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Impact of RES in Croatia to usage of ancillary services

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Portfolio description

- South East Europe versus Western Europe
  - Technical, infrastructural, market, hydrological and other similarities & differences
  - Congestions vs Pan-European network singularity
    - Financ. (forward) vs Phys. Long term Cap. Alloc.
    - NTC vs Flow based method in CORE CCR
    - Day ahead coupling
    - XBID – intraday coupling – implicit & explicit CA
    - AS and BE coupling (GLEB)
    - Bidding zone review
    - TYNDP 2018

„Software measures„

„Hardware measures„

Similarities between SEE and WE&NE regarding ancill. services and balanc. en.

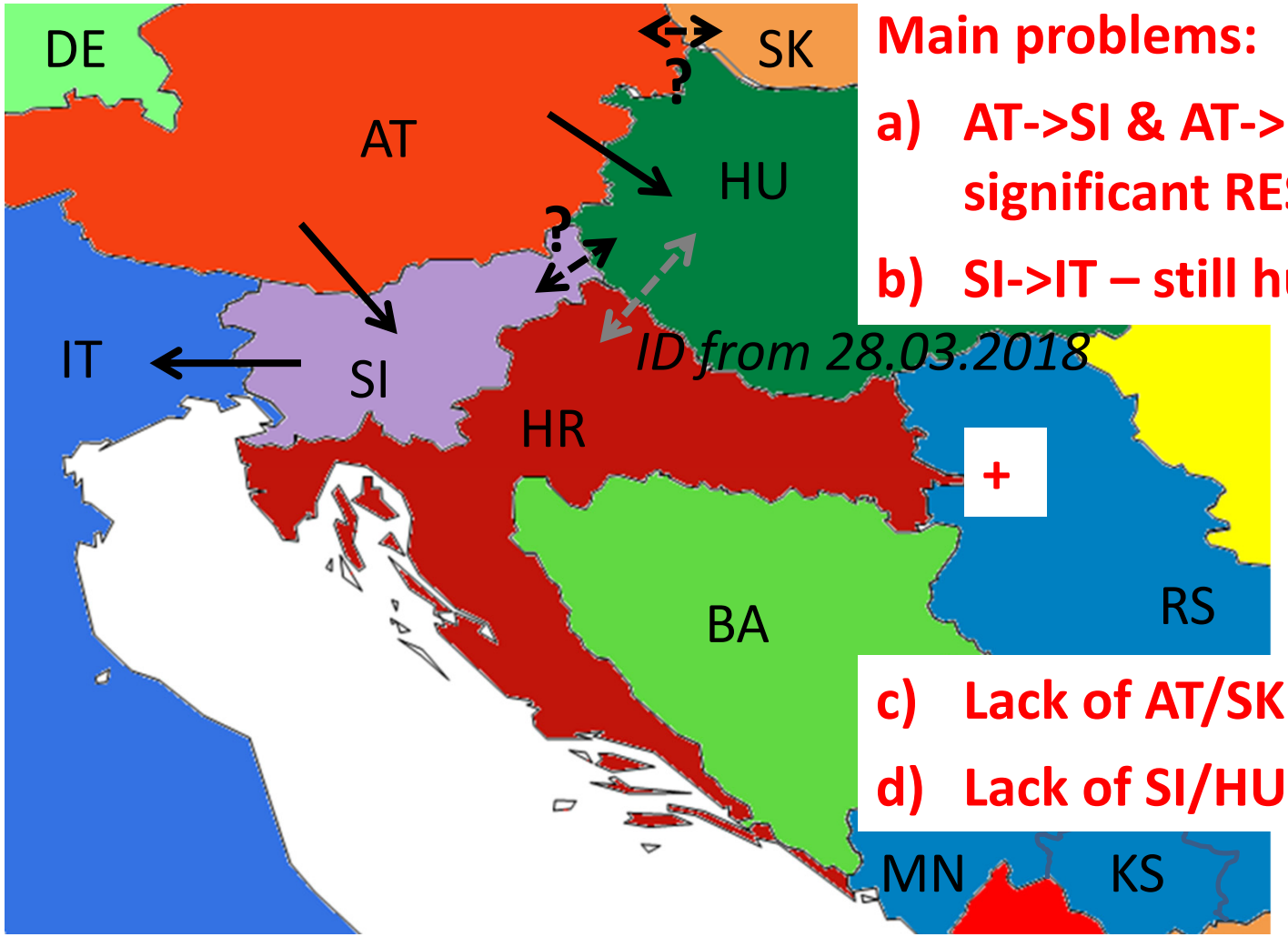
1. A long-lasting tradition in the usage of AS and BE in SEE countries
2. A huge share of installed HPPs and other RES
3. A huge potential for new RES, intraday market, AS & BE market

Obstacles for SEE vs WE and NE regarding IM, AS and BE market

1. Separate markets + Individual legal barriers for each country in SEE -> market illiquidity
2. Insufficient measurements for equal market conditions for each market player -> "black box" principle in many countries
3. Issue of preferential treatment for new-coming RES in comparison with the existing ones (obligations vs privileges) – the real cost of externalities

Obstacles for SEE vs WE and NE regarding IM, AS and BE market

4. CBTC Bottlenecks between SE and WE



Main problems:

