Energy Community

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Energy Institute Hrvoje Požar
Croatia

# STUDY ON THE 70% TARGET FOR ELECTRICITY INTERCONNECTION CAPACITIES TO BE MADE AVAILABLE TO MARKET PARTICIPANTS

## - 2nd workshop -

26 September 2023

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1. **Project in brief**
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3. **Calculation methodology** and input data
4. **MACZT results** for selected scenarios in **2021**
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6. Identification of **structural congestions**
7. **Proposal of activities and measures**

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# PROJECT IN BRIEF

# Study objectives

1. Address forthcoming **obligations** by the EnC CPs pursuant to the Electricity Regulation (2019/943)
2. Estimate the **existing situation** in each WB6 CP related to the 70% target
3. Identify **structural congestions** within the transmission networks
4. Analyze and reflect on the 70% target in cases of perspective application of **flow-based and NTC-based capacity calculation and allocation through market coupling**
5. Demonstrate the effect of applying the **flow-based capacity calculation**
6. Suggest, based on the calculations, **activities and measures** in the EnC CPs (except Georgia) as a basis for possible action plans to fulfil the 70 % target by **2028**

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# Study main purpose


**to support and educate** TSOs, NRAs and Ministries in the CPs

**to provide in-depth understanding of the legal framework and calculation background** governing the implementation of the 70% target

**Study calculation results and findings are not binding to any stakeholder**

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# Work plan

| Task | Start date | End date |
|---|---|---|
| Project commences | Wed 11/1/23 | Wed 11/1/23 |
| Methodology, work plan, data set definition (Inception report) | Wed 11/1/23 | Fri 20/1/23 |
| Provisions: Regulation (EU) 2019/943 and ACER recommendations | Mon 23/1/23 | Fri 3/2/23 |
| Analysis of the existing situation in each WB6 Contracting Party that is related to the 70% target | Mon 6/2/23 | Fri 5/5/23 |
| Workshop 1: explanation of 70% target and the existing situation on observed cross-zonal borders | Mon 15/5/23 | Mon 15/5/23 |
| Identification of the structural congestions | Thu 16/5/23 | Fri 16/6/23 |
| NTC and Flow-based calculation comparison for existing situation | Mon 6/2/23 | Fri 16/6/23 |
| Activities and measures in the EnC CPs to fulfil the 70 % target until 2028 | Fri 16/5/23 | Thu 31/8/23 |
| Draft Report | Fri 16/6/23 | Tue 19/9/23 |
| Workshop 2: summarize the whole study, activities and measures in each EnC CP to satisfy 70% target until 1 January 2028 | Tue 26/9/23 | Tue 26/9/23 |
| Final Report submission | Fri 13/10/23 | Fri 13/10/23 |

# Study in brief


The study consists of:

- 15 chapters written on
- 211 pages with
- 90 figures and
- 96 tables
- 67 literature references used

In addition, link to detailed results with:

- 16 excel files
- ~1500 figures
- 4,6 million numerical results

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# Study in brief


Analysis was done:

- per each Contracting Party
- per each internal network element 400 kV and 220 kV
- per each border between EnC CPs including those to EU MSs

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# Geographical scope: 8 power systems

As defined in the latest EnC MC decision and agreed in the Inception report:

1. Capacity Calculation Region **Shadow South-East Europe** (Shadow SEE CCR), shall include the bidding zone borders between WB6 CPs and borders to the neighboring EU countries

2. Capacity Calculation Region **Eastern Europe** (EE CCR) shall include the bidding zone border between Ukraine and Moldova and borders to the neighboring EU countries


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# RELEVANT LEGISLATIVE FRAMEWORK

# Motivation

## Clean energy for all Europeans package

| | |
|---|---|
| Energy performance of buildings | 19. 6. 2018.<br>(EU) 2018/844 |
| Promotion of the use of energy from renewable sources | 21. 12. 2018.<br>(EU) 2018/2001 |
| Energy efficiency | 21. 12. 2018.<br>(EU) 2018/2002 |
| Governance of the Energy Union and Climate Action | 21. 12. 2018.<br>(EU) 2018/1999 |
| **Internal market for electricity** | **19. 6. 2019.**<br>**(EU) 2019/943** |
| Common rules for the internal market for electricity | 19. 6. 2019.<br>(EU) 2019/944 |
| Risk-preparedness in the electricity sector | 19. 6. 2019.<br>(EU) 2019/941 |
| Establishing a European Union Agency for the Cooperation of Energy Regulators | 19. 6. 2019.<br>(EU) 2019/942 |

### Article 16.8:

- TSO shall not limit the volume of interconnection capacity to be made available to market participants
- **Minimum level of available capacity for cross-zonal should be 70 %** both for:
  - borders using a coordinated net transmission capacity approach and
  - borders using a flow-based approach
- Incorporated and adapted by the EnC Ministerial Council Decision D/2022/03/MC-EnC of 15 Dec 2022

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# Implementation

## Key documents

- **Regulation (EU) 2015/1222: Guideline on capacity allocation and congestion management (CACM)**
  - **Chapter 1: Capacity calculation (CCR, CGM, FB CCM, GSK, BZ, …)**
- **ACER Recommendation No 01/2019 on the implementation of the minimum margin available for cross-zonal trade pursuant to Article 16(8) of Regulation (EU) 2019/943**
- **ACER Decision on Core CCM**
  - **Day-ahead CCM of the Core capacity calculation region**
  - **Intraday CCM of the Core capacity calculation region**
  - **Long-term CCM of the Core capacity calculation region**
- **ENTSO-E, Generation and load shift key implementation guide**
- **Numerous of workshops: ACER, JAO, …**

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# Implementation

## Legal framework in CPs

- **Energy Community Ministerial Council Decision 2022/02/MC-EnC, adopted the 2030 energy and climate targets on 15 December 2022**

## Other supporting documents

- **ENTSO-E**
  - **Bidding Zone Review**
  - **Technical comments on ACER's 'Report on the result of monitoring the MACZT**
- **The Nordic TSOs: Supporting document for the Nordic Capacity Calculation Region's proposal for capacity calculation methodology**
- **T. Schittekatte, et al: The EU Electricity Network Codes**
- **J. Hentschel, et al: A comparison of different ways to implement the 70 percent rule**

- **In total, 67 references used in this study**

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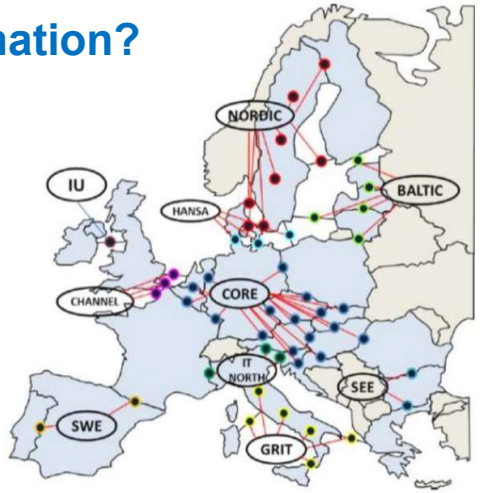
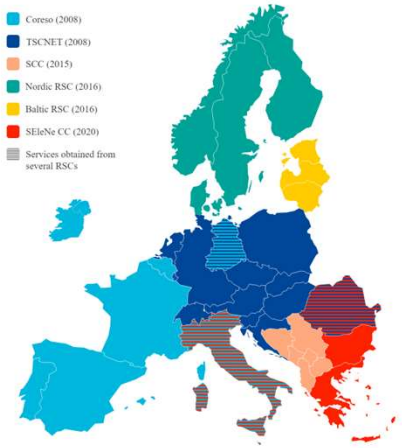
# Before calculation

**What should be done before capacity calculation and MACZT estimation?**

1. **Establishing Capacity Calculation Regions (CCR) and Regional Coordination Centre (RCC)**
   - CCRs are the key architecture of the EU Internal Electricity Market
   - CCRs consist of Biding Zones (BZ) borders
   - Shadow SEE and UA/MD BZ borders
2. **Calculation methodology**
   - ENTSO-E: All TSOs' proposal for a CGM methodology in accordance with CACM – guideline on capacity allocation (2016)
   - EnCS: TSOs' proposal of coordinated capacity calculation methodology for the day-ahead market timeframe (2018)
   - ACER paper on estimating the margin available for cross-zonal trade (December 2020)



# Calculation and results interpretation

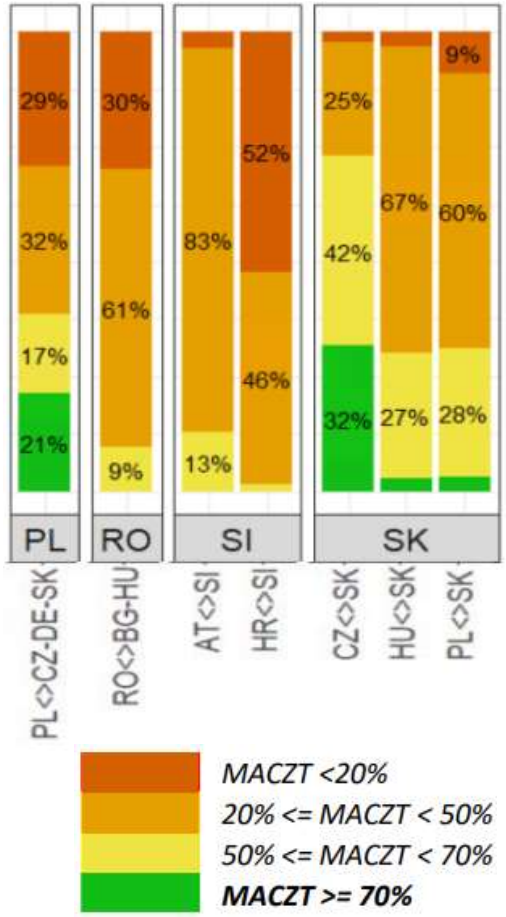
**… 70 % target estimation**

## 3. Calculation methodology basic components

- Grid model, BZ border identification
- List of Critical Network Element and Contingency – CNE(C)
- Equivalent generation and load represented by Generation Shift Key (GSK)
- DC power flow and Power Transfer Distribution Factors (PTDF) calculation
- Minimum capacity margin available for cross-zonal trade (MACZT) calculation

## 4. Results interpretation

- For each CNE(C) and BZ



# EU MS implementation status

**Most of EU MSs not fulfilling 70% target**

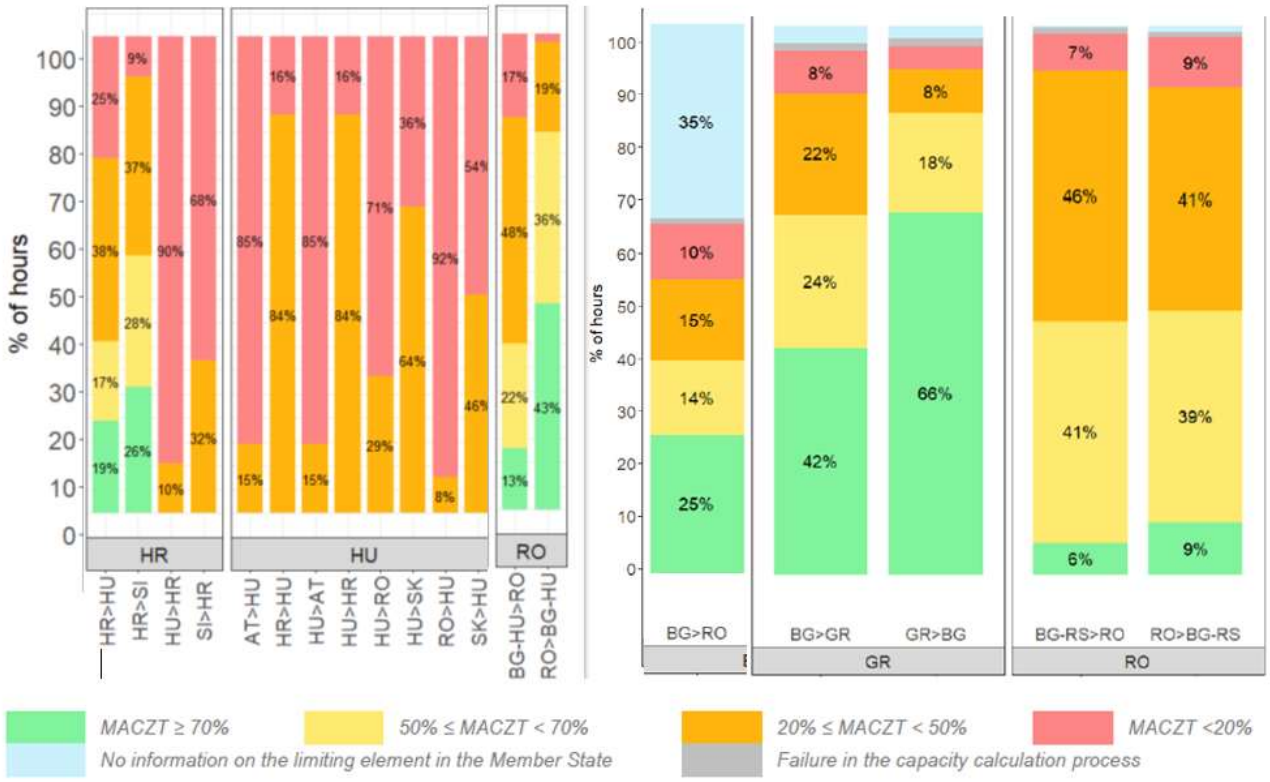
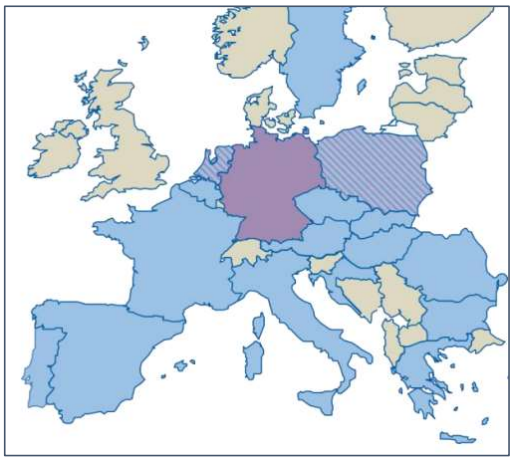


