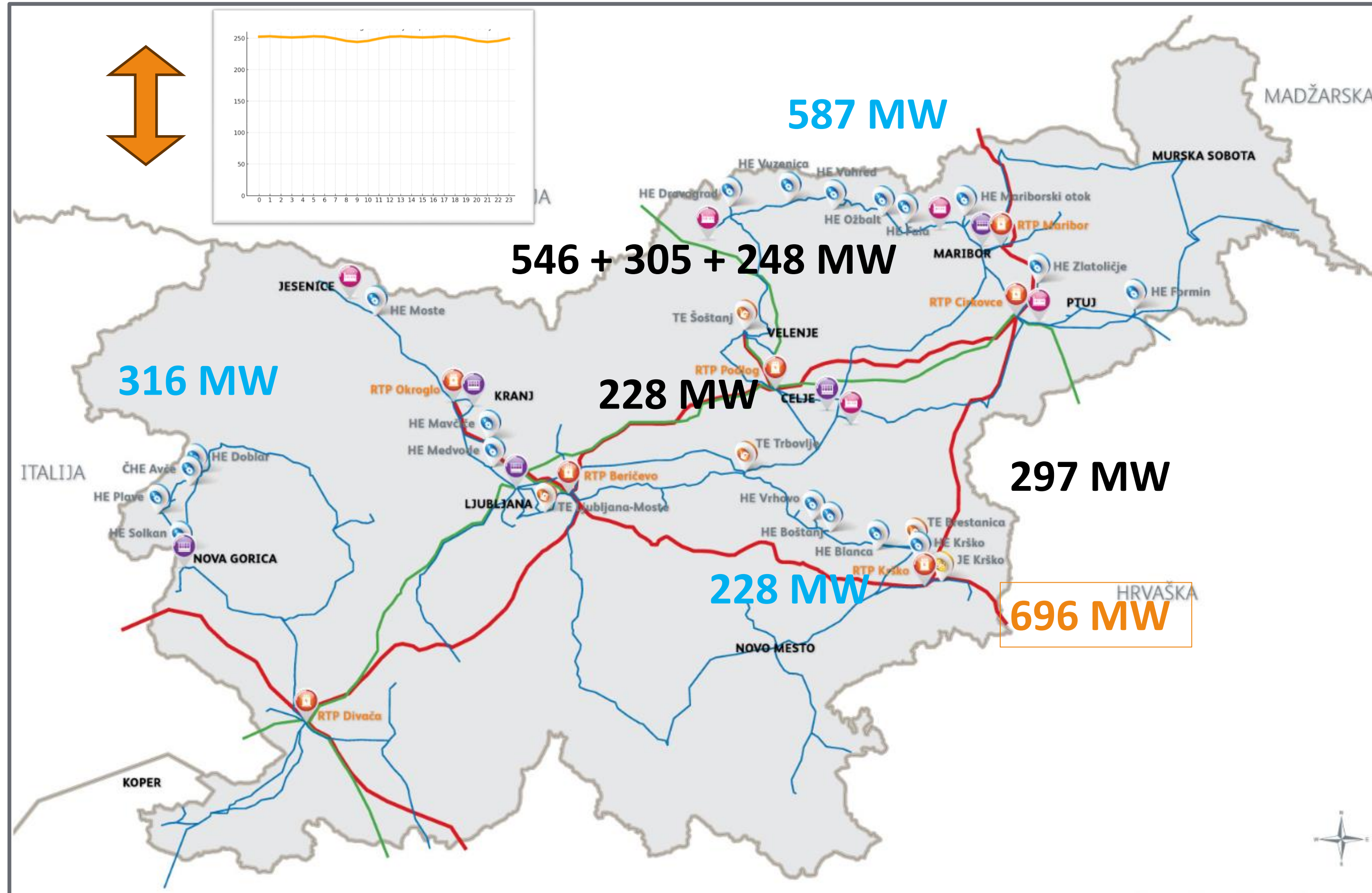


*Ensuring Slovenian Transmission System Resilience in  
Response to Green Transition Challenge*

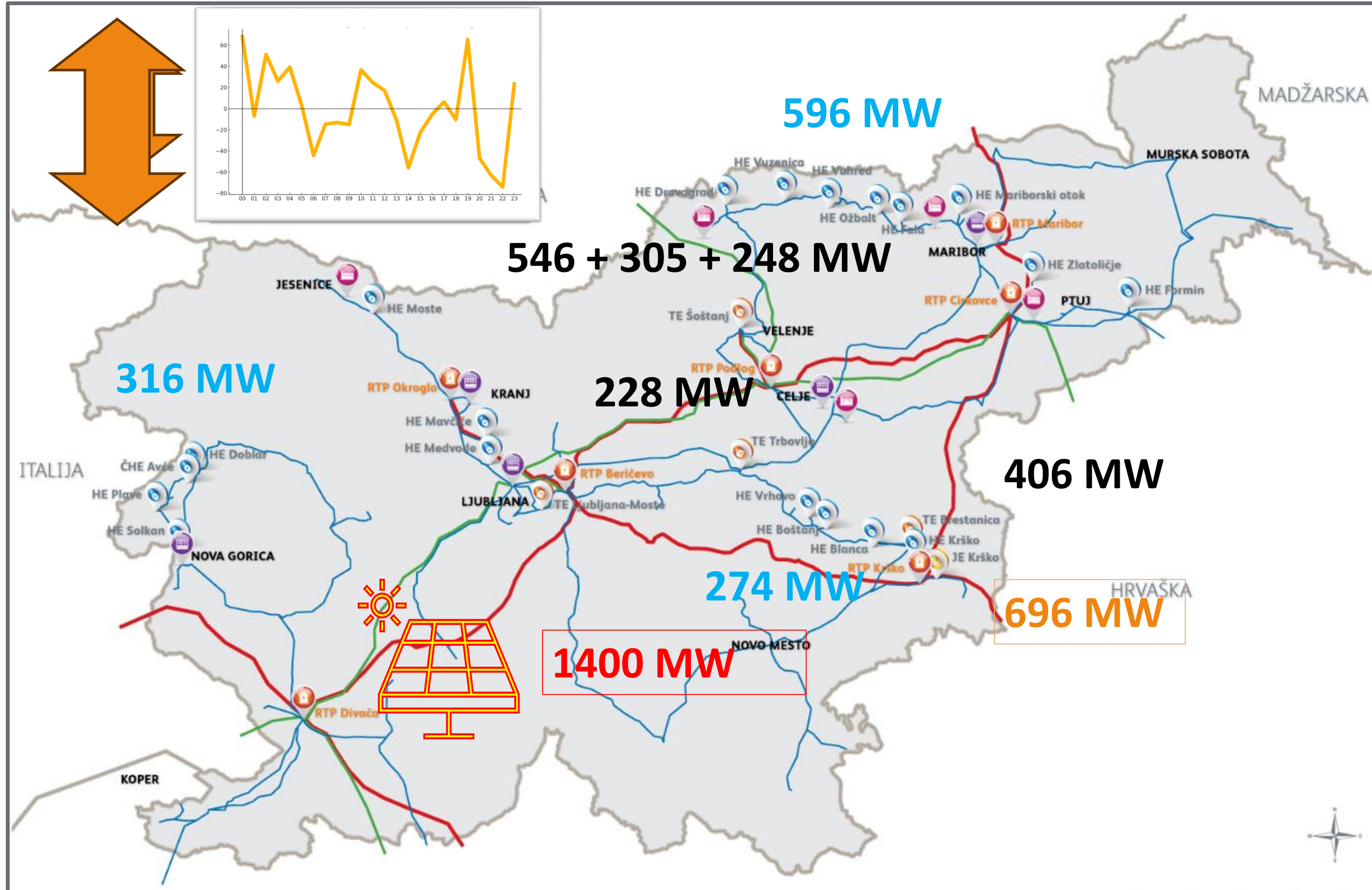
**Tadej Demšar**  
*System operation*

2015





2025





# How to deal with this changes?

- > Flexibility
- > Market design
- > Investments
- > Smart grid
- > Operation





# Devices for reactive power compensation

- Increase of RES > harder to control reactive power
- Goal to install own compensation devices
- SINCRO.GRID – EU project
- Less dependent on generators and have control over reactive power
- 400 kV and 220 kV
- High reactive power infeed from Balkan region