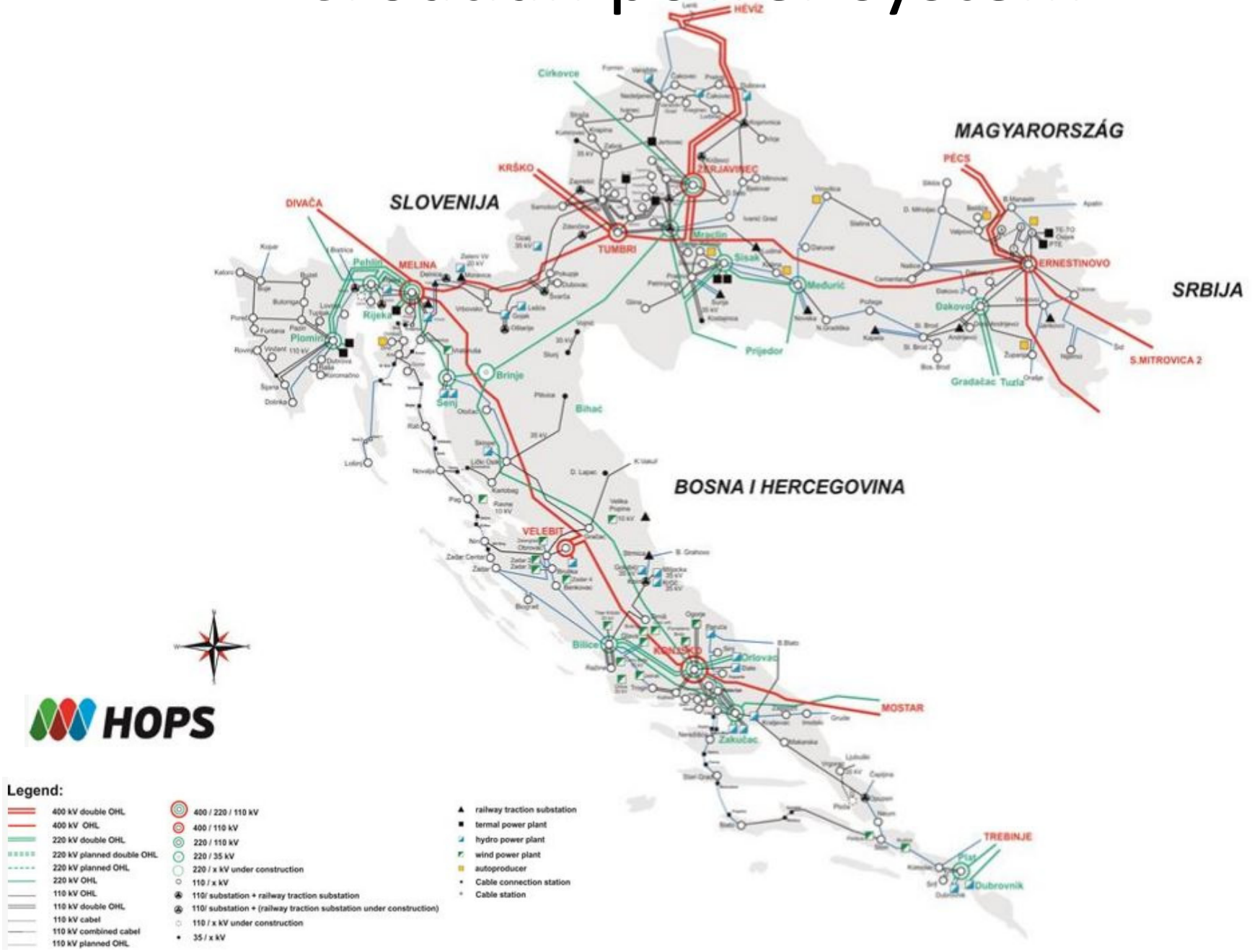
a) **AT->SI & AT->HU - in case of significant RES generation in DE**

