

## Workshop:

# ELECTRICITY INTERCONNECTION TARGETS IN THE ENERGY COMMUNITY CONTRACTING PARTIES

Virtual Webex meeting  
18. 02. 2021

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**RATIONALE AND OBJECTIVE**

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**INTERCONNECTION TARGET 2020**

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**INTERCONNECTION TARGET 2030**

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**EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY**

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**INTERCONNECTIVITY INDICATORS (existing situation)**

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**INPUT DATA AND ASSUMPTIONS**

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**COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS**

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**CONCLUSIONS**

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**RECOMMENDATIONS**

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**Rationale:** Carbon pricing gradual introduction in the EnC CPs supported by full electricity and gas market integration

**Study:** Electricity interconnection targets in the Energy Community Contracting Parties (EnC Secretariat, January 2021)

[https://www.energy-community.org/dam/jcr:97afc332-0495-479b-a1d6-848a2c6877a2/ECS\\_Interconnection\\_Targets\\_022021.pdf](https://www.energy-community.org/dam/jcr:97afc332-0495-479b-a1d6-848a2c6877a2/ECS_Interconnection_Targets_022021.pdf)

**Compliance of individual Contracting Parties against the 2020 and 2030 European Union (EU) interconnectivity targets**

**Future situation:**

- Market competition
- Large-scale renewables integration (transmission and distribution grid scale)
- Share of balancing resources
- Security of supply and power quality

## Interconnection target 10 %

Ratio between the sum of net transfer capacities and installed generation capacity.

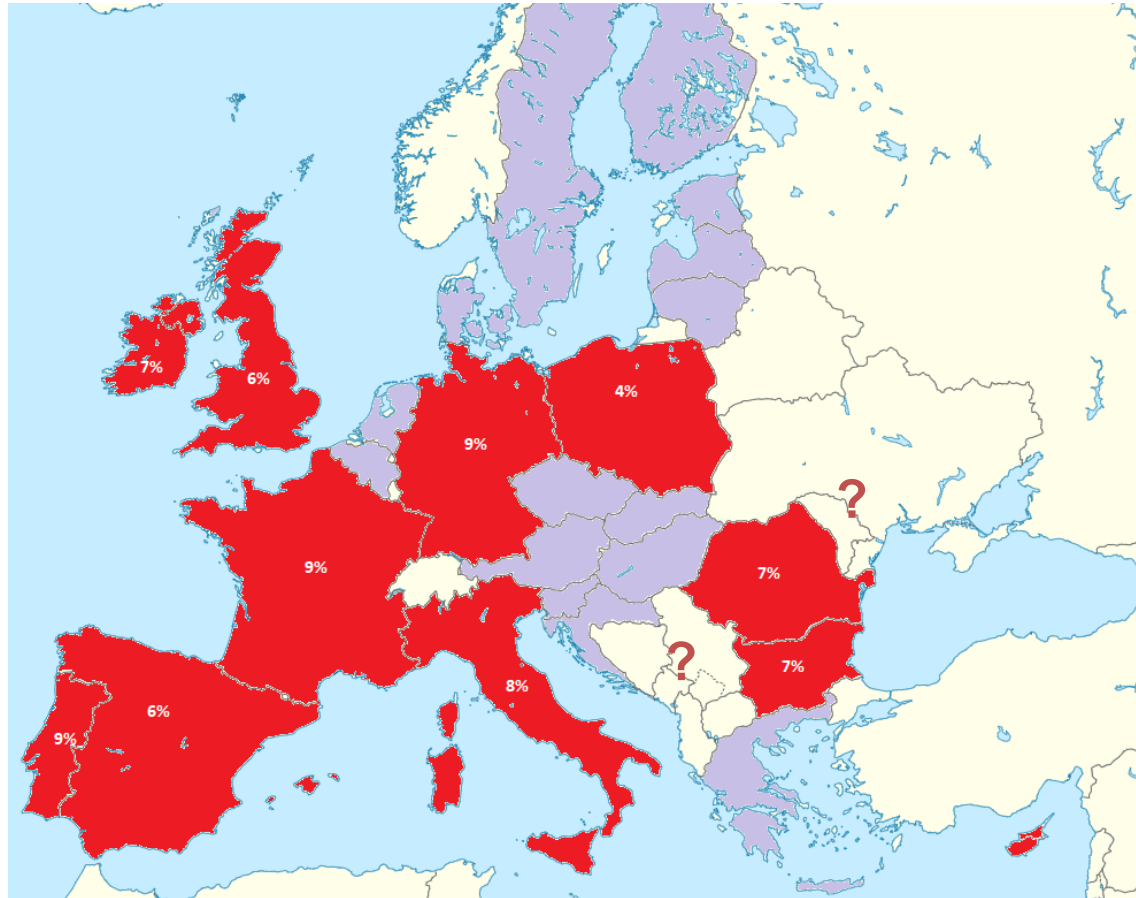
Each country should have in place transmission lines that allow at least 10% of the electricity produced by its power plants to be transported across its borders to neighbouring countries.

$$\text{Target 10 \%} \xrightarrow{\text{relates to}} \frac{\sum NTC (\text{import direction})}{MAX P_{\text{generation}}} * 100\% \geq 10\%$$

Interconnectivity target 2020 was set up to enhance market competition.

# INTERCONNECTION TARGET 2020

## EU situation (2017)



Source:  
Communication from the Commission to the European Parliament, the Council, the European economic and social committee and the Committee of the regions - Communication on strengthening Europe's energy networks, European Commission, 23. 11. 2017.

## Interconnection target 15 %:

- wholesale electricity price difference between member states/price zones (should be less than 2 €/MWh);

$$\text{Target 15 \% (sub - criterion 1)} \xrightarrow{\text{relates to}} \Delta(\text{AVG price}_A - \text{AVG price}_B) < 2 \text{ €/MWh}$$

- ratio between nominal transmission capacity of interconnectors and the peak load (should be higher than 30%);

$$\text{Target 15 \% (sub - criterion 2)} \xrightarrow{\text{relates to}} \frac{\sum P_n}{\text{MAX } P_{\text{load}}} * 100\% > 30\%$$

- ratio between nominal transmission capacity of interconnectors and installed renewable generation capacity (should be higher than 30%);

$$\text{Target 15 \% (sub - criterion 3)} \xrightarrow{\text{relates to}} \frac{\sum P_n}{\text{MAX } P_{\text{RES\_generation}}} * 100\% > 30\%$$

Interconnectivity targets 2030 are set up to enhance market competition, integration of renewables and security of supply.





- **Average wholesale price difference between member states/price zones (should be less than 2 €/MWh):**
  - **small difference (< 2 €/MWh)**
    - interconnections are not congested for a majority of time;
    - market competition is not restricted with low NTCs;
  - **larger difference (> 2 €/MWh but < cca. 5 €/MWh)**
    - congestions may occur more frequently;
    - NTC values prevent generators engagement according to increasing bids;
    - some generators may have market power;
    - if investments are needed to increase the NTC values economic analysis might be positive because some socio-economic welfare will occur;
  - **very large difference (> cca. 5 €/MWh)**
    - CBA analysis for new investments will probably be positive because of large SEW;

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**Large average wholesale electricity price difference points out to low NTC values.  
If investments are needed to increase the NTC values, NPV will probably be positive.**



- **Ratio between nominal transmission capacity of interconnectors and the peak load:**
  - **lower than 30%**
    - domestic consumption should be covered mostly by domestic generators no matter of their production price;
    - market may suffer;
    - generation mix should rely on predictable and reliable production;
    - ratio between installed power of domestic generators and peak load should be high enough;
  - **between 30% and 60%**
    - situation should be constantly monitored;
  - **larger than 60%**
    - existing interconnectors may provide significant support with respect to the electricity supply;

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**Large ratio between nominal transmission capacity of interconnectors and the peak load means that annual ENS values will be zero or very small. Economic analysis for a new interconnection project would probably be negative.**

- **Ratio between nominal transmission capacity of interconnectors and installed renewable generation capacity:**
  - **lower than 30%**
    - renewables production curtailments more often;
    - significant power reserve should be in place (back up power, probably CCGT or OCGT);
    - domestic balancing (load and frequency control) providers should be available;
    - large-scale integration of renewables more complicated and more expensive;
    - wholesale electricity prices might go up;
  - **between 30% and 60%**
    - situation should be constantly monitored
  - **larger than 60%**
    - renewables may be developed and deployed;
    - less curtailments;
    - lower wholesale price;

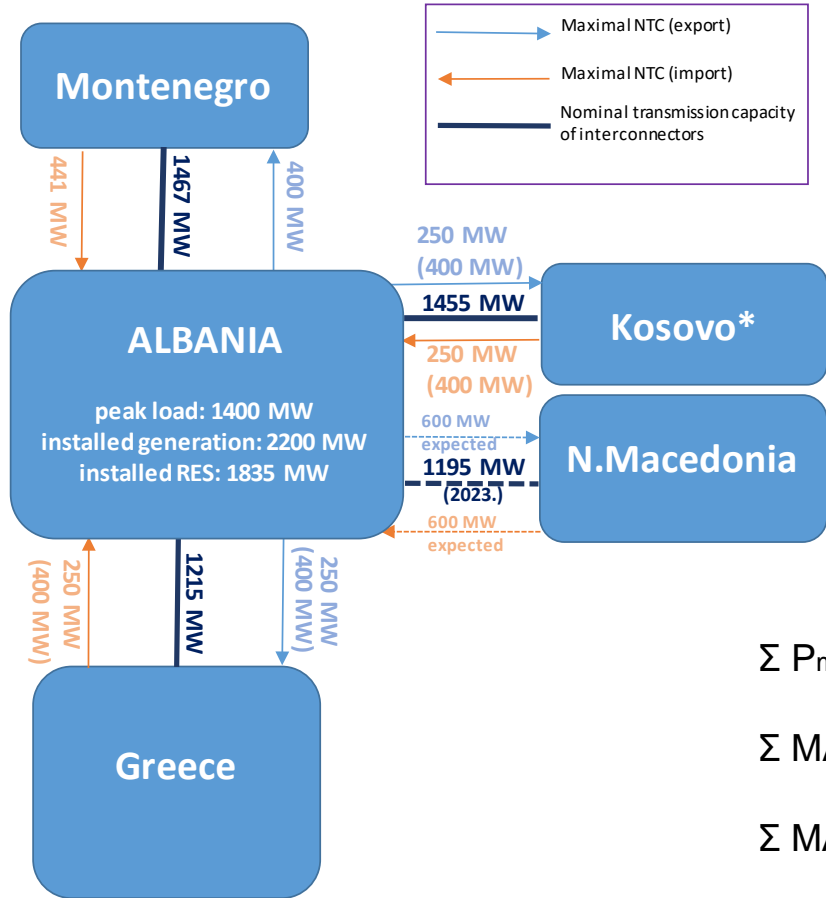
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**Large ratio between nominal transmission capacity of interconnectors and installed renewable generation capacity means that intermittency of RES should not cause more serious problems and increase necessary investments.**

# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY



Source: OST



$$\Sigma P_{max} = 4137 \text{ MW}$$

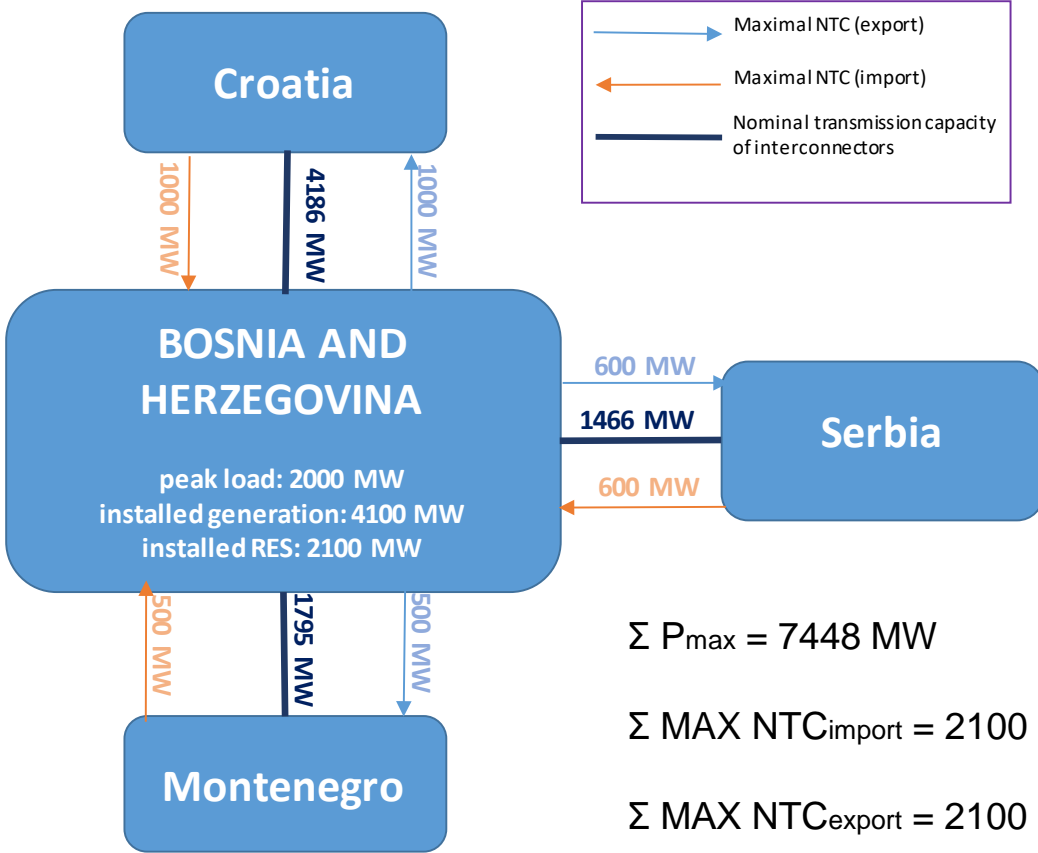
$$\Sigma \text{MAX NTC}_{import} = 1241 \text{ MW}$$

$$\Sigma \text{MAX NTC}_{export} = 1200 \text{ MW}$$

# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY



Source: Elektroprijenos BiH



$$\Sigma P_{\max} = 7448 \text{ MW}$$

$$\Sigma \text{MAX NTC}_{\text{import}} = 2100 \text{ MW}$$

$$\Sigma \text{MAX NTC}_{\text{export}} = 2100 \text{ MW}$$

# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY

TEN YEAR NETWORK DEVELOPMENT PLAN OF GEORGIA 2020-2030

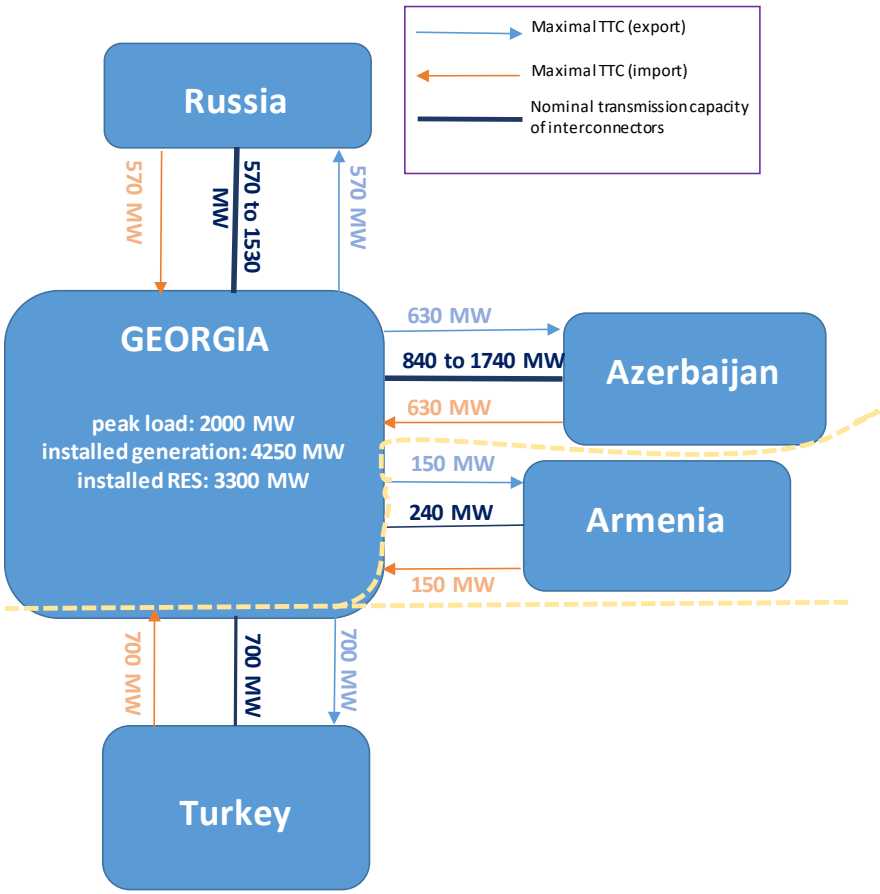


Source: GSE

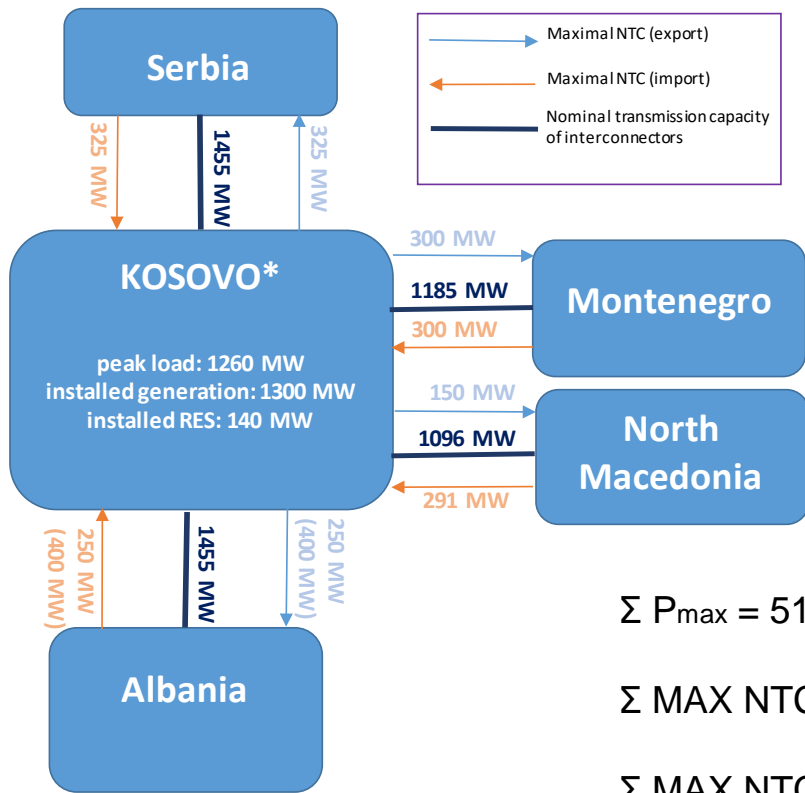
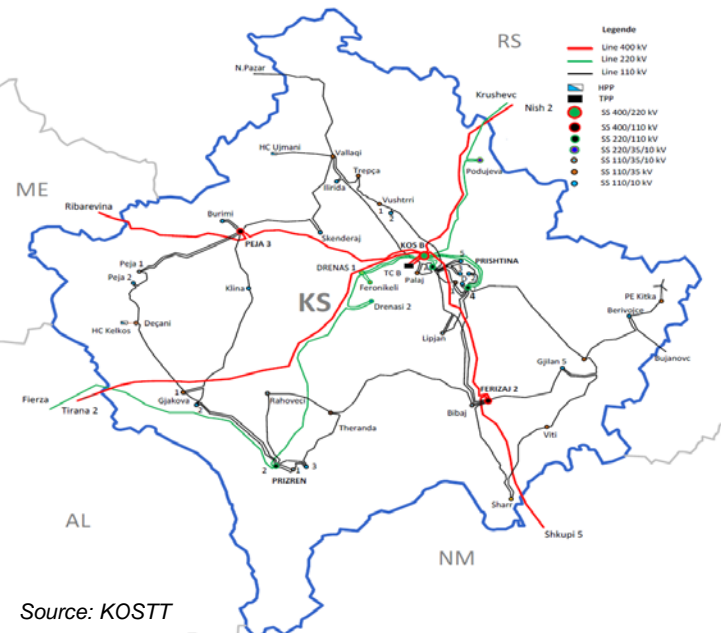
$$\Sigma P_{\max} = 2110 \text{ MW} - 3970 \text{ MW}$$

$$\Sigma \text{TTC}_{\text{import}} = 2050 \text{ MW}$$

$$\Sigma \text{TTC}_{\text{export}} = 2050 \text{ MW}$$



# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY



$$\Sigma P_{max} = 5192 \text{ MW}$$

$$\Sigma \text{MAX NTC}_{import} = 1316 \text{ MW}$$

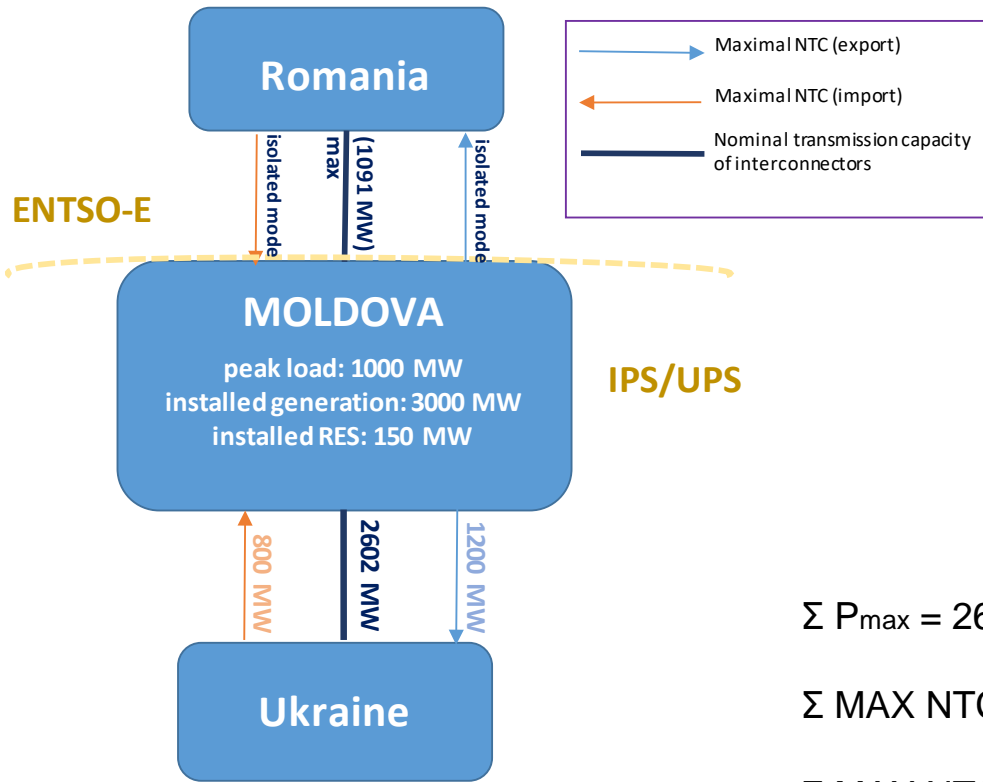
$$\Sigma \text{MAX NTC}_{export} = 1175 \text{ MW}$$



# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY



Source: Moldelectrica

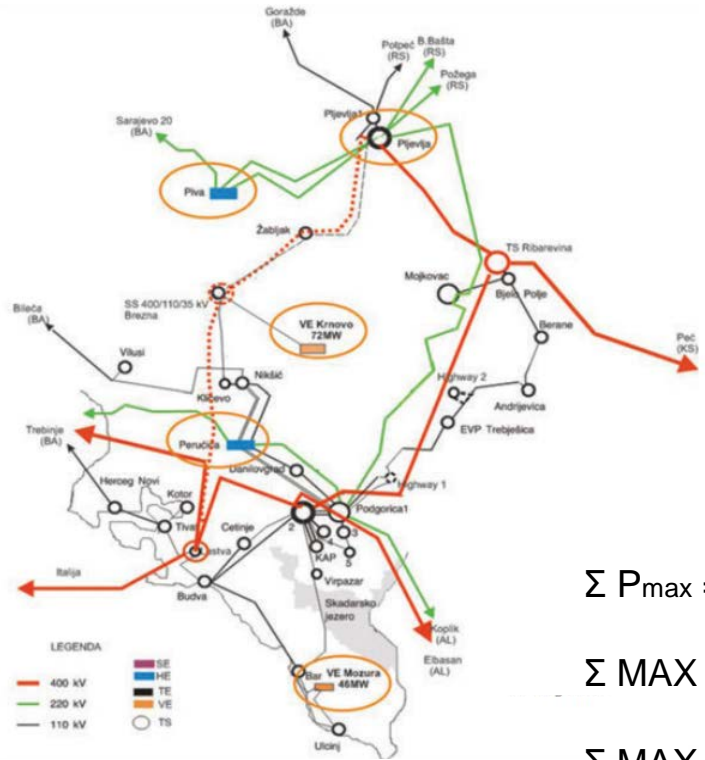


$$\Sigma P_{\max} = 2602 \text{ MW}$$

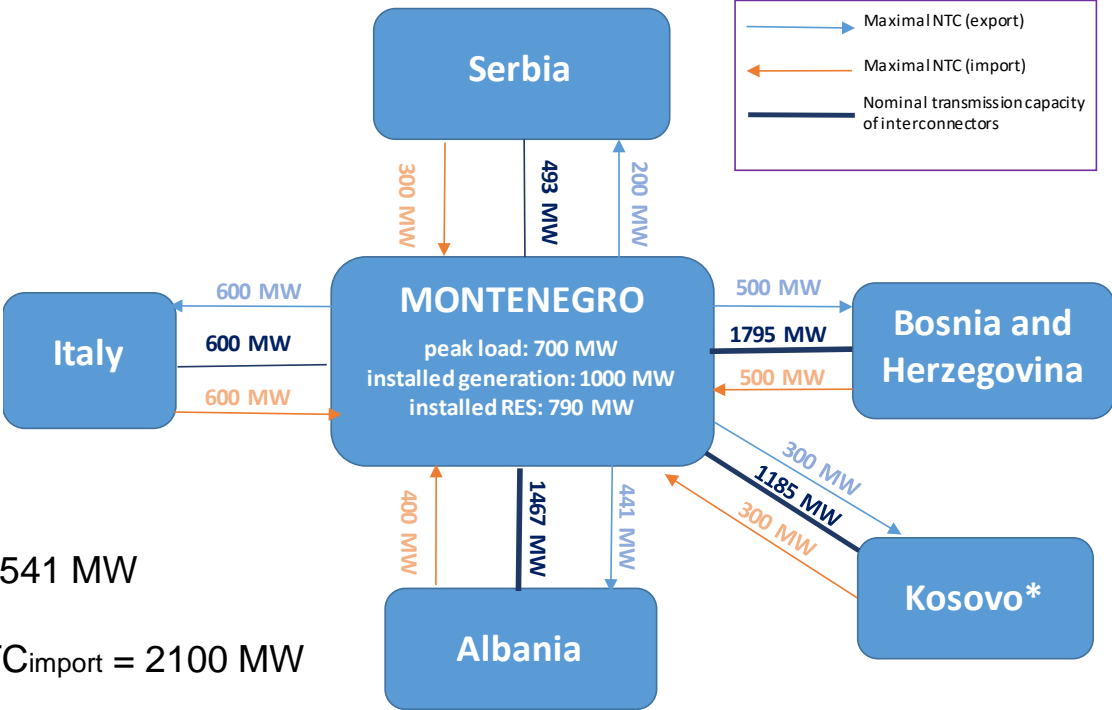
$$\Sigma \text{MAX NTC}_{\text{import}} = 800 \text{ MW}$$

$$\Sigma \text{MAX NTC}_{\text{export}} = 1200 \text{ MW}$$

# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY



Source: CGES

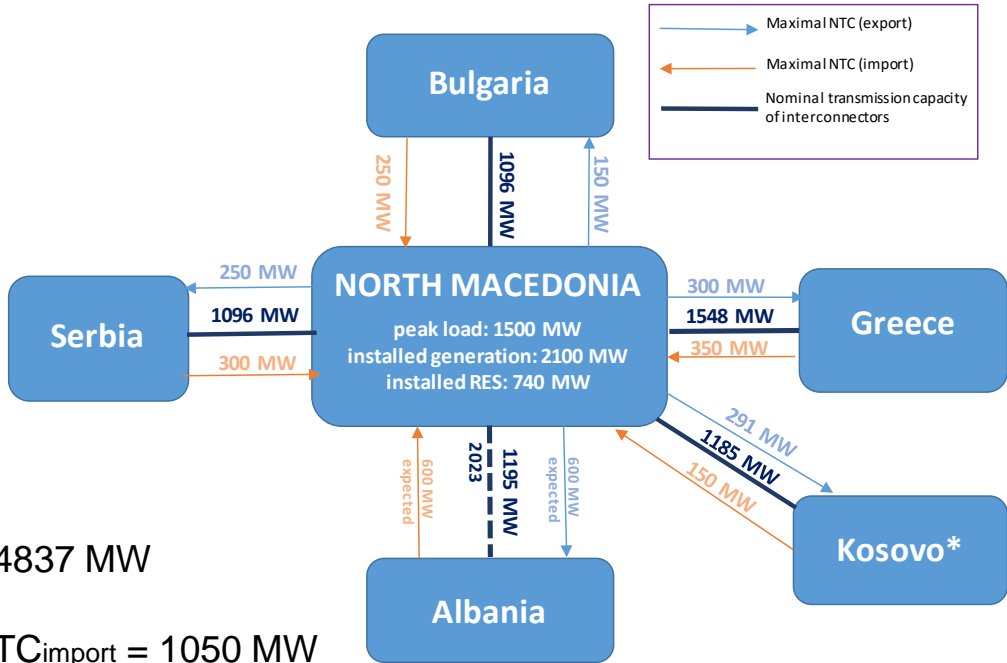


$\Sigma P_{max} = 5541 \text{ MW}$   
 $\Sigma \text{MAX NTC}_{import} = 2100 \text{ MW}$   
 $\Sigma \text{MAX NTC}_{export} = 2041 \text{ MW}$

# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY



Source: MEPSO



$$\Sigma P_{\max} = 4837 \text{ MW}$$

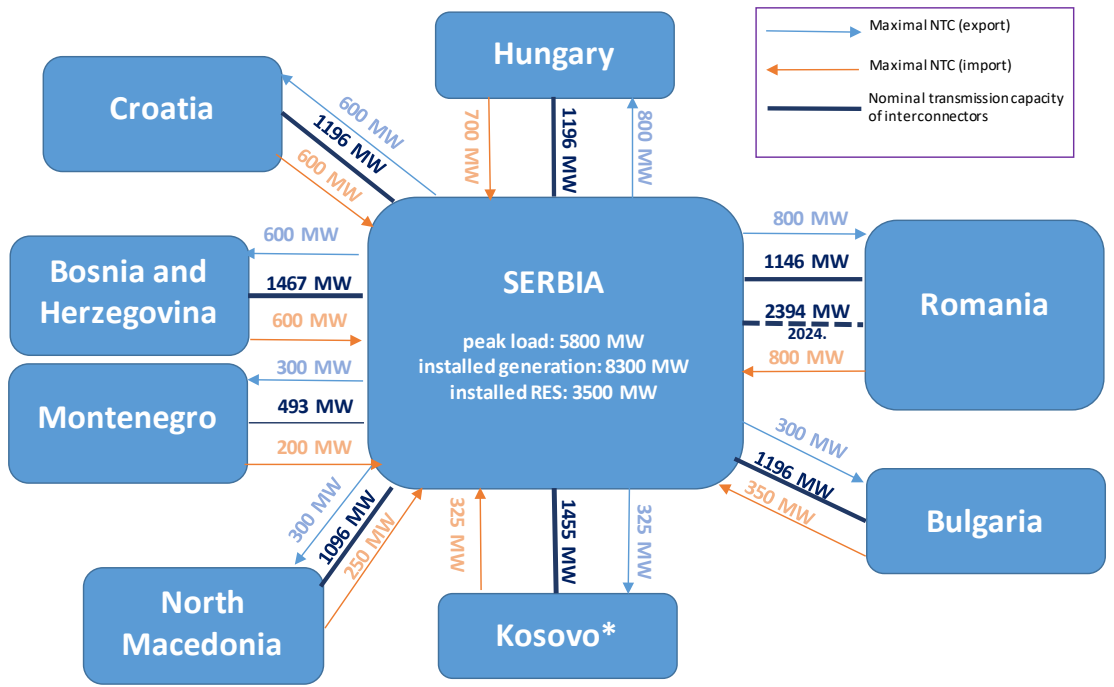
$$\Sigma \text{MAX NTC}_{\text{import}} = 1050 \text{ MW}$$

$$\Sigma \text{MAX NTC}_{\text{export}} = 991 \text{ MW}$$

# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY

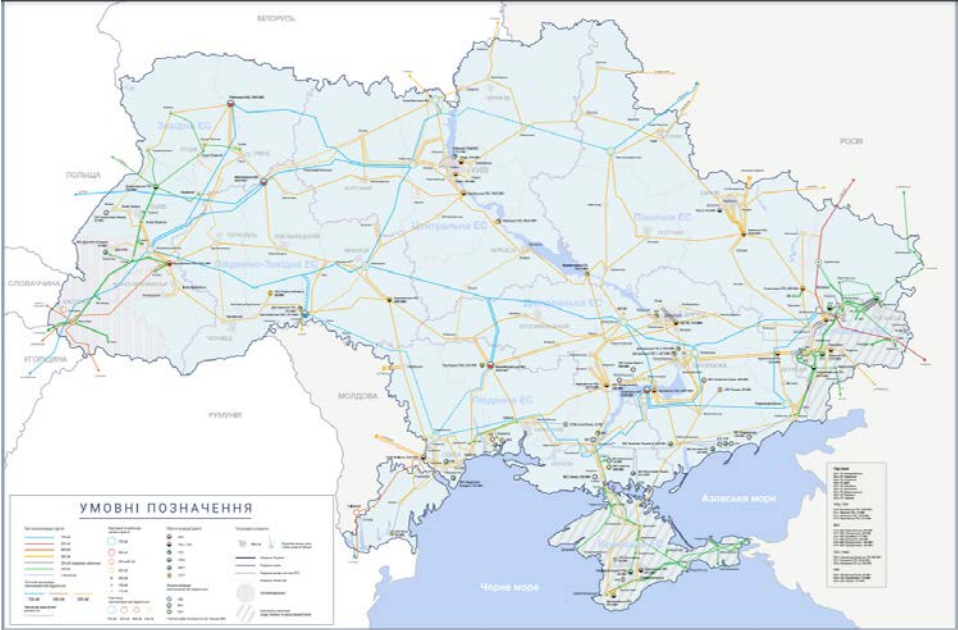


Source: EMS

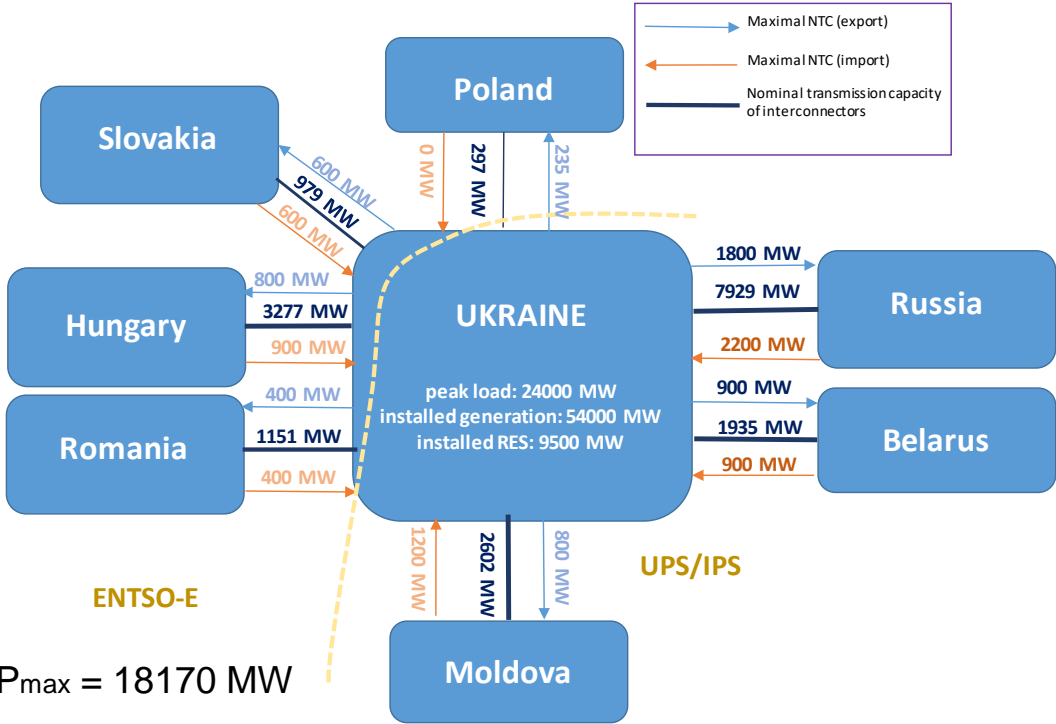


$\Sigma P_{max} = 9245 \text{ MW}$   
 $\Sigma \text{MAX NTC}_{import} = 3825 \text{ MW}$   
 $\Sigma \text{MAX NTC}_{export} = 4025 \text{ MW}$

