Operational challenges and experiences during extreme summer conditions in Montenegro

CIGRE SEERC Grid Resilience Workshop - Roma, January 2025

Power system of Montenegro

- Small system
  - around 3TWh of total annual consumption
  - Between 2.5 and 4 TWh of annual production
  - Predominantly hydro-generation based system
  - One large coal-fired TPP
- But well interconnected
  - 5 electrical borders
- 12 interconnectors (9 at 220kV level and above)

Changes

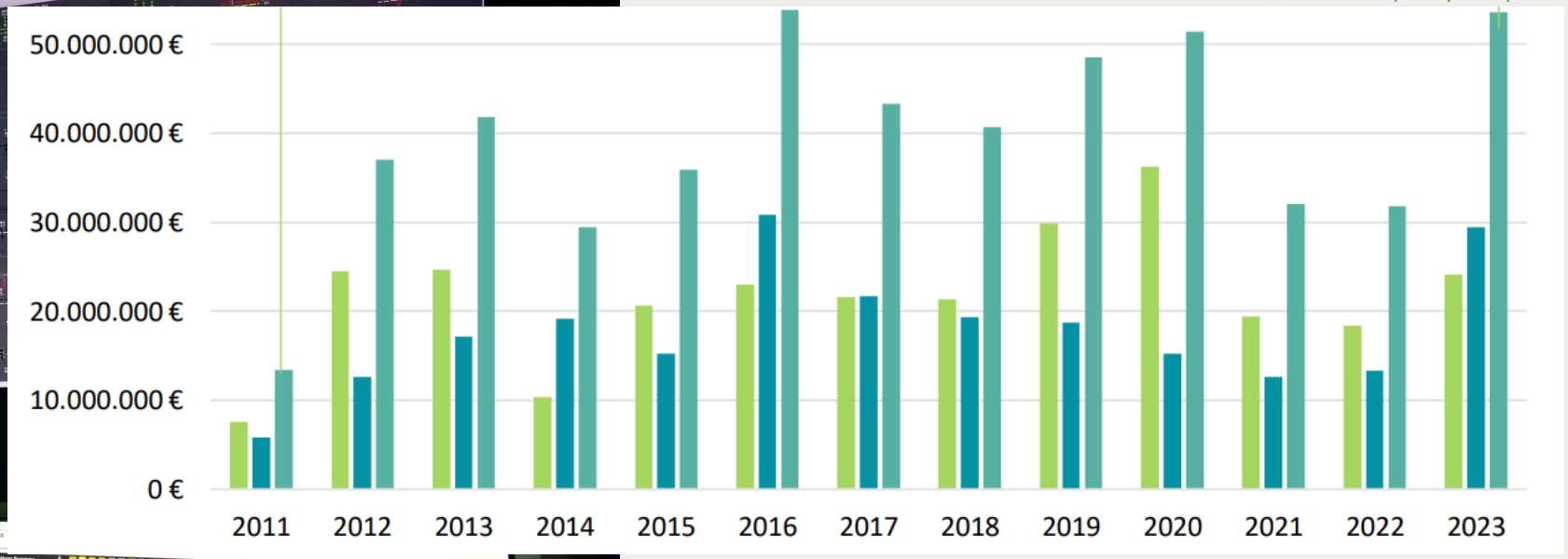
- Fastest development in 70s and 80s of last century
  - Industrial demand driven
- Second wave – 2010s
  - Enhancement of cross-border capacities
    - 400kV interconnection to Albania
    - HVDC link to Italy
- Trends
  - Load decrease, load migration, transit increase
  - Strong seasonal variations of power demand (tourism as predominant economic activity)
  - Seasons of extremely high voltages

Consequences

- Significant difference in operational patterns during seasons winter/spring(rain)/summer
- Hourly change of flows directions

Strategic response

- Improved regional coordination
- Increased operational planning efforts
- Permanent operational dpt. trainings
- New investments