# SINCRO.GRID

Compensation devices



Variable shunt reactor  
- 150 Mvar / 400kV SS Divača



# SINCRO.GRID

Compensation devices



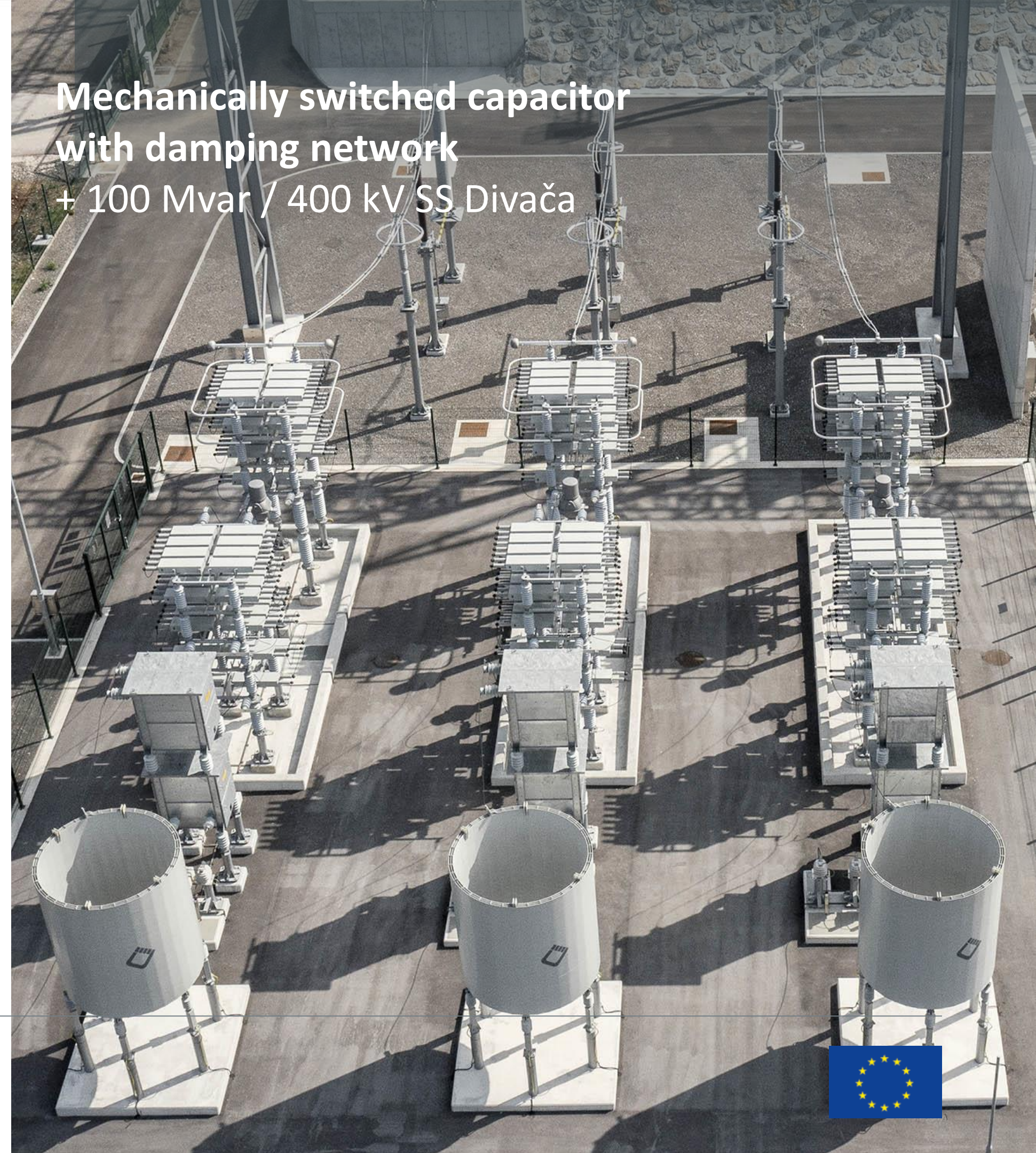
## Variable Shunt Reactor

- 150 Mvar / 400kV SS Cirkovce



# SINCRO.GRID

Compensation devices

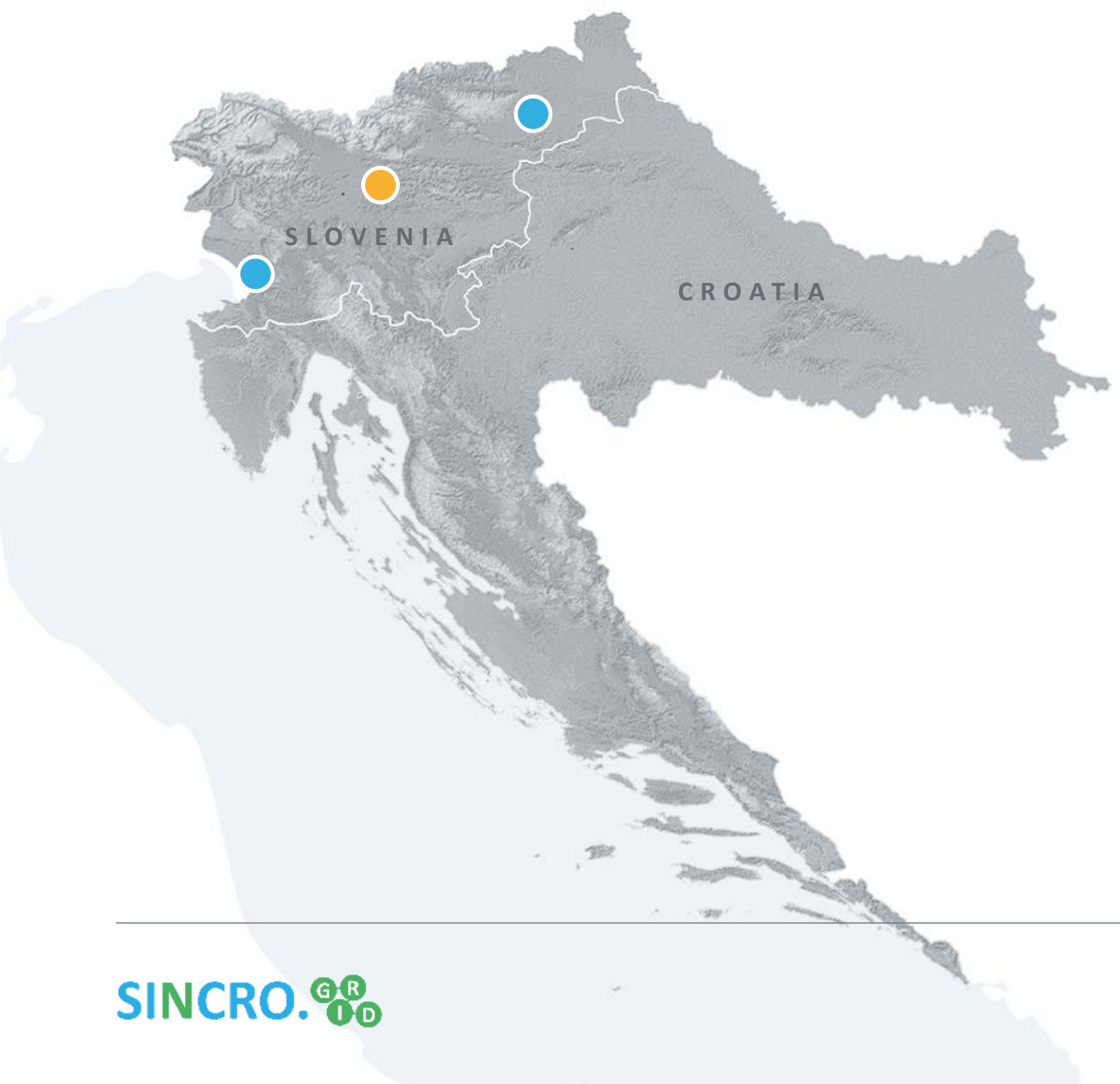


Mechanically switched capacitor  
with damping network  
+ 100 Mvar / 400 kV SS Divača



