Yenisei, Lower Angara, Nizhna Tunguskaya HPP (12 GW), Vitima, Aldan, Chuchura, Amur tributaries etc.






Thank you for your attention!

Acknowledgements

Most of hydropower data used in this presentation have been taken from the following sources:

- *H&D World Atlas & Industry Guide, Aqua Media 2018&19*
- *EIA and EUROSTAT websites*
- *national reports (especially: Poland, Czech Republic, Slovakia, Russian Federation)*

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