Row Labels	0 00:30	01:30	02:30	03:30	04:30	05:30	06:30	07:30	08:30	09:30	10:30	11:30	12:30	13:30	14:30	15:30	16:30	17:30	18:30	19:30	20:30	21:30	22:30	23:30
TR 400/220kV Koman									**98.89**	**98.94**														
TIE 220kV Prizren 2 - Fierza (AL)									98.89	98.94														
TIE 220kV Prizren 2 - Fierza (KS)									98.83	98.87														
TIE 400kV Peć 3 - Ribarevine																**92.89**	**105.33**	**104.4**	**104.6**	**96.9**	**91.25**			
TIE 220kV Prizren 2 - Fierza (AL)																92.88	105.33	104.4	104.6	96.89	91.23			
TIE 220kV Prizren 2 - Fierza (KS)																92.89	105.33	104.4	104.6	96.9	91.25			
TIE 400kV Koman - Kosovo B									**94.29**	**93.47**						**92.53**	**102.39**	**103.1**	**101.5**					
TIE 220kV Prizren 2 - Fierza (AL)									94.29	93.47						92.53	102.39	103.1	101.5					
TIE 220kV Prizren 2 - Fierza (KS)									94.29	93.47						92.53	102.39	103.1	101.5					
TIE 220kV Prizren 2 - Fierza																		**95.91**	**97.15**				**91.02**	
OHL 220kV Koman - Vau Dejes																		95.91	97.15				91.02	
TIE 220kV Koplik - Podgorica 1										**90.87**														
TIE 220kV Prizren 2 - Fierza (AL)										90.87														
TIE 220kV Prizren 2 - Fierza (KS)										90.87														
OHL 400kV Ribarevine - Podgorica 2																	**98.1**							
TIE 220kV Prizren 2 - Fierza (AL)																	98.1							
TIE 220kV Prizren 2 - Fierza (KS)																	98.1							
OHL 220kV Vau Dejes - Koplik									**90.19**	**91.72**														
TIE 220kV Prizren 2 - Fierza (AL)									90.19	91.72														
TIE 220kV Prizren 2 - Fierza (KS)									90.15	91.72														
OHL 220kV Titan - Tirana 1									**91.14**	**91.42**						**94.21**	**102.39**	**103.7**	**103.4**	**94.32**	**90.1**			
TIE 220kV Prizren 2 - Fierza (AL)									91.14	91.42						94.21	102.39	103.7	103.4	94.32	90.1			
TIE 220kV Prizren 2 - Fierza (KS)									91.14	91.42						94.19	102.38	103.7	103.4	94.3	90.09			
OHL 220kV Koman - Vau Dejes										**90.74**					**92.34**	**103.13**	**109.55**	**112.9**	**112.9**	**101.5**	**96.93**		**92.62**	
TIE 220kV Prizren 2 - Fierza (AL)										90.74					92.34	103.13	109.55	112.9	112.9	101.5	96.93		92.62	
TIE 220kV Prizren 2 - Fierza (KS)										90.74					92.29	103.11	109.54	112.9	112.9	101.5	96.91		92.6	
OHL 220kV Burrel - Elbasan 1									**92.5**	**92.47**						**97.29**	**105.27**	**106.3**	**106.1**	**97.51**	**93.15**			
TIE 220kV Prizren 2 - Fierza (AL)									92.5	92.47						97.29	105.27	106.3	106.1	97.51	93.15			
TIE 220kV Prizren 2 - Fierza (KS)									92.5	92.47						97.27	105.26	106.2	106.1	97.49	93.13			

However…

On 21 June 2024 at 12:24 CET, due to a major incident in the Continental Europe power system region, a large part of the transmission systems of Albania, Montenegro, Bosnia and Herzegovina as well as Croatia suffered a voltage collapse followed by a total blackout in this area.