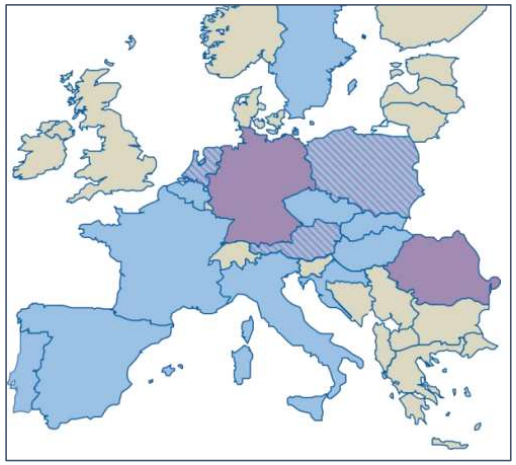

Figure 5 Percentage of hours when the minimum 70% target was reached per bidding zone border in 2022 considering third countries

# EU MS implementation status

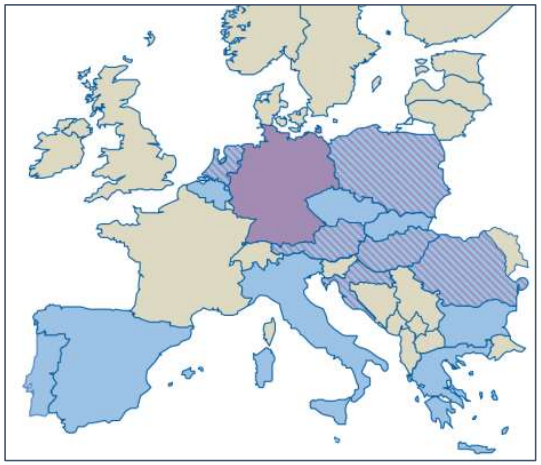
- In 2020, 2021 and 2022 most of EU MSs asked NRA for derogation or accepted Action Plan



2020



2021



2022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# CALCULATION METHODOLOGY


# Calculation methodology


1. **Approved** by EnCS in the Inception Report

2. **Discussed in detail, clarified and agreed** with ACER during the 1st workshop in May 2023

3. **Verified:** basic numerical indicators (PTDFs, RAM, MCCC, MNCC) calculated and compared with corresponding values published on the Joint Allocation Office (JAO) platform

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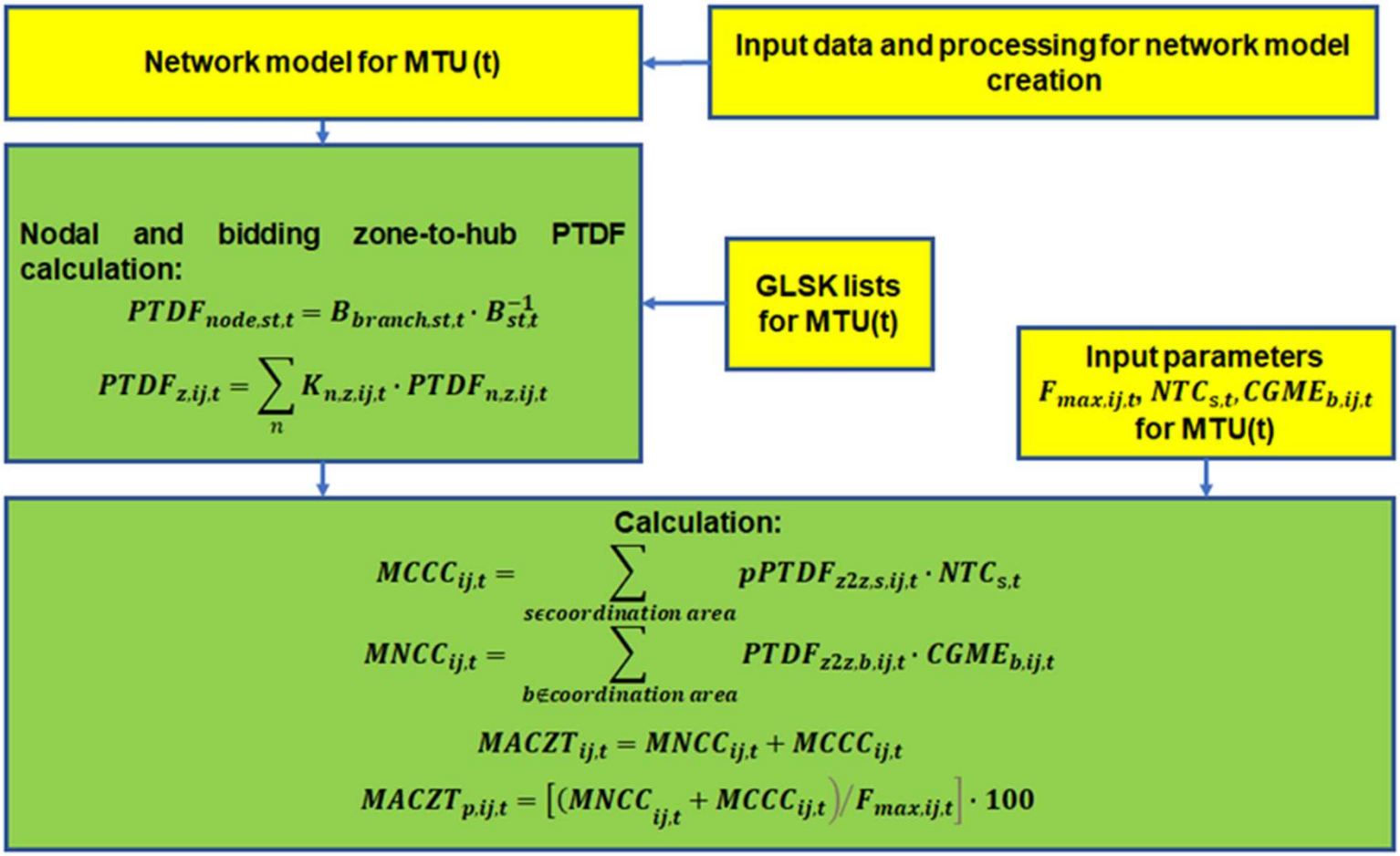
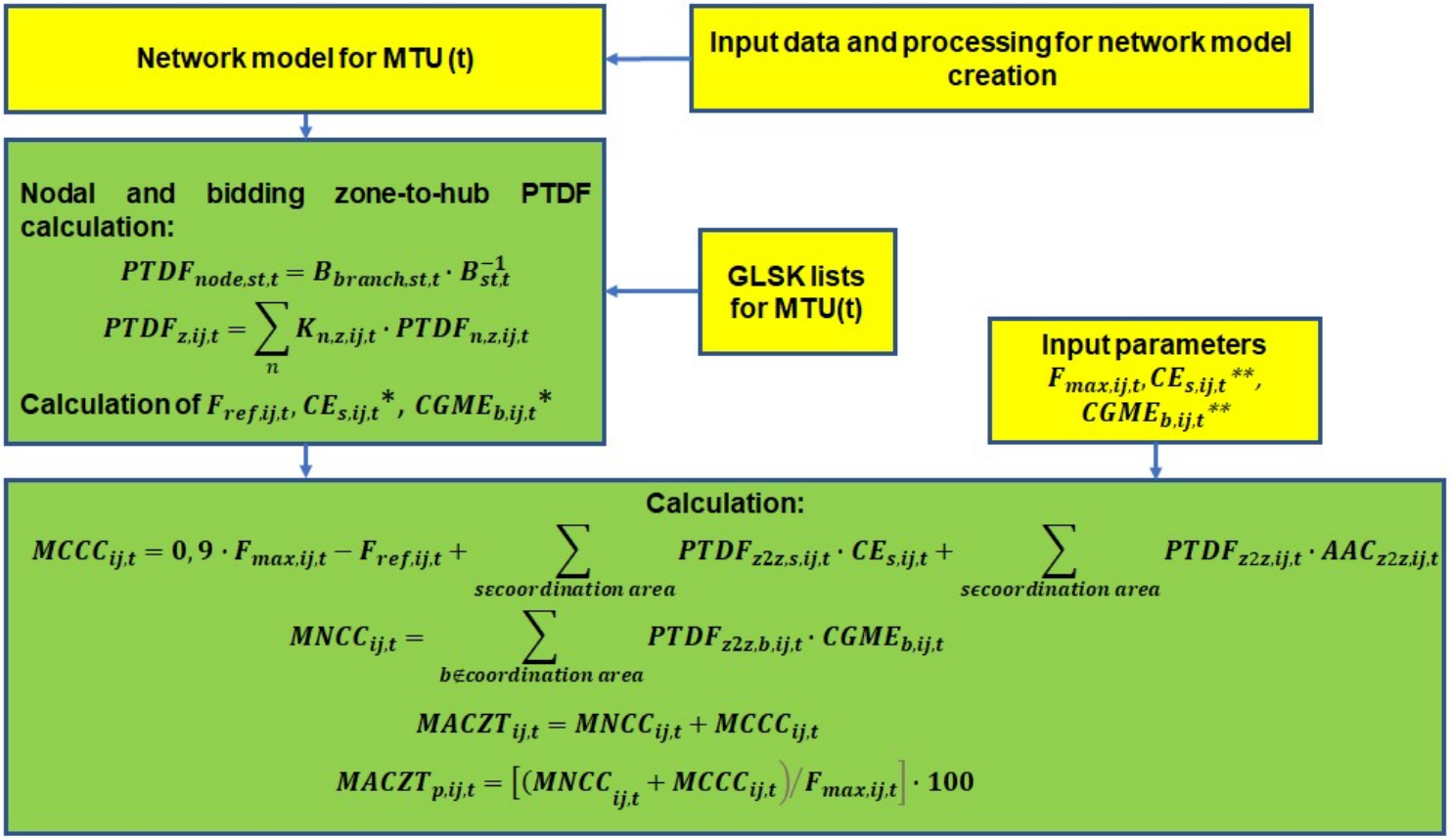
# MACZT calculation – NTC approach



# MACZT calculation – FB approach




*only regimes for 3rd Wednesday 2028 at 19:30
**only regimes for 3rd Wednesday 2021 at 19:30

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# Main steps in the MACZT calculation

| Contracting party | Total number of modeled elements | Total number of considered elements (basis for CNE(C) list) | Total number of CNE(C) candidates (element+ contingency +direction) |
|---|---|---|---|
| Albania | 69 | 24 | 2502 |
| BiH | 105 | 34 | 3492 |
| Kosovo* | 44 | 20 | 1198 |
| Montenegro | 32 | 23 | 1052 |
| North Macedonia | 19 | 19 | 704 |
| Serbia | 179 | 56 | 11050 |
| Ukraine | 425 | 66 | 52328 |
| Moldova | 22 | 17 | 872 |
| **TOTAL** | **895** | **259** | **73198** |

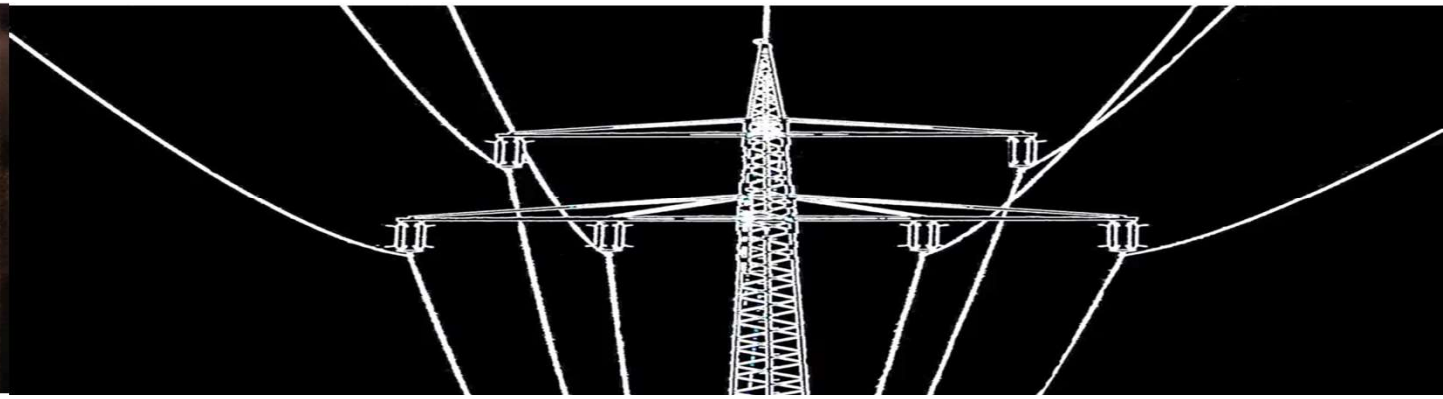
### 3) Definition of CNE(C) list

In this study all network elements (OHL, TR) were analyzed along with all contingencies

