



DEMO okolje za upravljanje z viri vključenimi v sekundarne systemske storitve



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant agreement n° 691777.

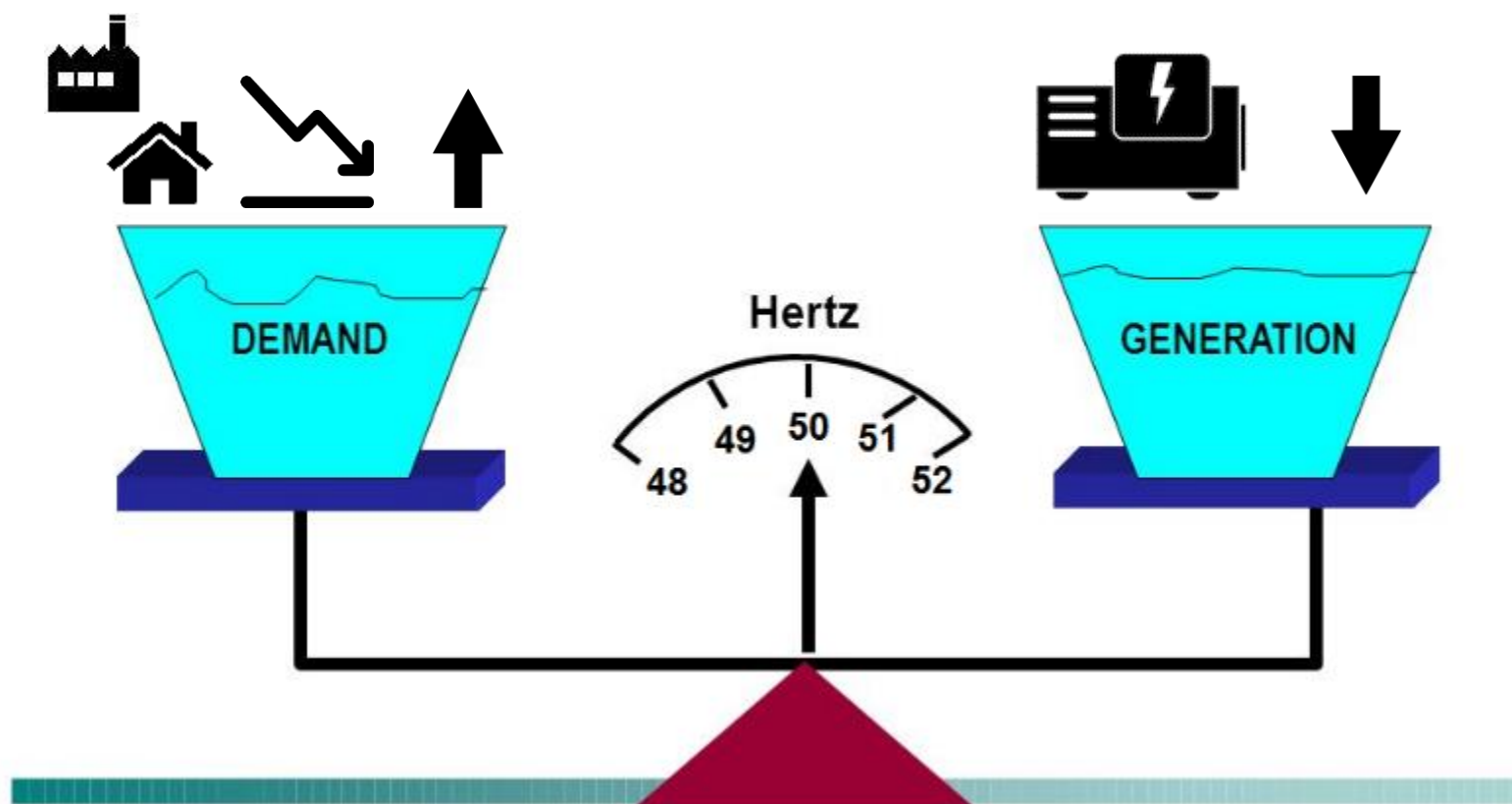
Leon Maruša



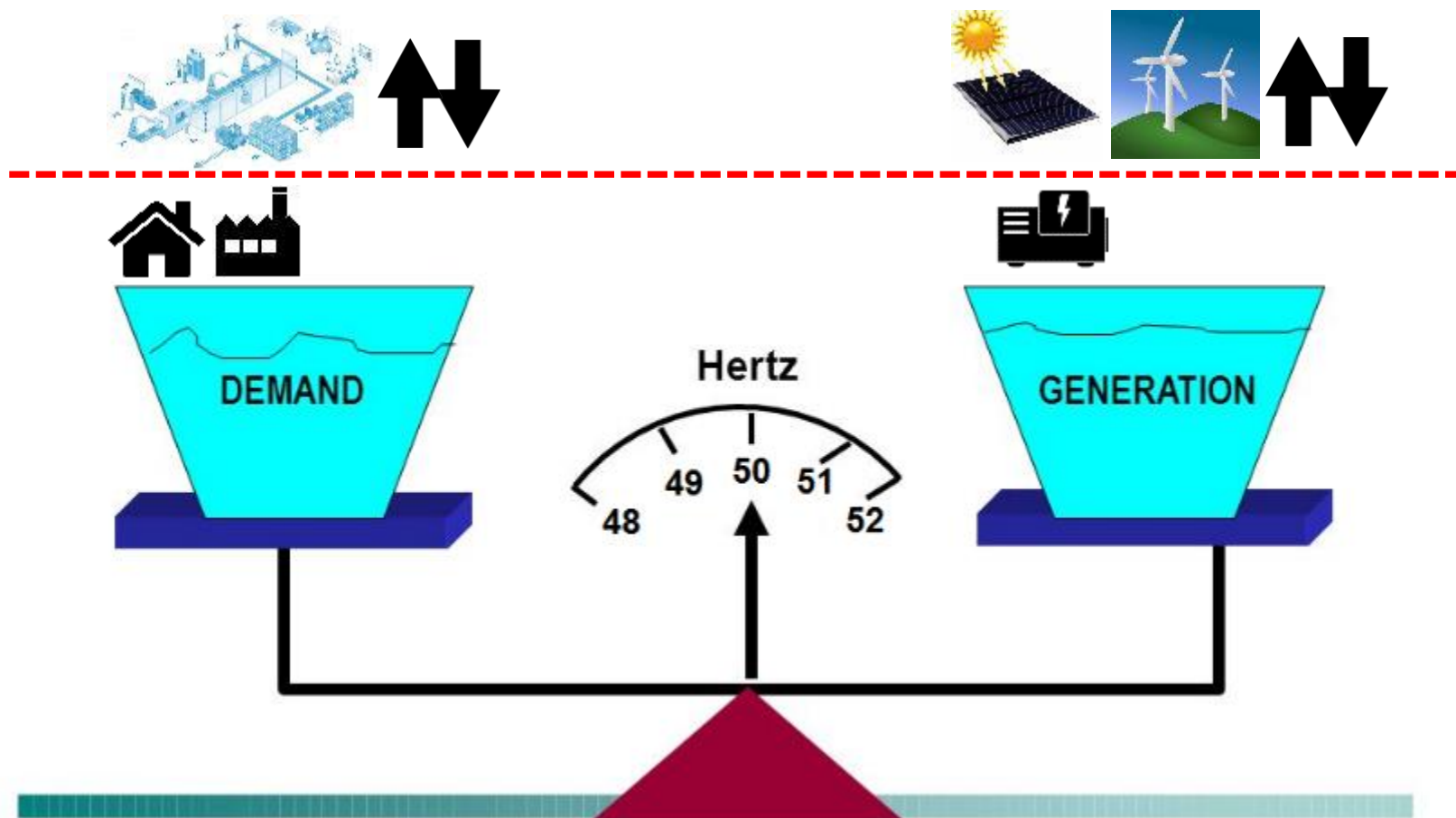
Elektro Ljubljana



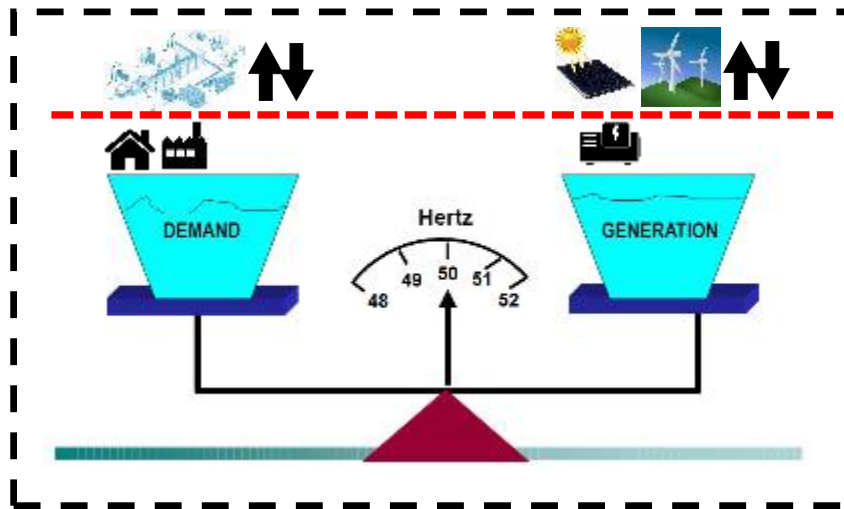
Proizvodnja in poraba



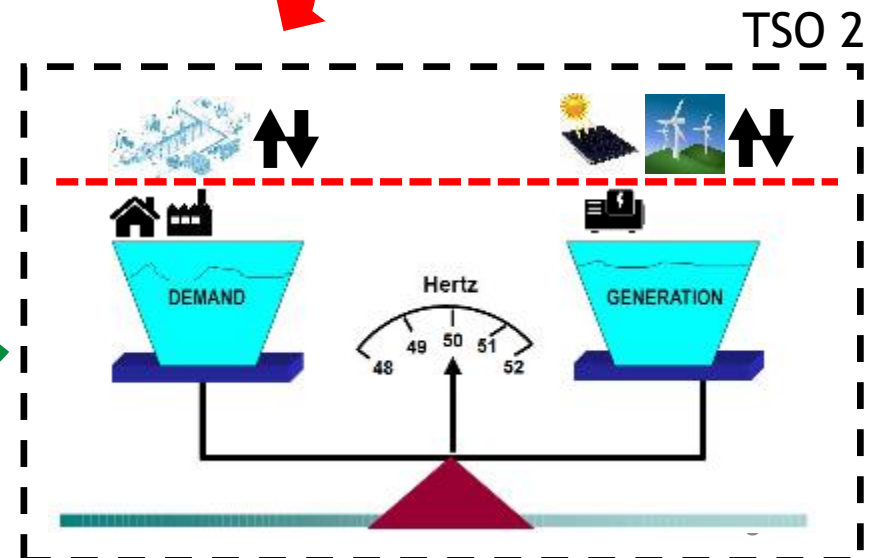
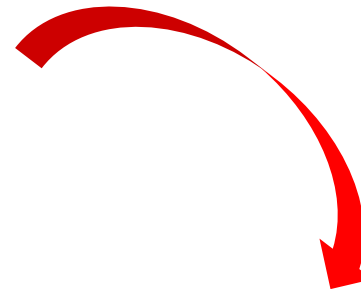
Proizvodnja in poraba