b) **SI->IT – still huge bottleneck**

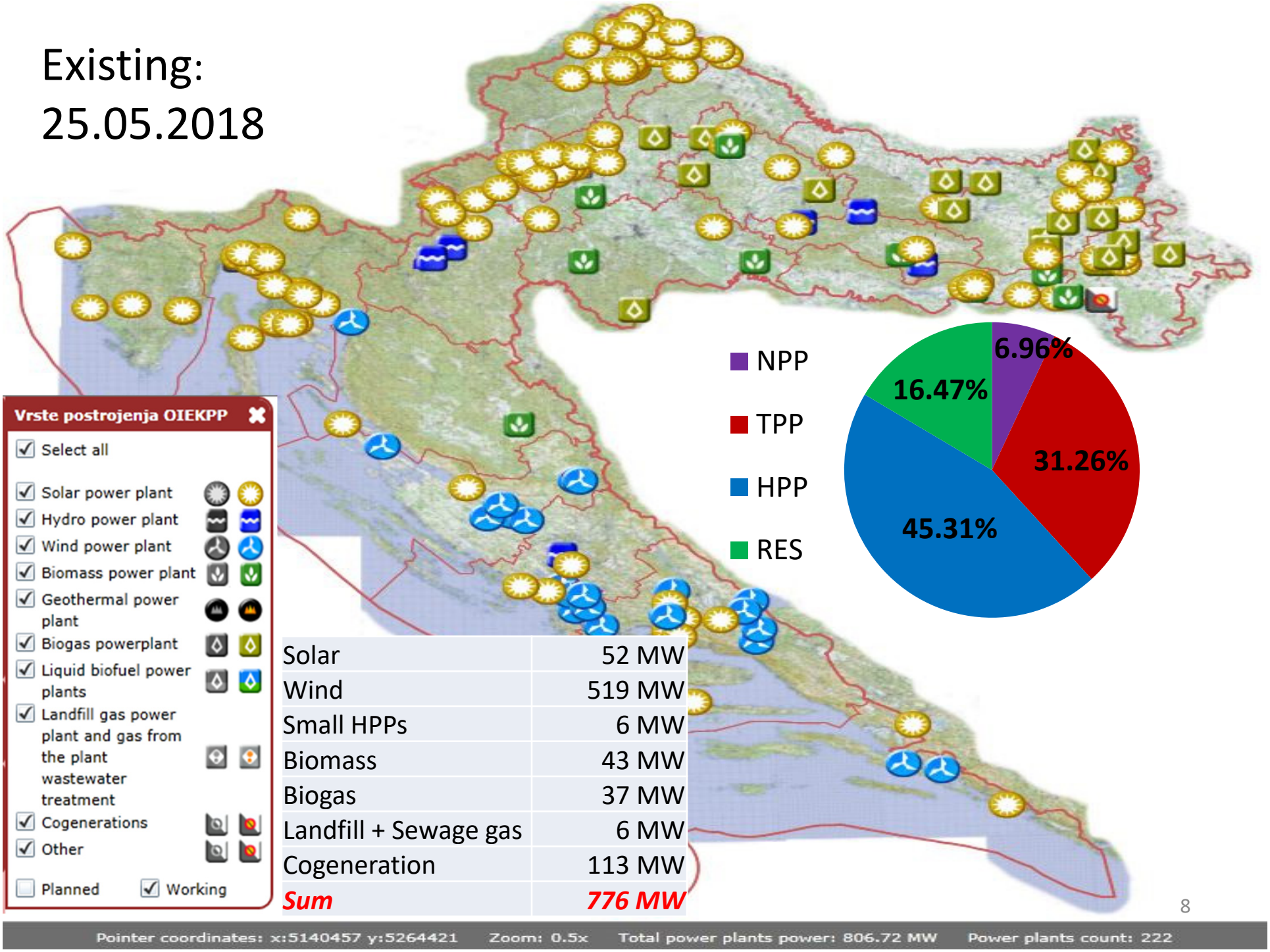
c) **Lack of AT/SK CBTC**

d) **Lack of SI/HU CBTC**

Croatian power system



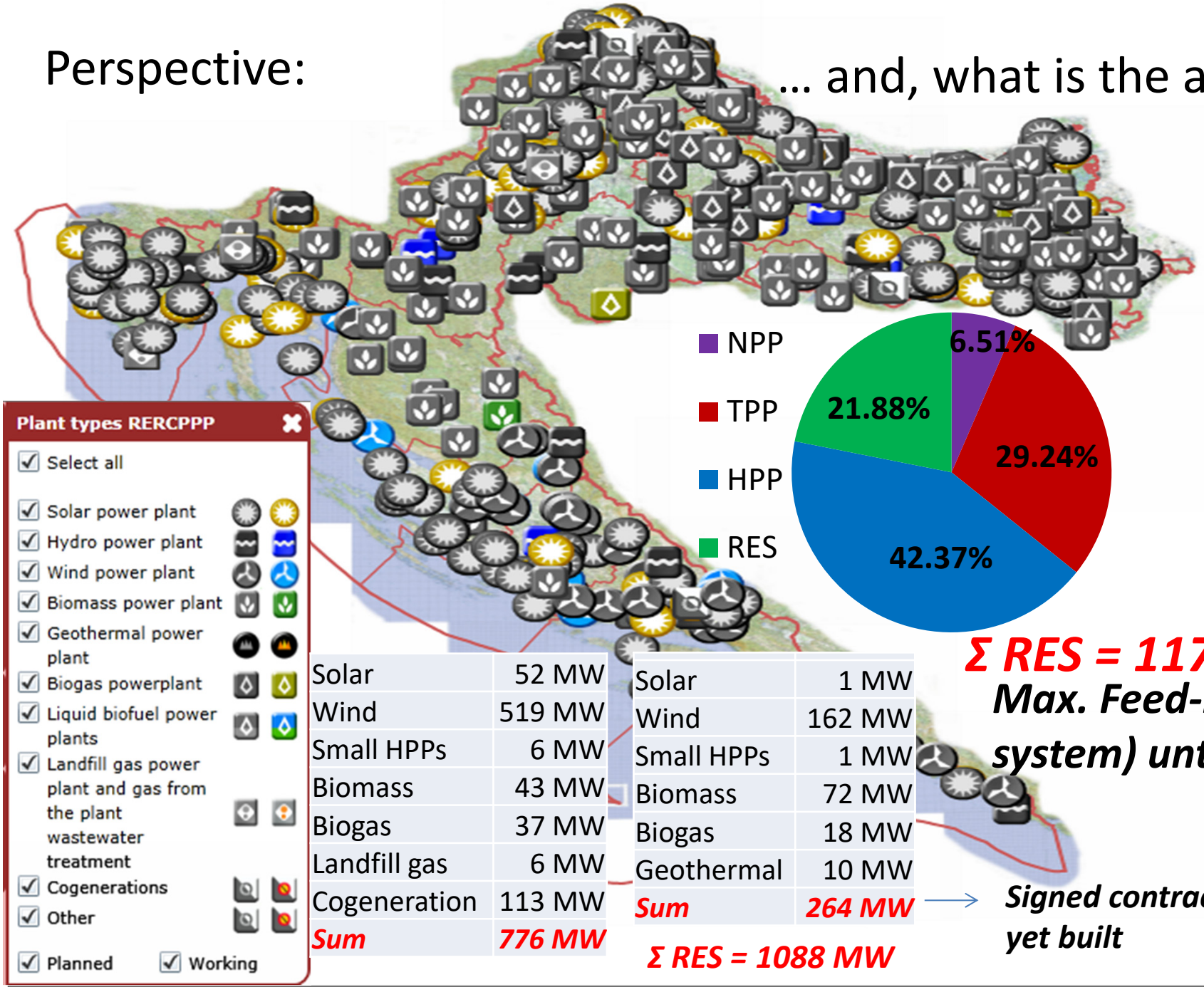
Existing:
25.05.2018



Solar	52 MW
Wind	519 MW
Small HPPs	6 MW
Biomass	43 MW
Biogas	37 MW
Landfill + Sewage gas	6 MW
Cogeneration	113 MW
Sum	***776 MW***

Perspective:

… and, what is the answer?



Solar	52 MW
Wind	519 MW
Small HPPs	6 MW
Biomass	43 MW
Biogas	37 MW
Landfill gas	6 MW
Cogeneration	113 MW
Sum	***776 MW***

Solar	1 MW
Wind	162 MW
Small HPPs	1 MW
Biomass	72 MW
Biogas	18 MW
Geothermal	10 MW
Sum	***264 MW***

Σ RES = 1088 MW

Σ RES = 1170 MW

Max. Feed-in (tariff system) until 2020

→ ***Signed contracts but not yet built***

Portfolio optimization – Croatian case

- Drivers (challenges) and constraints (risks) in different time horizons
  - solving of one equation with several unknowns with the goal of max. profit:

NPP + HPP + TPP + RES + (Buy – Sell) = Customer's load + system losses

What in case of market illiquidity?

  - a year ahead planning up to an hour ahead planning

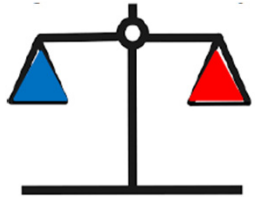
- Preparing enough „breathing space" (redundancy for volatilities) through the offer of ancillary services

Optimal planning of ancillary services

- Types of ancillary services (Croatian case):
  - aFRR – automatic secondary reserve (control)
  - mFRR – manual tertiary reserve (control)
  - Voltage maintenance through providing reactive power
  - Re-dispatching
  - Island operation
  - Black start
  - INC – sharing of aFRR and imbalances between SCB&H and Austria

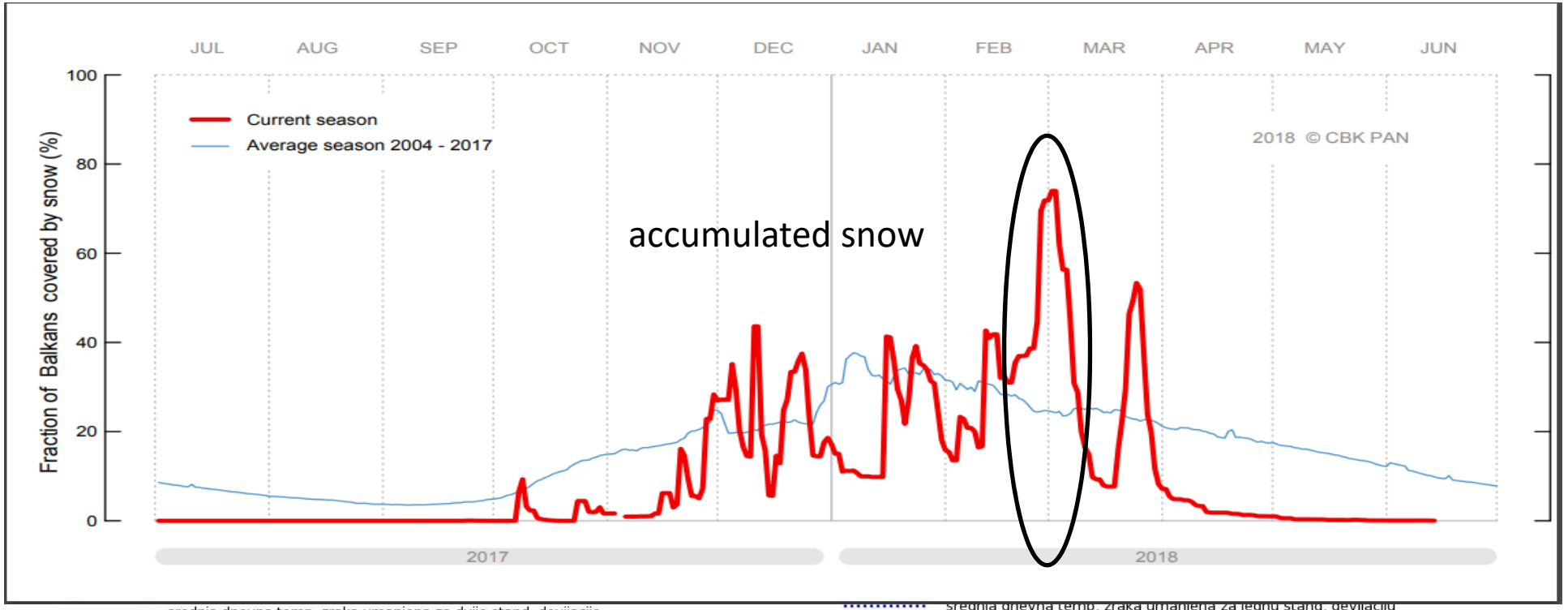
Different cases –> optimal (normal) case