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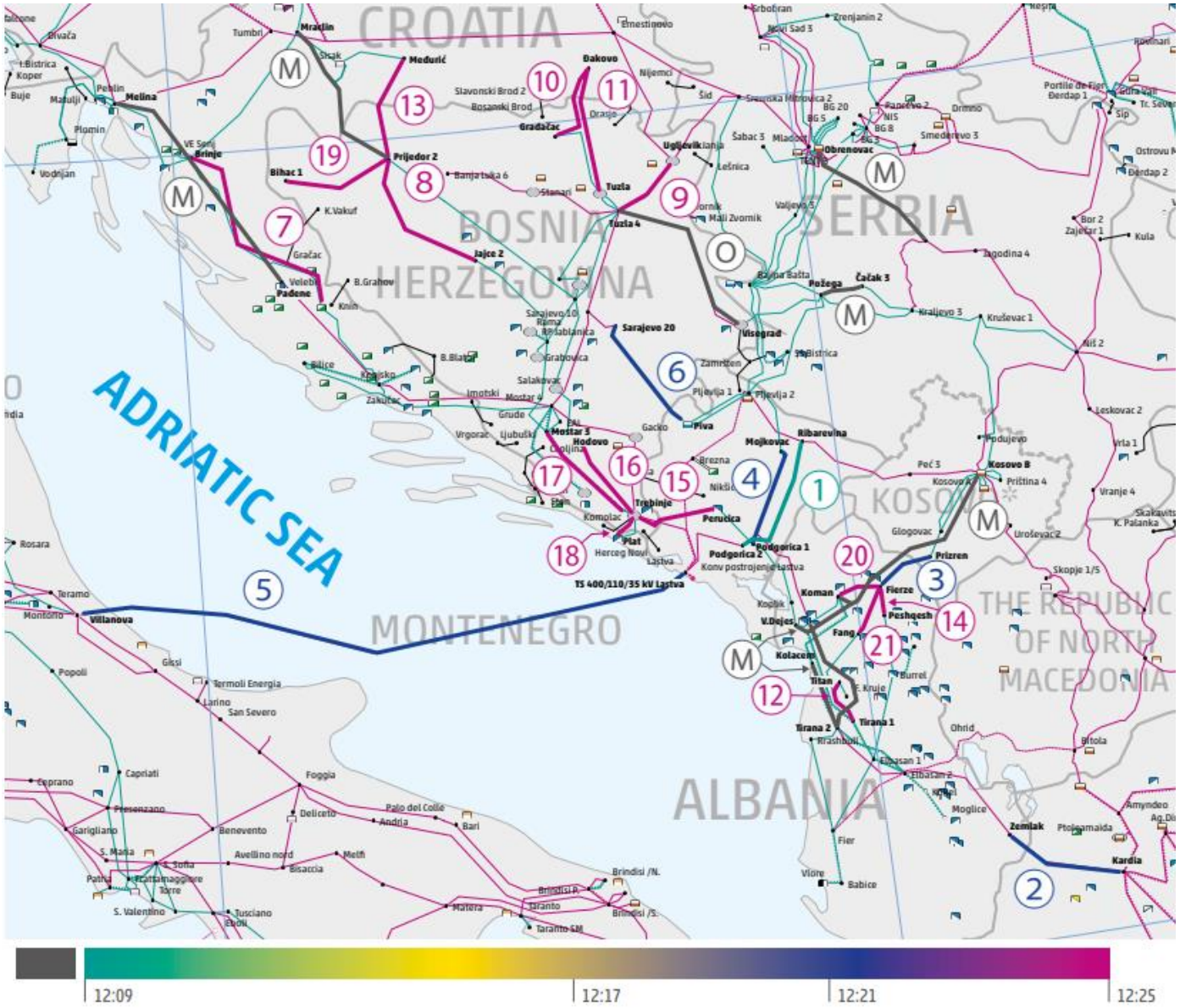
For power system expertise