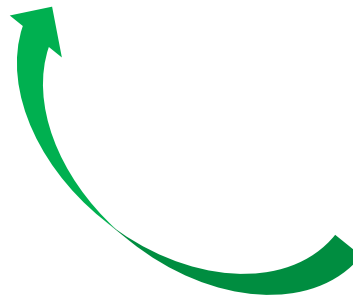
Proizvodnja in poraba



TSO 1



TSO 2



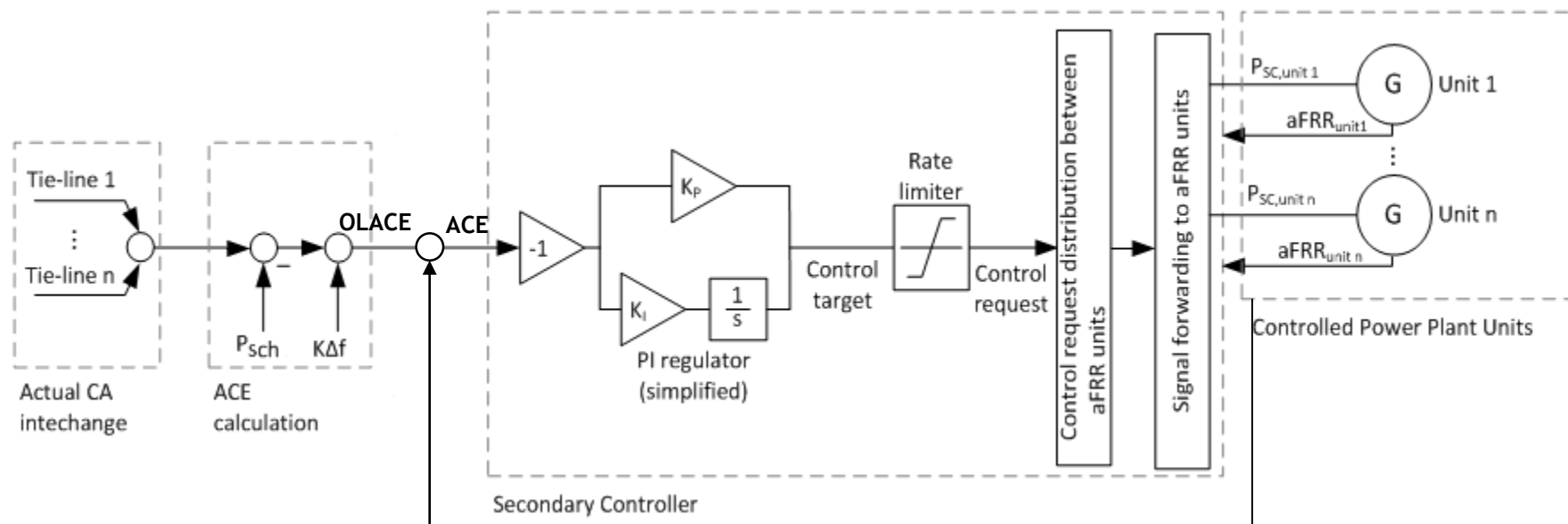
OLACE



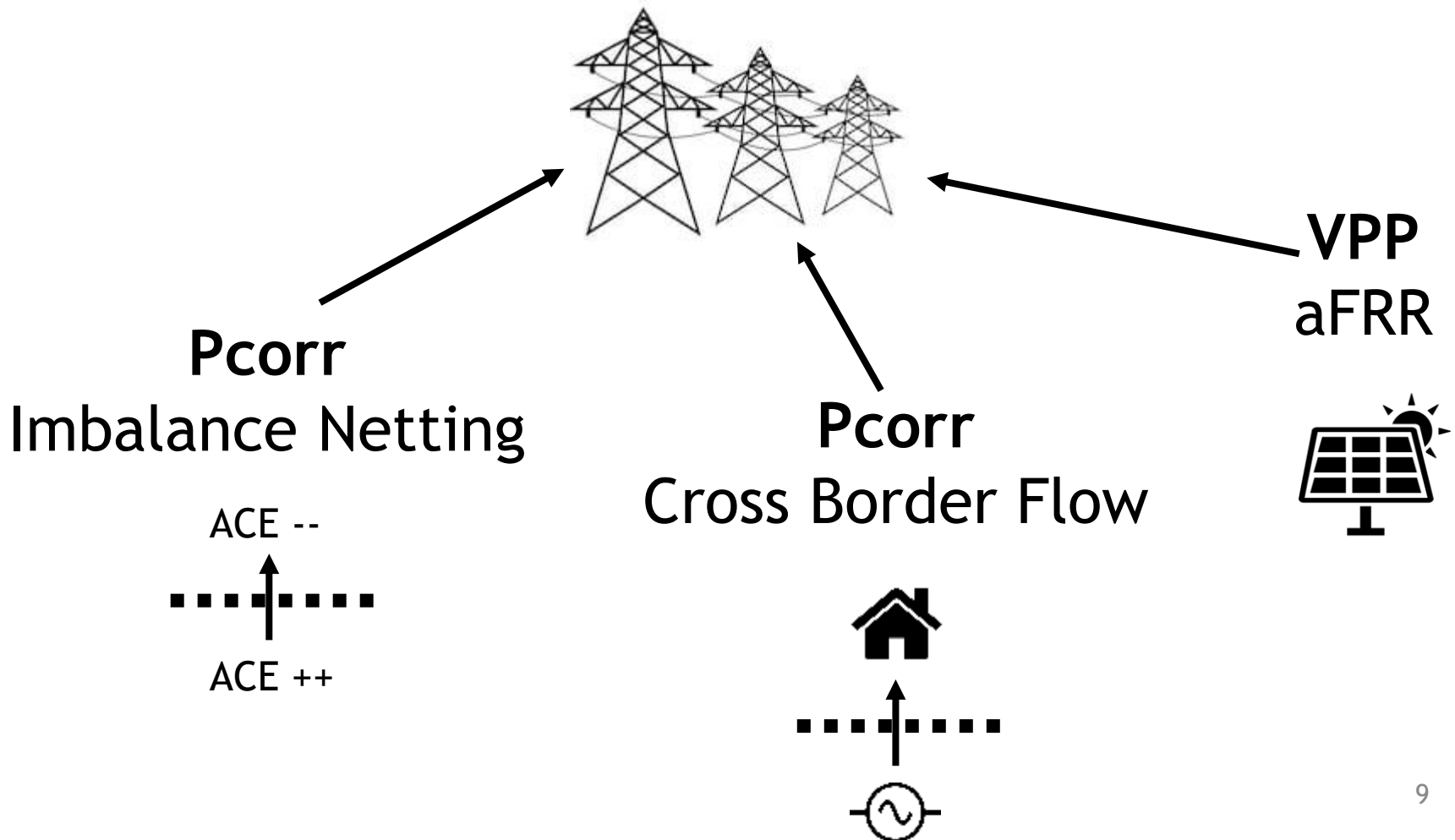
OLACE in ACE



Regulacijska shema - sedaj

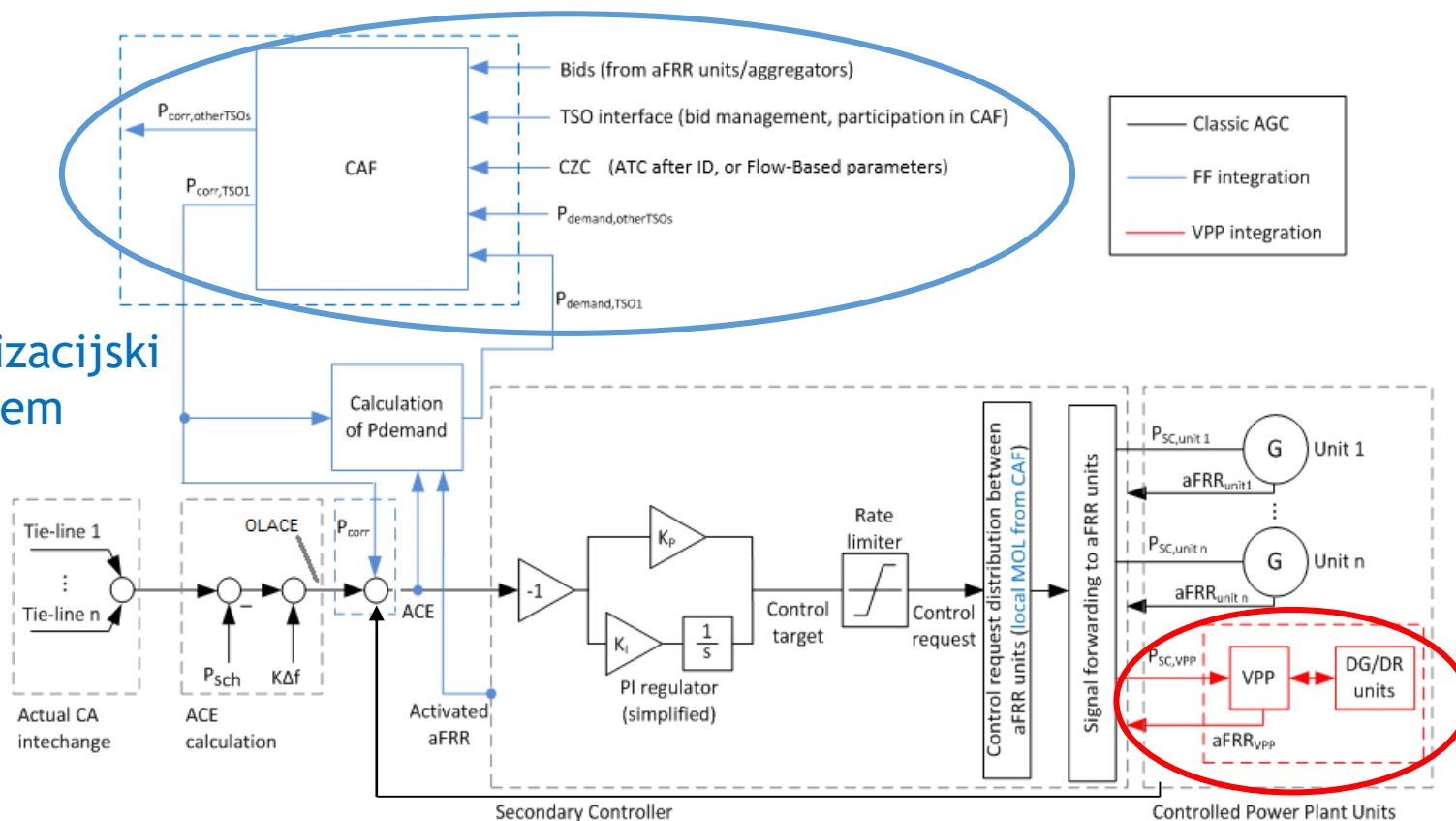


Balansiranje



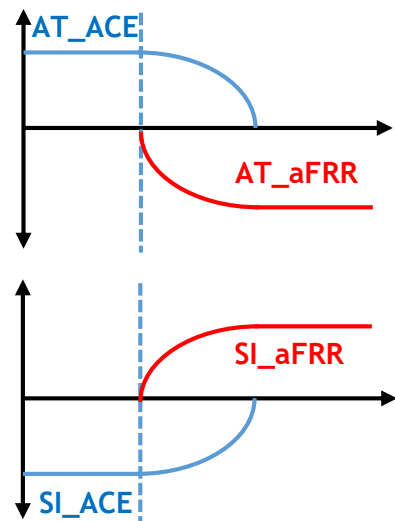
Regulacijska shema - FutureFlow

Optimizacijski
algoritem



Integracija virtualnih
elektrarn

P_{corrIN} - Imbalance netting

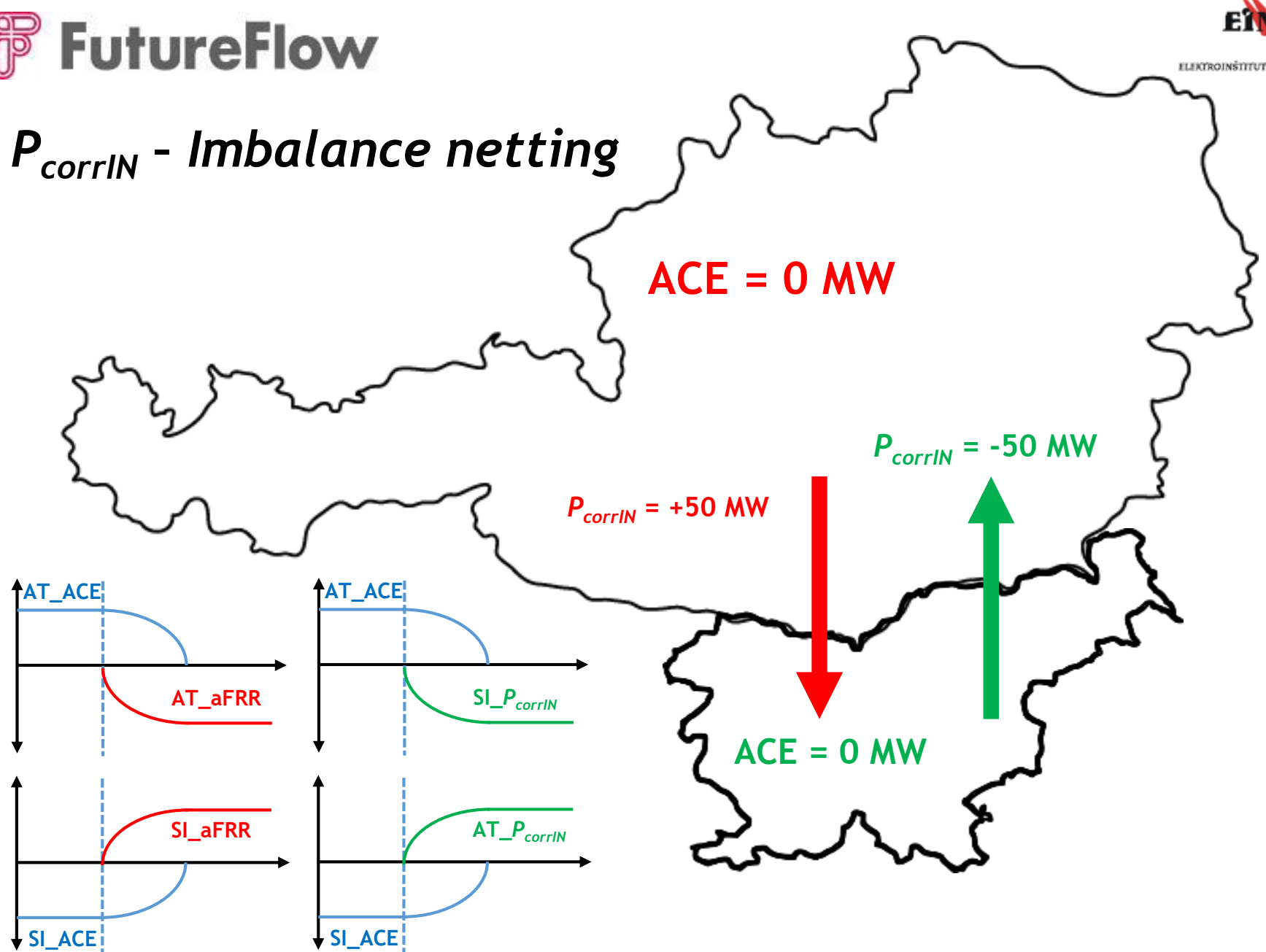


ACE = 0 MW

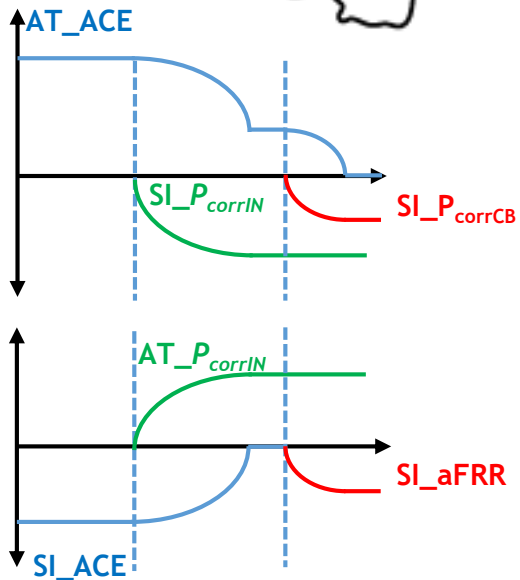
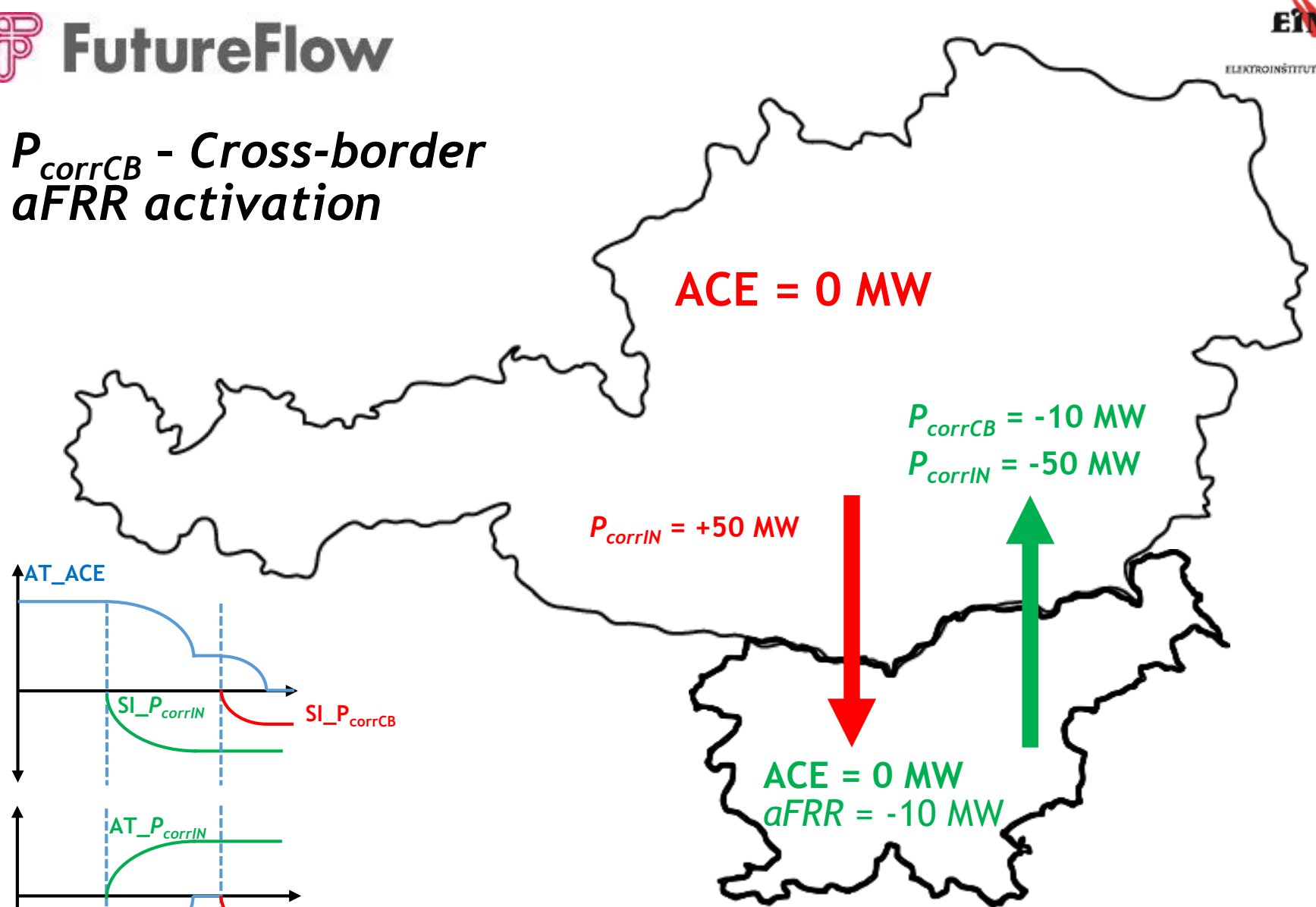
aFRR = -50 MW