# EnC CONTRACTING PARTIES EXISTING INTERCONNECTIVITY



Source: UKRENERGO

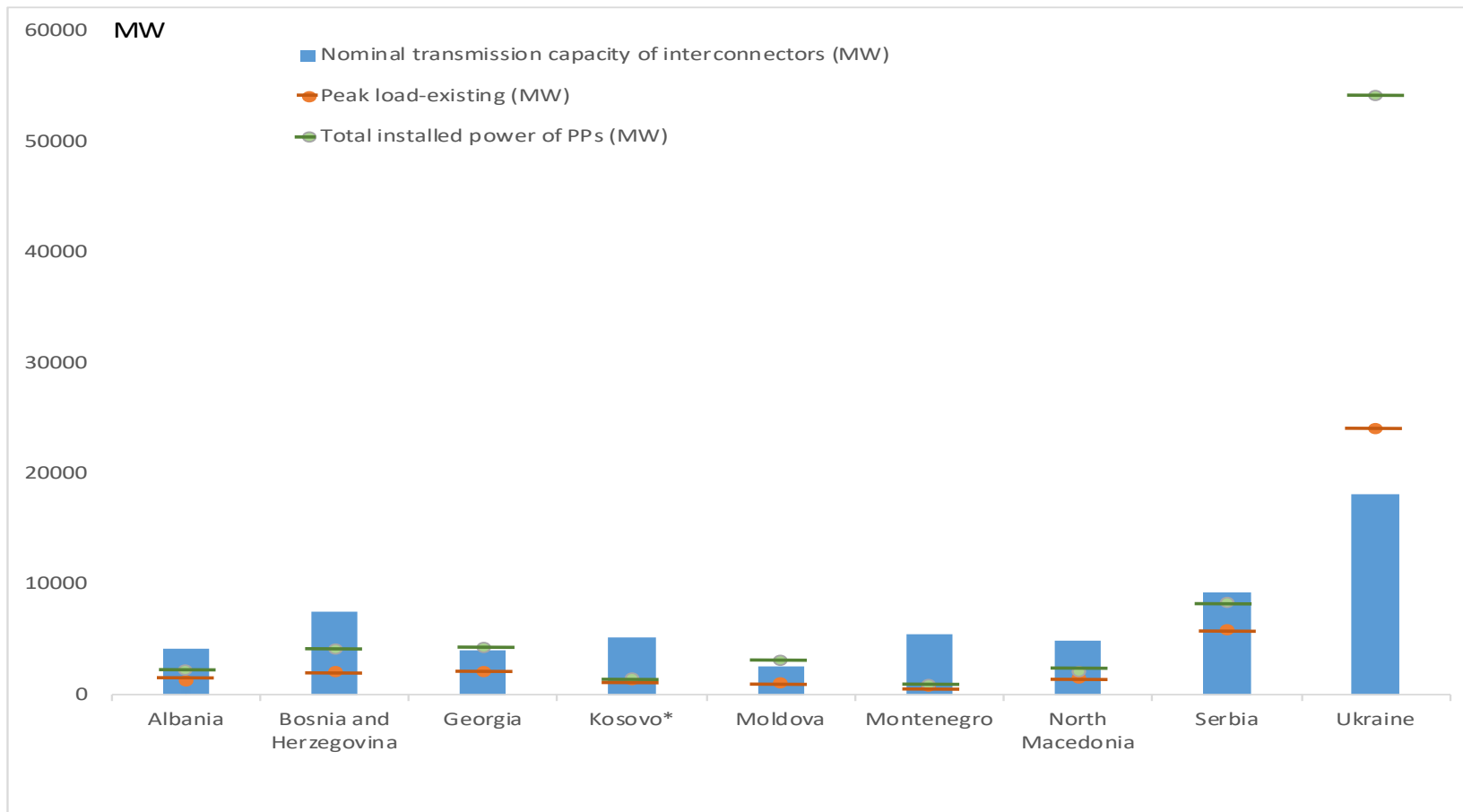


$$\Sigma P_{\max} = 18170 \text{ MW}$$

$$\Sigma \text{MAX NTC}_{\text{import}} = 6200 \text{ MW}$$

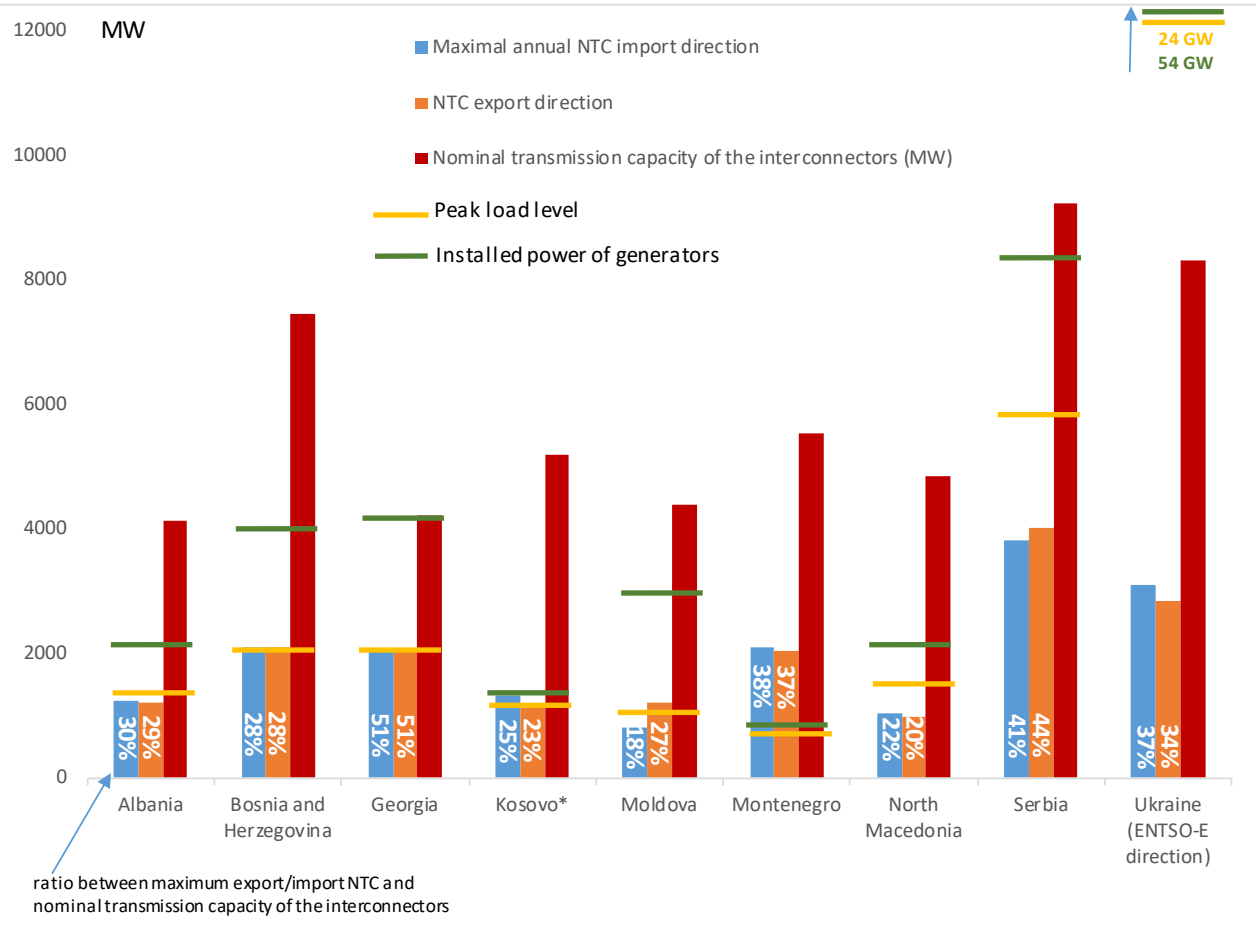
$$\Sigma \text{MAX NTC}_{\text{export}} = 5535 \text{ MW}$$

## INTERCONNECTIVITY INDICATORS (existing situation)

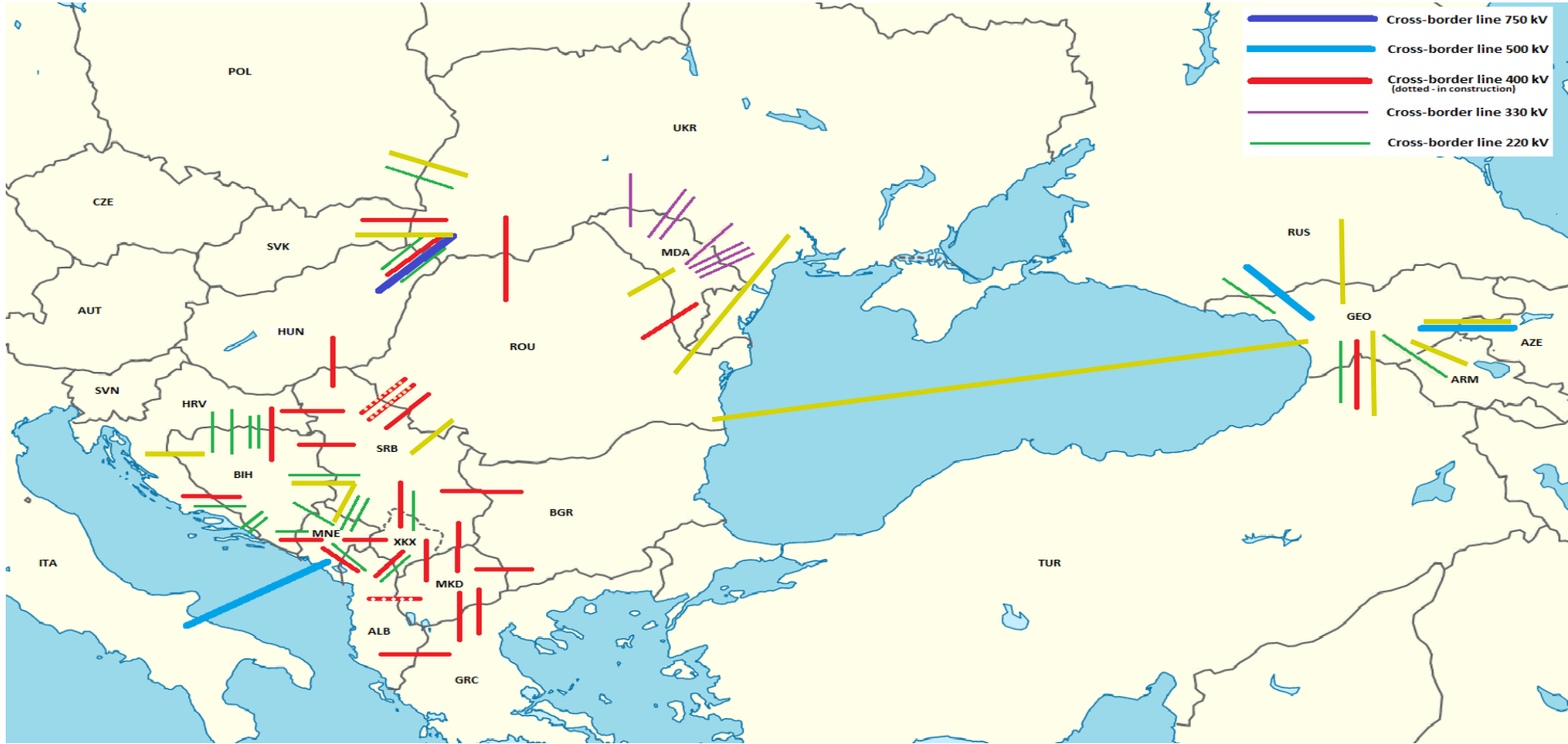




# INTERCONNECTIVITY INDICATORS (existing situation)



# INTERCONNECTIVITY INDICATORS (existing and future situation)



## MAXIMUM NTC VALUES (existing)

	From	ALB	BIH	GEO	XXK	MKD	MDA	MNE	SRB	UKR	BGR	GRC	HRV	HUN	ITA	POL	ROU	SVK	ARM	AZE	RUS	TUR	Maximum import (MW)			
To																										
ALB					400				441			400												1241		
BIH									500	600														2100		
GEO																						150	630	570	700	2050
XXK									291	300	325														1316	
MKD								150																	1050	
MDA																									800	
MNE																									2100	
SRB																									3825	
UKR																									3100	
BGR																										
GRC																										
HRV																										
HUN																										
ITA																										
POL																										
ROU																										
SVK																										
ARM																										
AZE																										
RUS																										
TUR																										
Maximum export (MW)																										
		1200	2100	2050	1175	991	1200	2041	4025	2835																