In total there were **~73000 CNE(C) candidates**. Finally, 259 considered elements analyzed

Follow-up studies can use already selected CNEC(C) and skip the calculation for all candidates

# INPUT DATA



# Input data set

- **Defined in the ToR and Inception Report**
- **Power system model for 2021 and 2028**
- **TSO questionnaire**
- **Two characteristic network model snapshots for 2021: 3rd Wednesday in January and 3rd Wednesday in July: 20 Jan 2021, 19:30 h, 21 July 2021, 19:30 h**
- **Two characteristic network model snapshots for 2028: 3rd Wednesday in January and 3rd Wednesday in July: 19 Jan 2028, 19:30 h, 19 July 2028, 19:30 h**
- **Hourly snapshots in 3-year timeframe (2020, 2021, 2022)**

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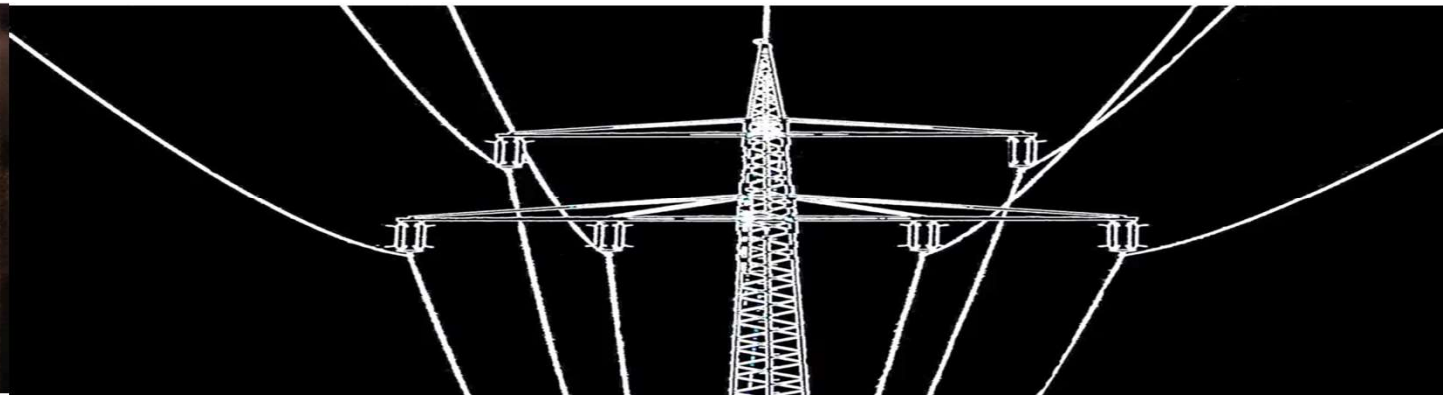
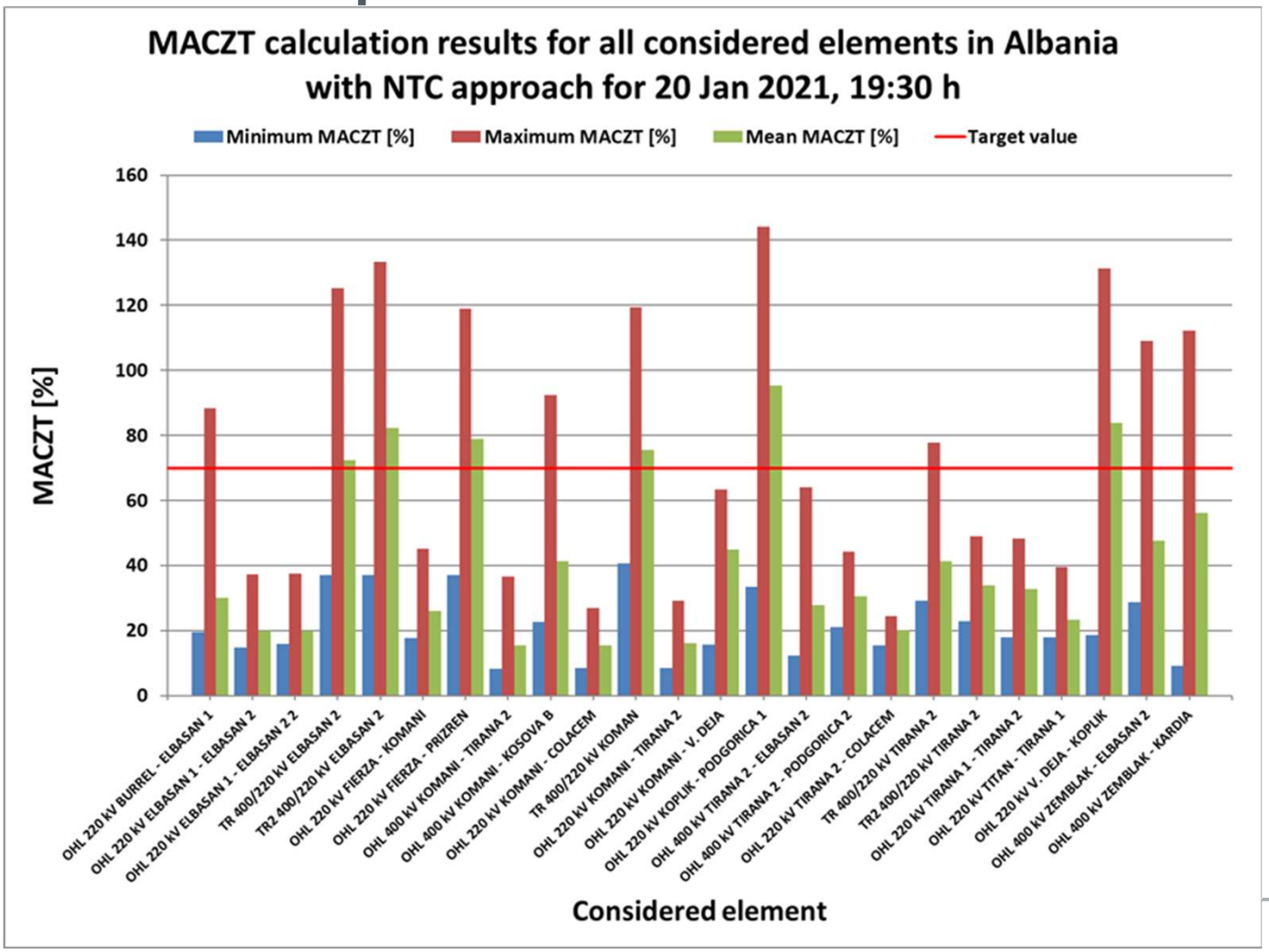
# Input data set for 2028

- **WB6 network modeled** as planned in network developments plans with support of SECI PSS models
- **Ukrainian network modeled as fully recovered,** with addition of OHL 400 kV Khmelnytskyi (UA) – Rzeszów (PL), previously operating on 750 kV
- **Moldovan network modeled as existing** with one new internal element - OHL 400 kV Vulcănești – Chisinau

# MACZT results in the existing network (2021)



# Example: ALBANIA – Jan 2021 - NTC




- **24 elements considered**
- **0 elements** with MACZT>70%
- Individual characteristic MACZT values are:
  - MINIMUM: **8 % - 40 %**
  - AVERAGE: **14 % - 95 %**
  - MAXIMUM: **22 % - 143 %**

# Example: ALBANIA – July 2021 - NTC

Table 20 List of calculated minimum MACZT values below 20% for considered element on 21 July 2021 at 19:30 h with **NTC approach in Albania**

| Worst-case CNE(C) | | Minimum MACZT [%] |
|---|---|---|
| **Element** | **Direction and contingency** | |
| **OHL 400 kV ZEMBLAK – KARDIA (GR)** | DIRECT OHL 400 kV ZEMBLAK - ELBASAN 2 | 10,0 |
| **OHL 400 kV KOMANI - TIRANA 2** | OPPOSITE TR 400/220 kV ELBASAN 2 | 10,4 |
| **OHL 400 kV TIRANA 2 - ELBASAN 2** | OPPOSITE OHL 400.0 kV TIRANA 2 - PODGORICA 2 (ME) | 13,0 |
| **OHL 220 kV ELBASAN 1 - ELBASAN 2** | DIRECT OHL 400.0 kV ZEMLAK – KARDIA (GR) | 15,5 |
| **OHL 220 kV ELBASAN 1 - ELBASAN 2 2** | DIRECT OHL 400.0 kV ZEMLAK – KARDIA (GR) | 16,6 |
| **OHL 220 kV TIRANA 2 - COLACEM** | DIRECT OHL 220 kV BURREL - ELBASAN 1 | 17,6 |
| **OHL 220 kV KOMANI - COLACEM** | OPPOSITE OHL 220 kV BURREL - ELBASAN 1 | 17,7 |
| **OHL 220 kV KOMANI - TIRANA 2** | OPPOSITE OHL 220 kV BURREL - ELBASAN 1 | 19,0 |

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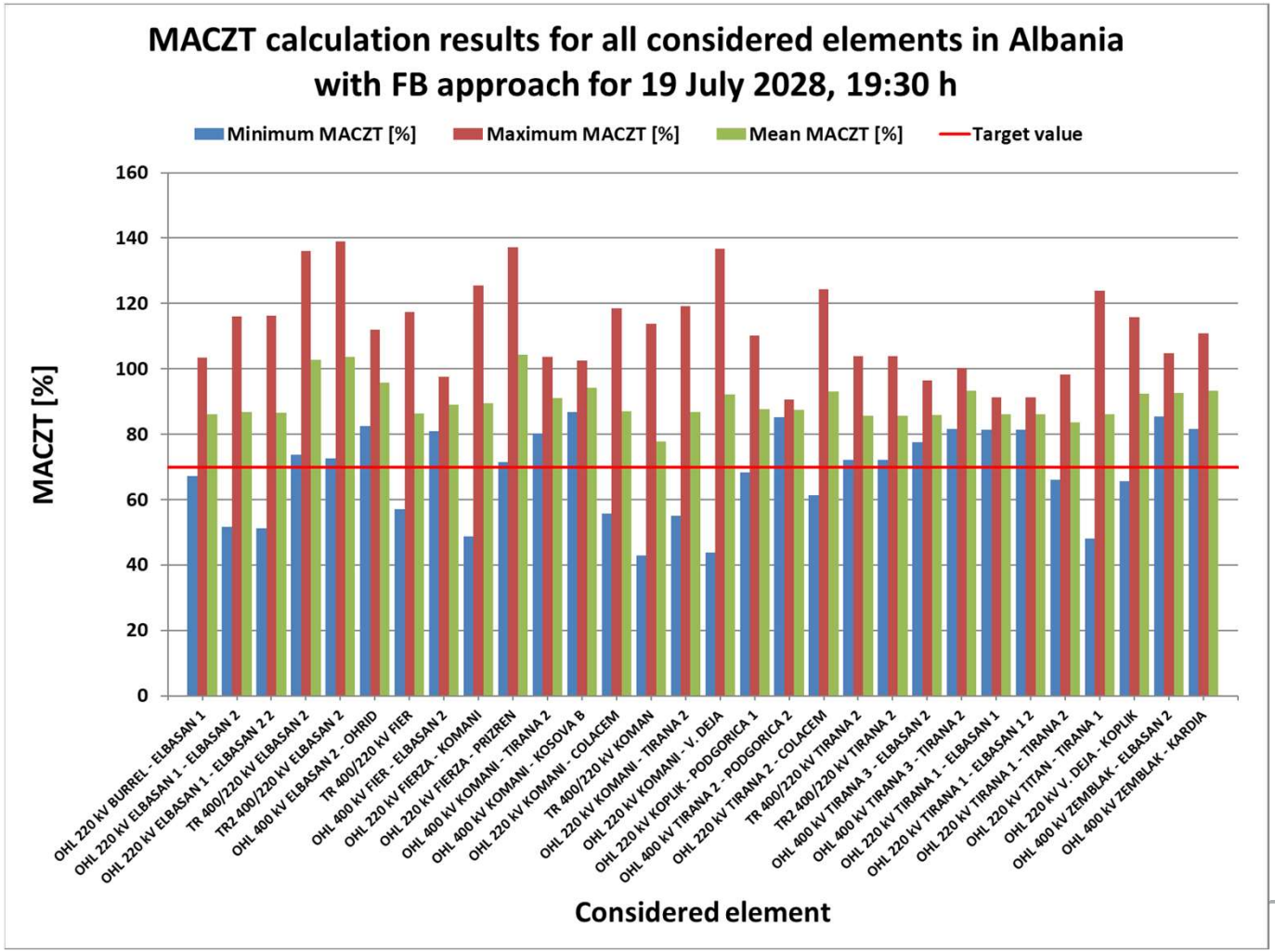
# Example: ALBANIA – July 2028 - FB