ACE = 0 MW
aFRR = +50 MW

P_{corrIN} - Imbalance netting



P_{corrCB} - Cross-border
aFRR activation



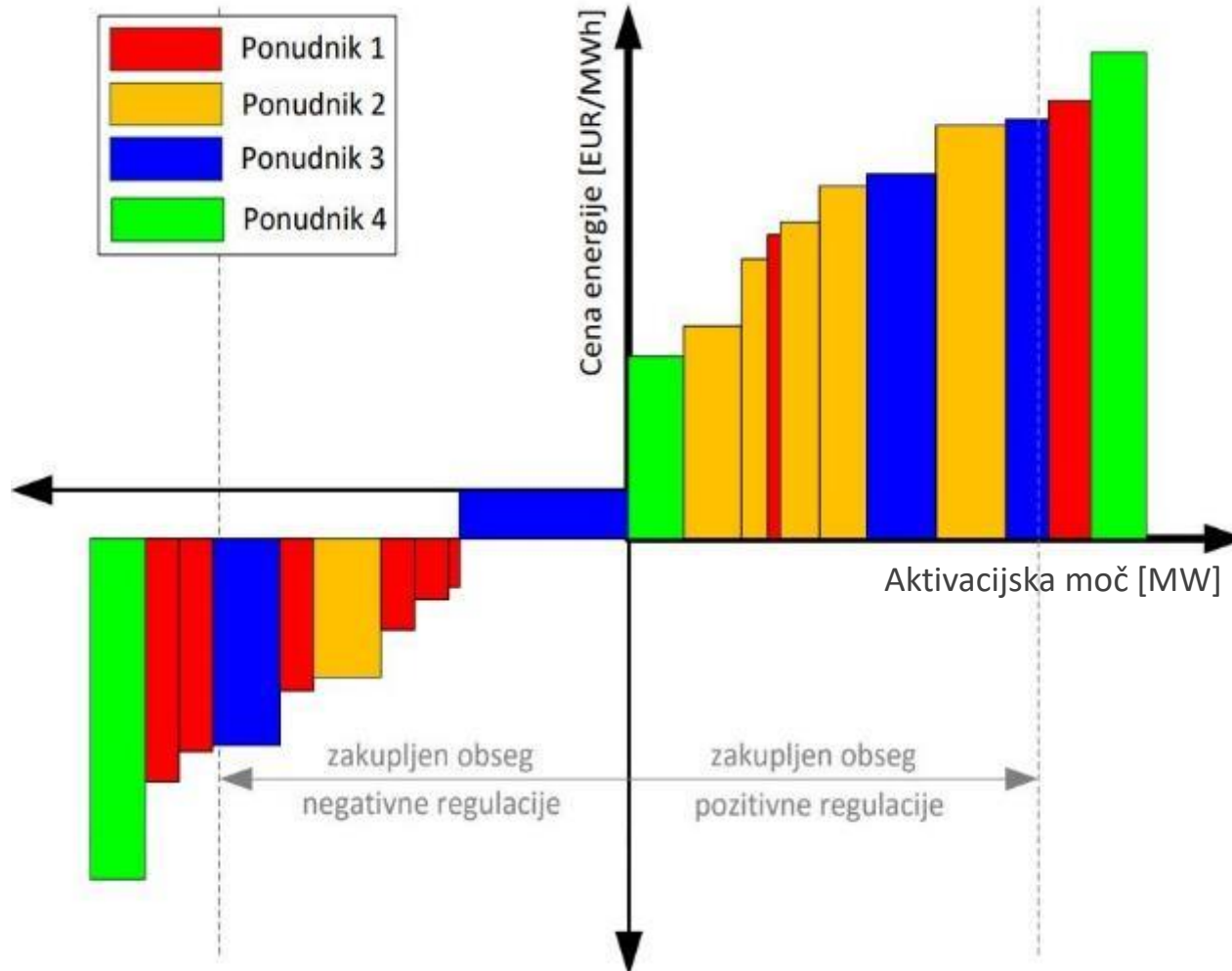
RAZVITA REŠITEV

PROGRAMSKA PLATFORMA

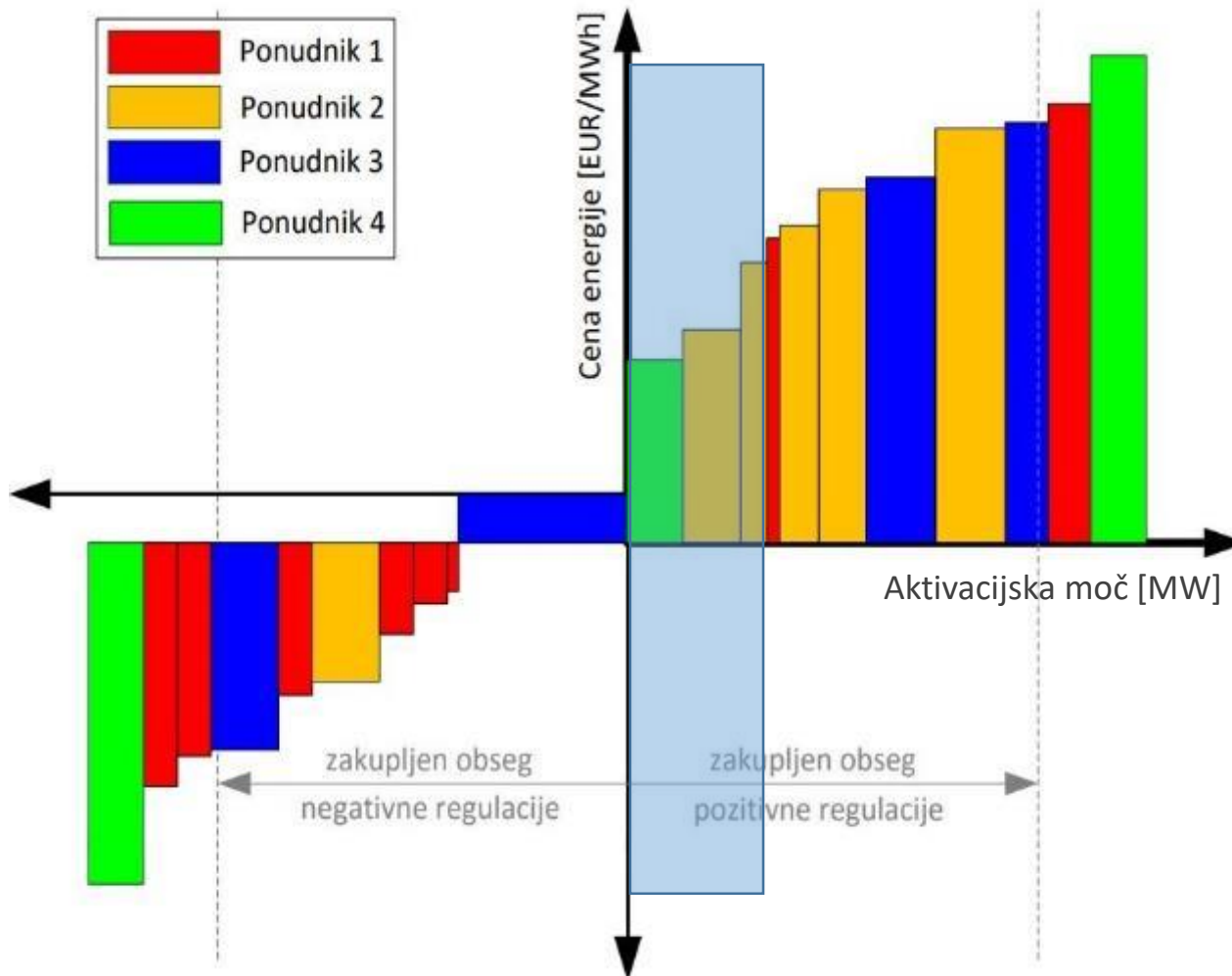
UPORABLJENA ORODJA

STORITVE PLATFORME