# INPUT DATA AND ASSUMPTIONS

## NTC VALUES INCREASE DUE TO PLANNED INTERCONNECTIONS (long-term)

To	From	ALB	BIH	GEO	XKX	MKD	MDA	MNE	SRB	UKR	BGR	GRC	HRV	HUN	ITA	POL	ROU	SVK	ARM	AZE	RUS	TUR	ΔMaximum import (MW)	
ALB						600																	600	
BIH									710				644											1354
GEO																	1000						4030	
XKX																							0	
MKD		600																					600	
MDA																	1100						1100	
MNE									430														430	
SRB			1130					80									1466						2676	
UKR																600	1000	257					1857	
BGR																							12647	
GRC																								
HRV		298																						
HUN																								
ITA																								
POL																		600						
ROU				1000			1000		947	1000														
SVK										100														
ARM				700																				
AZE				630																				
RUS				1000																				
TUR				700																				
ΔMaximum export (MW)		600	1428	4030	0	600	-	80	2087	1700	10525													

# INPUT DATA AND ASSUMPTIONS

## NOMINAL TRANSMISSION CAPACITY OF INTERCONNECTORS (existing, short-term, mid-term, long-term future values)

To	From	ALB	BIH	GEO	XKX	MKD	MDA	MNE	SRB	UKR	BGR	GRC	HRV	HUN	ITA	POL	ROU	SVK	ARM	AZE	RUS	TUR	Nominal transmission capacity of interconnectors (MW)	
ALB					1455			1467				1215												4137
BIH								1795	1466				4186											7448
GEO*																			240	1740	1530	700	3970	
XKX		1455						1185	1455															5192
MKD					1096				1096		1096	1548												4837
MDA																								2602
MNE		1467	1795		1185				493						600									5541
SRB			1466		1455	1096		493			1196		1196	1196								1146		9245
UKR							2602							3277		297	1151	979				7929		8306
BGR						1096		1196																51278
GRC		1215				1548																		
HRV			4186					1196																
HUN								1196	3277															
ITA								600																
POL																								
ROU									-	1146	1151													
SVK										979														
ARM				240																				
AZE				1740																				
RUS				1530																				
TUR				700																				

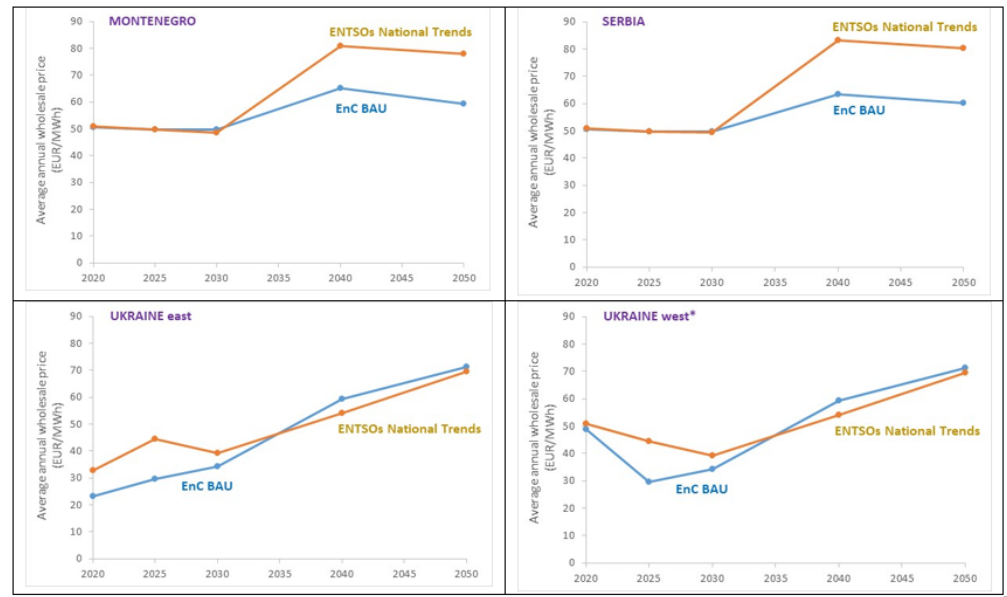
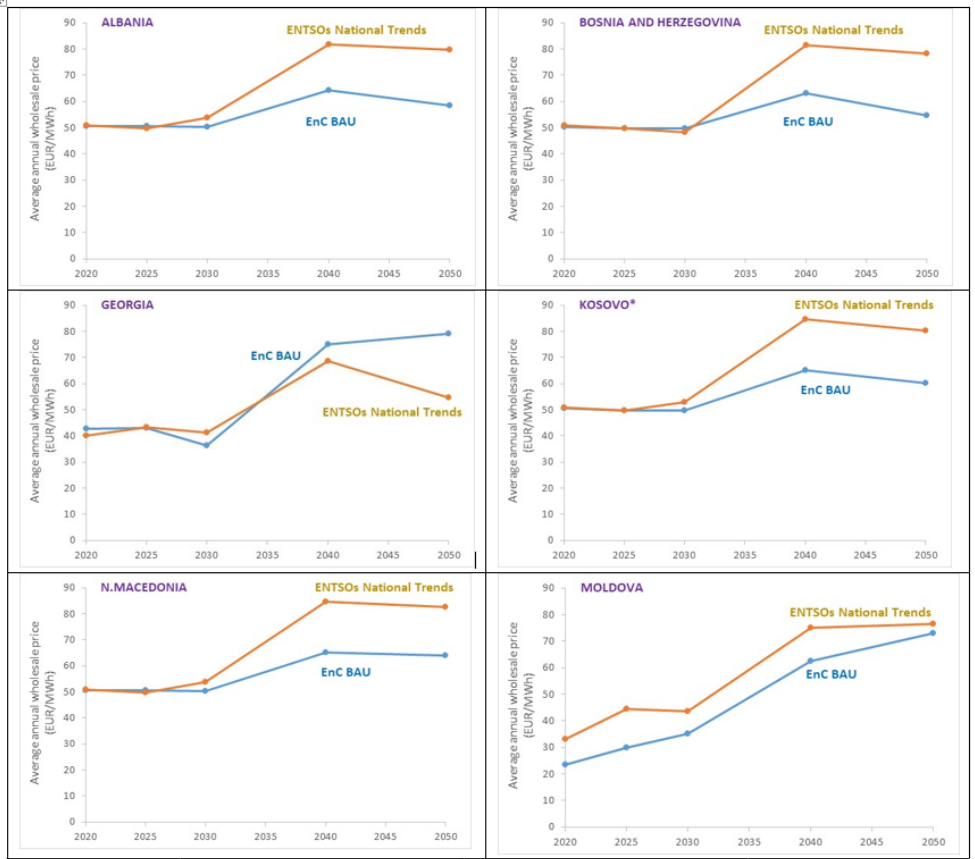
# INPUT DATA AND ASSUMPTIONS

## NOMINAL TRANSMISSION CAPACITY OF INTERCONNECTORS (existing, short-term, mid-term, **long-term future** values)

To	From	ALB	BIH	GEO	XKX	MKD	MDA	MNE	SRB	UKR	BGR	GRC	HRV	HUN	ITA	POL	ROU	SVK	ARM	AZE	RUS	TUR	Nominal transmission capacity of interconnectors (MW)	Δ	
ALB					1455	1195		1467				1215											5332	1195	
BIH								1795	2662				5382											9840	2392
GEO*																	1000		940	2450	3060	1400	7910	3940	
XKX		1455				1096		1185	1455															5192	0
MKD		1195			1096				1096		1096	1548												6032	1195
MDA										2602							1919							4521	1919
MNE		1467	1795		1185				1690						600									6738	1197
SRB			2662		1455	1096			1689				1196	1196	1196		4685							15177	5932
UKR							2602							3277		2052	2951	1969			7929			12851	4545
BGR						1096			1196															73592	
GRC		1215				1548																		73592	
HRV			5382						1196															73592	
HUN									1196	3277														73592	
ITA								600																73592	
POL																								73592	
ROU				1000			1919		4685	2951														73592	
SVK																								73592	
ARM				940																				73592	
AZE				2450																				73592	
RUS				3060																				73592	
TUR				1400																				73592	