Short destription od the 21/6/2024 event



12:09 – First outage
12:21 – Second independent outage

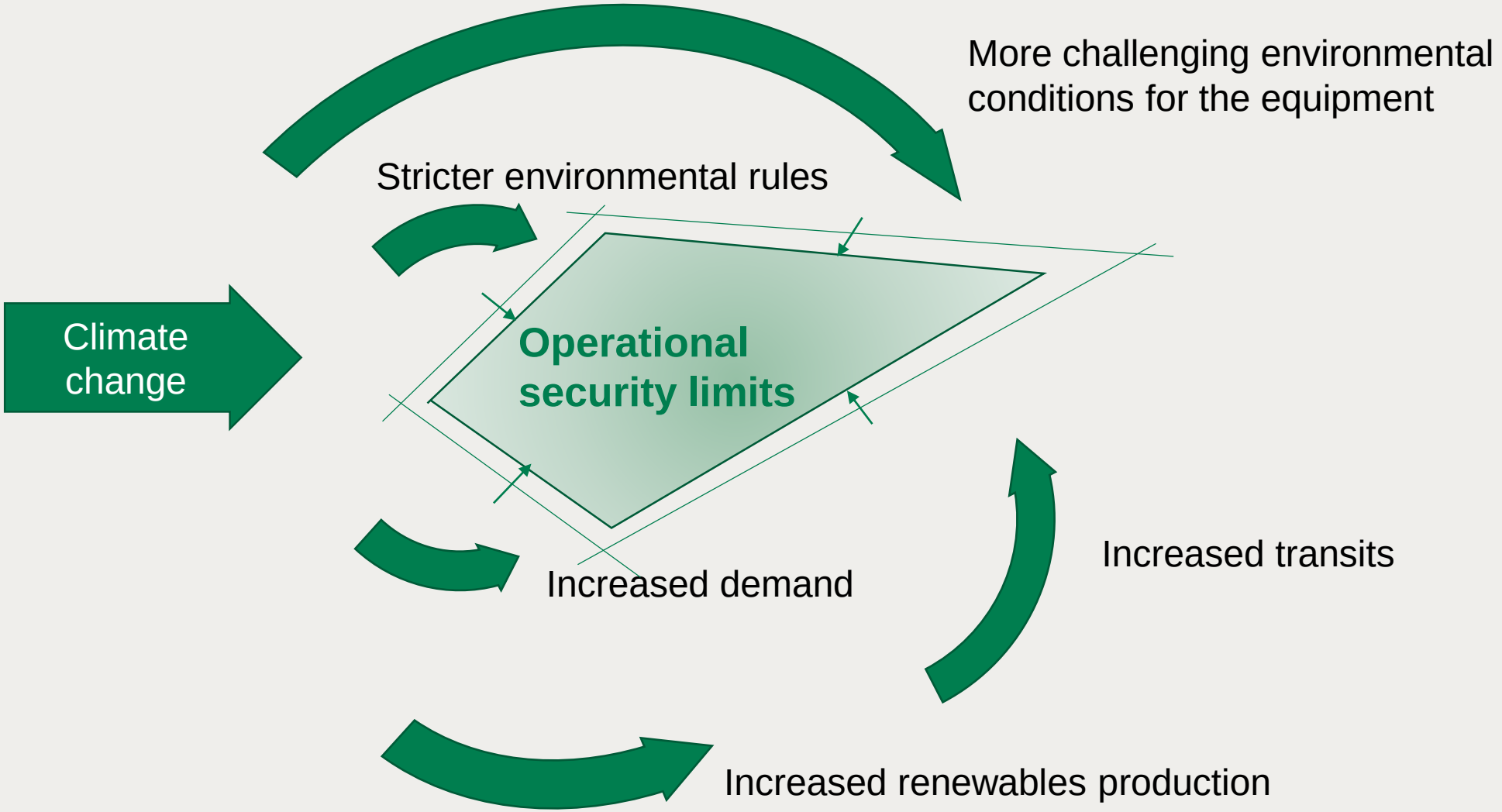
12:22-12:25 - tripping of several other transmission lines and a voltage collapse in Bosnia and Herzegovina, Montenegro, Albania and Croatia. T

Affected TSOs experienced the load loss within a duration of less than one minute.

The total load loss was approximately 3.5GW.

The restoration process began with the first action at 12:33, and restoration process of the load for all TSOs was completed around 16h