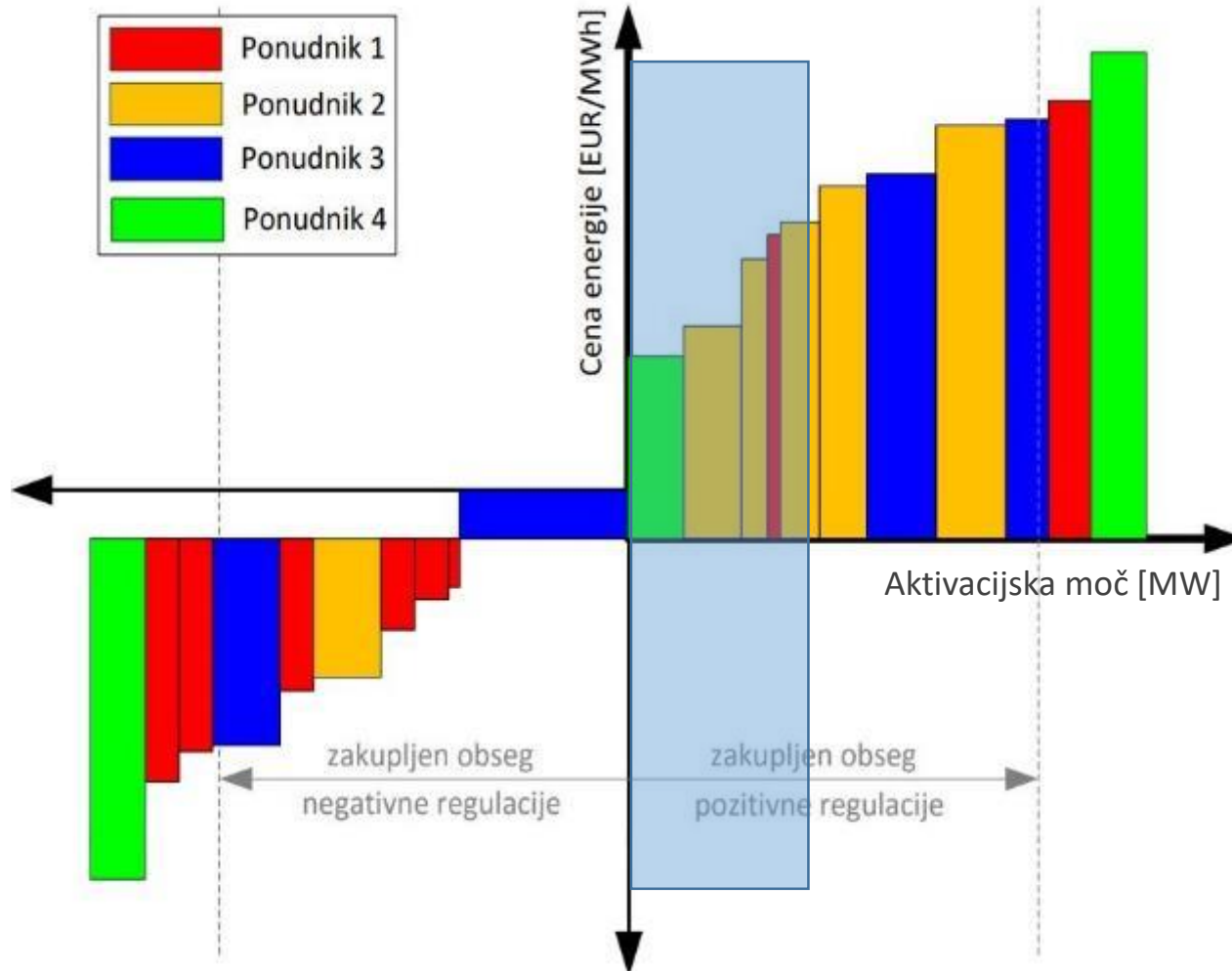
CMOL (Common Merit Ordered List)



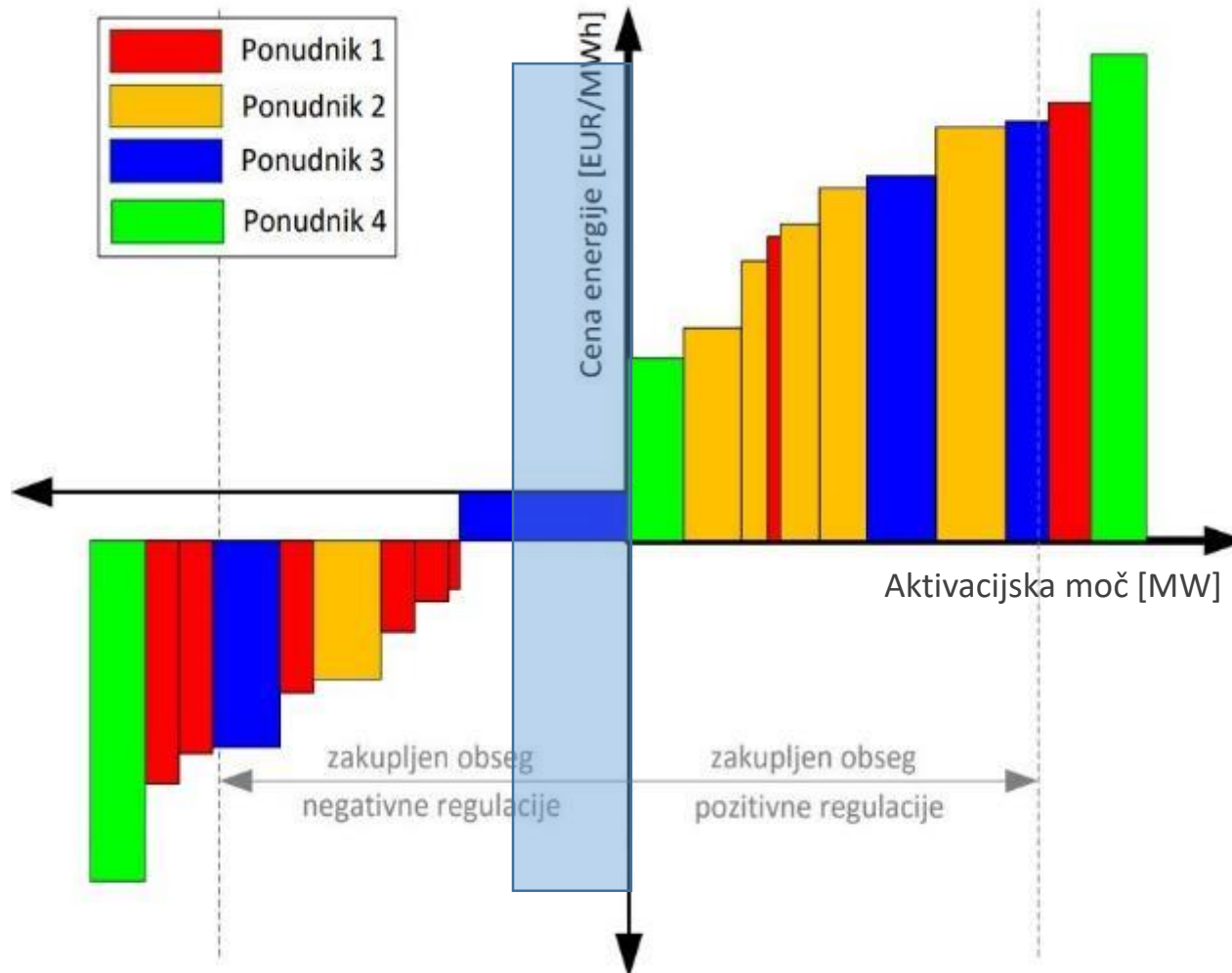
Primer aktivacije ($ACE < 0$)



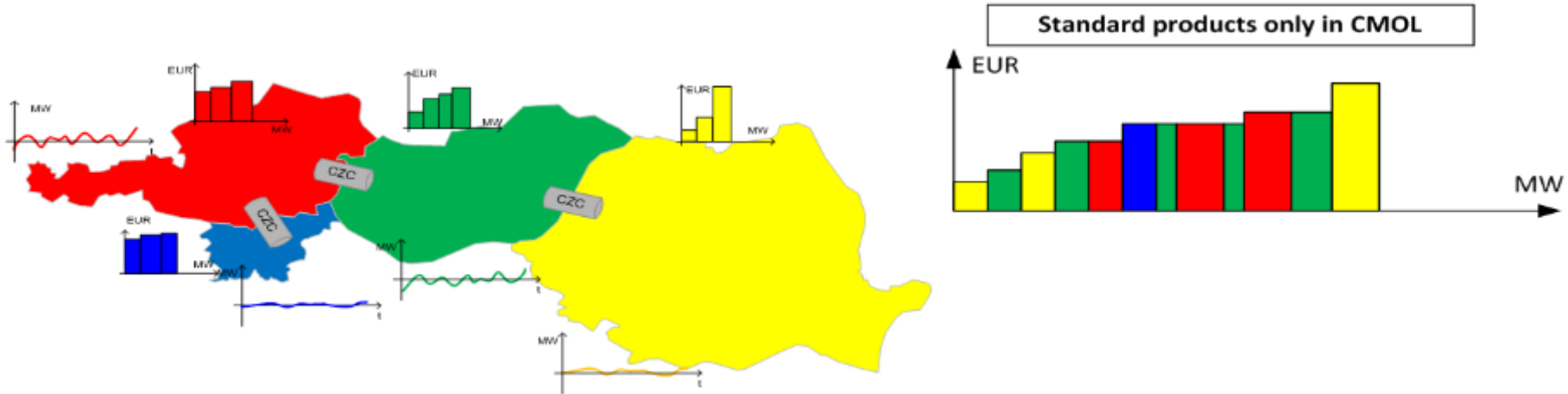
Primer aktivacije ($ACE < 0$)



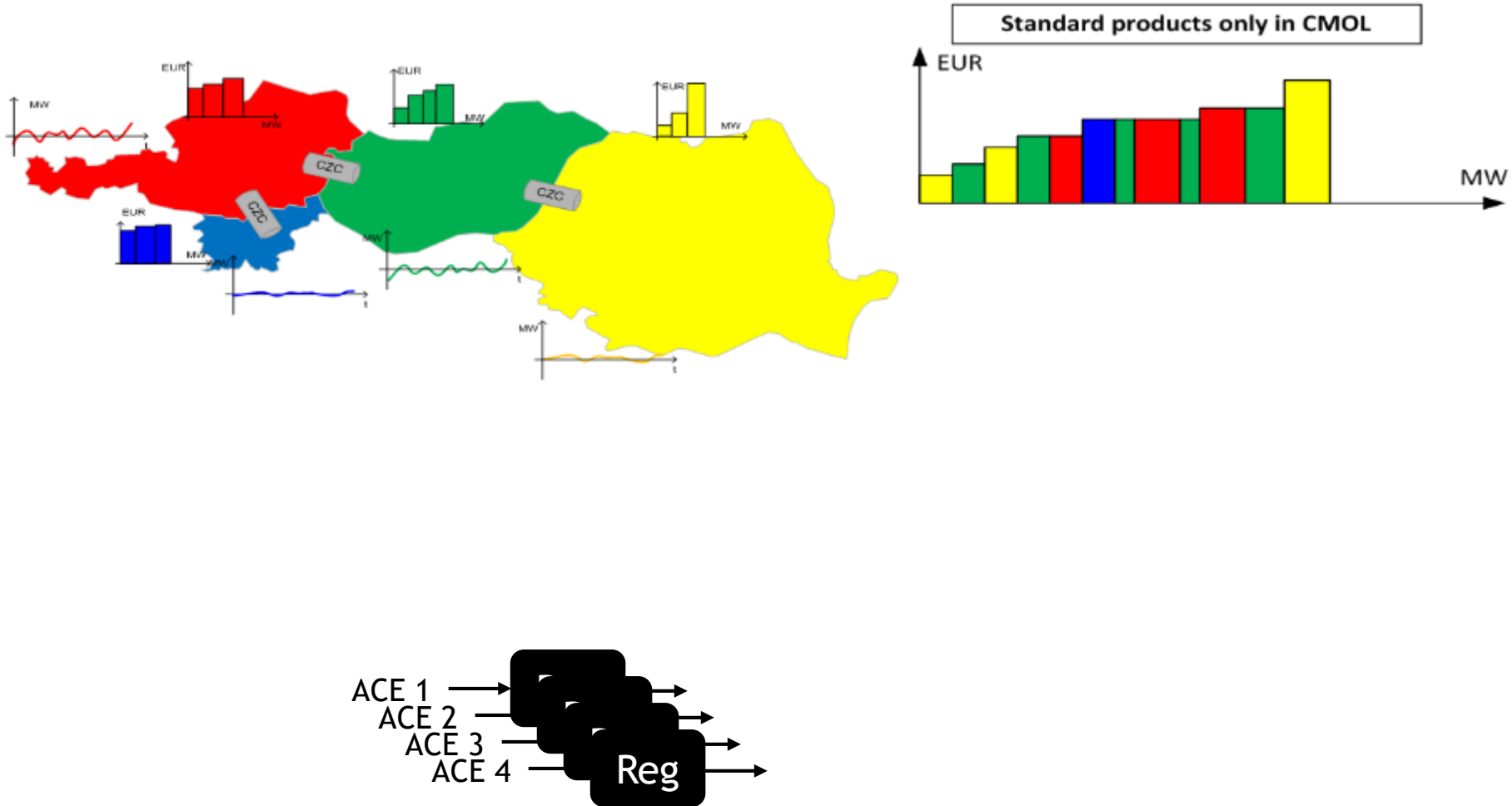
Primer aktivacije (ACE > 0)