## WHOLESALE ELECTRICITY MARKET PRICES (2030, 2040)

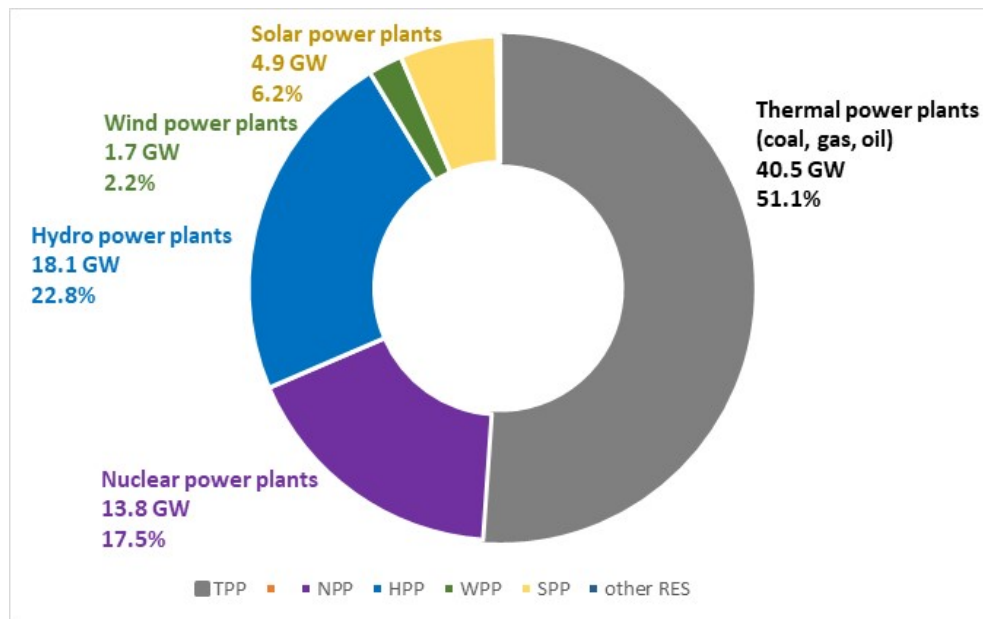


## PEAK LOAD VALUES

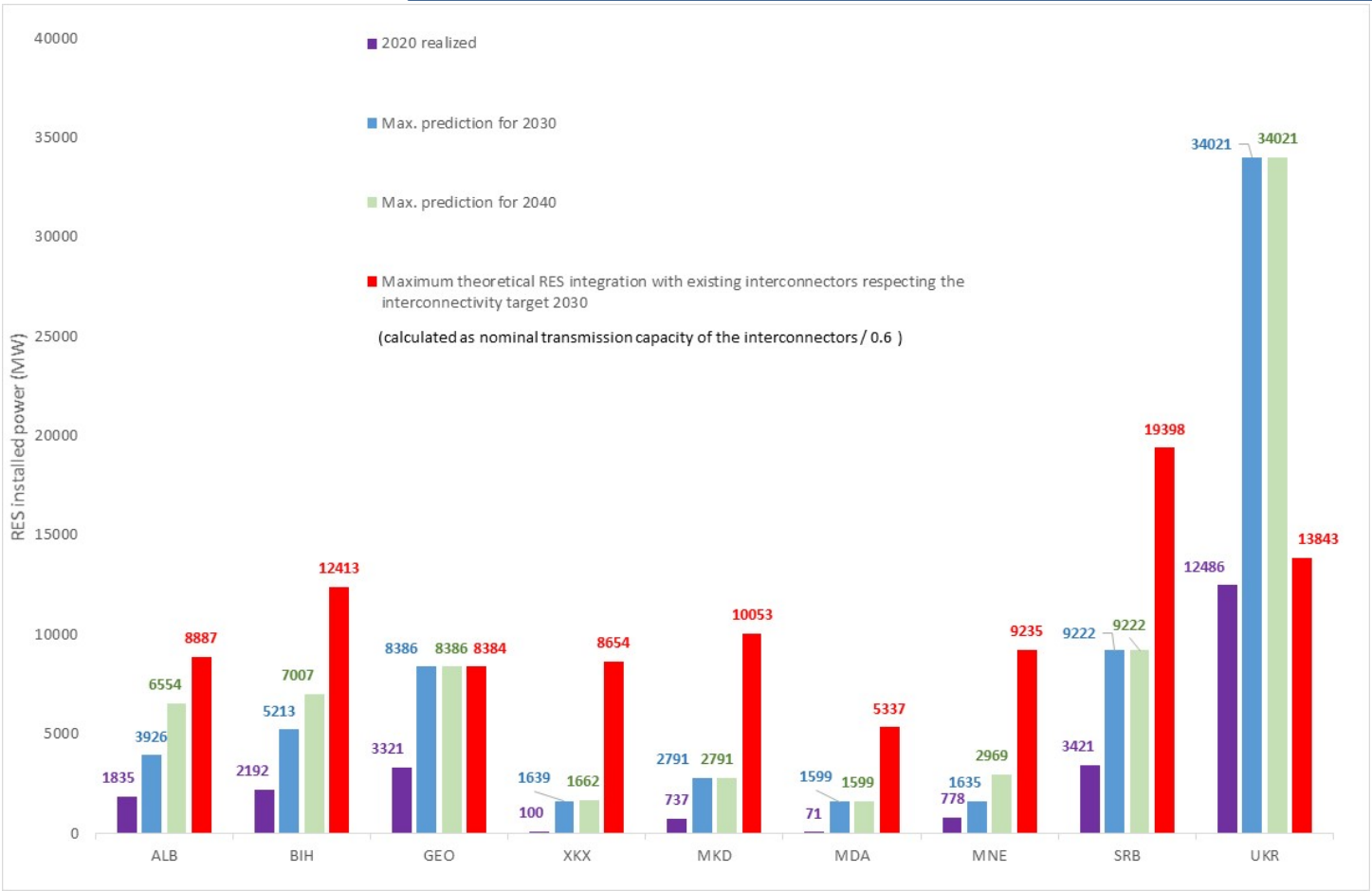
Country	2030			2040		
	National Trends	Global Ambition	Distributed Energy	National Trends	Global Ambition	Distributed Energy
ALB	1955	1955	1955	1955	1955	1955
BIH	2130	2206	2138	2148	2213	2184
GEO	2934 - 6458			-		
XKX	1174 - 1410			-		
MKD	1603	1311	1518	1713	1382	1529
MDA	1280			-		
MNE	776	479	532	946	495	525
SRB*	7735	4582	5445	8827	4729	5526
UKR	20000 - 27000			28000 - 53000		

\* including Kosovo\*

## INSTALLED GENERATION CAPACITY



# INPUT DATA AND ASSUMPTIONS



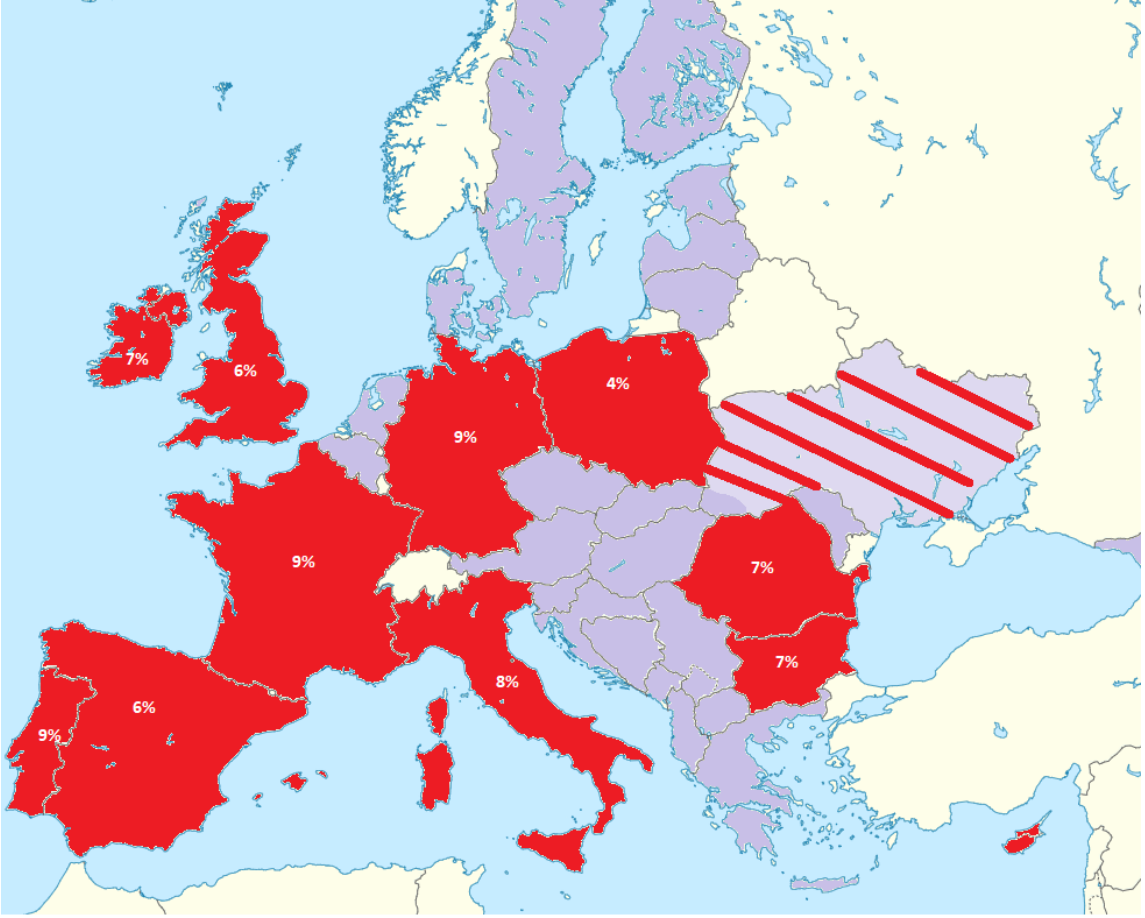
## INSTALLED RENEWABLE ENERGY SOURCES CAPACITY

# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2020

EU situation  
(2017)

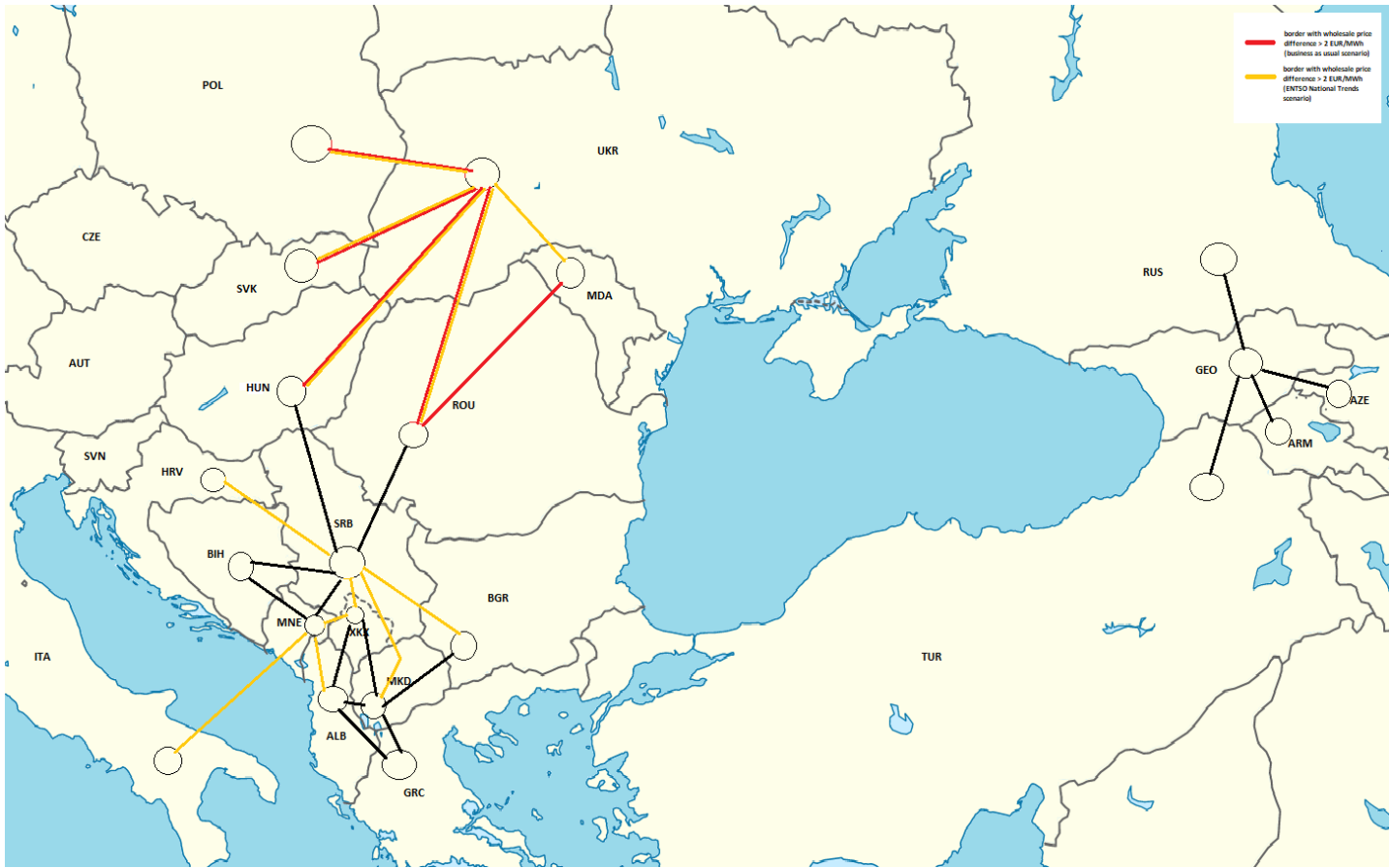
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EnC CPs  
(2020)



Country	Interconnectivity target 2020
ALB	64%
BIH	51%
GEO	48%
XKX	106%
MKD	55%
MDA	27%
MNE	210%
SRB	50%
UKR	11%

# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2030



## WHOLESALE ELECTRICITY PRICES DIFFERENCE (2030)

BORDERS	Business as Usual	ENTSO-e National Trends
	2030	2030
Albania - Montenegro		5.30
Albania - Greece		
Albania - Kosovo*		
Albania - N. Macedonia		
BiH - Croatia		
BiH - Serbia		
BiH - Montenegro		
Georgia - Russia		
Georgia - Azerbaijan		
Georgia - Armenia		
Georgia - Turkey		
Kosovo - Serbia		3.54
Kosovo - Montenegro		4.56
Kosovo - N. Macedonia		
Moldova - Ukraine		4.21
Moldova - Romania	-14.57	
N. Macedonia - Serbia		4.35
N. Macedonia - Bulgaria		
N. Macedonia - Greece		
Montenegro - Albania		
Montenegro - Serbia		
Montenegro - Italy		2.96
Serbia - Croatia		2.06
Serbia - Bulgaria		-5.03
Serbia - Romania		
Serbia - Hungary		
Ukraine - Poland	-17.26	-8.53
Ukraine - Slovakia	-14.23	-8.43
Ukraine - Hungary	-15.30	-8.20
Ukraine - Romania	-15.30	-9.92
<b>MAX</b>	<b>17.26</b>	<b>9.92</b>