**30 elements considered**

**16 elements** with MACZT>70%

Individual characteristic MACZT values are:

MINIMUM: **42 % - 85 %**

AVERAGE: **78 % - 102 %**

MAXIMUM: **90 % - 138 %**

# Example: ALBANIA – July 2028 - FB

List of calculated minimum MACZT values below 70% for considered element on 19 July 2028 at 19:30 h with **FB approach in Albania**

| Worst-case CNE(C) | | Minimum MACZT [%] |
|---|---|---|
| Element | Direction and contingency | |
| TR 400/220 kV KOMAN | DIRECT OHL 220 kV FIERZA - PRIZREN | 42,9 |
| OHL 220 kV KOMANI - V. DEJA | DIRECT TR 400/220 kV KOMAN | 43,9 |
| OHL 220 kV TITAN - TIRANA 1 | DIRECT OHL 220 kV FIERZA - KOMANI | 48,2 |
| OHL 220 kV FIERZA - KOMANI | DIRECT OHL 220 kV TITAN - TIRANA 1 | 48,8 |
| OHL 220 kV ELBASAN 1 - ELBASAN 2 2 | OPPOSITE OHL 220 kV ELBASAN 1 - ELBASAN 2 | 51,3 |
| OHL 220 kV ELBASAN 1 - ELBASAN 2 | OPPOSITE OHL 220 kV ELBASAN 1 - ELBASAN 2 2 | 51,6 |
| OHL 220 kV KOMANI - TIRANA 2 | DIRECT OHL 220 kV KOMANI - COLACEM | 55,1 |
| OHL 220 kV KOMANI - COLACEM | DIRECT OHL 220 kV KOMANI - TIRANA 2 | 55,7 |
| TR 400/220 kV FIER | OPPOSITE OHL 400 kV TIRANA 3 - ELBASAN 2 | 57,1 |
| OHL 220 kV TIRANA 2 - COLACEM | OPPOSITE OHL 220 kV KOMANI - V. DEJA | 61,5 |
| OHL 220 kV V. DEJA - KOPLIK | DIRECT TR 400/220 kV KOMAN | 65,7 |
| OHL 220 kV TIRANA 1 - TIRANA 2 | DIRECT OHL 220 kV KOMANI - TIRANA 2 | 66,2 |
| OHL 220 kV BURREL - ELBASAN 1 | DIRECT OHL 220 kV TITAN - TIRANA 1 | 67,2 |
| OHL 220 kV KOPLIK - PODGORICA 1 | OPPOSITE OHL 220 kV ELBASAN 1 - KURUM | 68,3 |

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# Recap of the regional network results for 2021

| Contracting party | Total number of modeled elements | Total number of considered elements (basis for CNE(C) list) | Total number of CNE(C) candidates (element+ contingency +direction) | Jan 2021 | | July 2021 | |
|---|---|---|---|---|---|---|---|
| | | | | NTC - Total number of elements with MACZT<70% | FB - Total number of elements with MACZT<70% | NTC - Total number of elements with MACZT<70% | FB - Total number of elements with MACZT<70% |
| Albania | 69 | 24 | 2502 | 22 | 20 | 24 | 15 |
| BiH | 105 | 34 | 3492 | 33 | 16 | 33 | 11 |
| Kosovo* | 44 | 20 | 1198 | 19 | 14 | 19 | 3 |
| Montenegro | 32 | 23 | 1052 | 17 | 20 | 18 | 10 |
| North Macedonia | 19 | 19 | 704 | 19 | 16 | 15 | 4 |
| Serbia | 179 | 56 | 11050 | 55 | 44 | 56 | 40 |
| **TOTAL** | **448** | **176** | **19998** | **165** | **130** | **165** | **83** |

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# Recap of the regional network results for 2021

| 20 January 2021, 19:30 h | | |
|---|---|---|
| Contracting party | Share of elements with MACZT>70% NTC | Share of elements with MACZT>70% FB |
| Albania | 8,3 | 16,7 |
| BiH | 2,9 | 52,9 |
| Kosovo* | 5,0 | 30,0 |
| Montenegro | 26,1 | 13,0 |
| North Macedonia | 0,0 | 15,8 |
| Serbia | 1,8 | 21,4 |
| TOTAL | 6,3 | 26,1 |

| 21 July 2021, 19:30 h | | |
|---|---|---|
| Contracting party | Share of elements with MACZT>70% NTC | Share of elements with MACZT>70% FB |
| Albania | 7,7 | 42,3 |
| BiH | 2,9 | 67,6 |
| Kosovo* | 5,0 | 85,0 |
| Montenegro | 21,7 | 56,5 |
| North Macedonia | 16,7 | 77,8 |
| Serbia | 3,4 | 31,0 |
| TOTAL | 7,8 | 53,6 |

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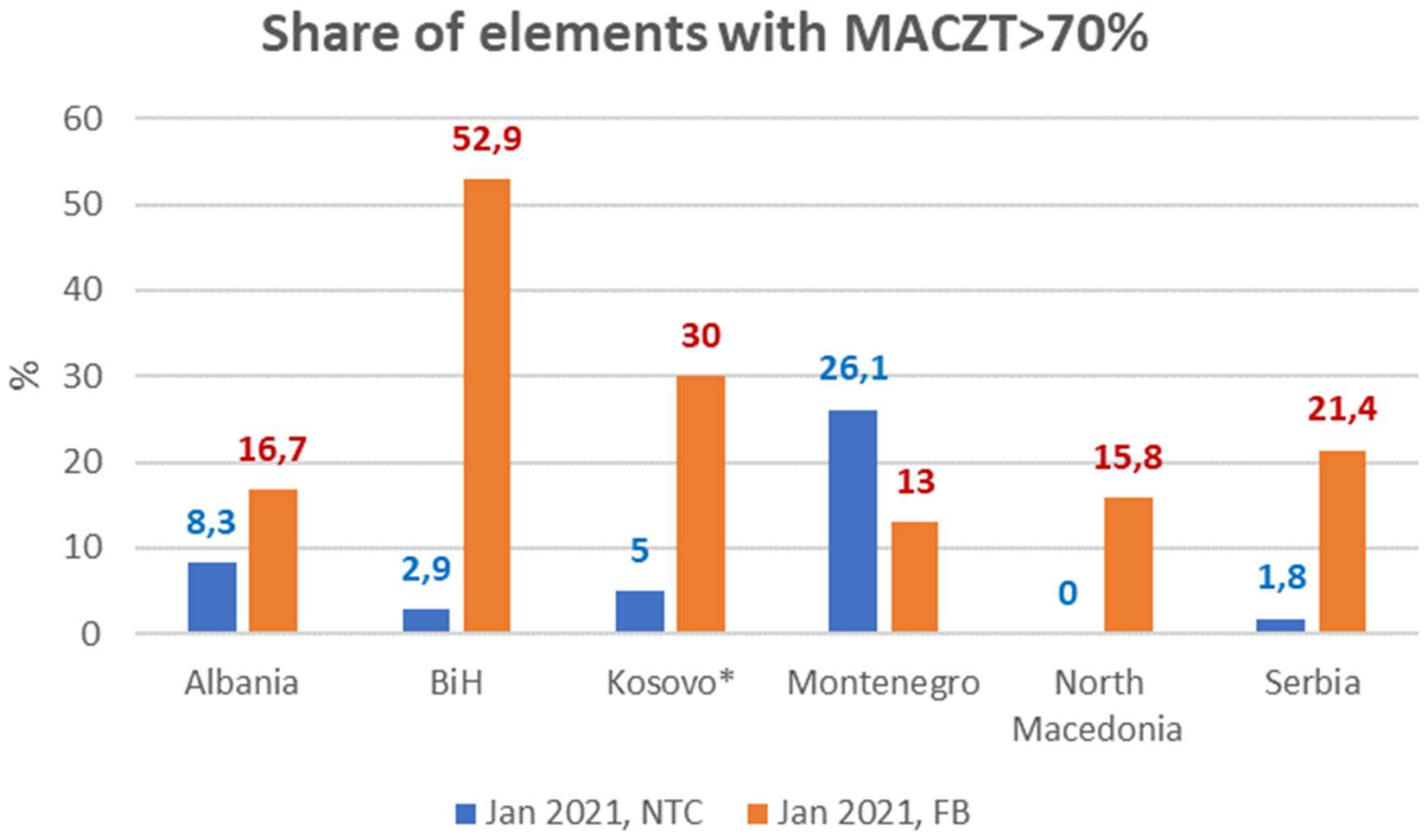
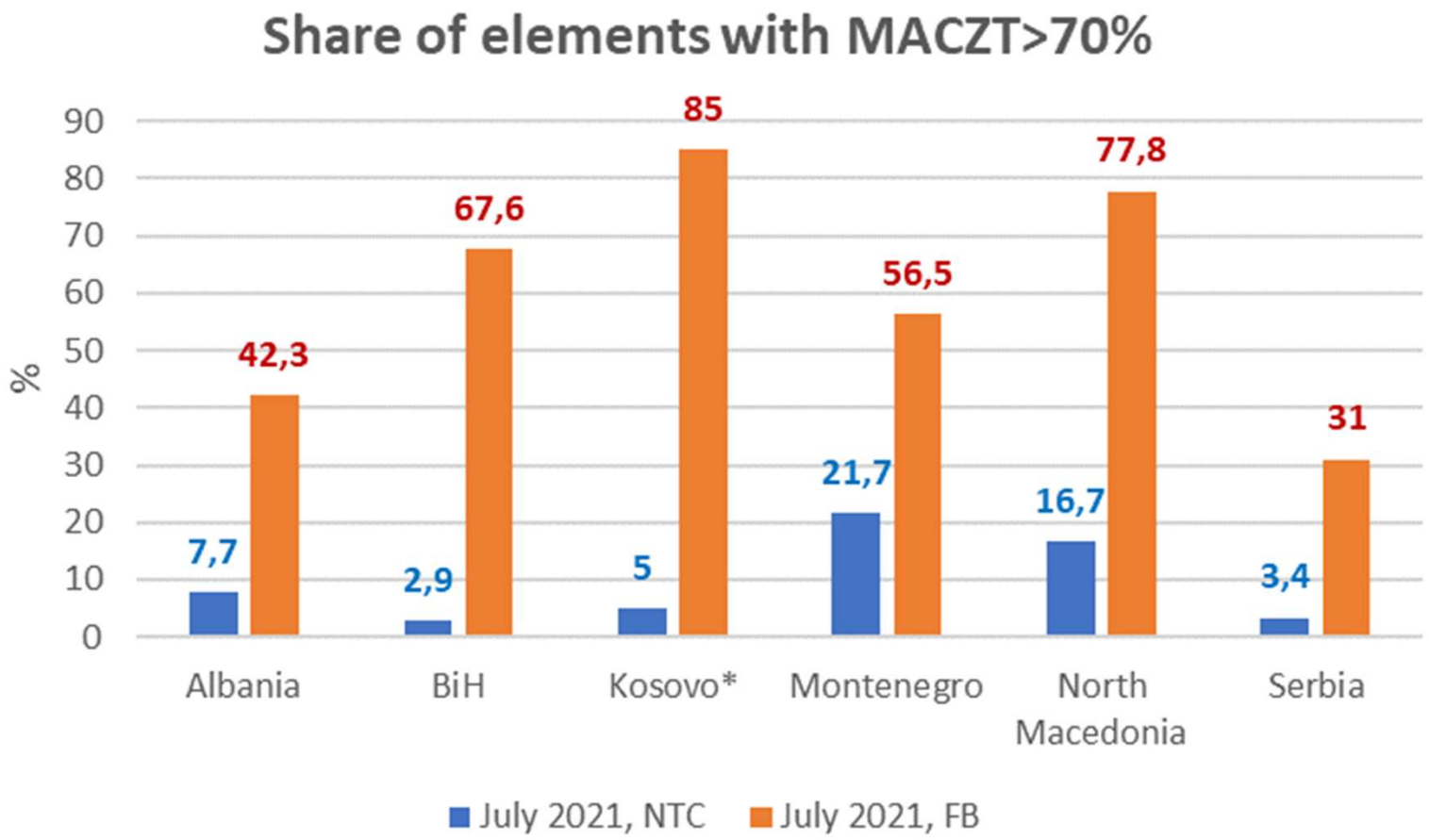
# Recap of the regional network results for 2021



# Recap of the regional network results for 2021



# Comparison between NTC and FB approach

1. Comparison based on **two characteristic regimes**
2. **Existing (bilateral) NTC** approach and **FB** approach are compared
3. **Evident positive effect of FB** approach detected in this case, but NRAs are in charge to decide on the most appropriate approach
4. **Switching** from the NTC to FB approach in the EnC CPs would be a **complex and time-consuming process**
5. This study primarily serves as an **educational showcase**, rather than an explicit proof in decision-making process
6. As a **follow-up** to this study it is suggested to perform **additional studies** on optimal network configuration using adequate measures to maximize MACZT on bidding zone borders