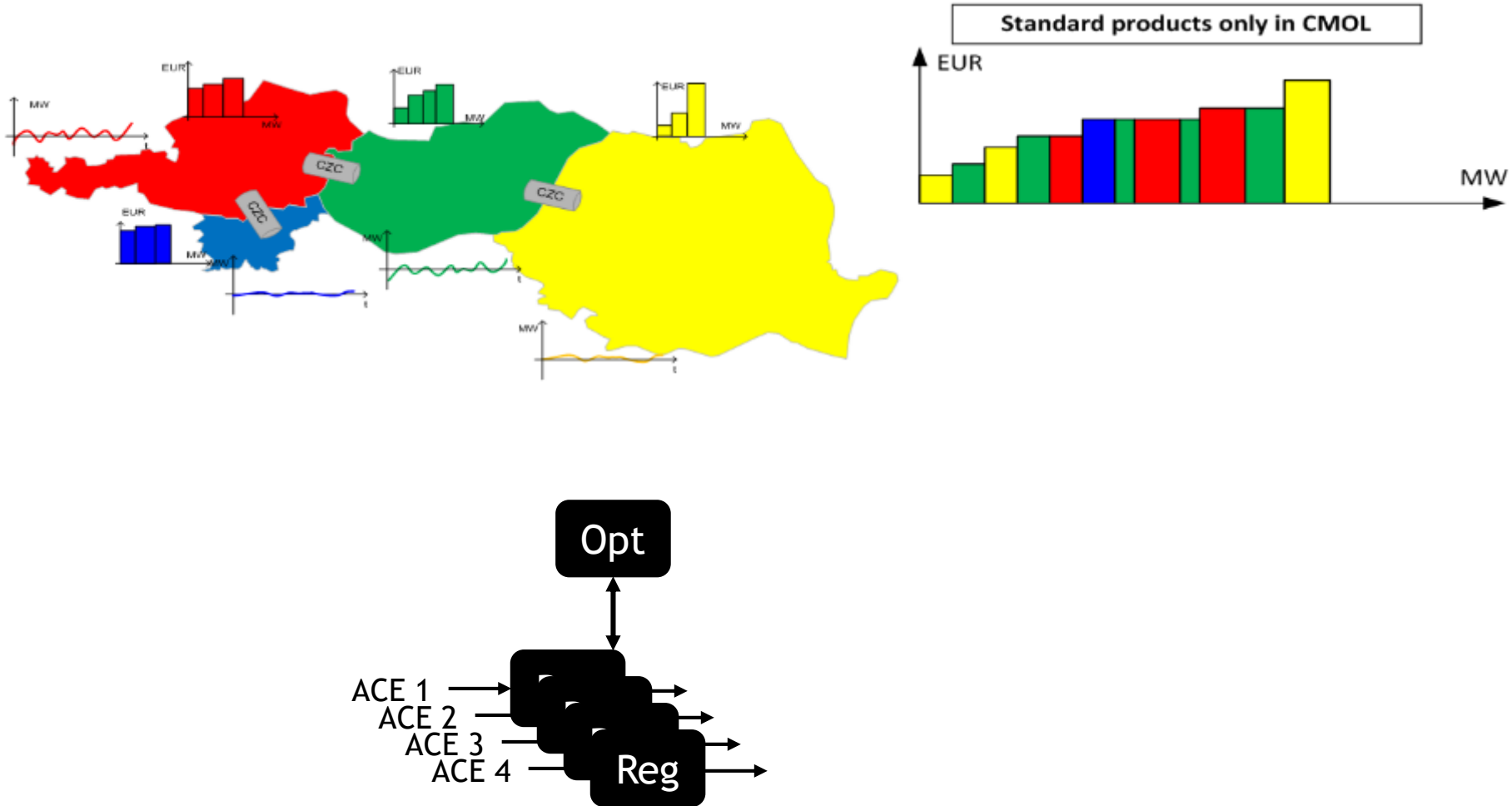
Razvoj DEMO platforme



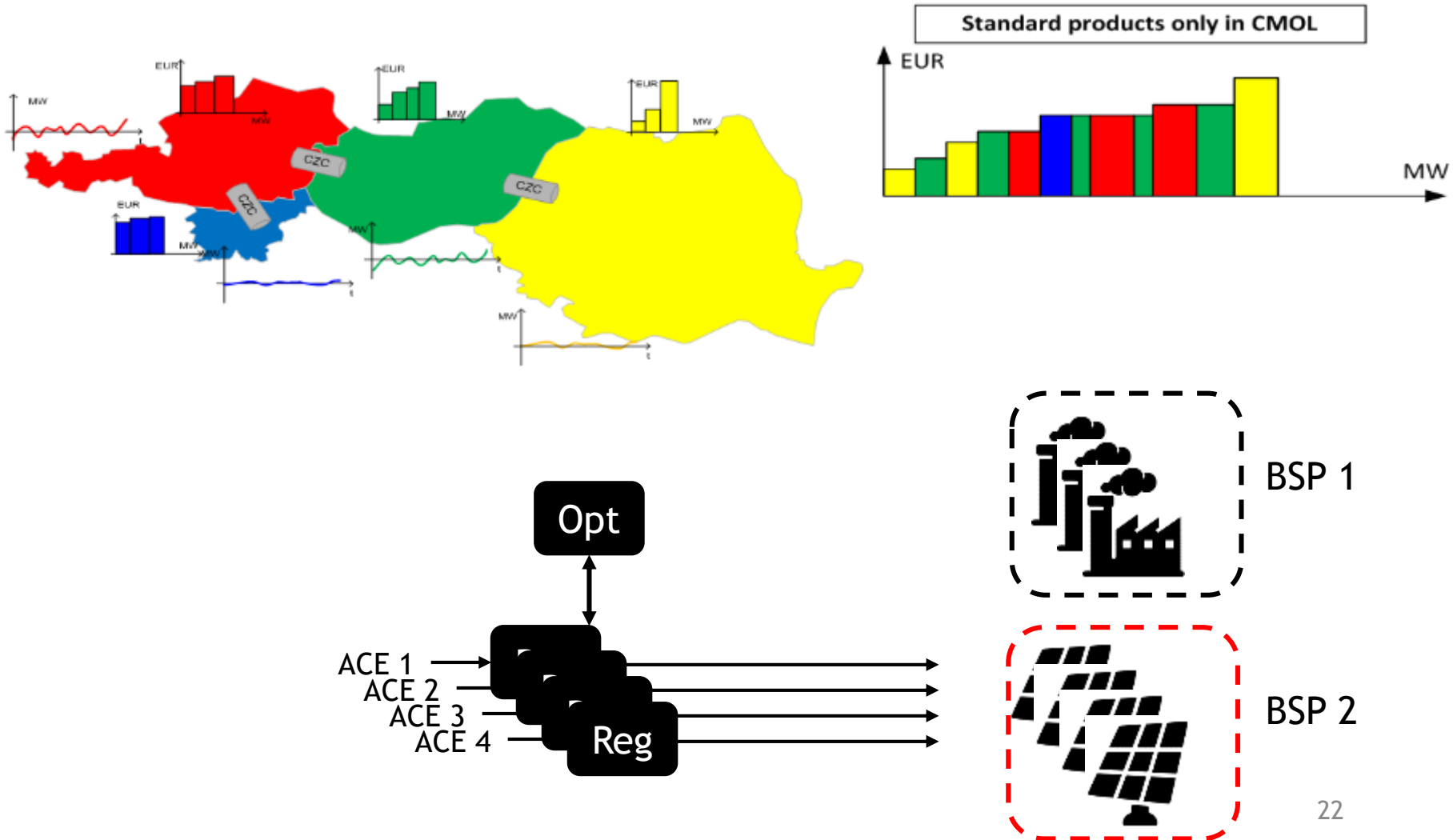
Razvoj DEMO platforme



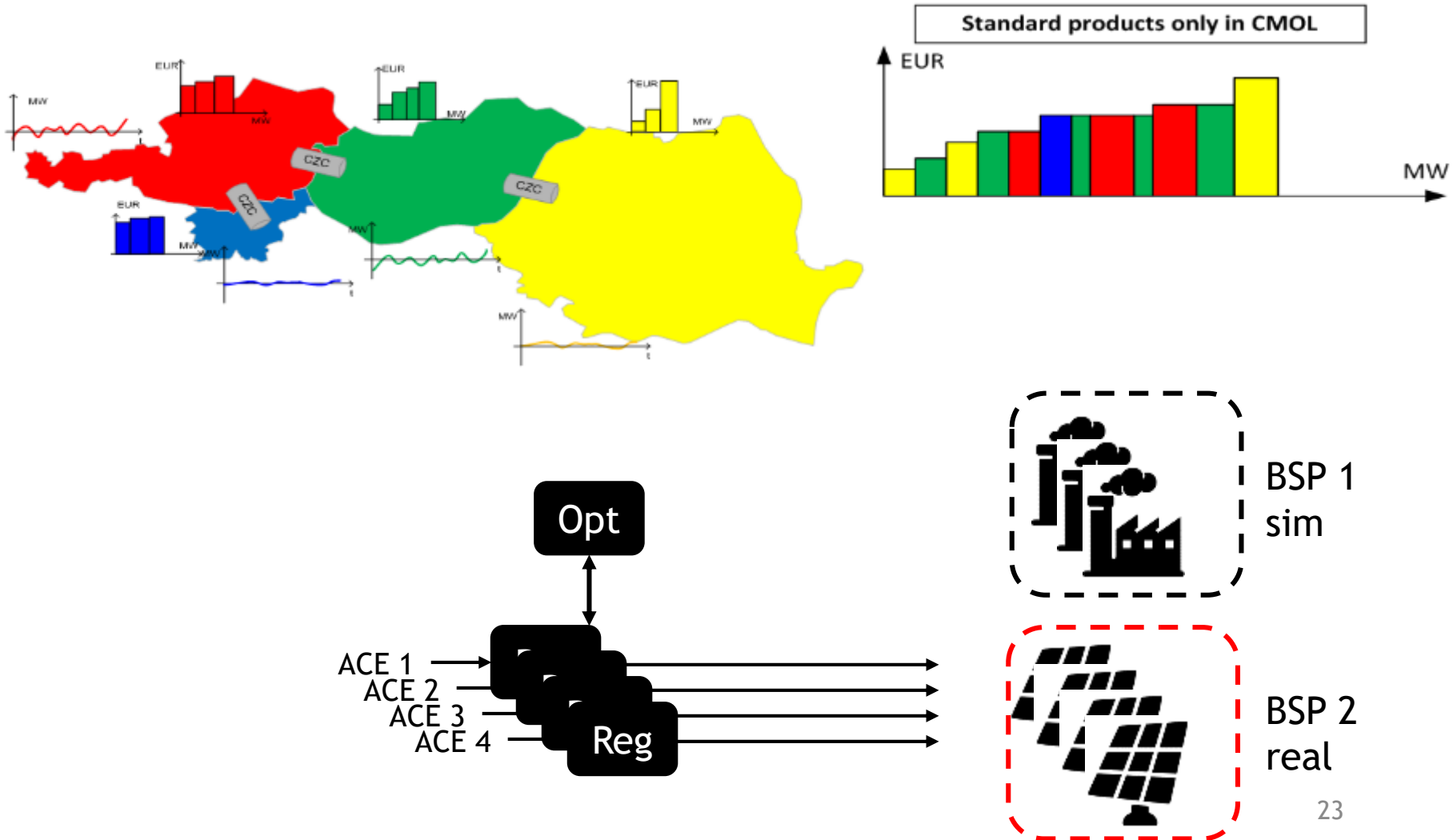
Razvoj DEMO platforme



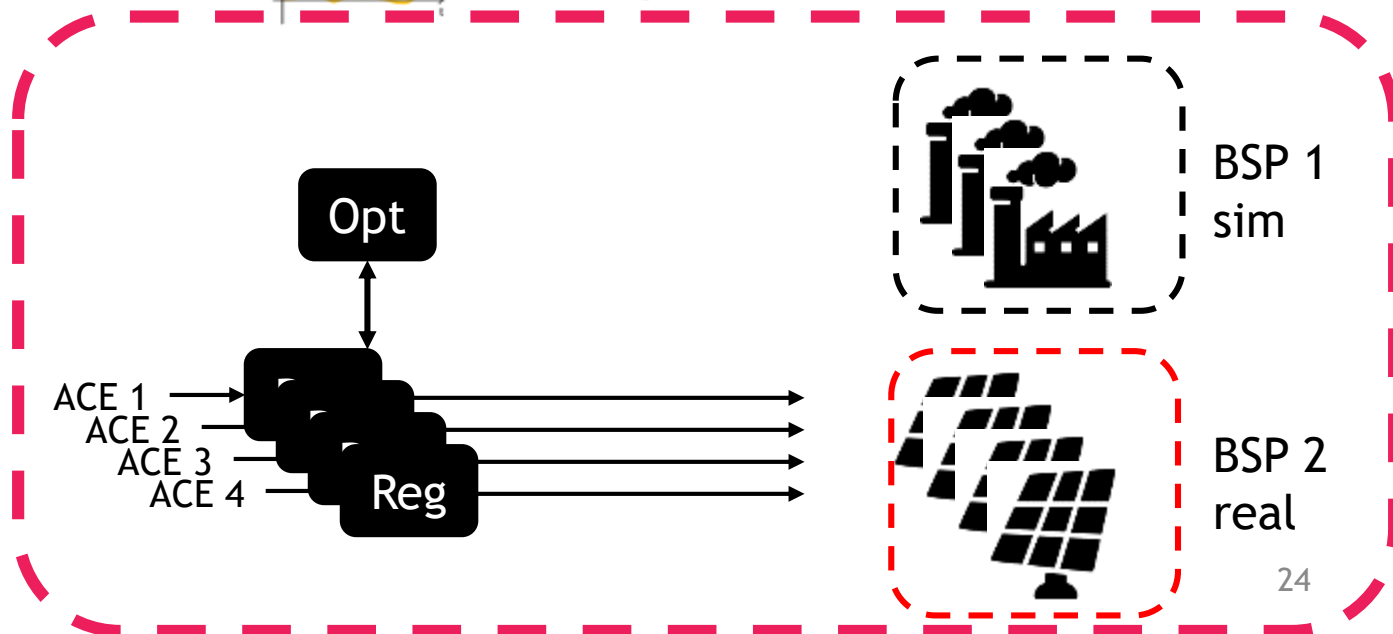
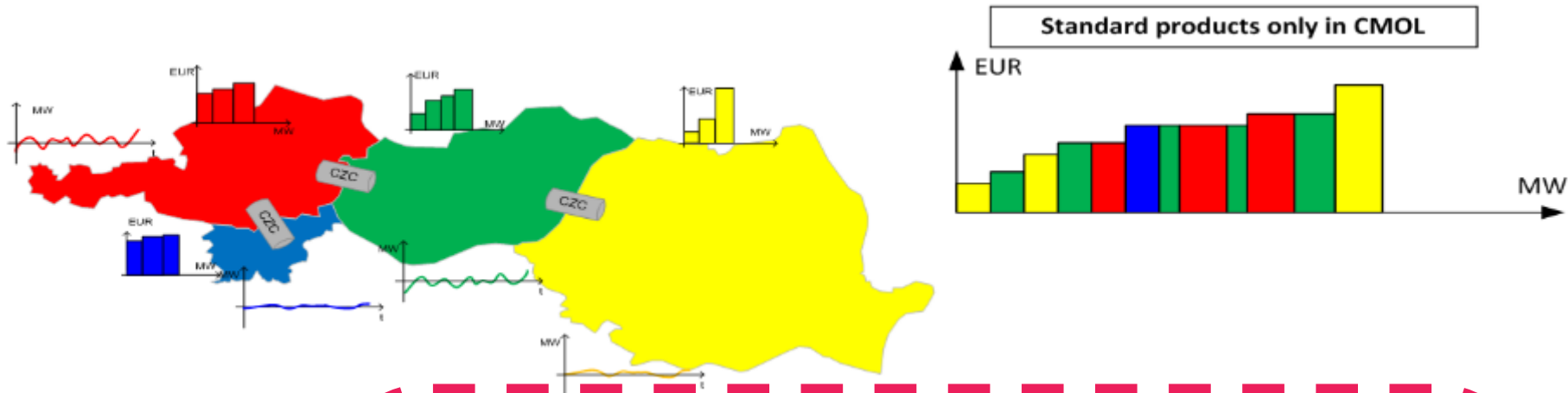
Razvoj DEMO platforme



Razvoj DEMO platforme

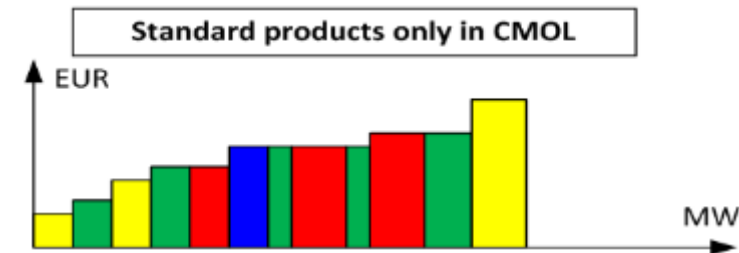
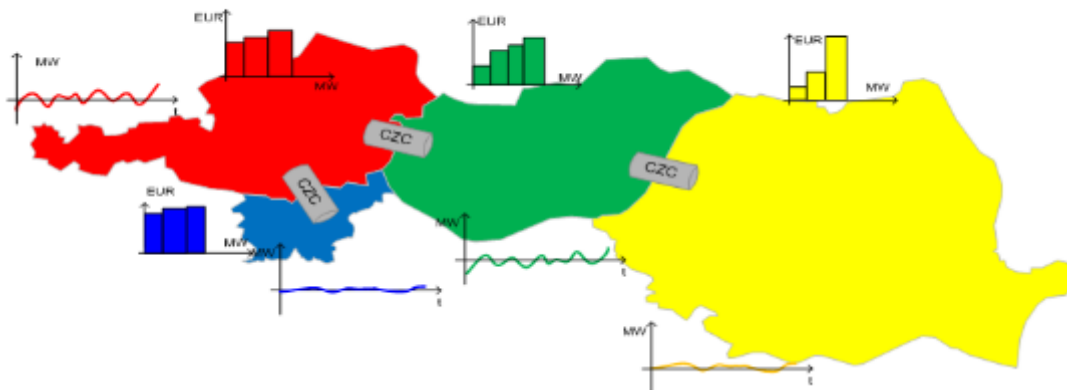


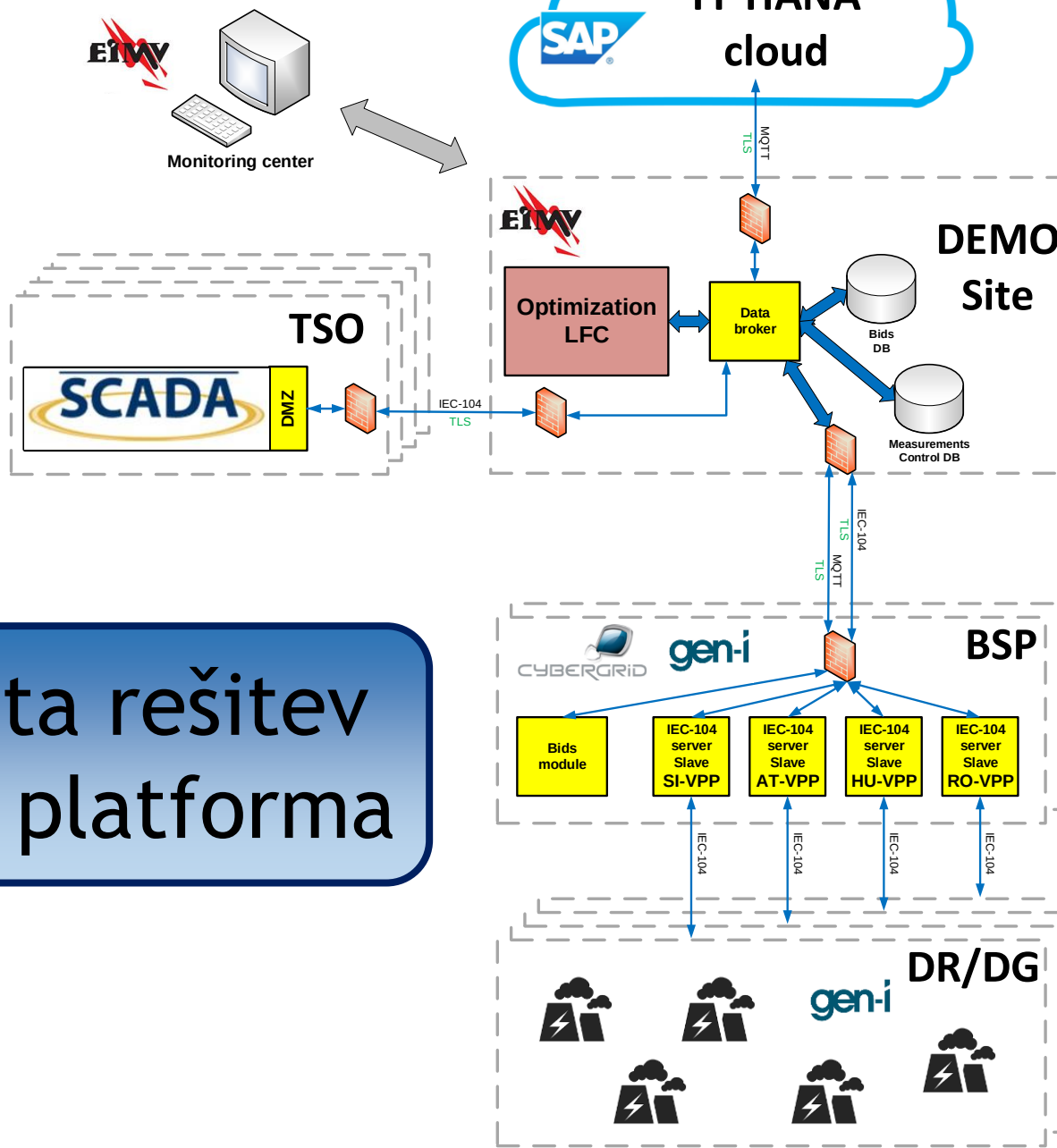
Razvoj DEMO platforme



Razvoj DEMO platforme

- Komunikacije: BSP-TSO-DEMO (standardizirani protokoli)
- Simulacija TSO sek. regulatorja
- Simulacija BSP ponudnikov
- Lokalna/globalna optimizacija
- Razvoj storitev za TSO in BSP





Razvita rešitev
DEMO platforma

DEMO platforma



Komunikacijski protokoli

VPP:	IEC 60870-5-104, TLS
Bidding in optimizacija	MQTT (XML, CIM-XSD), TLS
TSO SCADA	ICCP -> OPC DA -> NMEA, TLS
Monitoring web vmesniki	HTML/CSS/JS, JSON, XML, LP
Interni pretok podatkov	• MQTT (LP (Line protocol)) • NMEA • M/S binary protocol

Uporabljena orodja

Regulacija in lok. Optimizacija	Matlab & Simulink
Virtualizacija	Docker
MQTT broker	Mosquitto
Podatkovne baze	InfluxDB, MariaDB
Komponente za InfluxDB	Telegraf, Kapacitor
IEC 60870-5-104	IEC104Bridge (posebej razvita)
TLS enkripcija	Stunnel
Data Traffic sonda	SmartSNO, SmartNIM
Web vmesniki	NginX
Parser aplikacije	posebej razvite (Java, Python, C++ & Qt)
Vizualizacija	Grafana