# SINCRO.GRID

Compensation devices



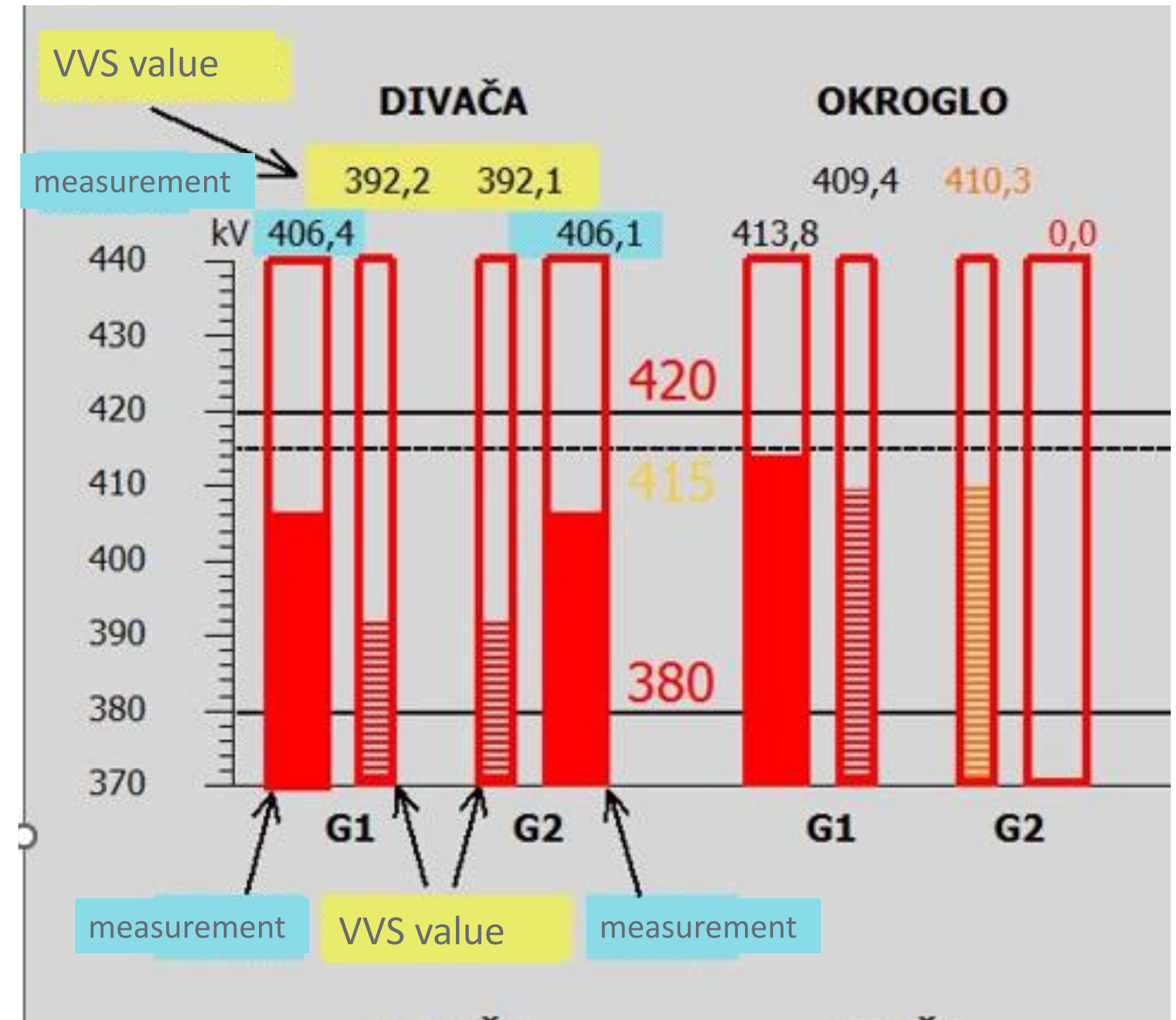
## Static synchronous compensator +/- 150 Mvar / 400 kV SS Beričevo





# Voltage Var Scheduler – VVS

- Assist with optimize voltage profile in SI and HR grid
- Minimise losses and cross-border reactive power exchange between ELES and HOPS
- DACF and IDCF > Power Flow
- Optimal reactive power, settings from compensation devices,
- Actual time, SCADA snapshots, optimal settings, commands for operator