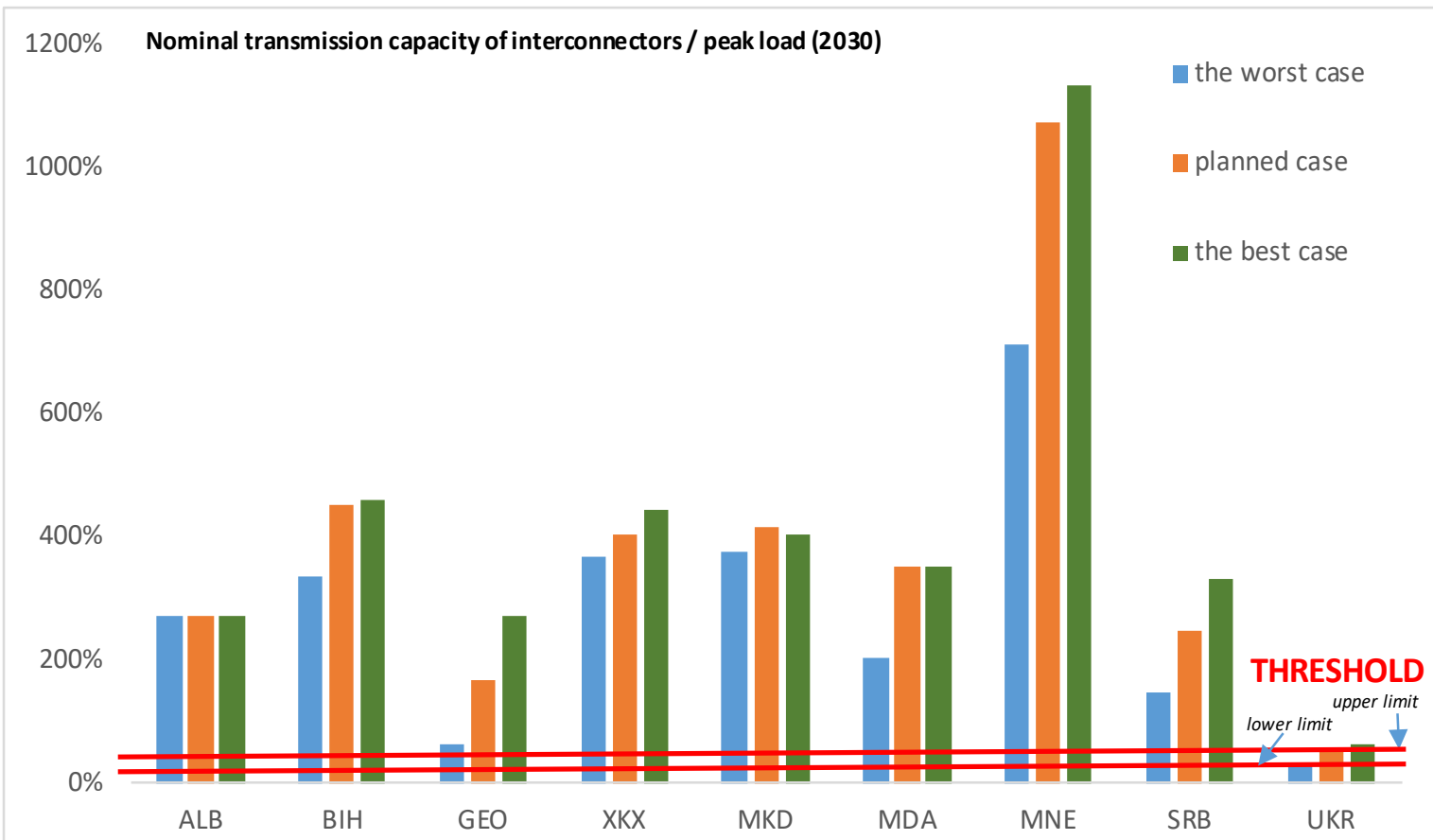
# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2040



## WHOLESALE ELECTRICITY PRICES DIFFERENCE (2040)

BORDERS	Business as Usual	ENTSO-e National Trends
	2040	2040
Albania - Montenegro		
Albania - Greece	2.24	-2.51
Albania - Kosovo*		-2.96
Albania - N. Macedonia		-2.82
BiH - Croatia		
BiH - Serbia		
BiH - Montenegro		
Georgia - Russia		
Georgia - Azerbaijan		
Georgia - Armenia		
Georgia - Turkey		
Kosovo - Serbia		
Kosovo - Montenegro		3.79
Kosovo - N. Macedonia		
Moldova - Ukraine	3.23	21.13
Moldova - Romania		-7.91
N. Macedonia - Serbia		
N. Macedonia - Bulgaria		
N. Macedonia - Greece	3.37	
Montenegro - Albania		
Montenegro - Serbia		-2.42
Montenegro - Italy		29.39
Serbia - Croatia		
Serbia - Bulgaria		
Serbia - Romania		
Serbia - Hungary		
Ukraine - Poland		-8.78
Ukraine - Slovakia		-33.47
Ukraine - Hungary	-3.71	-28.99
Ukraine - Romania	-3.88	-29.04
<b>MAX</b>	<b>3.88</b>	<b>33.47</b>

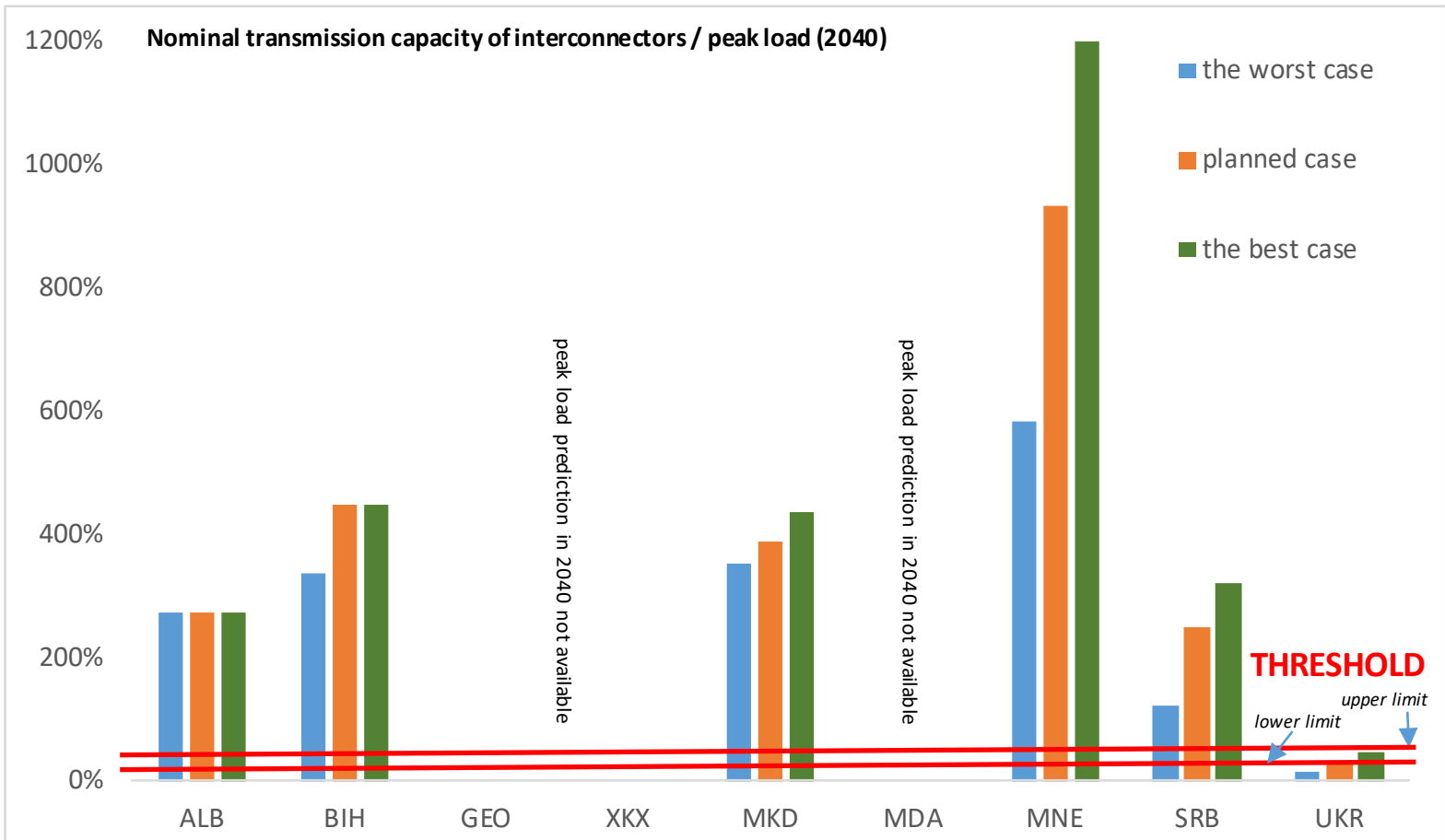
# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2030