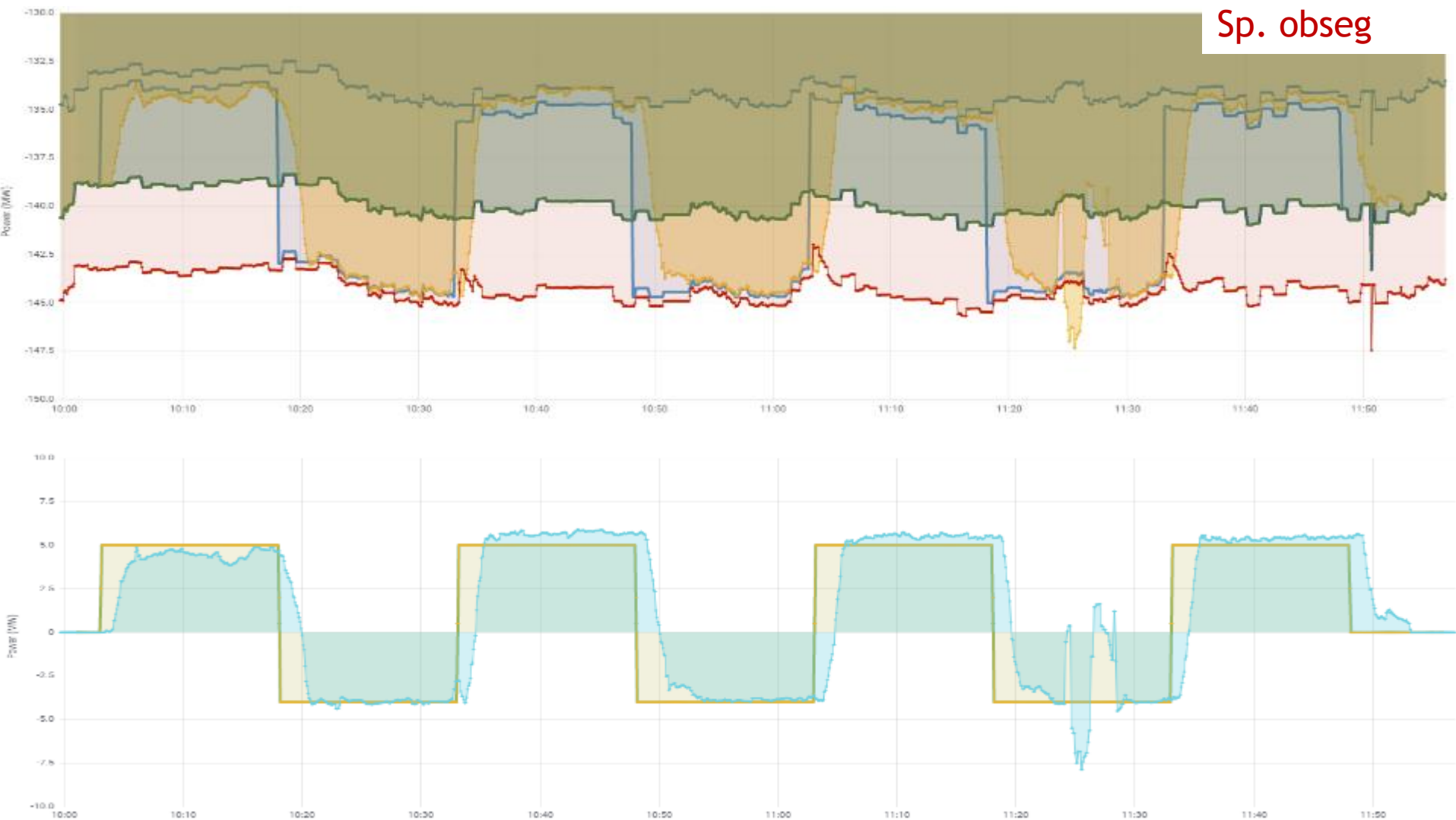
Storitve za BSP

- Testiranja odzivov:
 - Predkvalifikacijski testi
 - ACE scenariji
 - Spremembe CMOL
- Odkrivanje napak v VPP delovanju
- Vrednotenje odziva - ovojnica

Preqtest - stopnice

VPP-SI

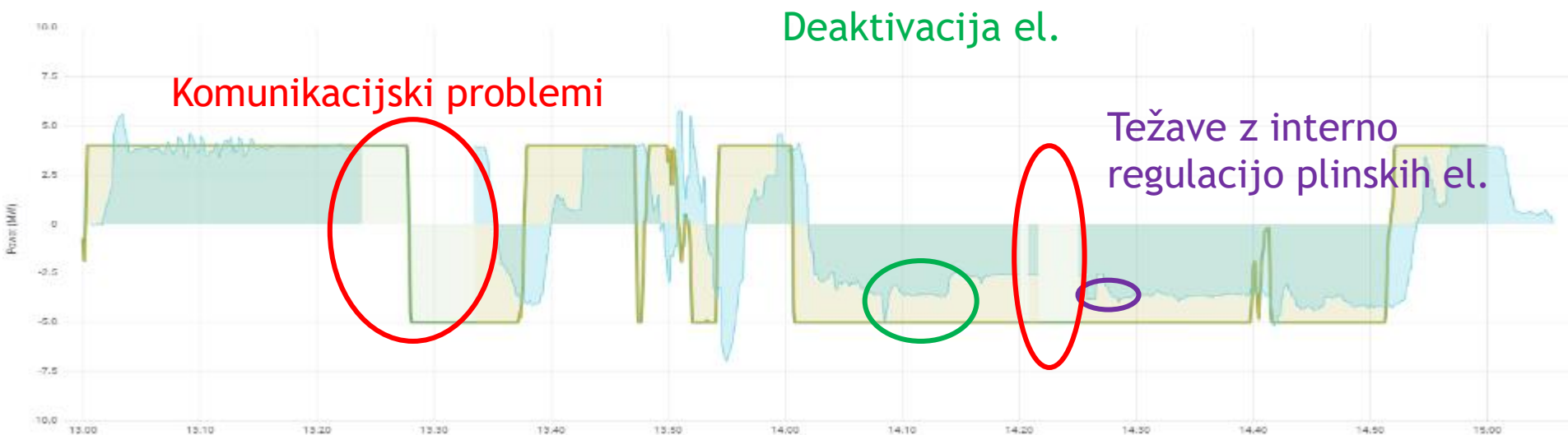
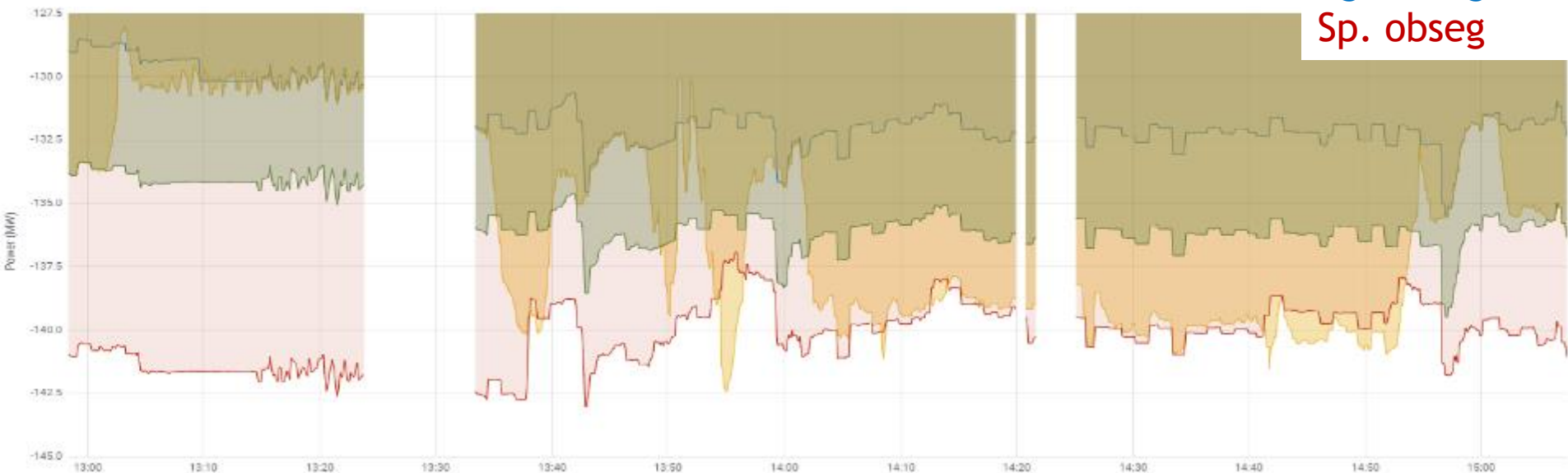
Polna moč
Bazna moč
Zg. obseg
Sp. obseg

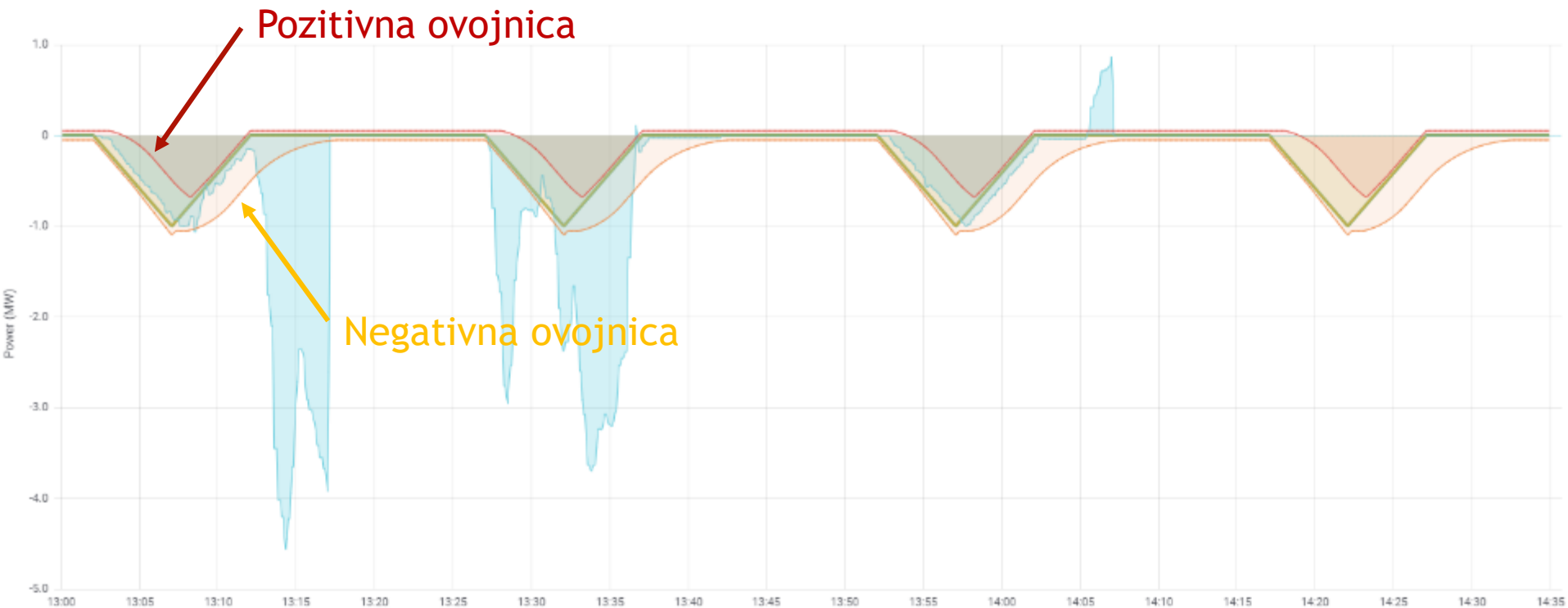


Realni test - +/- ACE

VPP-SI

Polna moč
Bazna moč
Zg. obseg
Sp. obseg





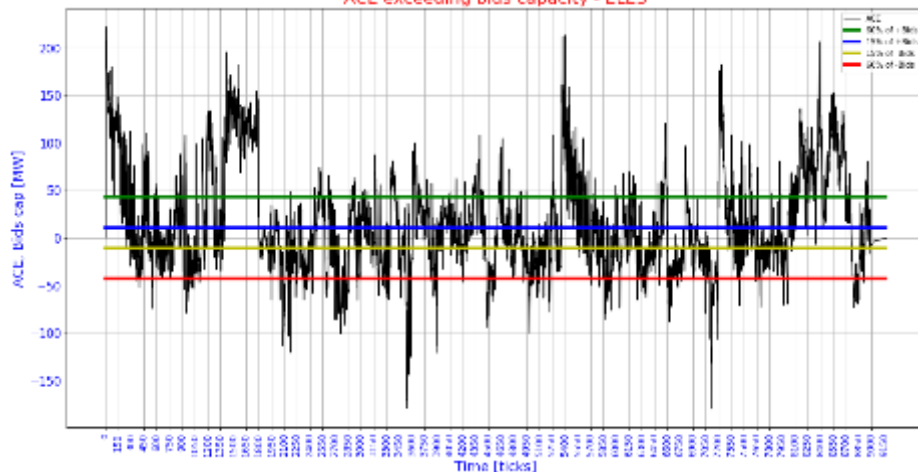
Storitve za TSO

- Izračun KPI:
 - Tehnični
 - Ekonomski
- Testiranje ustreznosti BSP za nudenje sek. regulacije.