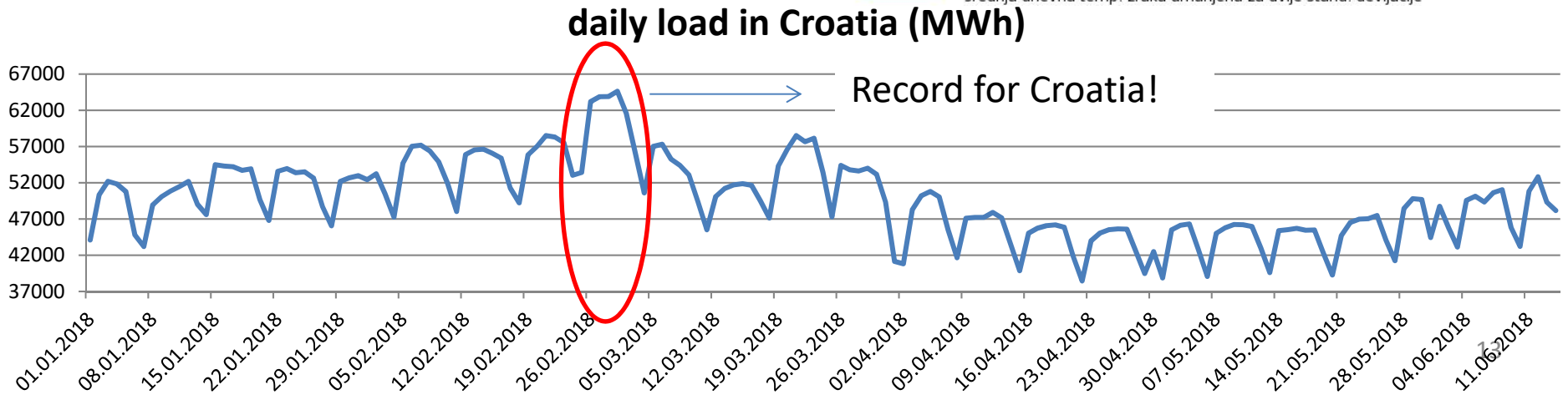
NPP + HPP + TPP + RES + (Buy – Sell) = Customer's load + grid losses



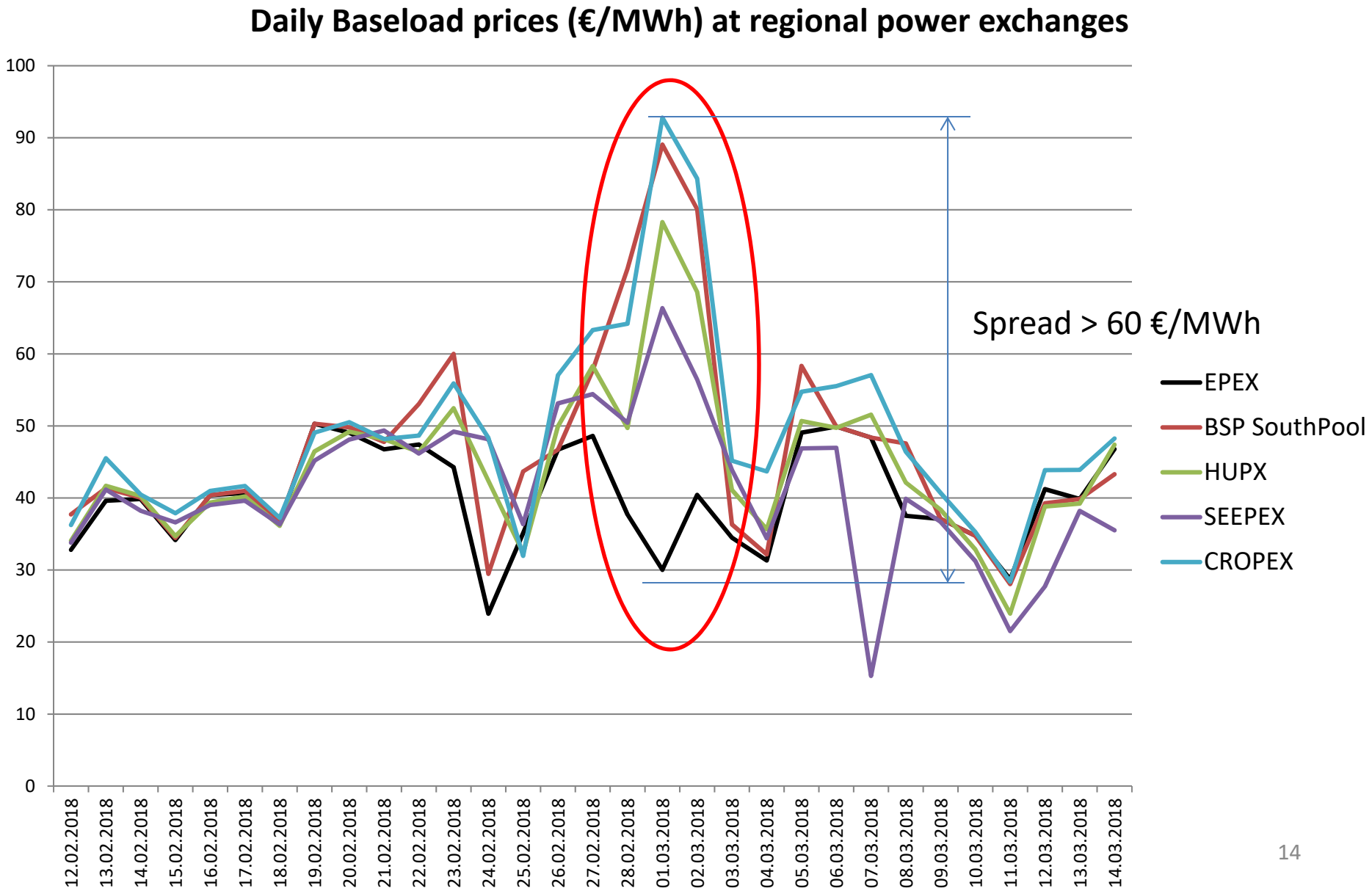
a) All influential variables within „normal values"
b) Enough space in every hour of a day at many plants for offering ancillary services for „breathing purposes"
c) Market liquidity and market prices (DA, ID, BE & AS) motivating for giving an extra „marginal quantity"
d) Weather forecast favorable
e) Hydro and gas reservoirs at optimal levels -> giving or reducing an extra „marginal quantity" won't influence optimal plans in forthcoming days
f) Relatively rare occasions