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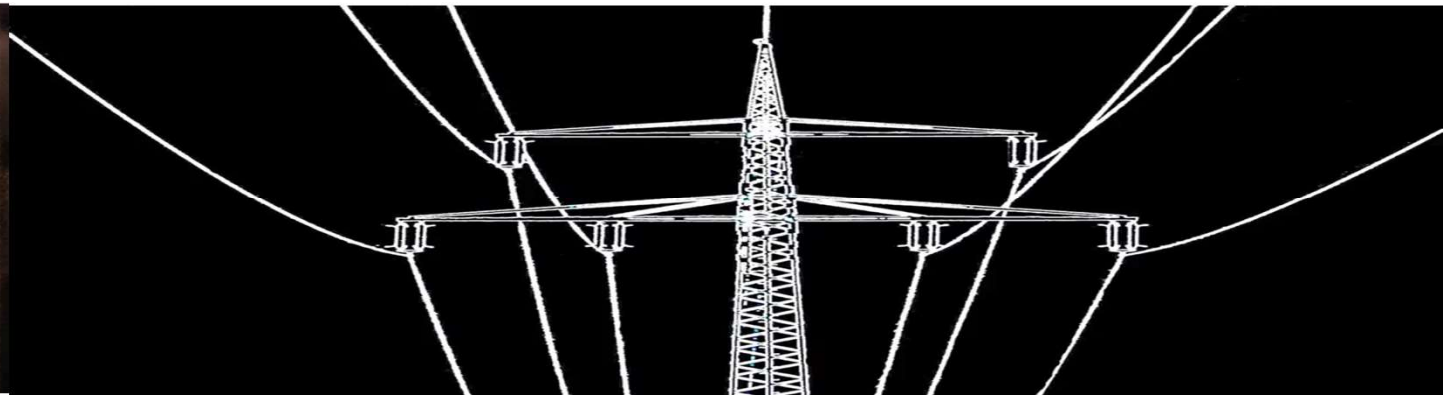
# MACZT results in the future network (2028)



# Results comparison 2021 vs 2028 – FB approach

| | 20 Jan 2021, 19:30 h | | 19 Jan 2028, 19:30 h | |
|---|---|---|---|---|
| Contracting party | Total number of considered elements | Total number of elements with MACZT>70% | Total number of considered elements | Total number of elements with MACZT>70% |
| Albania | 24 | 4 | 33 | 13 |
| BiH | 34 | 18 | 27 | 10 |
| Kosovo | 20 | 6 | 22 | 5 |
| Montenegro | 23 | 3 | 23 | 7 |
| North Macedonia | 19 | 3 | 22 | 8 |
| Serbia | 56 | 12 | 54 | 24 |
| Ukraine | - | - | 66 | 20 |
| Moldova | - | - | 17 | 14 |
| TOTAL | 176 | 46 | 264 | 101 |

| Contracting party | Share of elements with MACZT>70% on 20 Jan 2021, 19:30 h | Share of elements with MACZT>70% on 19 Jan 2028 at 19:30 h |
|---|---|---|
| Albania | 16,7 | 36,4 |
| BiH | 52,9 | 37 |
| Kosovo* | 30 | 22,7 |
| Montenegro | 13 | 30,4 |
| North Macedonia | 15,8 | 36,4 |
| Serbia | 21,4 | 42,6 |
| TOTAL WB6 | 26,1 | 39,4 |
| Ukraine | - | 30 |
| Moldova | - | 82,4 |
| TOTAL UA/MD | - | 40,9 |

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# Results comparison 2021 vs 2028 – FB approach

| | 21 July 2021, 19:30 h | | 19 July 2028, 19:30 h | |
|---|---|---|---|---|
| Contracting party | Total number of considered elements | Total number of elements with MACZT>70% | Total number of considered elements | Total number of elements with MACZT>70% |
| Albania | 26 | 11 | 30 | 16 |
| BiH | 29 | 23 | 19 | 13 |
| Kosovo* | 20 | 17 | 21 | 12 |
| Montenegro | 23 | 13 | 21 | 15 |
| North Macedonia | 18 | 14 | 22 | 21 |
| Serbia | 58 | 18 | 61 | 40 |
| Ukraine | | | 66 | 18 |
| Moldova | | | 23 | 11 |
| TOTAL | 174 | 96 | 263 | 146 |

| Contracting party | Share of elements with MACZT>70% on 21 July 2021, 19:30 h | Share of elements with MACZT>70% on 19 July 2028 at 19:30 h |
|---|---|---|
| Albania | 42,3 | 53,3 |
| BiH | 79,3 | 68,4 |
| Kosovo* | 85 | 57,1 |
| Montenegro | 56,5 | 71,4 |
| North Macedonia | 77,8 | 95,5 |
| Serbia | 31 | 65,6 |
| TOTAL WB6 | 55,2 | 67,2 |
| Ukraine | - | 27,3 |
| Moldova | - | 47,8 |
| TOTAL UA/MD | | 32,5 |

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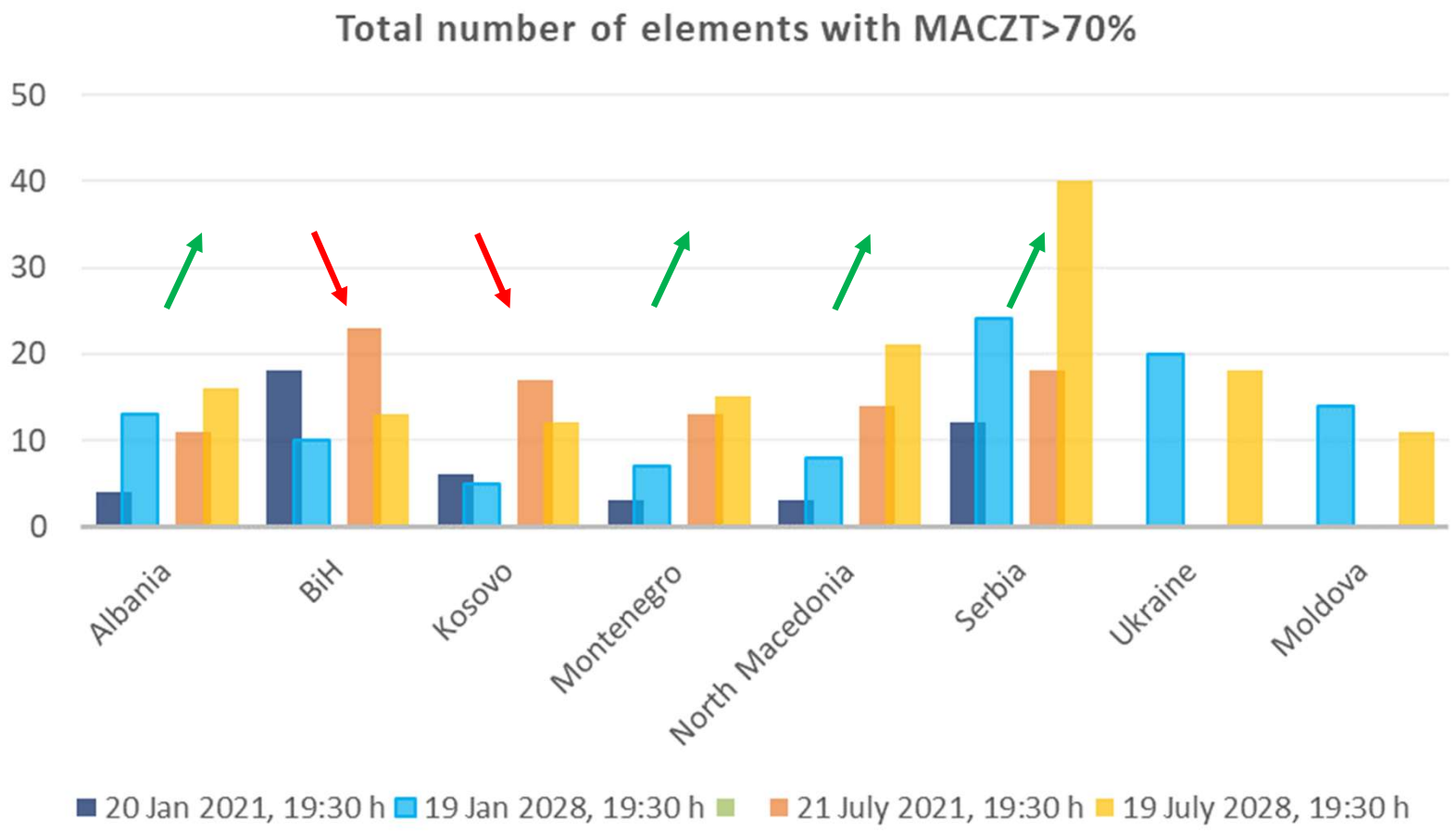
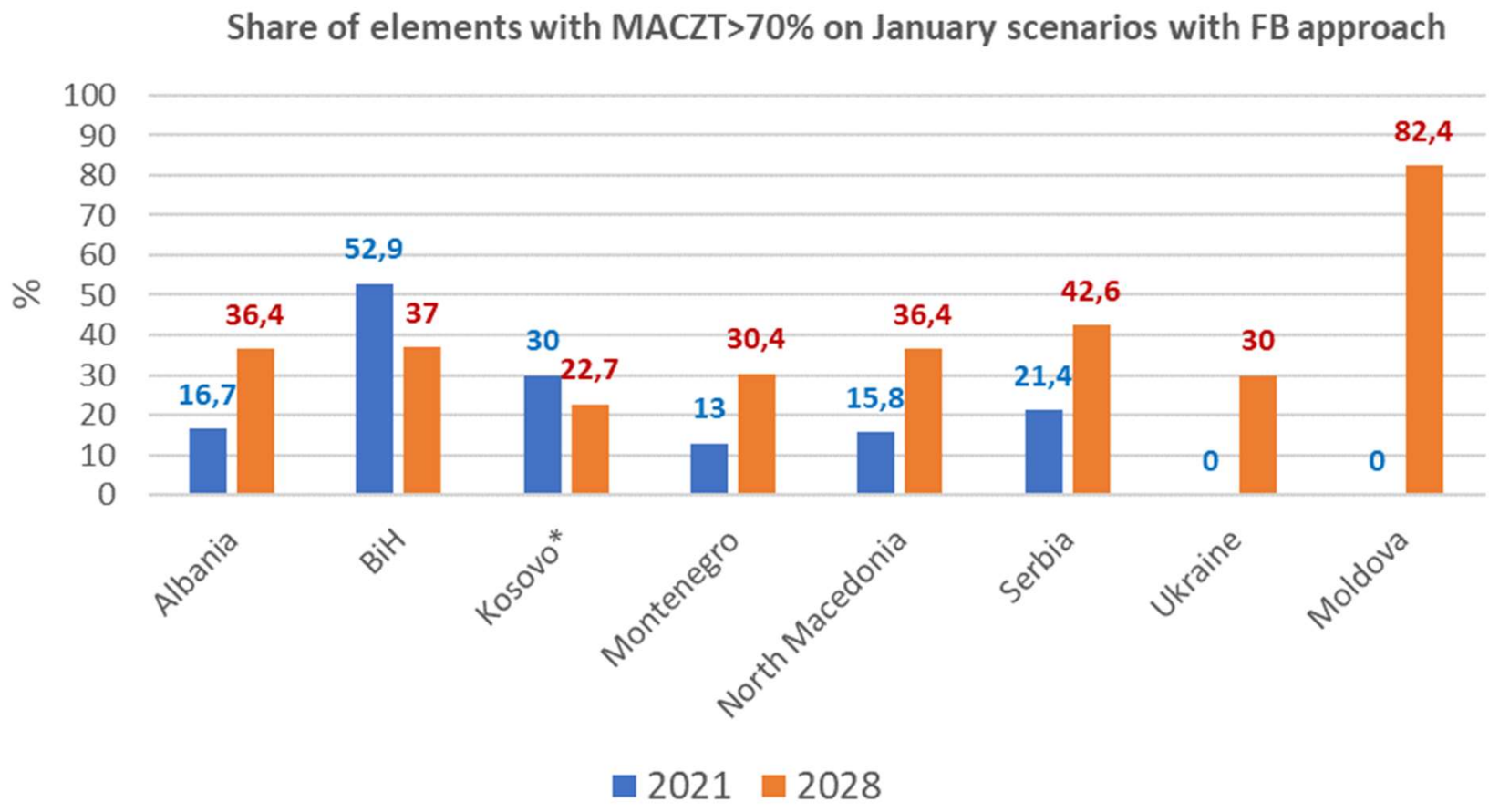
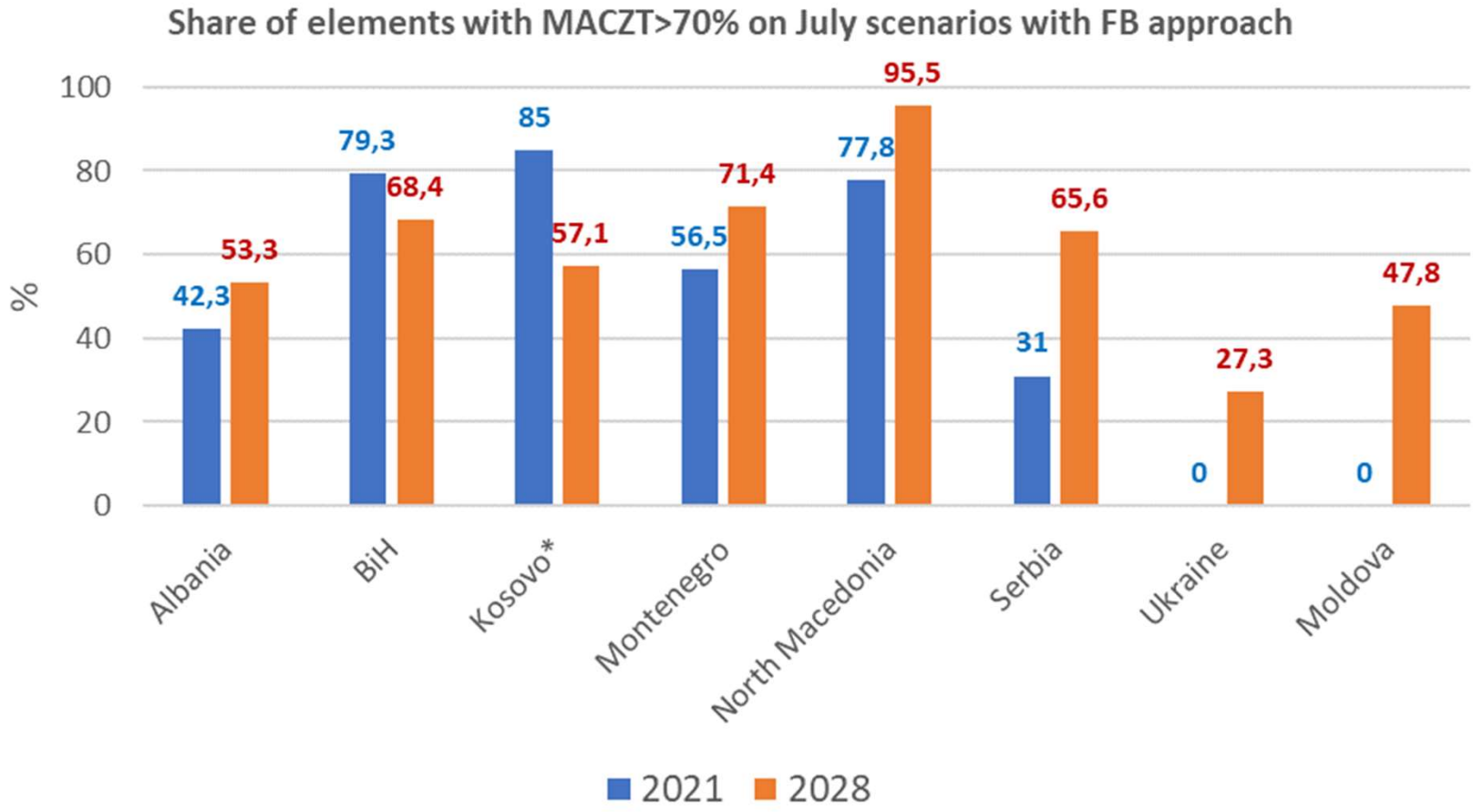
# Results comparison 2021 vs 2028