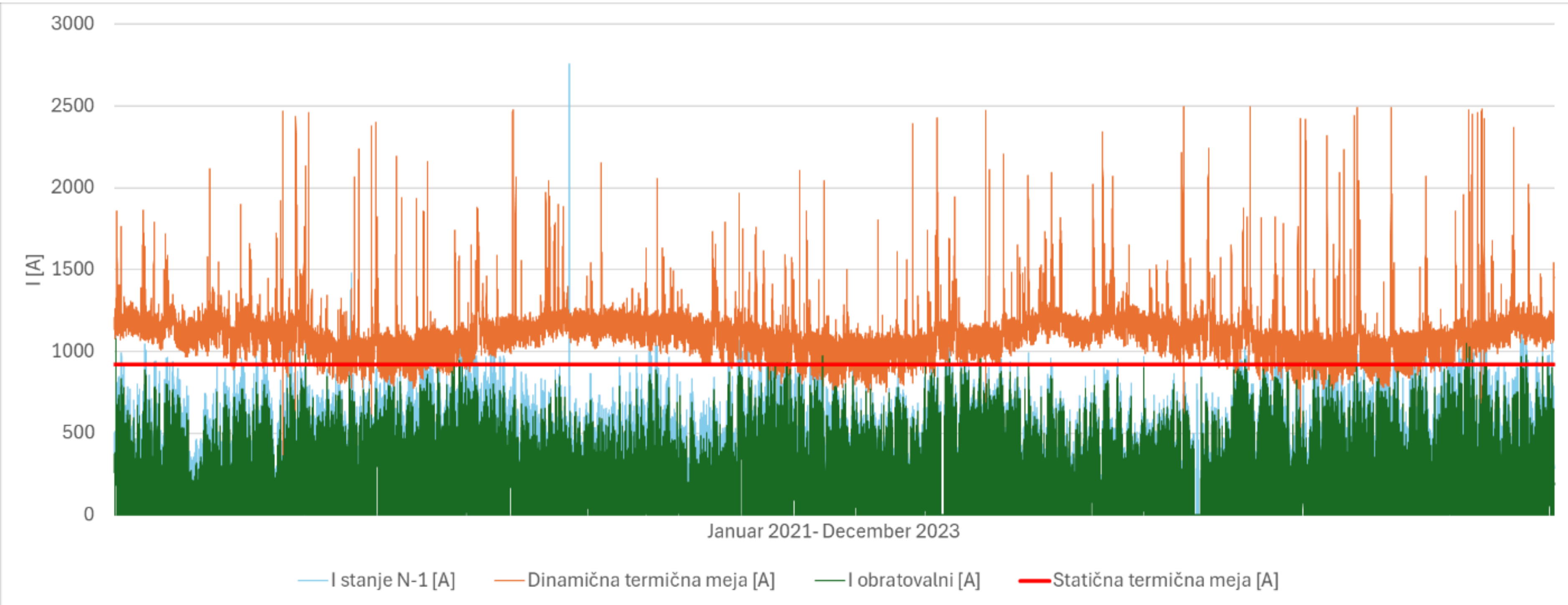


# SUMO

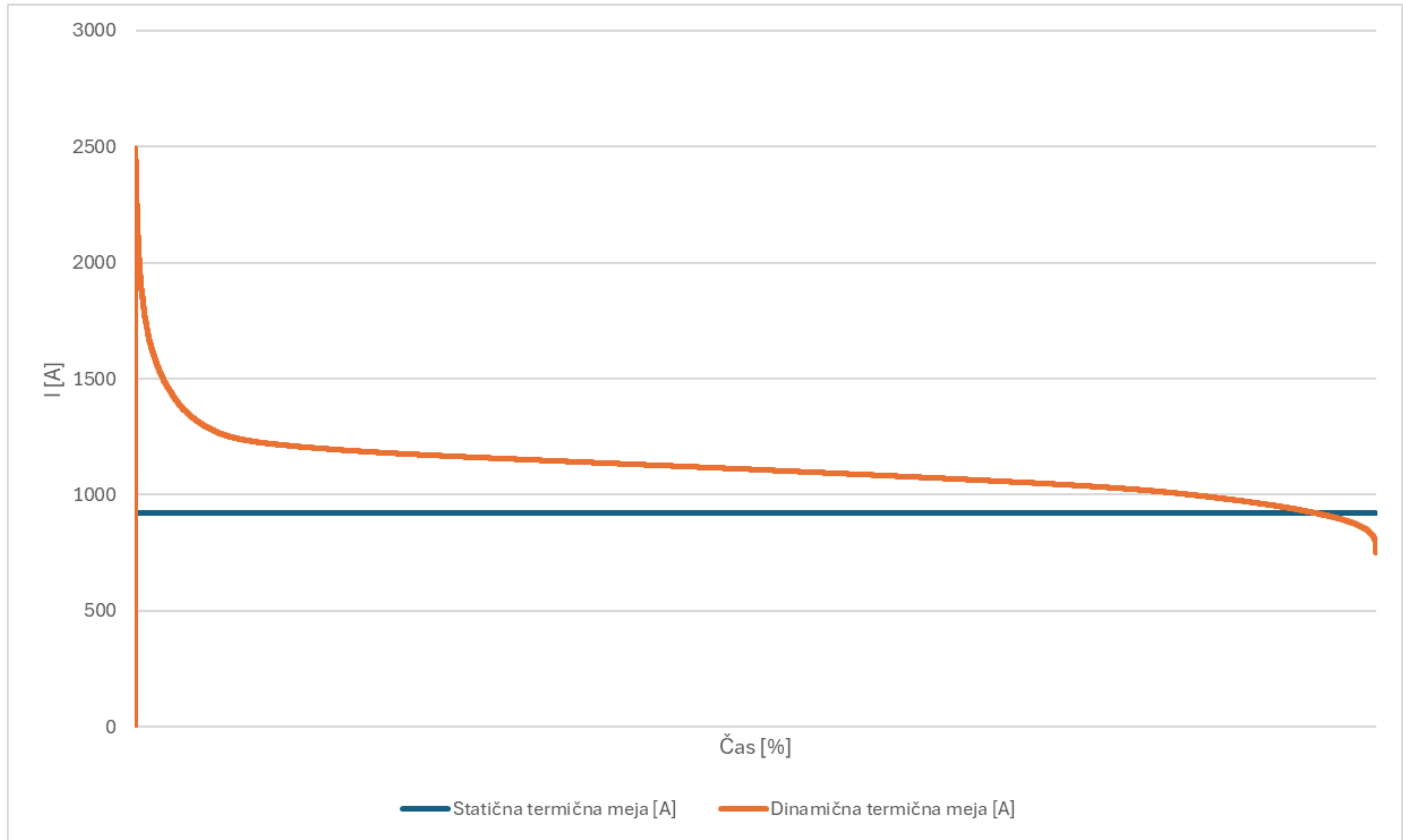
- Modelling and calculating effects of environmental parameters on line
- Temp, wind are modelled, Weather stations on primary spans
- Max acceptable loading under new conditions
- N-1
- 4-quadrant visualization
- 92-96 % thermal limit is higher,
- Median increase 15-20 %
- Extreme weather conditions, heat waves, no wind > lower limit