Draught case & high market prices

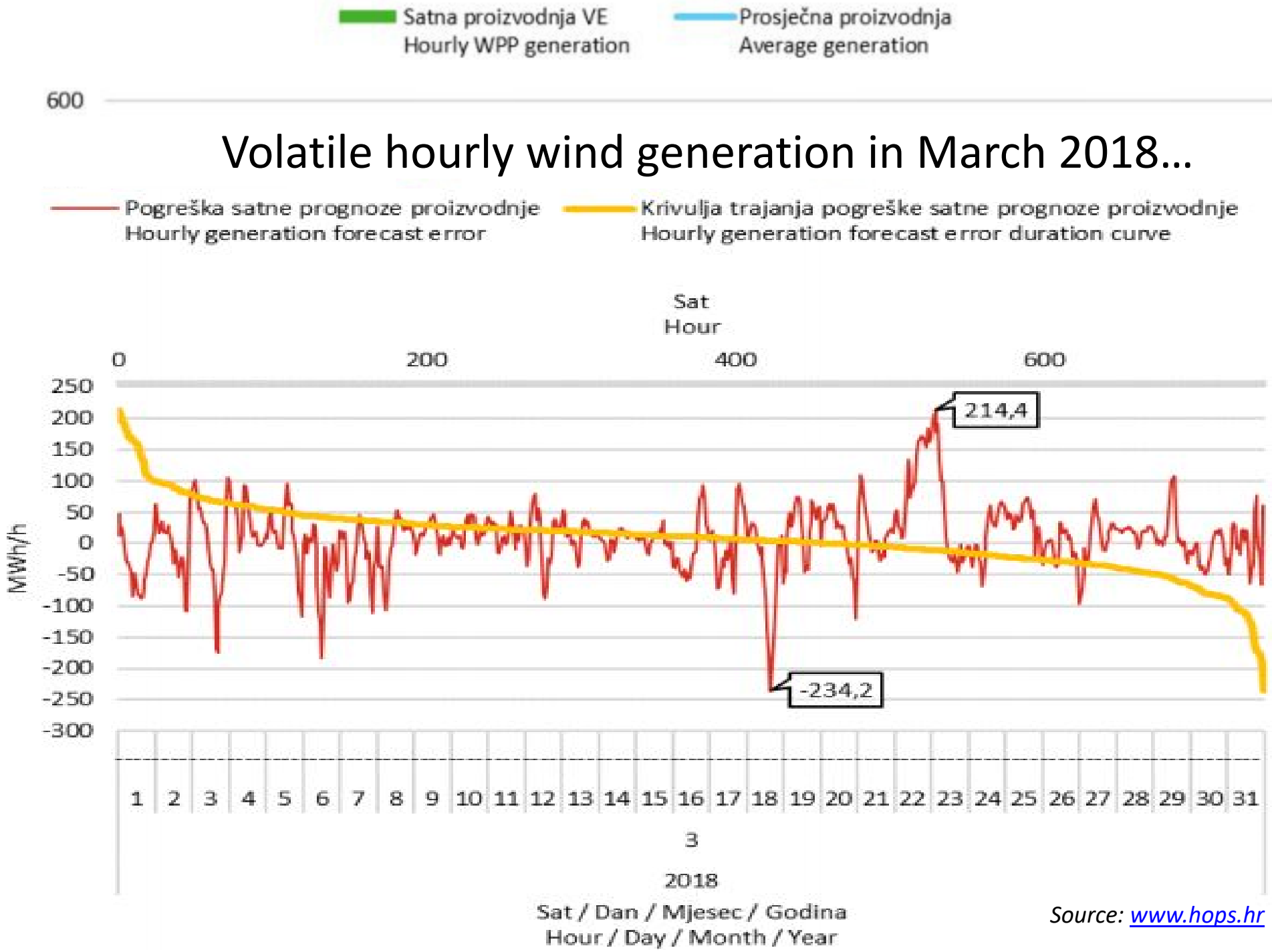




Draught case & high market prices



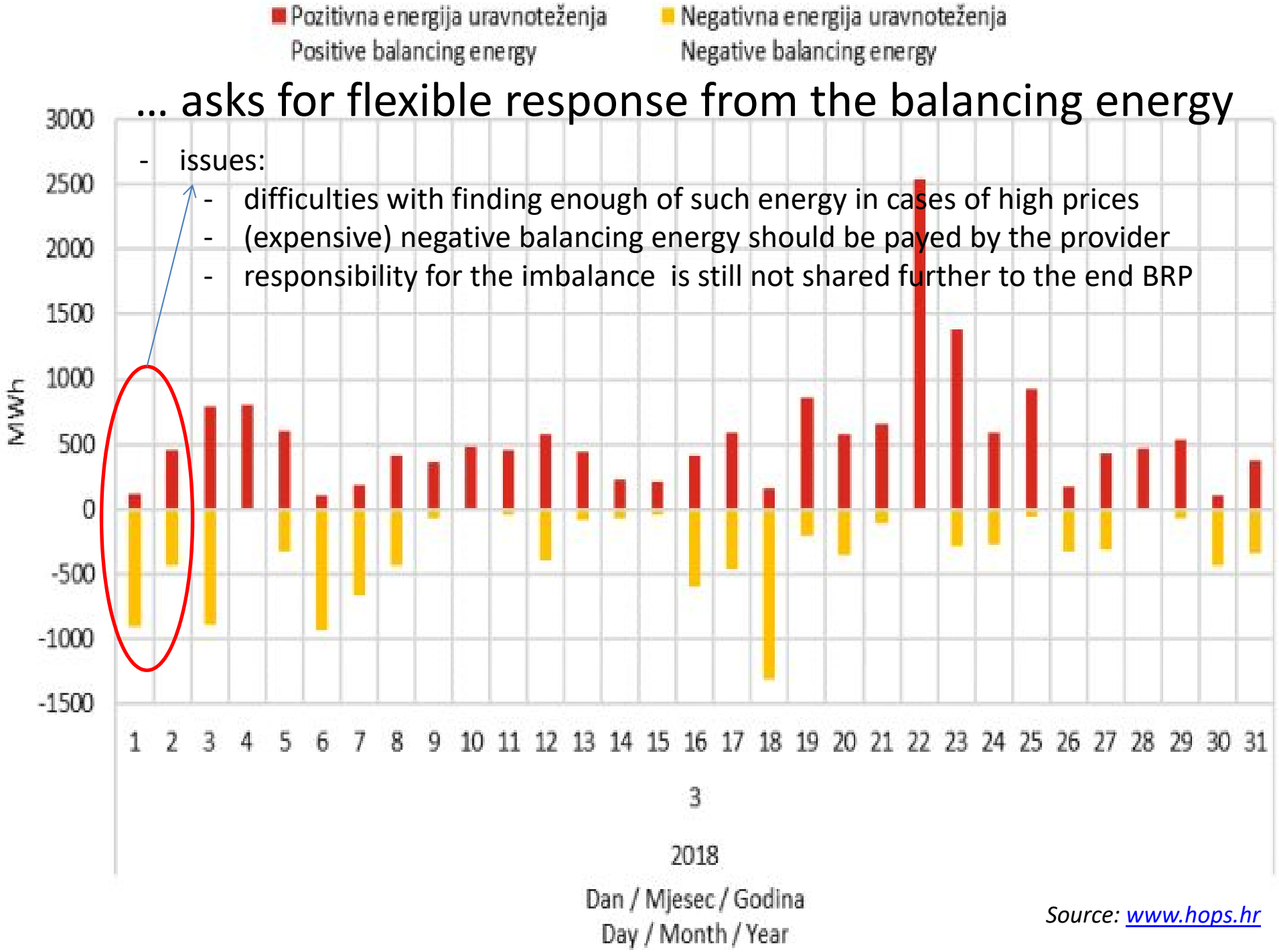
Volatile hourly wind generation in March 2018…