# Results comparison 2021 vs 2028



# Results comparison 2021 vs 2028

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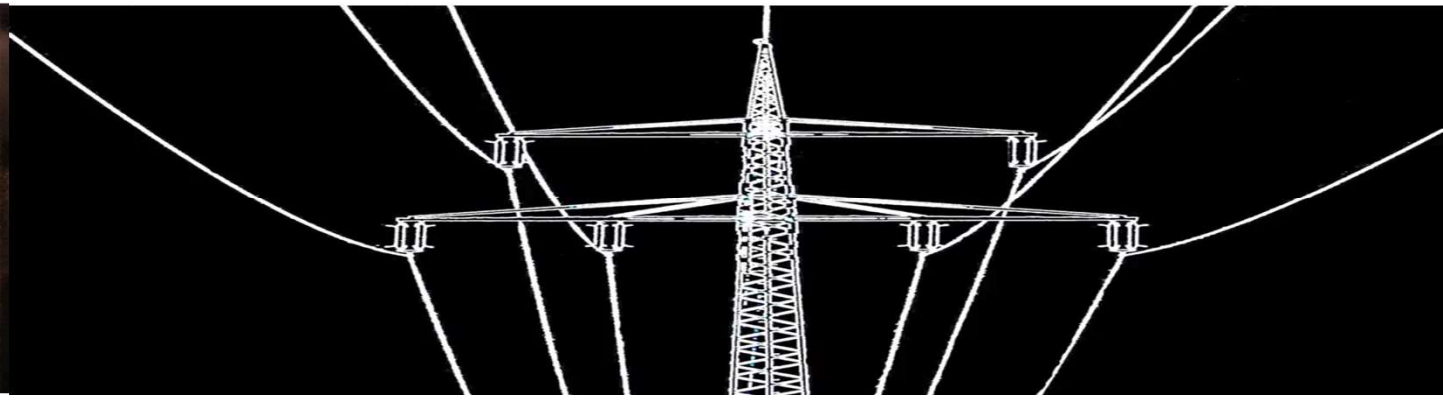
# IDENTIFICATION OF STRUCTURAL CONGESTIONS



# Definition

The main criterion for structural congestion is based on the EU best practices as follows:

***Elements with more than 5% of hours during the year with MACZT<70% are considered as elements with structural congestion.***

# Basic methodology details

- 3-year timeframe analyzed (**2020, 2021 and 2022**) on hourly basis
- for every single considered element
- NTC approach used
- 4 625 280 results in total
- Results given per each border and internal network
- Results grouped in 4 MACZT ranges:
    a) MACZT < 20%
    b) 20% ≤ MACZT < 50%
    c) 50% ≤ MACZT < 70%
    d) MACZT ≥ 70%

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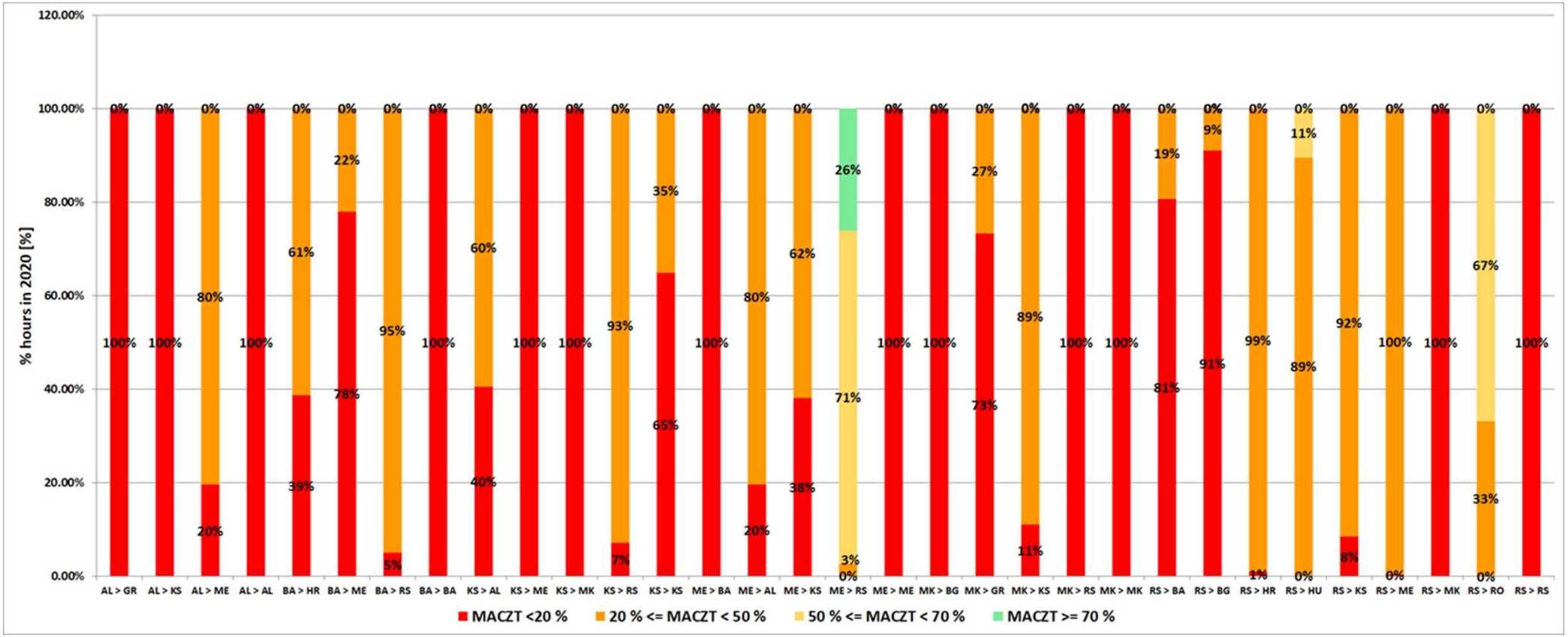
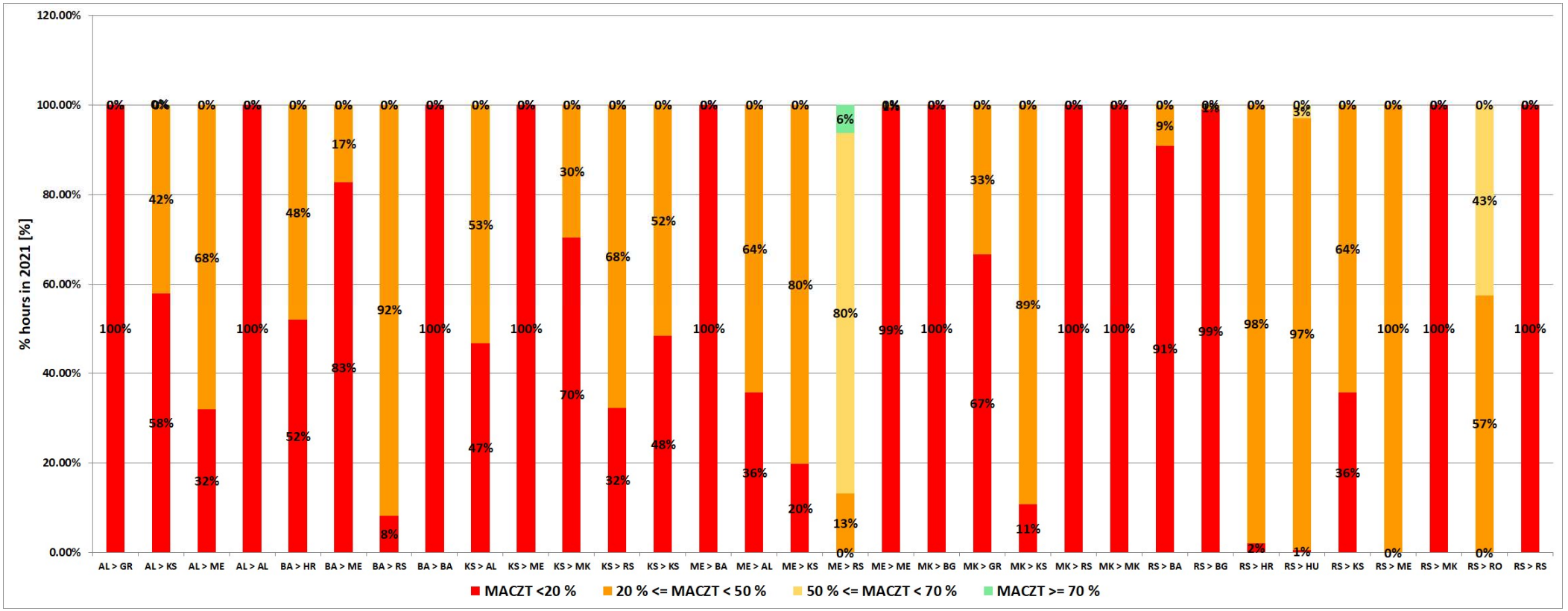
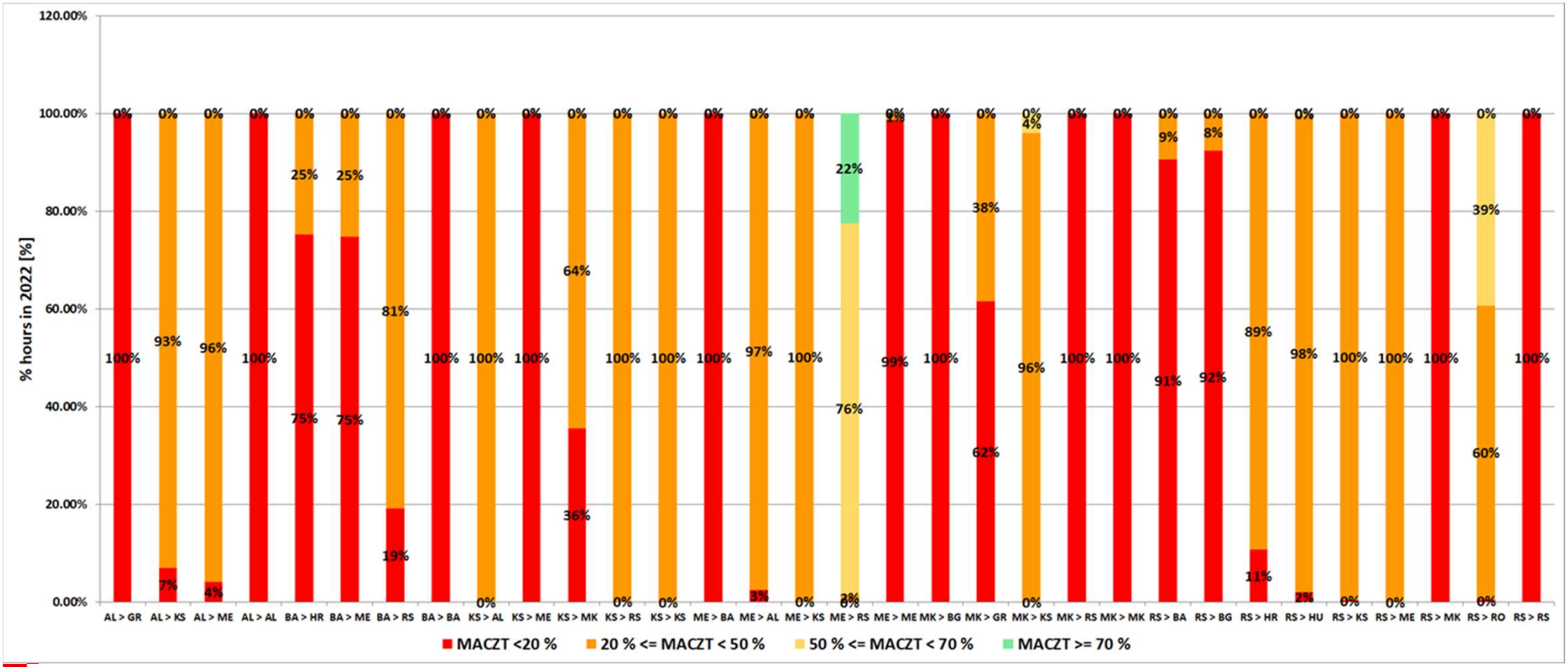
# % of time with MACZT intervals in **2020**