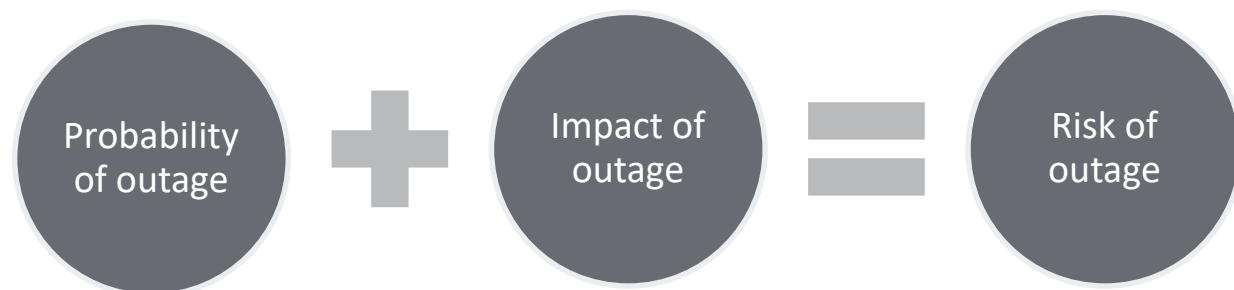




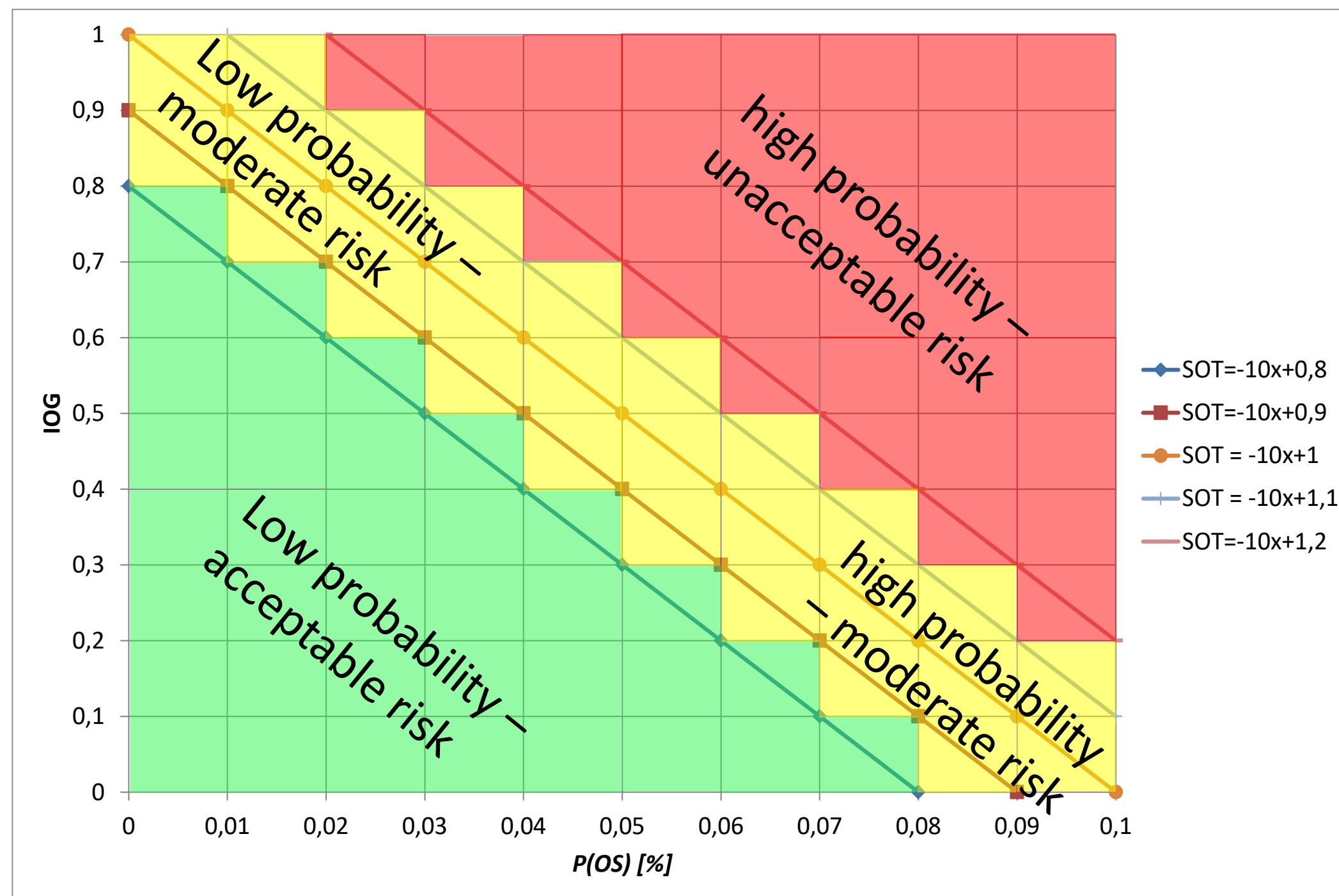




# Real Time Risk Assessment



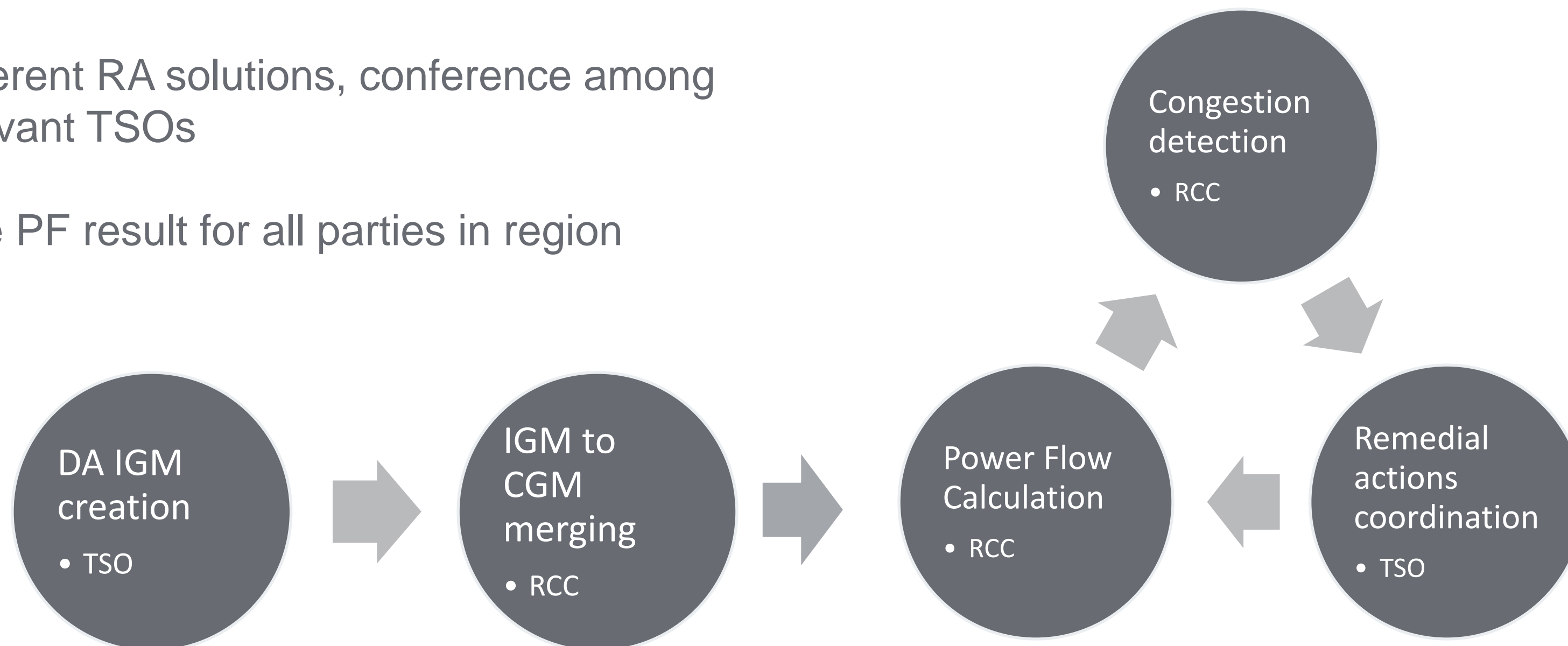
- 10 years of past data
- IOG (Impact on the Grid factor calculated from contingency analysis)
- In testing / developing phase





# Coordinates security operation

- DACF – all Continental Europe TSOs
- Continuous process, expected congestions
- Different RA solutions, conference among relevant TSOs
- One PF result for all parties in region