Source: www.hops.hr

… asks for flexible response from the balancing energy

- issues:
  - difficulties with finding enough of such energy in cases of high prices
  - (expensive) negative balancing energy should be payed by the provider
  - responsibility for the imbalance is still not shared further to the end BRP



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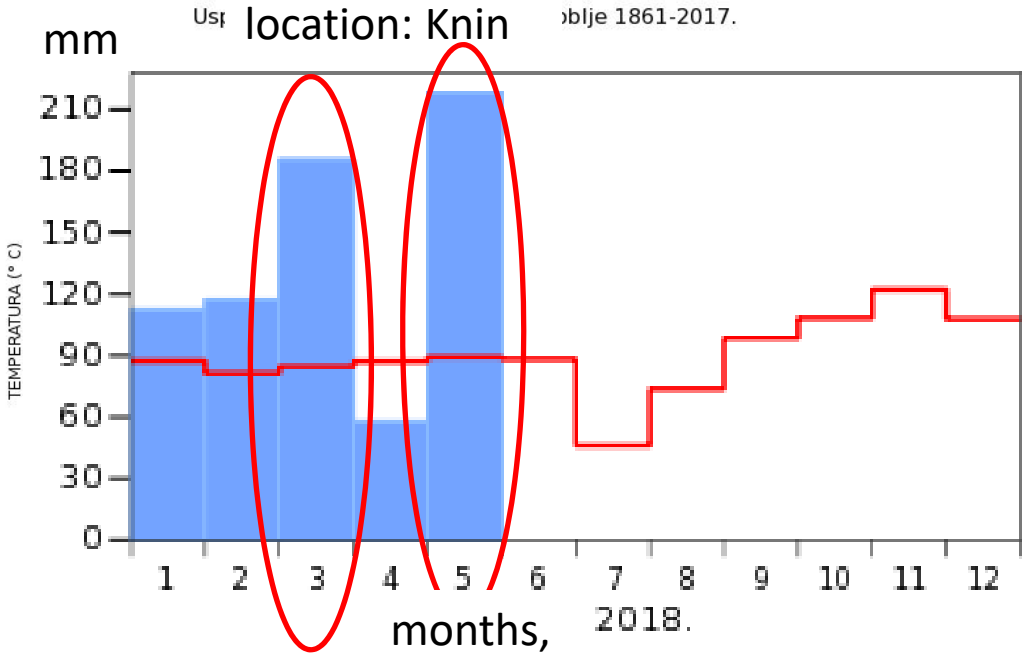
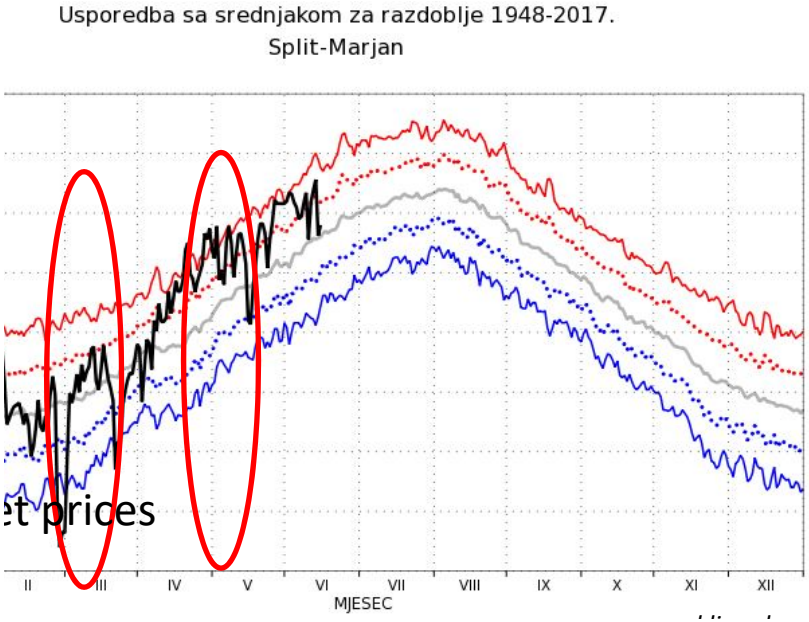
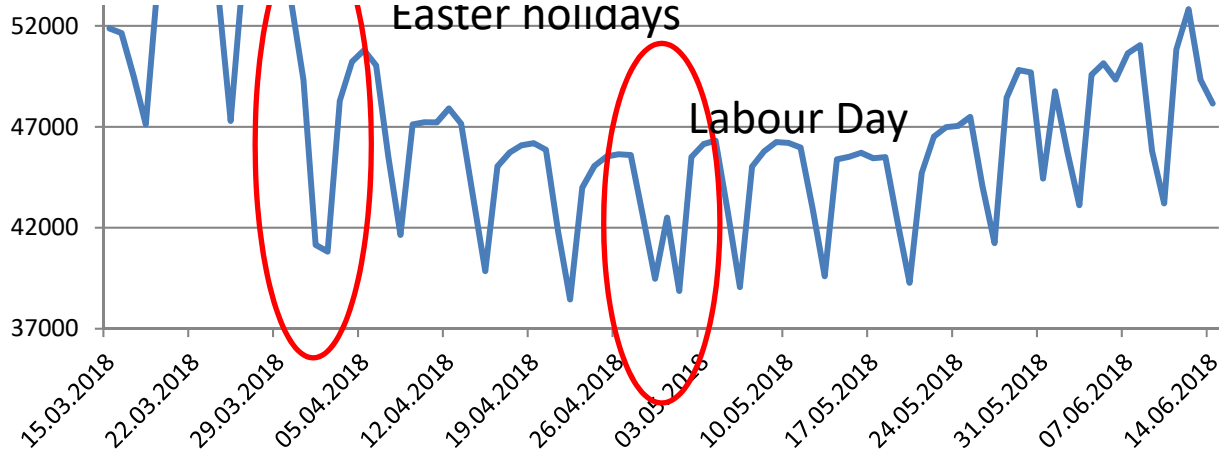
Wet case & low (negative) market prices