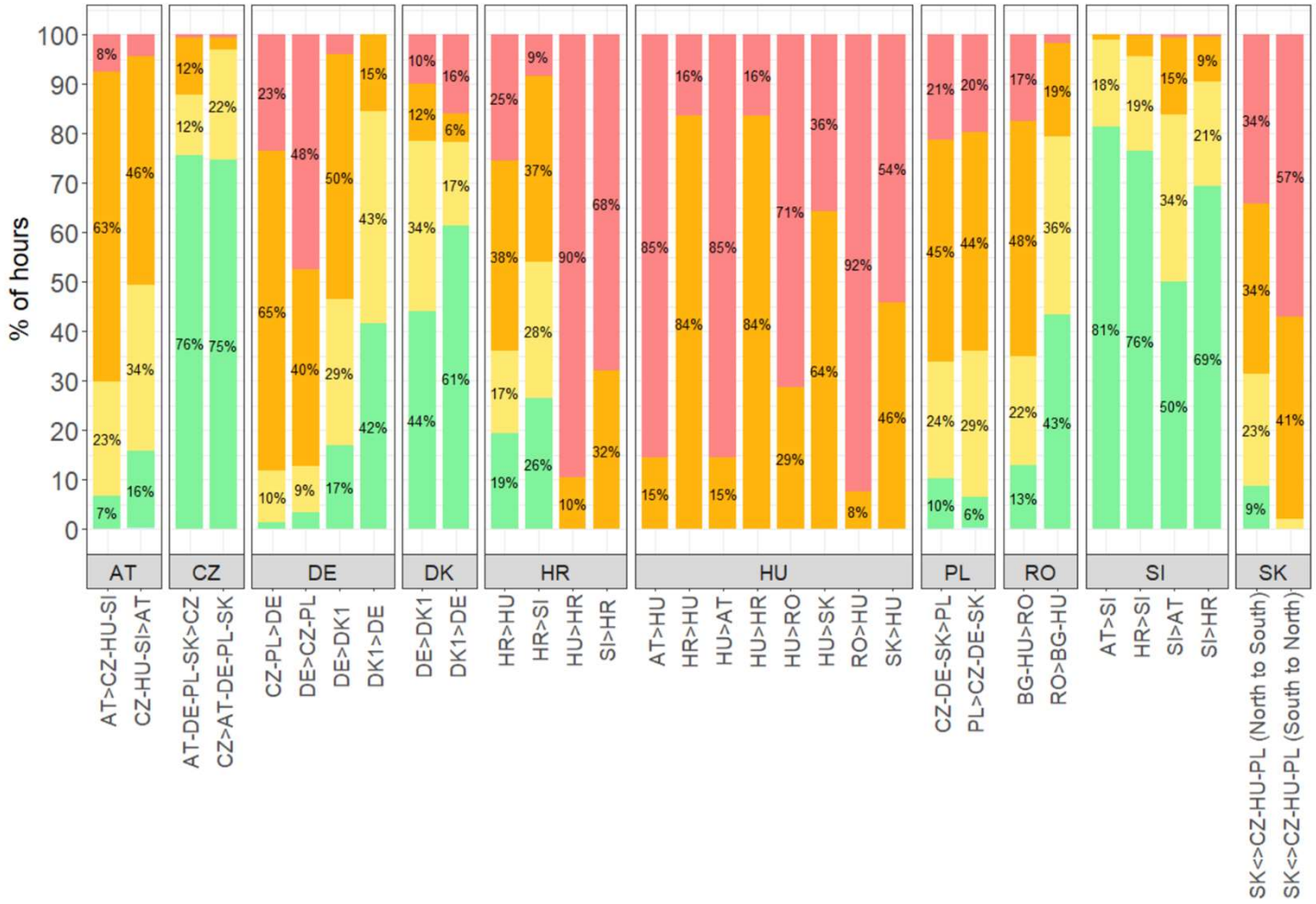
# % of time with MACZT intervals in **2021**



# % of time with MACZT intervals in **2022**



# % of time with MACZT intervals in **2022 in EU**



# Structural congestions in **Albania**

| No | Structural congestion elements in Albania |
|---|---|
| | **400 kV** |
| 1 | OHL 400 kV ZEMBLAK - KARDIA (GR) |
| 2 | OHL 400 kV KOMANI - KOSOVA B (KS) |
| 3 | OHL 400 kV TIRANA 2 - PODGORICA 2 (ME) |
| 4 | OHL 400 kV TIRANA 2 - ELBASAN 2 |
| 5 | OHL 400 kV KOMANI - TIRANA 2 |
| | **220 kV** |
| 6 | OHL 220 kV ELBASAN 1 - ELBASAN 2 |
| 7 | OHL 220 kV TIRANA 2 – COLACEM |
| 8 | OHL 220 kV KOMANI – COLACEM |
| 9 | OHL 220 kV ELBASAN 1 - ELBASAN 2 2 |
| 10 | OHL 220 kV TITAN - TIRANA 1 |
| 11 | OHL 220 kV KOPLIK - PODGORICA 1 (ME) |
| 12 | OHL 220 kV FIERZA – PRIZREN (KS) |

# Structural congestions in **BiH**

| No | Structural congestion elements in BiH |
|---|---|
| | **400 kV** |
| 1 | OHL 400 kV MOSTAR 4 – KONJSKO (HR) |
| 2 | OHL 400 kV TPP UGLJEVIK – ERNESTINOVO (HR) |
| 3 | OHL 400 kV TREBINJE – LASTVA (ME) |
| 4 | OHL 400 kV TPP UGLJEVIK - S. MITROVICA 2 (RS) |
| 5 | OHL 400 kV TPP GACKO - MOSTAR 4 |
| 6 | OHL 400 kV TPP GACKO – TREBINJE |
| 7 | OHL 400 kV VISEGRAD - TUZLA 4 |
| 8 | OHL 400 kV SARAJEVO 20 - SARAJEVO 10 |
| 9 | OHL 400 kV SARAJEVO 10 - TUZLA 4 |
| 10 | OHL 400 kV SARAJEVO 10 - MOSTAR 4 |
| | **220 kV** |
| 11 | OHL 220 kV SARAJEVO 20 - PIVA (ME) |
| 12 | OHL 220 kV VISEGRAD - VALJEVO (RS) |

# Structural congestions in **Kosovo***

| No | Structural congestion elements in Kosovo* |
|---|---|
| | **400 kV** |
| 1 | OHL 400 kV TPP KOSOVA B - KRAGUJEVAC 2 (RS) |
| 2 | OHL 400 kV PEJA 3 - RIBAREVINE (ME) |
| 3 | OHL 400 kV FERIZAJ 2 - SKOPJE 5 (MK) |
| 4 | OHL 400 kV TPP KOSOVA B - NIS 2 (RS) |
| | **220 kV** |
| 5 | OHL 220 kV DRENAS 1 - TPP KOSOVA B |
| 6 | OHL 220 kV PRIZREN 2 – FIERZA (AL) |
| 7 | OHL 220 kV PODUJEVA - KRUSEVAC 1 (RS) |

# Structural congestions in **Montenegro**

| No | Structural congestion elements in Montenegro |
|---|---|
| | **400 kV** |
| 1 | OHL 400 kV PODGORICA 2 - TIRANA 2 (AL) |
| 2 | OHL 400 kV LASTVA - TREBINJE (BIH) |
| 3 | OHL 400 kV RIBAREVINE - PEJA 3 (KS) |
| 4 | OHL 400 kV LASTVA - PODGORICA 2 |
| 5 | OHL 400 kV RIBAREVINE - PODGORICA 2 |
| | **220 kV** |
| 6 | OHL 220 kV TPP PLJEVLJA - BAJINA BASTA (RS) |
| 7 | OHL 220 kV TPP PLJEVLJA - BISTRICA (RS) |
| 8 | OHL 220 kV HPP PERUCICA - TREBINJE (BIH) |
| 9 | OHL 220 kV HPP PIVA - SARAJEVO (BIH) |
| 10 | OHL 220 kV PODGORICA 1 - V. DEJA (AL) |

# Structural congestions in **N. Macedonia**

| No | Structural congestion elements in N.Macedonia |
|---|---|
| | **400 kV** |
| 1 | OHL 400 kV STIP - C. MOGILA (BG) |
| 2 | OHL 400 kV BITOLA - LARISA (GR) |
| 3 | OHL 400 kV DUBROVO - THESSALONIKI (GR) |
| 4 | OHL 400 kV SKOPJE 5 - FERIZAJ 2 (KS) |
| 5 | OHL 400 kV BITOLA - SKOPJE 4 |
| 6 | OHL 400 kV DUBROVO - SKOPJE 4 |
| 7 | OHL 400 kV STIP - VRANJE 4 (RS) |
| 8 | OHL 400 kV BITOLA - DUBROVO |
| | **220 kV** |
| | |

# Structural congestions in **Serbia**

| No | Structural congestion elements in Serbia |
|---|---|
| | **400 kV** |
| 1 | OHL 400 kV S. MITROVICA 2 - UGLJEVIK (BIH) |
| 2 | OHL 400 kV NIS 2 - SOFIA (BG) |
| 3 | OHL 400 kV S. MITROVICA - ERNESTINOVO (HR) |
| 4 | OHL 400 kV SUBOTICA 3 - SANDORFALVA (HU) |
| 5 | OHL 400 kV NIS 2 - KOSOVA B (KS) |
| 6 | OHL 400 kV VRANJE 4 - STIP (MK) |
| 7 | OHL 400 kV HPP DJERDAP 1 - PORTILE DE FIER 1 (RO) |
| 8 | OHL 400 kV VRANJE 4 - LESKOVAC 2 |
| 9 | OHL 400 kV KRAGUJEVAC 2 - JAGODINA 4 |
| 10 | OHL 400 kV JAGODINA 4 - NIS 2 |
| 11 | OHL 400 kV OBRENOVAC - KRAGUJEVAC 2 |
| 12 | OHL 400 kV PANCEVO 2 - BEOGRAD 20 |
| 13 | OHL 400 kV BEOGRAD 8 - BEOGRAD 20 |
| 14 | OHL 400 kV PANCEVO 2 - WPP CIBUK 1 |
| 15 | OHL 400 kV WPP CIBUK 1 - DRMNO |
| 16 | OHL 400 kV SMEDEREVO 3 - DRMNO |
| 17 | OHL 400 kV SMEDEREVO 3 - BEOGRAD 8 2 |
| 18 | OHL 400 kV HPP DJERDAP 1 - DRMNO |
| 19 | OHL 400 kV NIS 2 – LESKOVAC 2 |
| 20 | OHL 400 kV OBRENOVAC - MLADOST |
| 21 | OHL 400 kV OBRENOVAC - MLADOST 2 |
| 22 | OHL 400 kV BOR 2 - NIS 2 |
| 23 | OHL 400 kV BOR 2 - HPP DJERDAP 1 |
| 24 | OHL 400 kV OBRENOVAC - BEOGRAD 8 |
| 25 | OHL 400 kV DRMNO - TPP DRMNO |
| | **220 kV** |
| 26 | OHL 220 kV BISTRICA - PLJEVLJA 2 (ME) |
| 27 | OHL 220 kV VARDISTE - VISEGRAD (BIH) |
| 28 | OHL 220 kV B. BASTA - VALJEVO 3 |
| 29 | OHL 220 kV KRUSEVAC 1 - PODUJEVO (KS) |