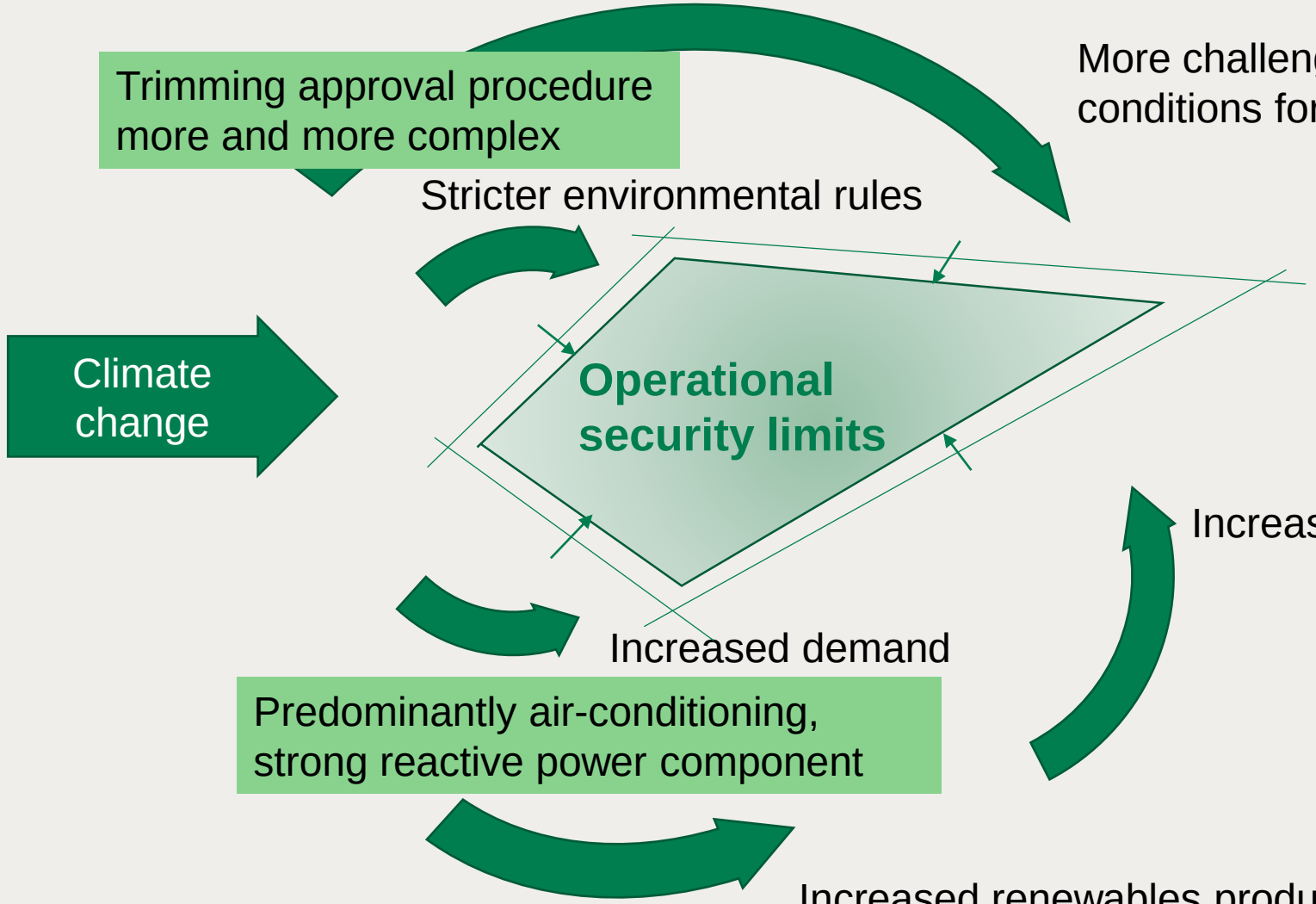
New era challenges



Global challenges

- Climate change itself reflects on old operational routines
- Our answer to climate change asks for the change of operational routines

New era challenges – in practice



Initial conclusions

- Yes there is space:
  - To increase maintenance efforts
  - To improve regional coordination
  - To enlarge observability areas
  - To extend operational planning efforts
  - To invest in grid development
- However
  - Increased probability of faults coincidence will not decrease in future (probably will even more increase)

How to keep the resilience?

“What are the odds for this to repeat?”

- High and increasing

For power system expertise

Some possible answers

- Deep root cause analysis and conclusions
  - No Jumping into conclusions
- Exchange of recent experiences
  - ENTSO-E ICS and similar mechanisms
- Extensive public discussions based on expert knowledge and practical experiences

Thank you!

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