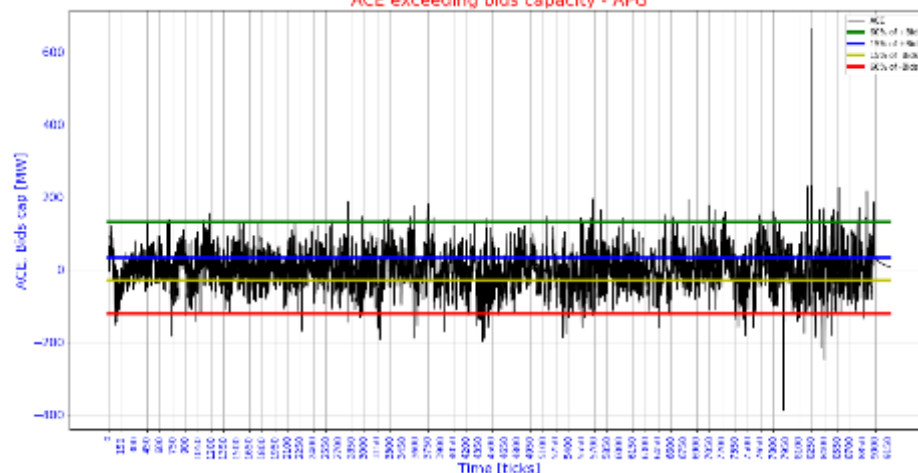


Primer: Tehniční KPI - ACE dogodki

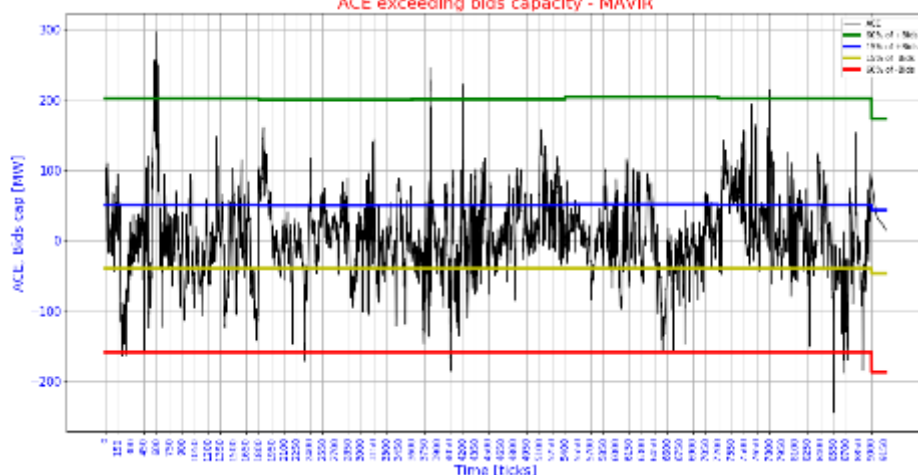
ACE exceeding bids capacity - ELES



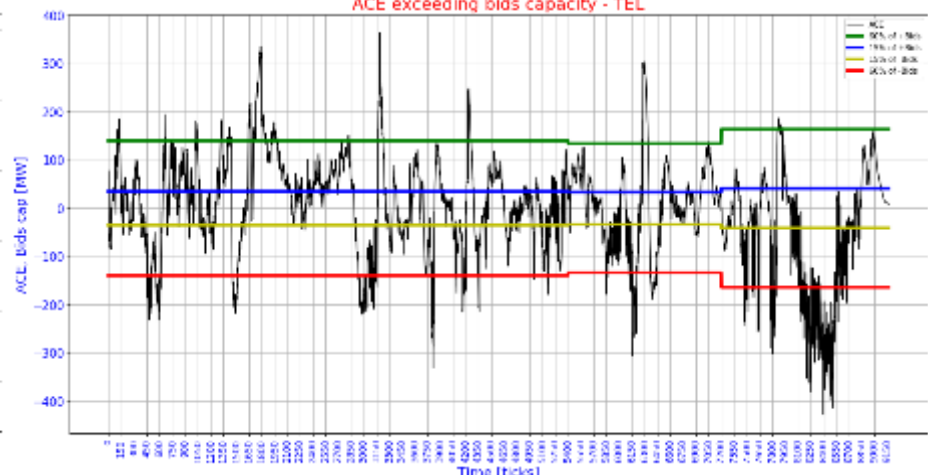
ACE exceeding bids capacity - APG



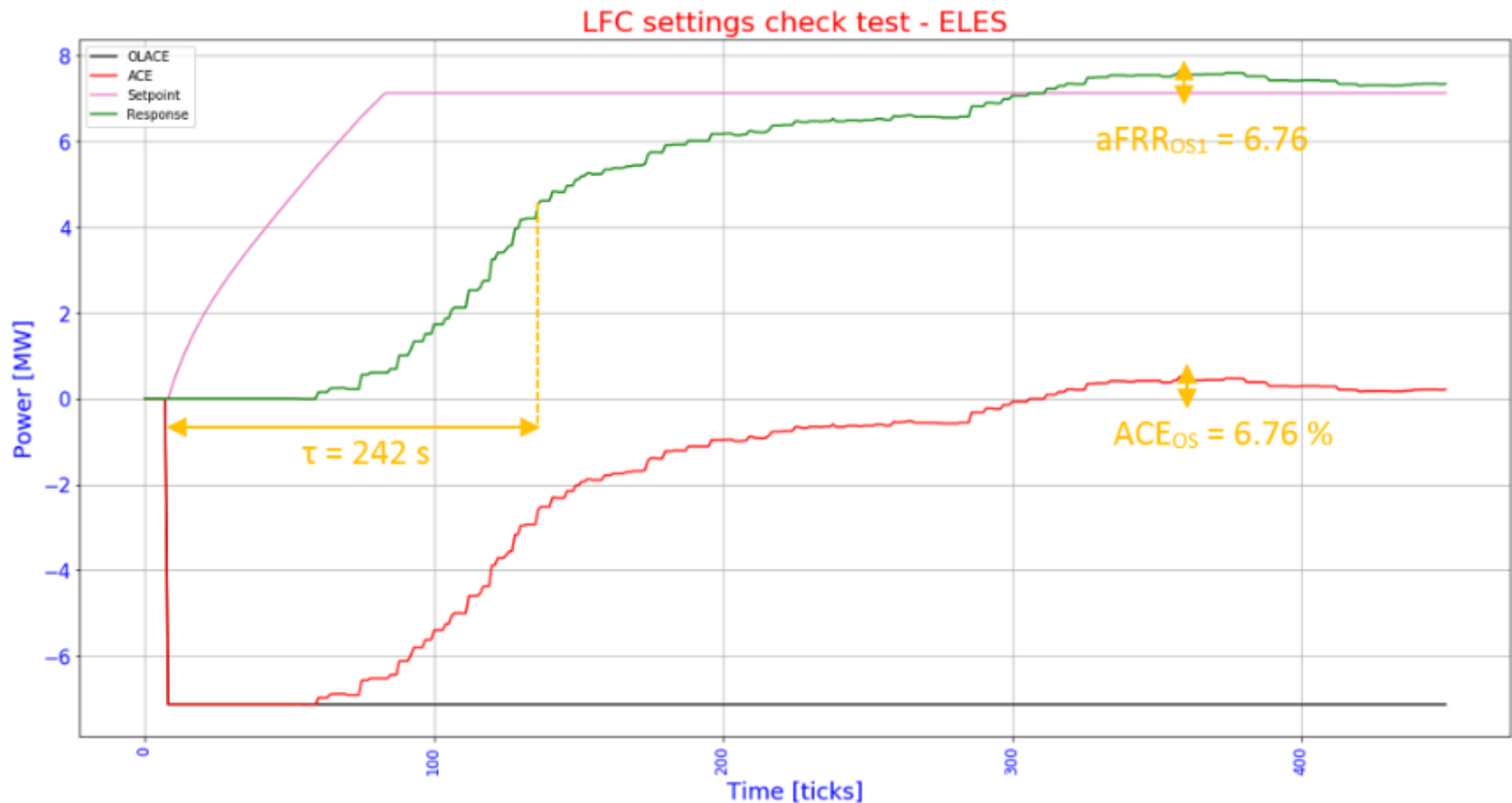
ACE exceeding bids capacity - MAVIR



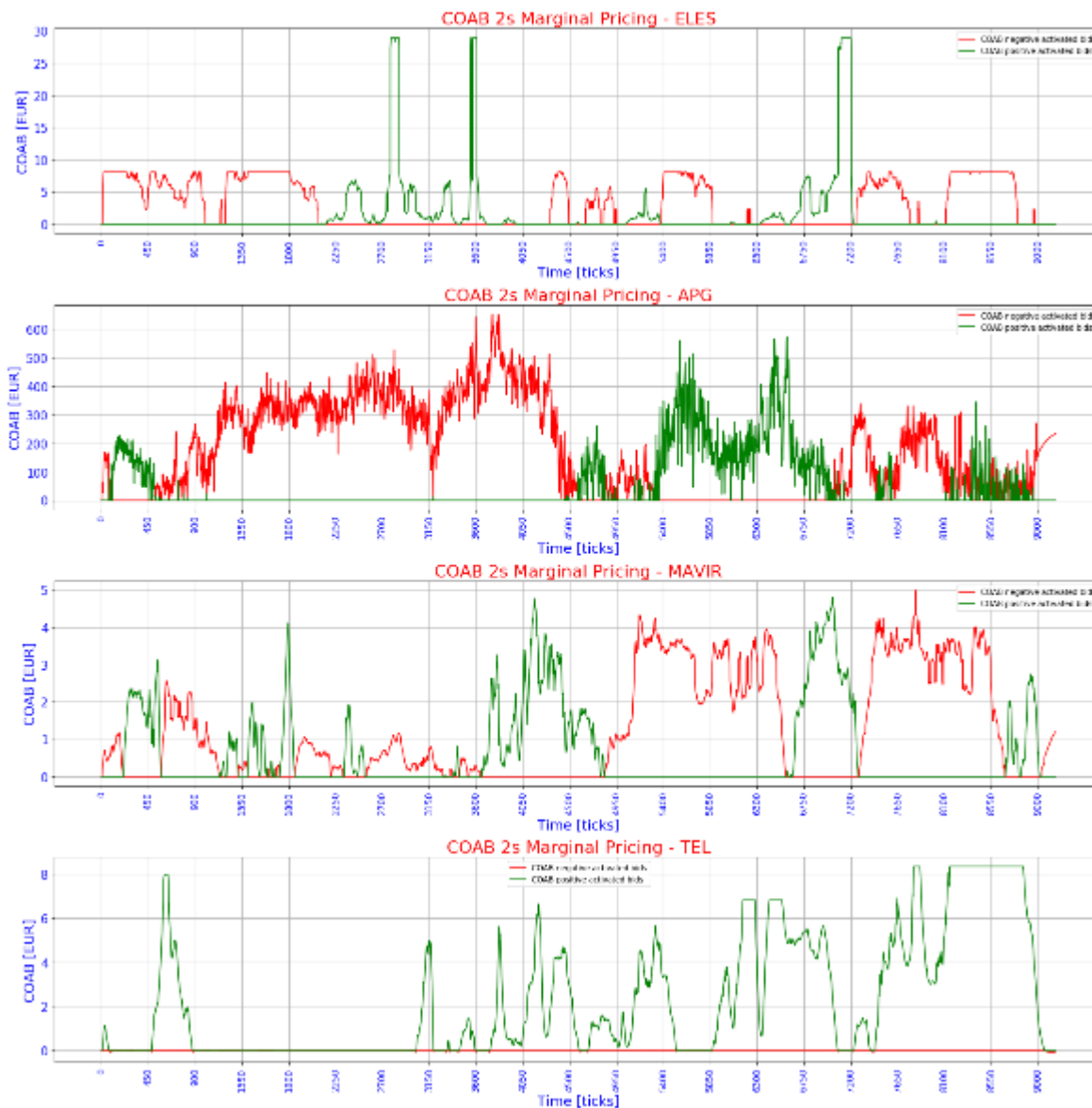
ACE exceeding bids capacity - TEL



Primer: Tehnični KPI - LFC settings



Primer: Ekonomski KPI - cena energije (shema MP2s)



Primer: Ekonomski KPI - cena energije (shema MP15m)