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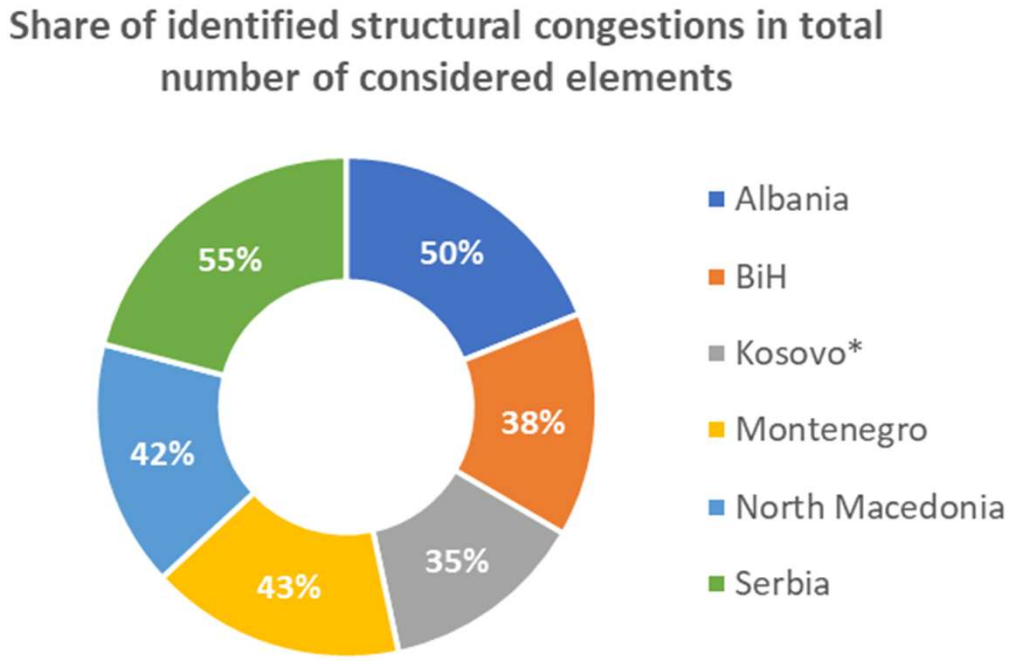
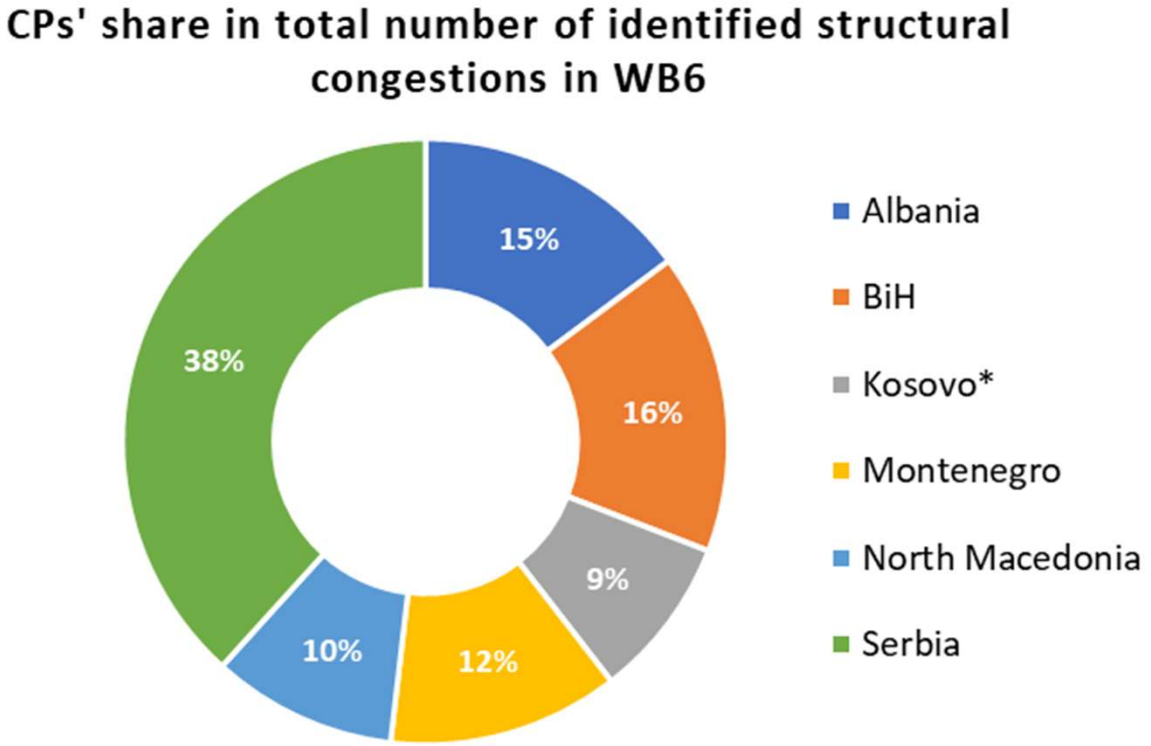
# Structural congestions in **Serbia**

# Structural congestions recap

| Contracting party | Total number of considered elements | Total number of identified structural congestions |
|---|---|---|
| **Albania** | 24 | 12 |
| **BiH** | 34 | 13 |
| **Kosovo*** | 20 | 7 |
| **Montenegro** | 23 | 10 |
| **North Macedonia** | 19 | 8 |
| **Serbia** | 56 | 31 |
| **TOTAL** | **176** | **81** |



# Structural congestions recap



# Structural congestions recap

| No of structural congestions | Albania | BiH | Kosovo* | Monte negro | North Macedonia | Serbia | TOTAL |
|---|---|---|---|---|---|---|---|
| 400 kV | 5 | 10 | 4 | 5 | 8 | 25 | 57 |
| 220 kV | 7 | 2 | 3 | 5 | 0 | 4 | 21 |
| TOTAL | 12 | 12 | 7 | 10 | 8 | 29 | 78 |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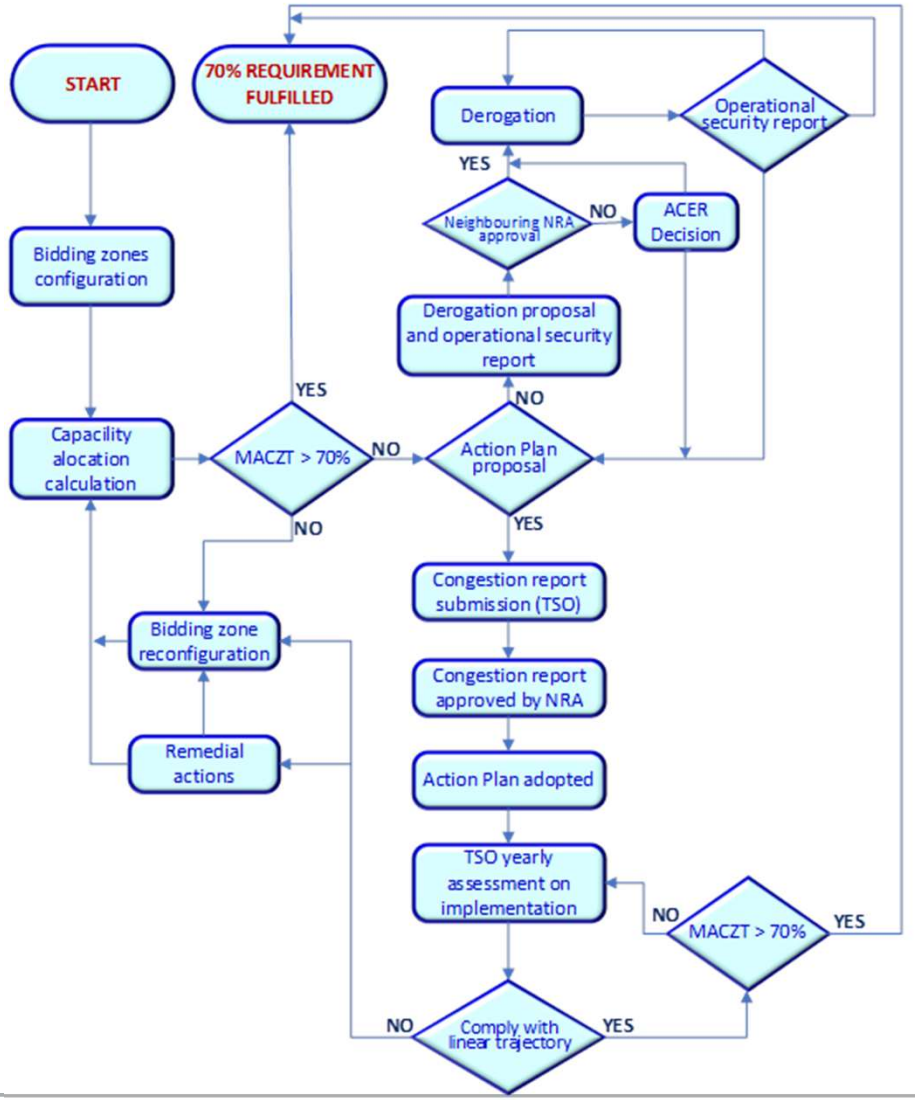
# PROPOSAL OF THE MEASURES AND ACTIVITIES


# Block-diagram of 70% fulfilment process



# Conclusions and takeaways

**CPs have three basic options to cope with 70% target**:

1. To prove that 70% target is fully satisfied
2. To request short-term derogation
3. To prepare and adopt Action Plan (after structural congestions are approved by relevant NRA)

# Derogation

**TSO may request from the NRA to grant a derogation** from the 70% target fulfillment.

It has to be on foreseeable grounds for maintaining operational security. TSO has to develop and publish a methodology and projects that shall provide a long-term solution.

Before derogation, the NRA **needs to consult other NRAs** from the affected capacity calculation region.

Derogations can be granted for no more than 1-year at a time, or, up **to a max of 2 years**.

**IT IS STRONGLY RECOMMENDED NOT TO USE DEROGATIONS REPETITIVELY**

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# Action Plan


Derogation and Action Plan are **2 different processes**

Action Plans are not needed for derogation decisions

**In case of structural congestions** (and the respective report approved in a CP), **CP needs to define Action Plan**

In practice, it is possible to have derogation in parallel with the Action Plan.

# Action Plan


Proposed measures and activities in the **Action Plan should cover the following 3 most important pillars**:

1. **Optimal techno-economic solution**, without jeopardising market liquidity
2. Precise adoption and implementation **schedule**
3. Definition of the **starting MACZT value and linear trajectory** through the implementation period in which the 70% target will be fully reached.

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# Action Plan


Action Plan **general structure**:

1. Introduction
2. Legal background and decision on adoption of the Action Plan
3. Starting point calculation results and linear trajectory
4. Measures to reduce structural congestions
5. Supervision and Action Plan implementation monitoring
6. Appendix – concrete list of activities.

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# Conclusions and takeaways

1. MACZT values are supposed to be **calculated by each TSO** and have to be **approved by the relevant NRA**
2. The main purpose of this project is **to support and educate** TSOs in the CPs, with **no obligatory findings**
3. 70% target fulfillment seems to be **very poor in the CPs**
4. MACZT implementation is **quite challenging** task, especially for **small, well-connected systems**, like WB6
5. It is **illustrated** on the selected snapshots in **2021 and 2028**

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# Conclusions and takeaways

6. No obligation to use NTC or FB approach, but the one that is more convenient and efficient. On given scenarios in WB6 **FB approach gives much better results than bilateral NTC approach**
7. Results for 2028 are much **better** than for 2021 due to planned network construction, but **still below 70% target**
8. There are **78 identified structural congestions** in WB6
9. Half of the structural congestions identified in internal networks, while remaining half on the cross-zonal elements
10. **As a follow-up to this study: to perform additional studies on optimal network configuration using adequate measures to maximize MACZT values on bidding zone borders**

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# Activities and measures

1. **Full activation of the coordinated capacity region** in WB6 and EE, including eventual **BZ reconfiguration**
2. **Coordinated capacity calculation** and allocation should be implemented in the whole Shadow SEE and Eastern Europe CCRs
3. **Investments/construction of new OHLs**
4. **Investments/reinforcement** (nominal capacity increase with conductor cross-section upgrade, HTLS technology etc.) of the existing 220 kV network should also be carefully considered
5. **Other network capacity increase options**, including existing and new technologies (smart metering systems, dynamic thermal rating etc.)
6. **Remedial actions** (**redispatching**, demand side response, topology changes, energy storages, active power flow control etc.). MACZT can be improved with flow decomposition (loop flow elimination and internal flow on CZ elements)

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# Thank you for your attention


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