**NOMINAL TRANSMISSION CAPACITY OF THE INTERCONNECTORS TO THE PEAK LOAD RATIO (2030)**

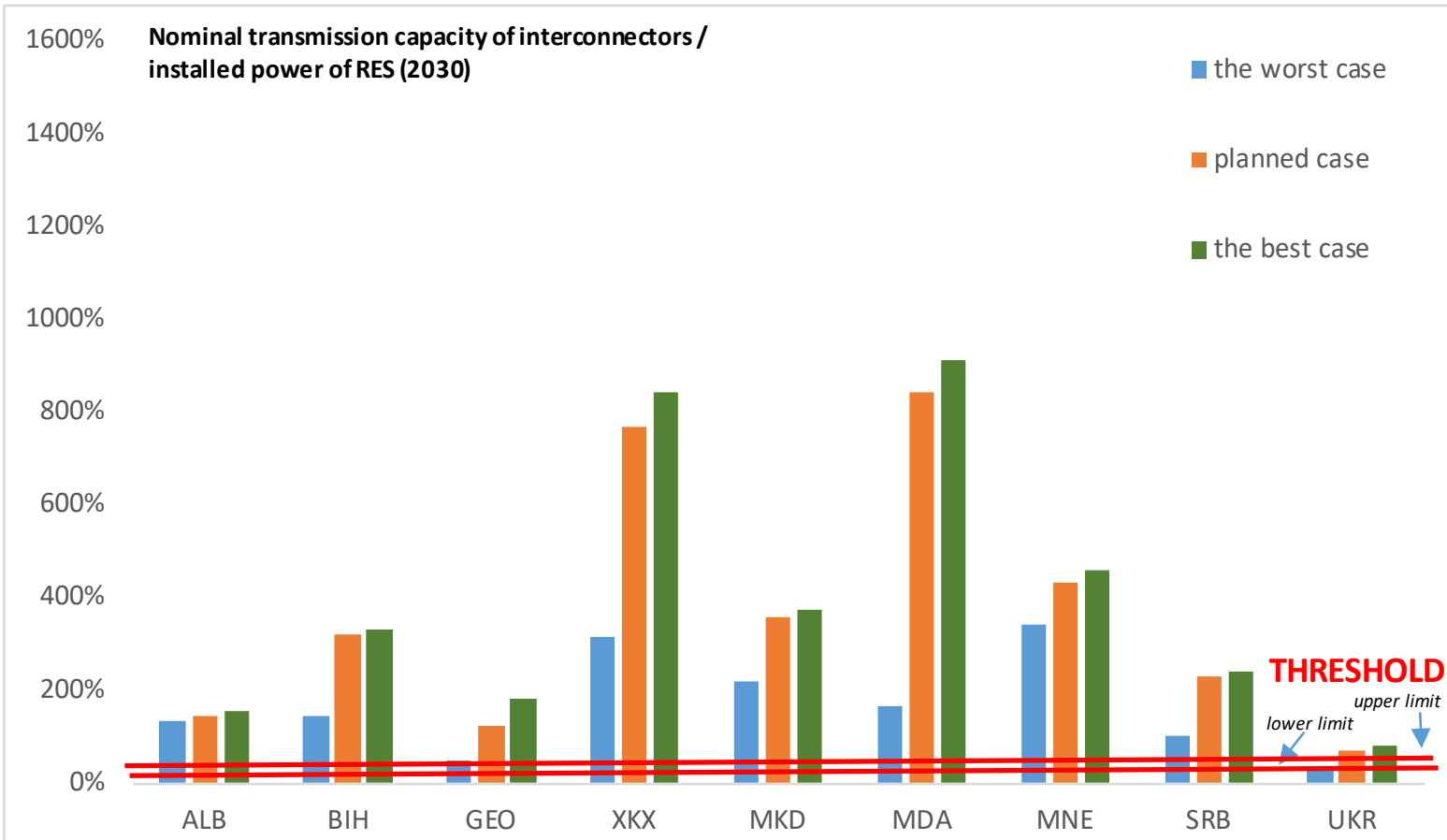


# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2040



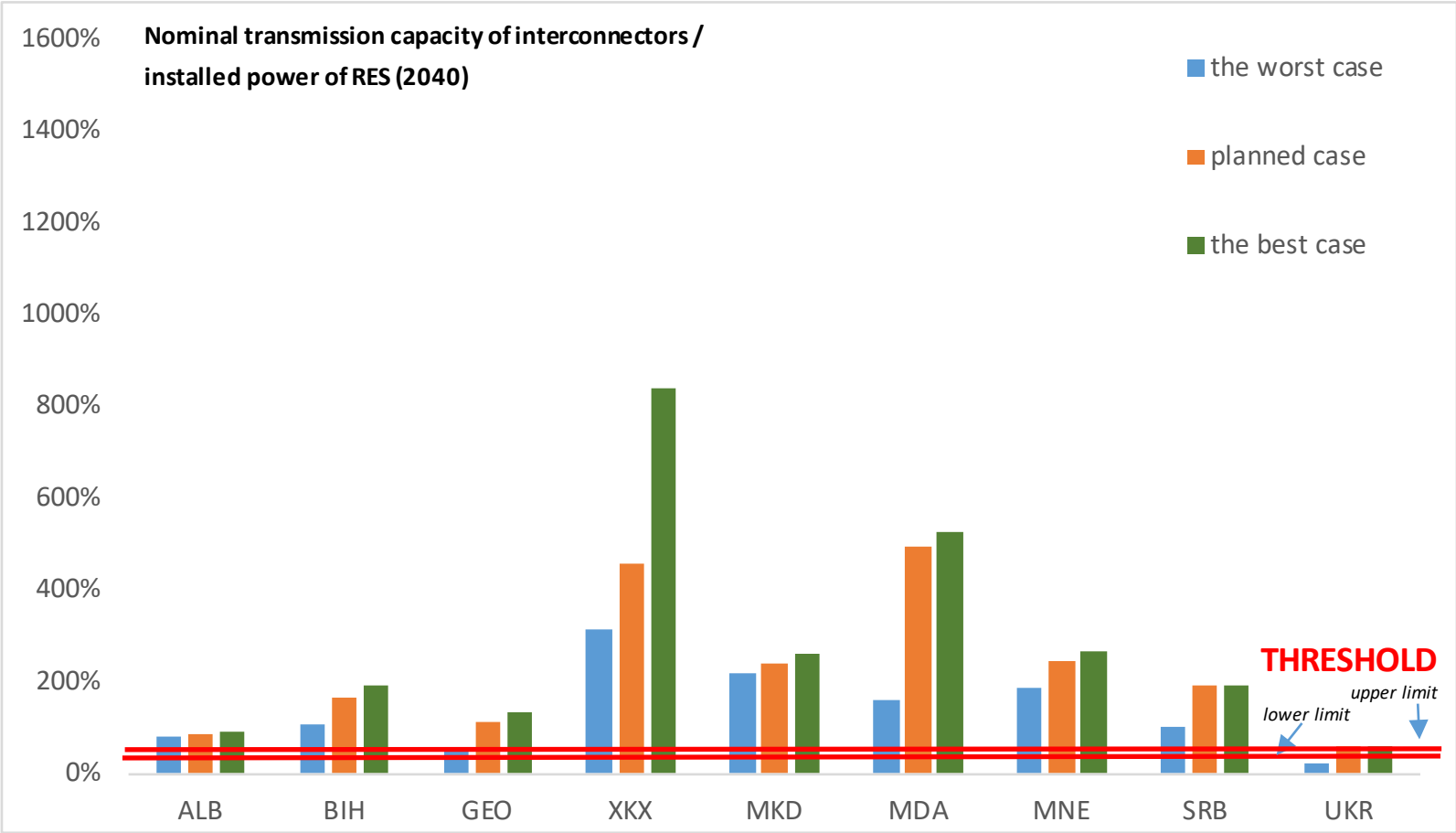
**NOMINAL TRANSMISSION CAPACITY OF THE INTERCONNECTORS TO THE PEAK LOAD RATIO (2040)**

# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2030



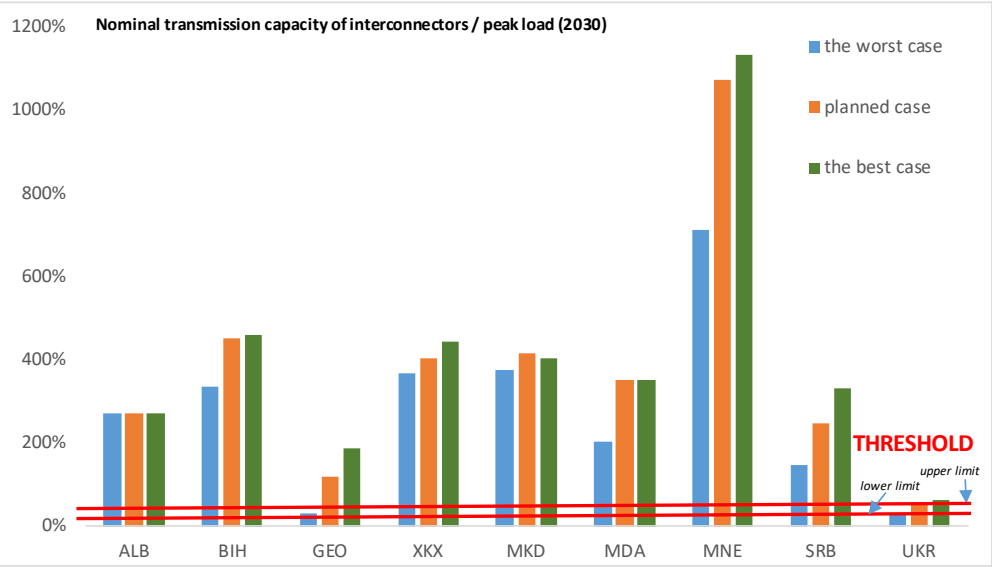
**NOMINAL TRANSMISSION CAPACITY OF THE INTERCONNECTORS TO THE INSTALLED RES GENERATION RATIO (2030)**

# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2040



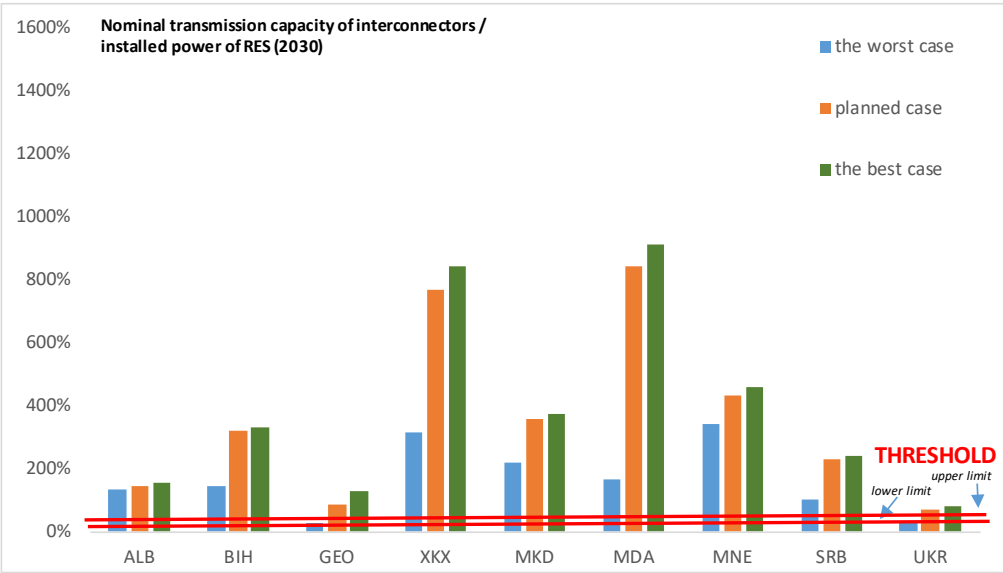
**NOMINAL TRANSMISSION CAPACITY OF THE INTERCONNECTORS TO THE INSTALLED RES GENERATION RATIO (2040)**

# COMPLIANCE WITH THE INTERCONNECTIVITY TARGETS 2030: Georgian case



## DECREASED NOMINAL TRANSMISSION CAPACITIES OF EXISTING LINES 500 KV TO RUSSIA AND AZERBAIJAN:

- To Russia: Pn=570 MW, 1984, ACSR 3x300
- To Azerbaijan: Pn=630, 1989/2011, ACSR 3x330



### RECOMMENDATIONS:

- CONTROL OVER CROSS-BORDER LINES (OWNERSHIP)
- REVITALISATION
- MAINTENANCE

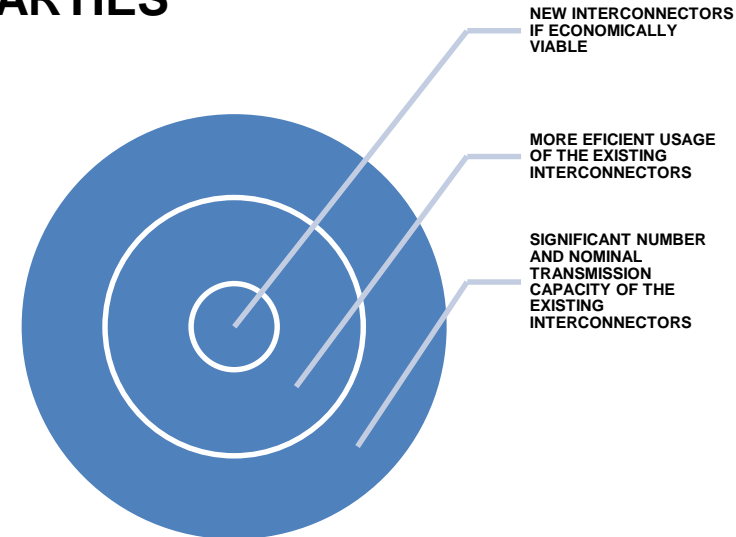
**INTERCONNECTIVITY TARGETS 2020 AND 2030 ARE OR EXPECTED TO BE FULLFILED BY ALL CONTRACTING PARTIES**

**UNCERTAINTY IS RELATED TO UKRAINE DUE TO ITS SYNCHRONISATION WITH THE ENTSO-E, NEW INTERCONNECTIONS MIGHT BE NECESSARY**

**MORE EFFICIENT USAGE OF THE EXISTING INTERCONNECTIONS SHOULD BE PUT IN FOCUS**

**NTC VALUES ARE GENERALLY TOO LOW TODAY**

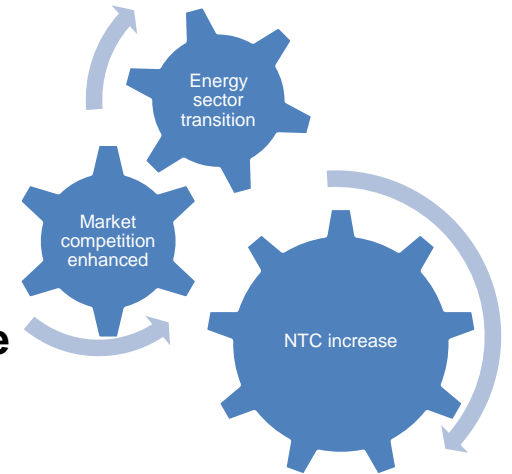
**ATTENTION SHOULD BE ALSO DIRECTED TO INTERNAL NETWORKS REINFORCEMENTS**



**NTC VALUES → RE-EVALUATED → INCREASED → MARKET COUPLINGS → FLOW BASED.**

**TSOs AND NRAs: TO IDENTIFY CRITICAL NETWORK ELEMENTS WHICH RESTRICT THE NTC VALUES AND TO PROPOSE SOLUTIONS TO RELIEVE INTERNAL BOTTLENECKS.**

- NTC values increase should be done by different means, starting with the **fastest ones** and the **cheapest ones**.
- If necessary, the NTC values should be further increased by **reinforcing the internal networks** through different actions based on the lowest cost approach.
- New cross-border infrastructure projects construction at the end if **economically viable**.





**THANK YOU**  
**FOR YOUR ATTENTION**

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