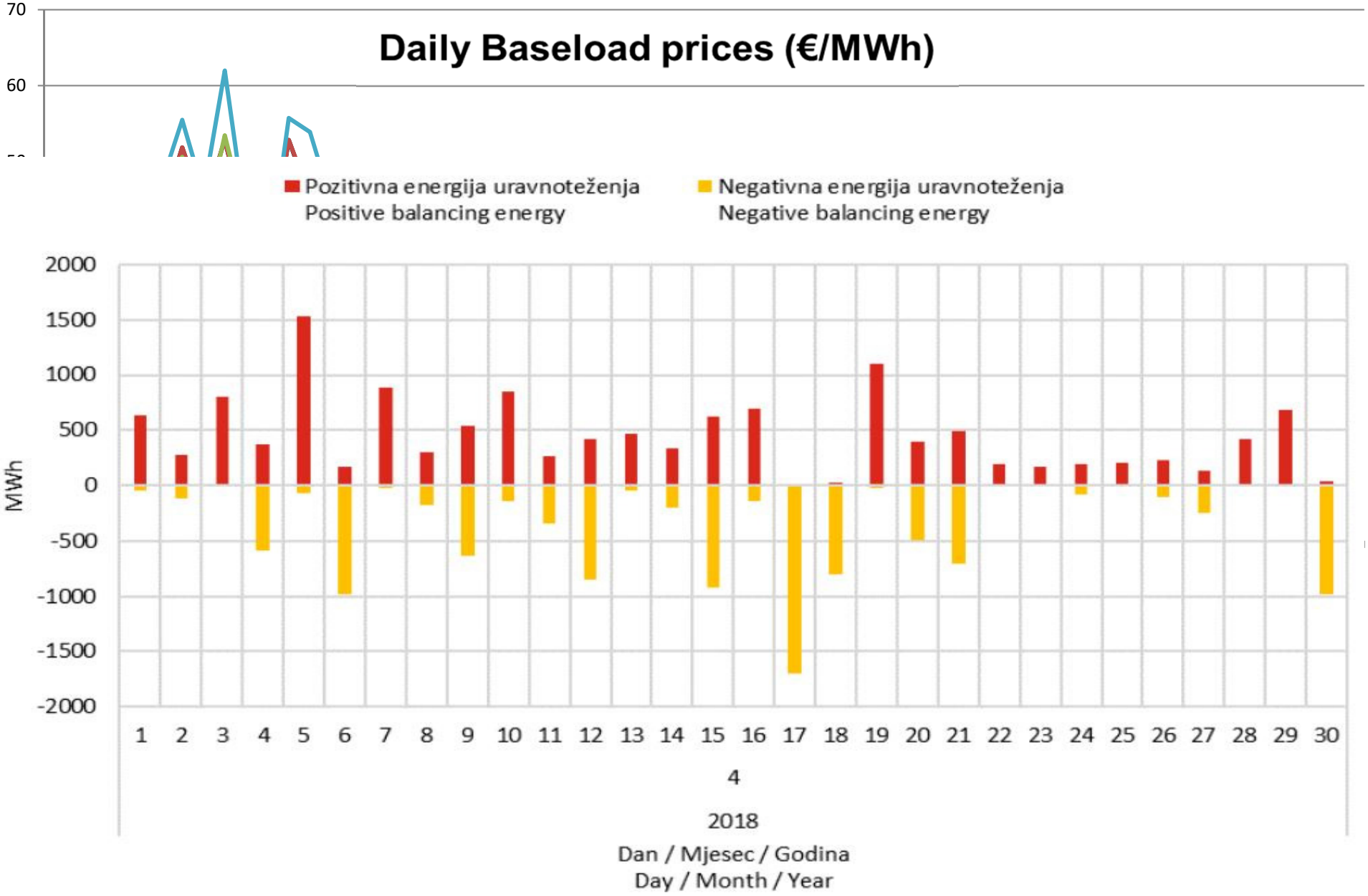


t prices

daily load (MWh)



Wet case & low (negative) market prices



Volatile optimization variables

a) Both Load and Generation side extremely influential by weather conditions
   - More households in a share comparing to stable industrial customers
   - Social component dominant (tourist seasons, migration effects, etc)
   - Energy efficiency effects
   - HPP's and RES's shares take majority in total generation mix
   - TPPs become uncompetitive & capacity market is not enough supportive to give them opportunity for a constant operation

b) Climate changes cause more and more „extreme events" -> High possibility for the exceedance of the influential variables outside of „normal range"

c) Not enough space at remaining conventional plants nor in scarce reservoirs for offering ancillary services for covering such exceedance throughout a whole year

Volatile optimization variables

d) RES due to „feed in" tariff systems are not obliged to make market plans nor be penalized for imbalances -> huge problem!

e) Market illiquidity at isolated markets, cross-biddinig zones congestions and unplanned power flows, non-harmonized remedial actions and usage of cross-border AS as well as volatile market prices don't give enough signals for new investments in AS and BE markets