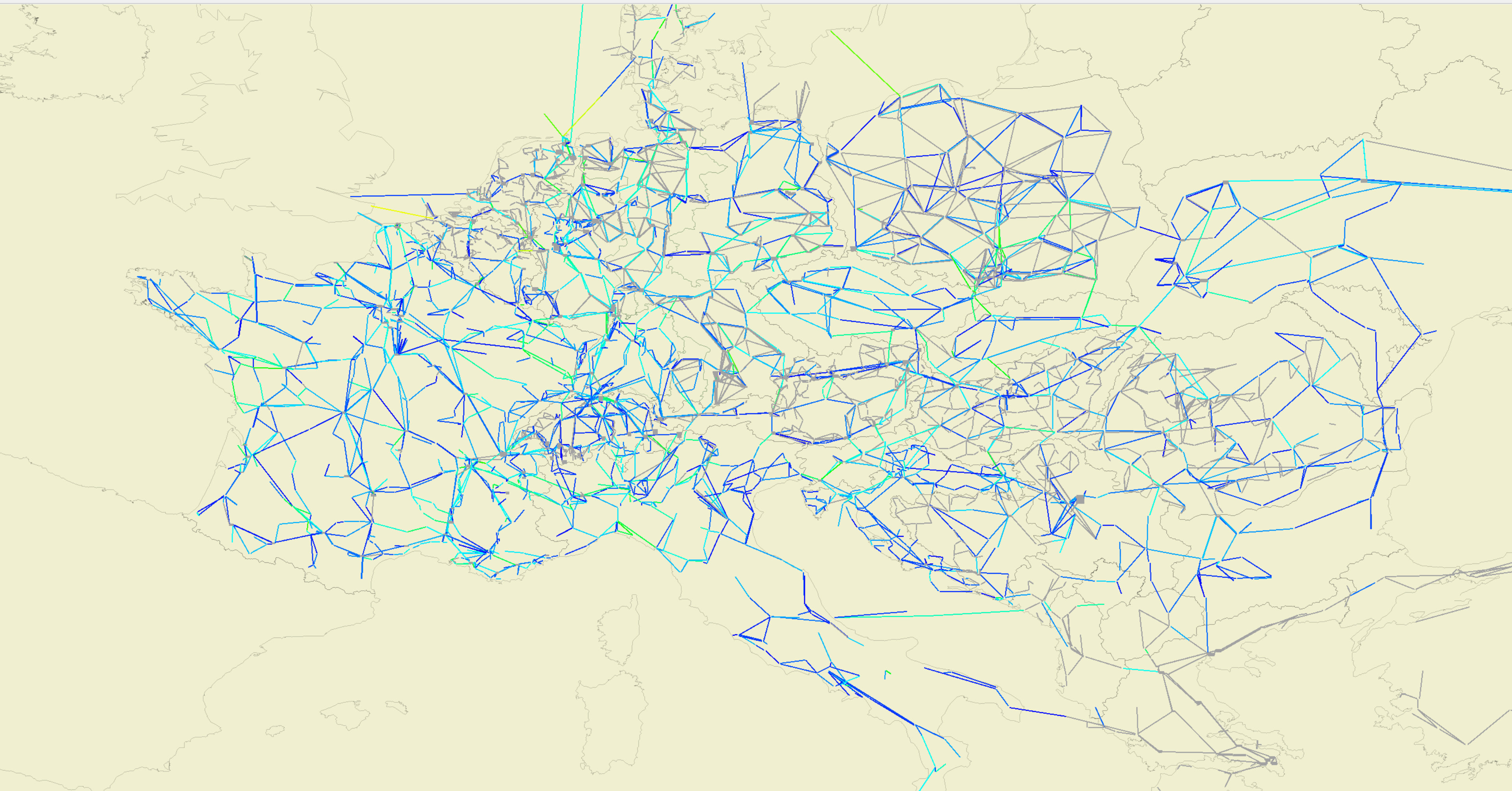
Color: Load

Analog: Output

Layer:  Base  700kV  400kV  200kV  150kV  100kV

01:30 21.1.2025

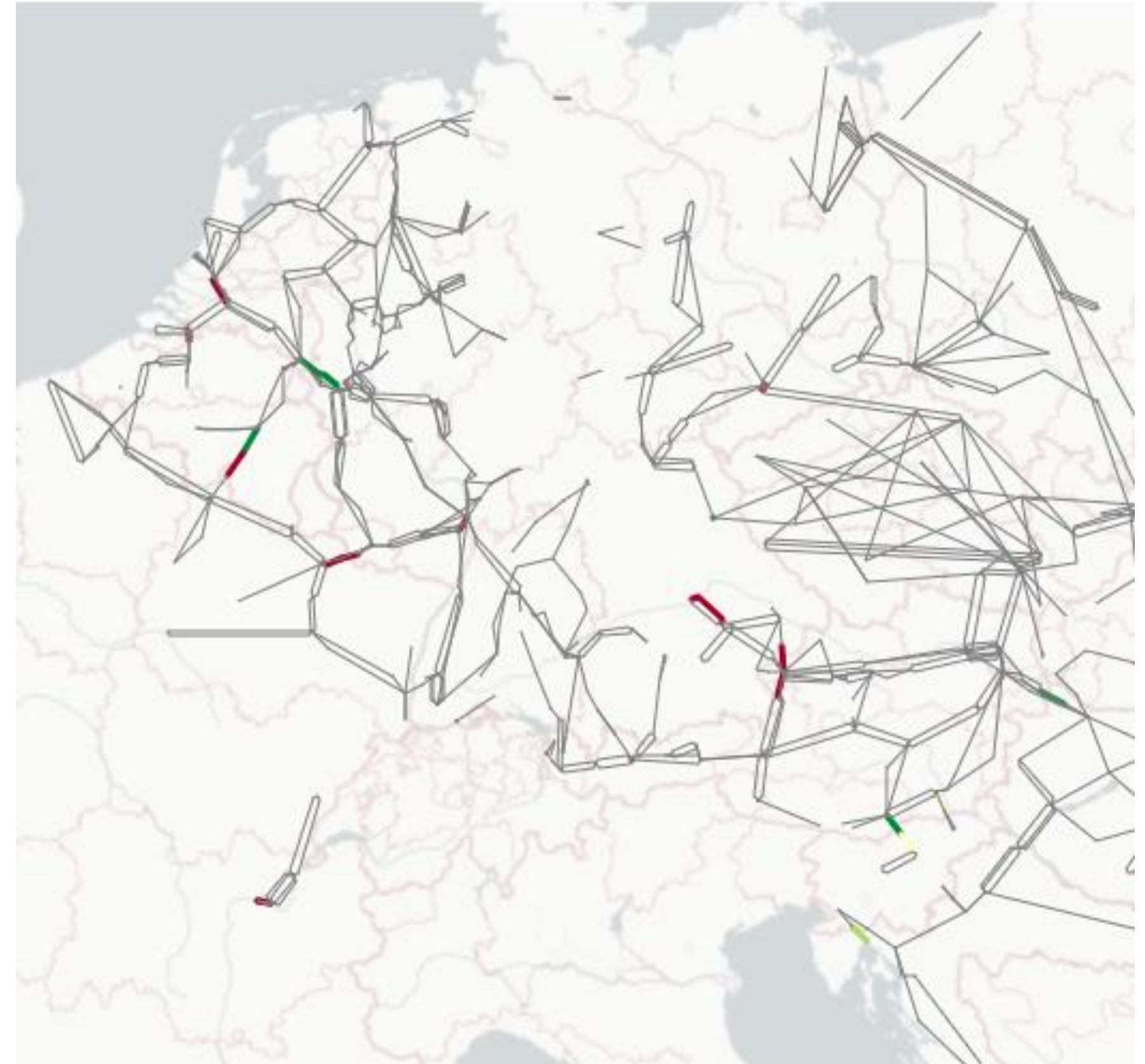
LF • CA





# Core Coordinated Capacity Calculation

- Coordinated process among all Core TSOs
- All tie-lines are Critical Network Elements with Contingency
- ELES: 12 tie-lines, 100 CNECs
- Calculated CBC ensure secure operation
- Max CBC available to market





# Coordinated PST operation in Italian border

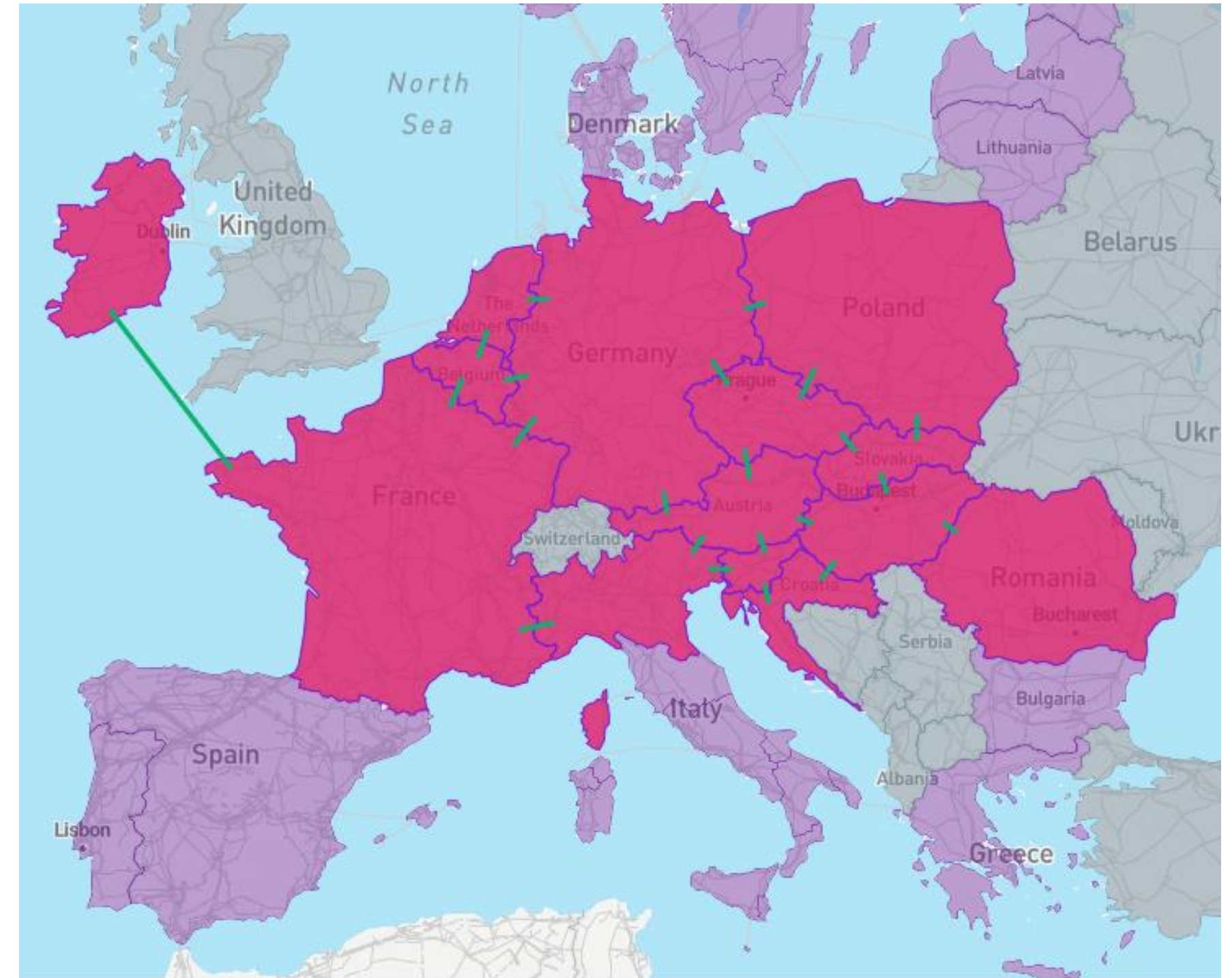
- Close to real time PST operation
- SI  $\leftrightarrow$  IT flows affect all members of IN region
- Target flow
- In case of security issue  $\rightarrow$  modification of flow  $\rightarrow$  informing others
- TSOs can propose new TF during IDCF, all TSOs must agree, if not  $\rightarrow$  costly RA
- relieving critical congestions, minimizing redispatch or countertrading and more cross border capacities





# Merging of Capacity Calculation Regions

- APG, ELES and RTE operate in Core and Italy North CCR
- Core + Italy North = Central Europe
- Each Region operates with individual processes, methodologies and PST's coordination's
- One region > half processes, security operation
- Anomalies in flows, potential security concerns
- Optimal CC





# New investments

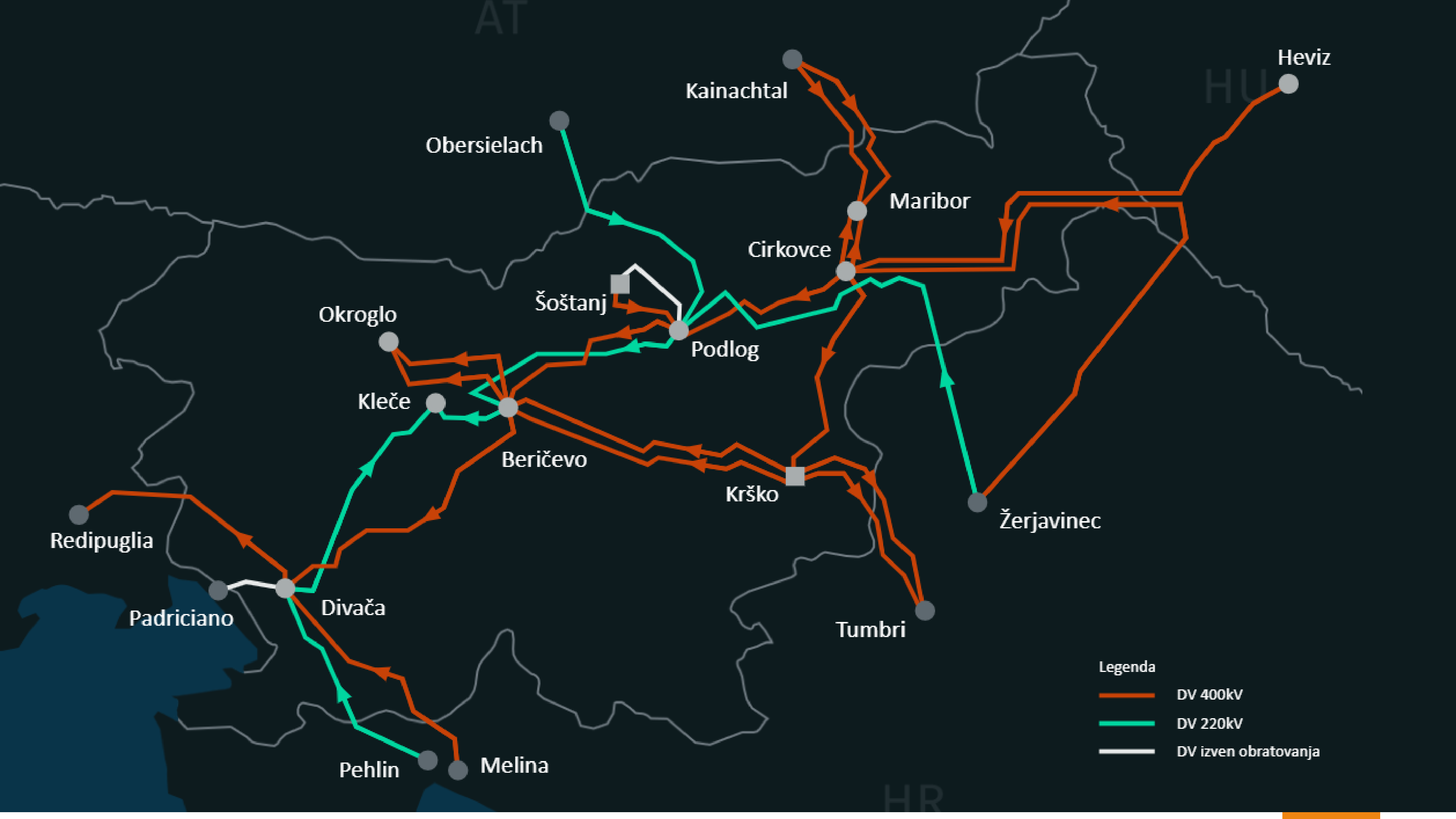
- 2 new 400 kV lines in past 15 years
- SSSC on Okroglo - Obersielach 220 kV







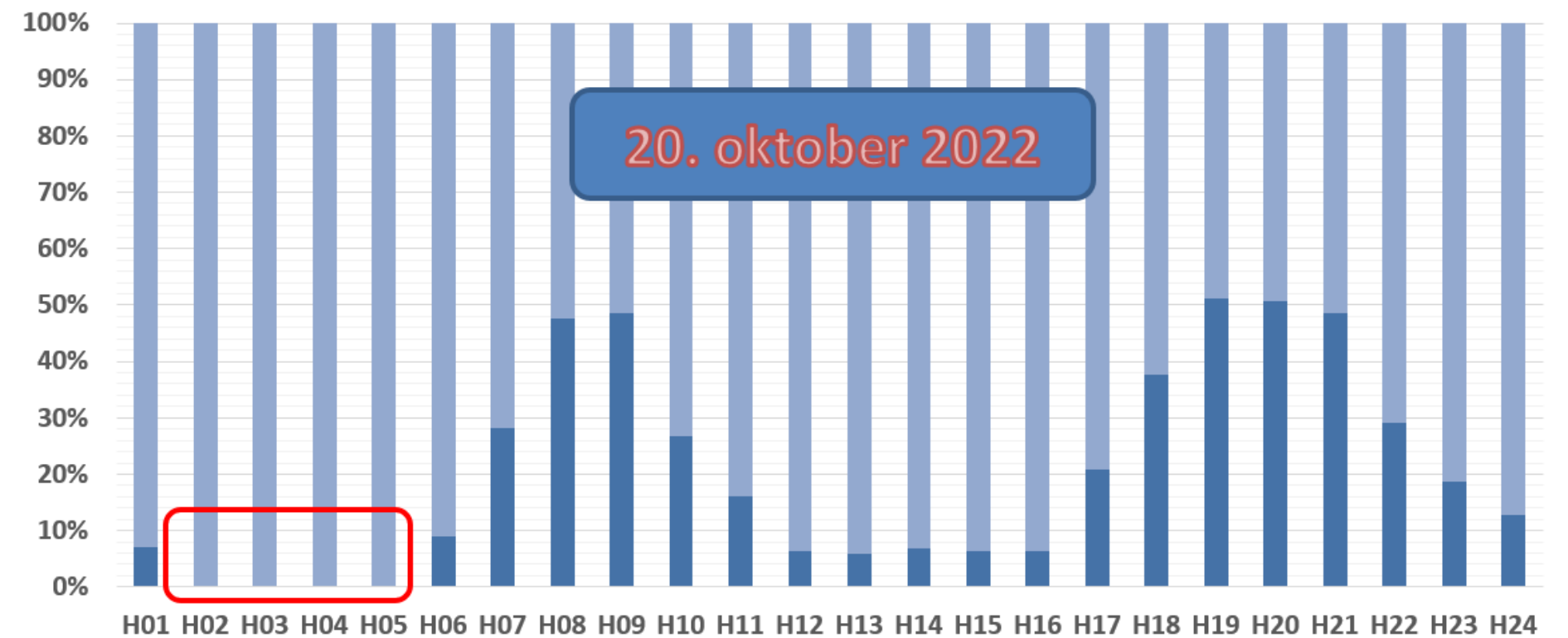






# Market design

- 2007 market liberalization
- Market coupling – physical and commercial flows
- Flow-based market coupling
- Security of supply
- Two large units > outage > easy to supply





# Using new technologies for providing auxiliary services

- Affordable new technologies (BESS, hybrid inverters, demand side management)
- New auxiliary providers, private equities – aFRR, mFRR
- One provider for aFRR in 2020, now 4