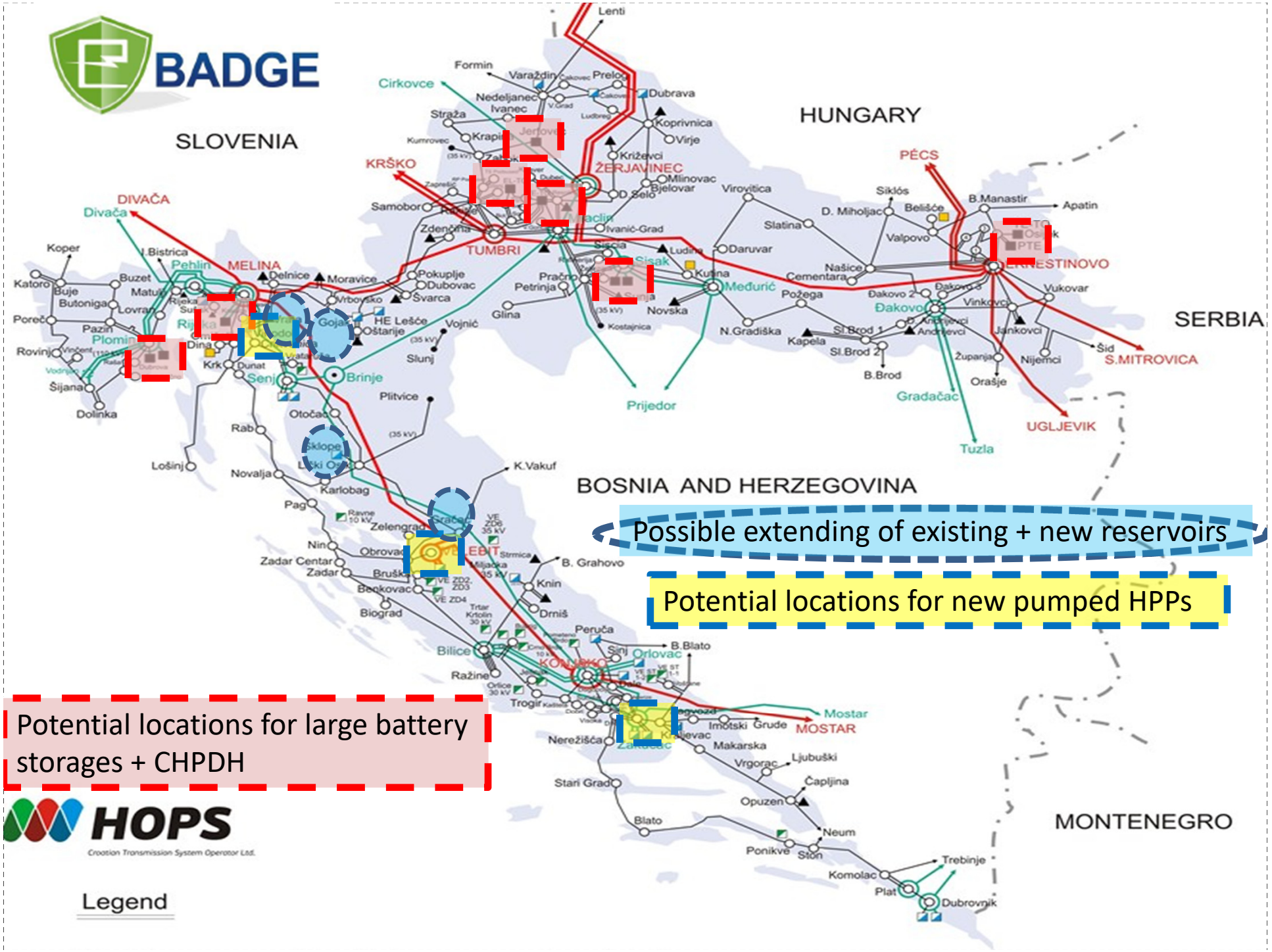
f) Weather forecast becomes more and more speculative

g) Hydro and gas reservoirs scarce -> NATURA 2000, existing infrastructure, supply routes, LNG, etc.

h) Market speculations vs Market & energy stability

A glance into the future

1. What will bring new capacity management and market coupling in aspect of AS and BE in the SEE?
2. „Winter energy package" – goals for 2030
3. Possible extending of existing + new reservoirs
4. Transparency in measurements & data management
5. Cooperation with IT sector -> potential for VPPs
6. Equal imbalance treatment for each network member
7. New pumped HPPs
8. A lot of TPPs uncompetitive for market prices -> potential locations for storage (CHPDH, batteries, inertia wheels, LNG, gas, etc.)
9. Wider usage of electric cars -> advantages for tourism in SEE too


BADGE
SLOVENIA
HUNGARY
SERBIA
BOSNIA AND HERZEGOVINA
MONTENEGRO
Possible extending of existing + new reservoirs
Potential locations for new pumped HPPs
Potential locations for large battery storages + CHPDH
HOPS
Croatian Transmission System Operator Ltd.
Legend
KRŠKO
ŽERJAVINEC
TUMBRI
MELINA
DIVAČA
Divača
Cirkovce
Lenti
PÉCS
ERNESTINOVO
S.MITROVICA
UGLJEVIK
Tuzla
Prijedor
Brinje
Senj
Ričice
Bilice
KONJSKO
MOSTAR
Mostar
Trebinje
Dubrovnik
Đakovo
Međurić
Sisak
Zagreb
Rijeka
Pehlin
Plomin
Lovran
Buzet
Koper
Pula
Poreč
Rovinj
Pazin
Šijana
Dolinka
Katoro
Buje
Butoniga
Matulji
Rab
Pag
Novalja
Karlobag
Lošinj
Otočac
Plitvice
Gojak
Oštarije
HE Lešće
Vojnić
Slunj
Glina
Petrinja
Sisak
Kutina
Novska
Daruvar
Virovitica
Slatina
Našice
Cementara
Požega
N.Gradiška
Kapela
Sl.Brod 1
Sl.Brod 2
B.Brod
Gradačac
Županja
Orašje
Nijemci
Šid
Vukovar
Vinkovci
Jankovci
Đakovo 2
Đakovo 3
Valpovo
Belišće
D. Miholjac
Siklós
B.Manastir
Apatin
Osijek
PTE
Samobor
Zdenčina
Ivanić-Grad
Križevci
Koprivnica
Virje
Dubrava
Prelog
Varaždin
Formin
Nedeljanec
Ivanec
Straža
Krapina
Kumrovec
Mlinovac
Bjelovar
D.Selo
Sisačka
Ludina
Pračno
Kostajnica
Delnice
Moravice
Vrbovsko
Pokuplje
Dubovac
Švarca
Dina
Krk
Dunat
Zelengrad
Nin
Zadar Centar
Zadar
Obrovac
Benkovac
Biograd
Bruška
Knin
K.Vakuf
B. Grahovo
Drniš
Peruča
Sinj
Orlovac
B.Blato
Ražine
Trogir
Nerežišća
Makarska
Vrgorac
Ljubuški
Čapljina
Opuzen
Stari Grad
Blato
Neum
Ponikve
Ston
Komolac
Plat
Imotski
Grude
Jelovac
Zakučac
Strmica
Miljacka
Trtar Krtolin
Ravne
Lički Osik
Klopeč
Jertovec
Zagvozd

Conclusion

- Rise of RES's share requires more flexible systems
- Ancillary services and balancing energy play a crucial role
- Power systems of SEE require stronger adjustment, better measurement systems, an equal system of penalizing all market participants, regional market coupling, as well as closer integration with the rest of Europe
- It is necessary to start realizing the potential provided by energy storage and Demand Side Management as soon as possible