Year	Hydro+ coal	BESS
2020	60 / 60	0 / 0
2025	20 / 20	40 / 40

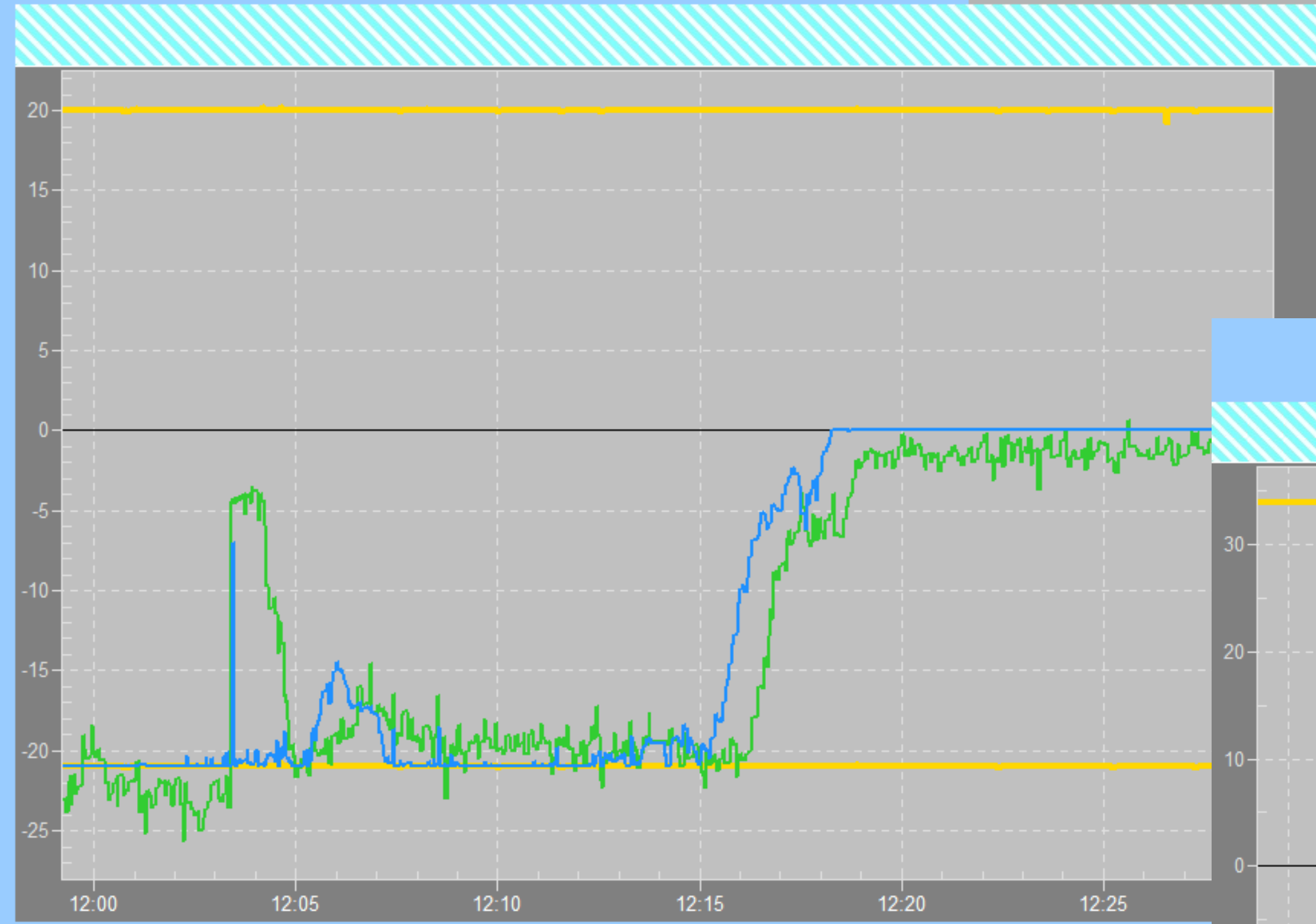
- 2025 – MARI and PICASSO





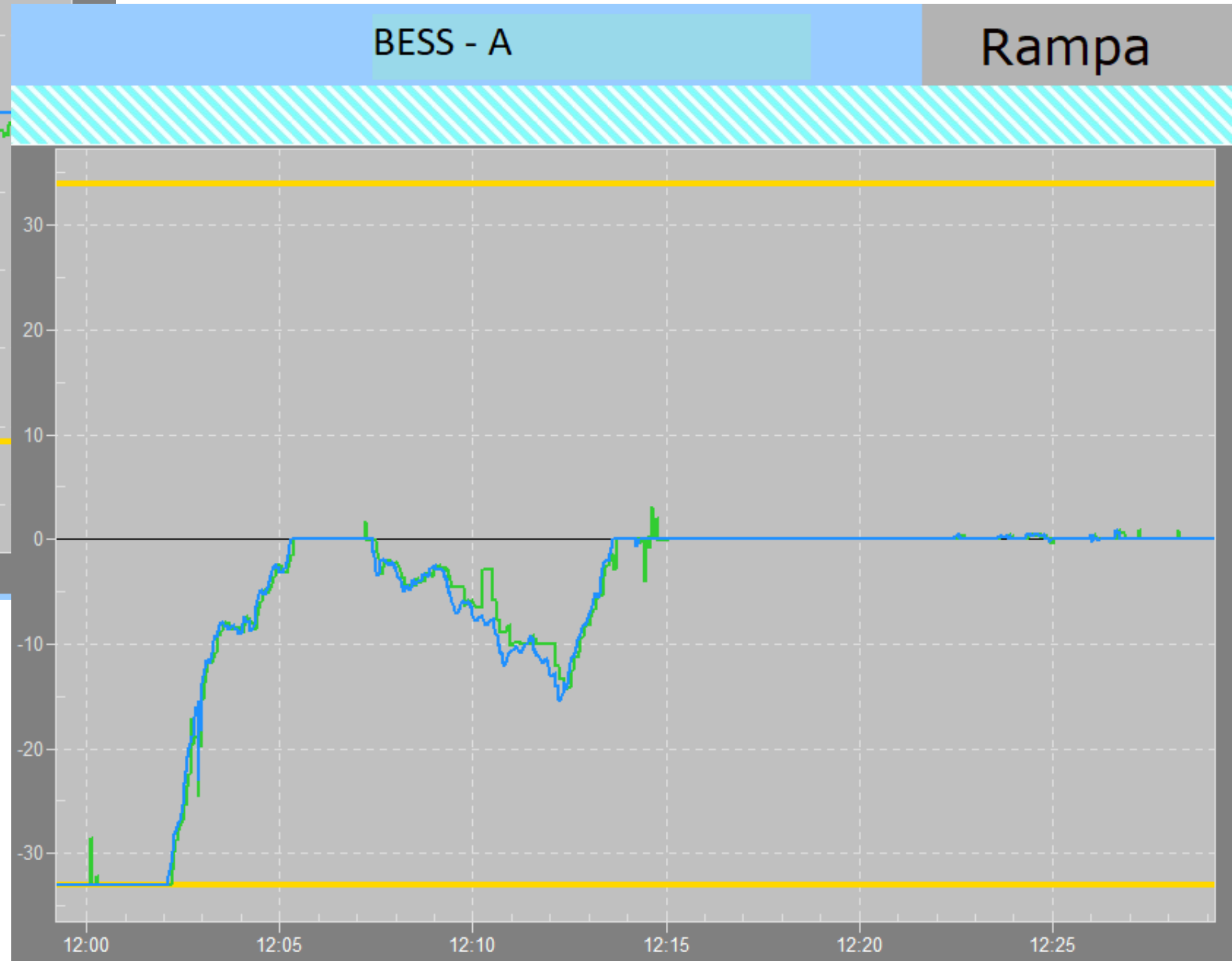
HYDRO

Rampa



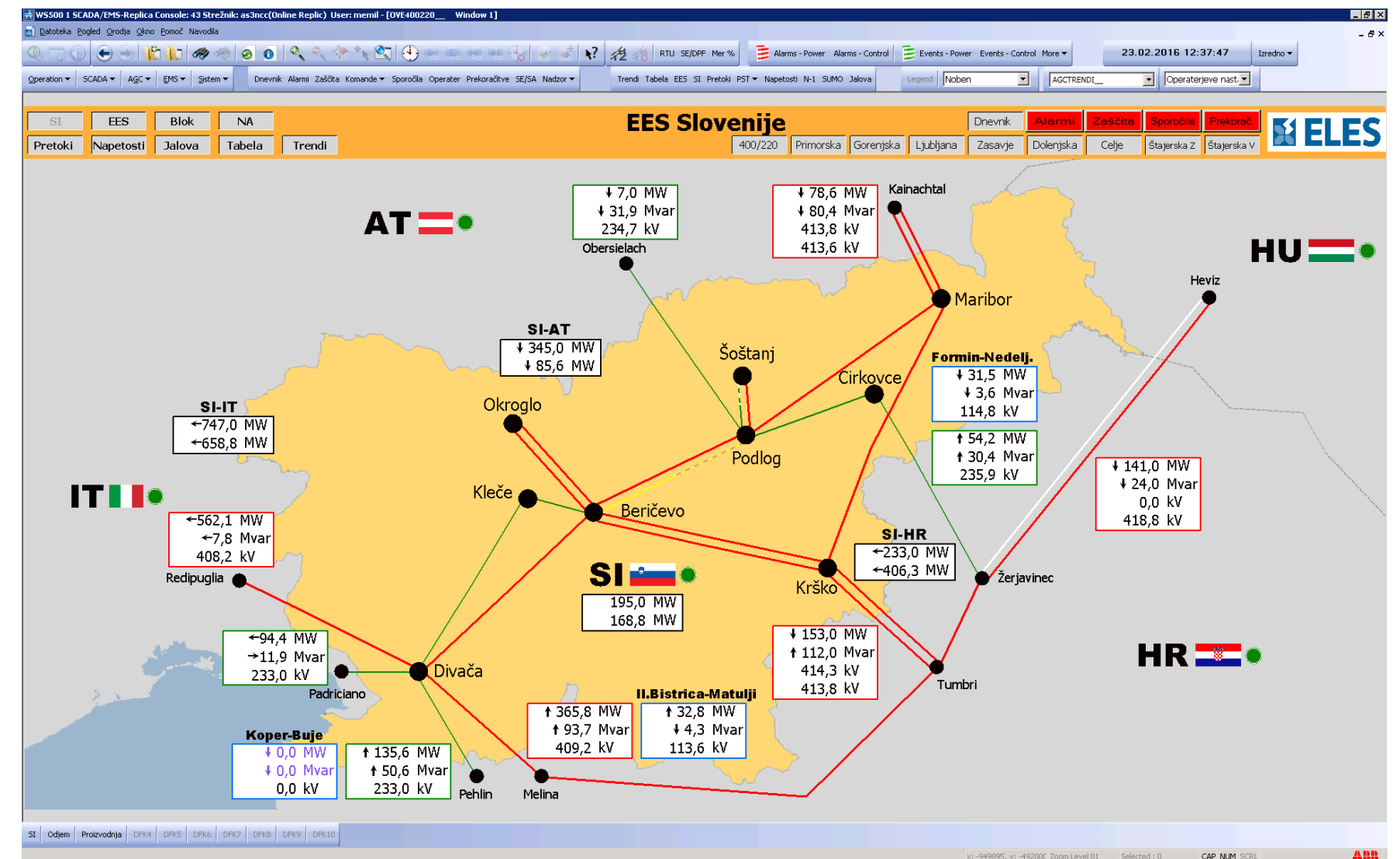
BESS - A

Rampa



# Conclusions

- 10 years ago > today
- Less investments in power lines
- More smart solution
- Analytics





Thank you.

