

# The Changing Impact of System Disturbance Events



**2022 SPRING TECHNICAL WORKSHOP**

**March 21-24, 2022**  
Loews Ventana Canyon Resort  
Tucson, AZ

21 March 2022



Dr. Tahir Kapetanovic

Head of National Control Centre & Vice President International @Austrian Power Grid  
Chair of System Operations Committee @ENTSO-E

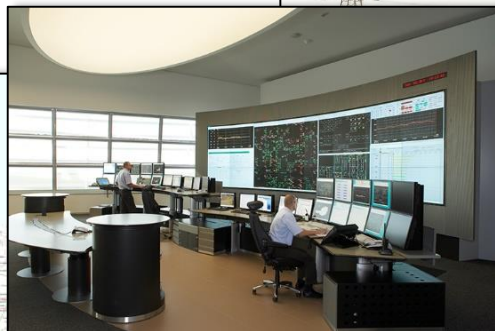




# Welcome !

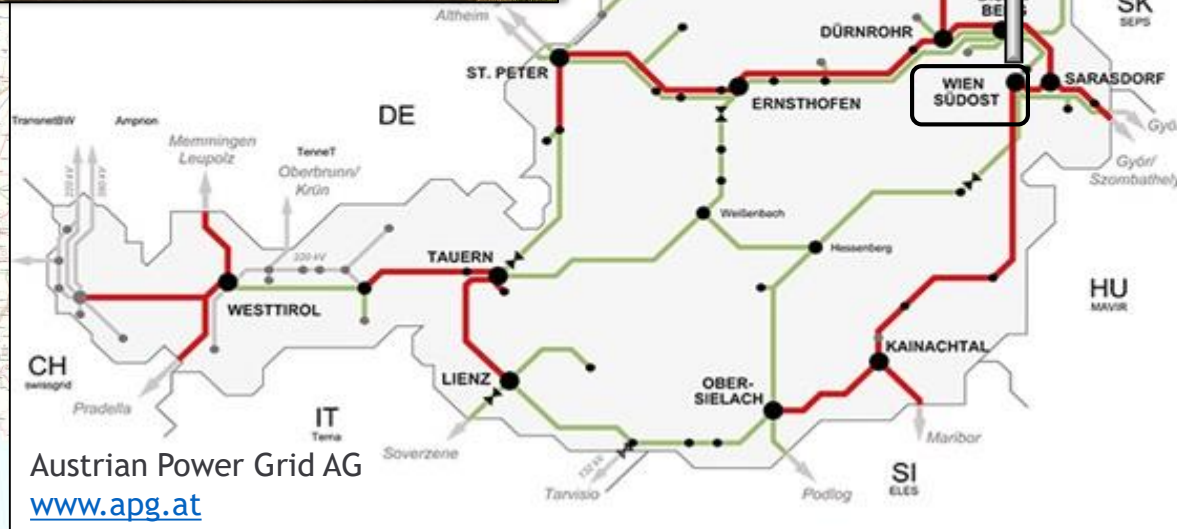
APG National Control Centre - Power Grid Control

<https://www.apg.at/en/About-us/Control-centre>

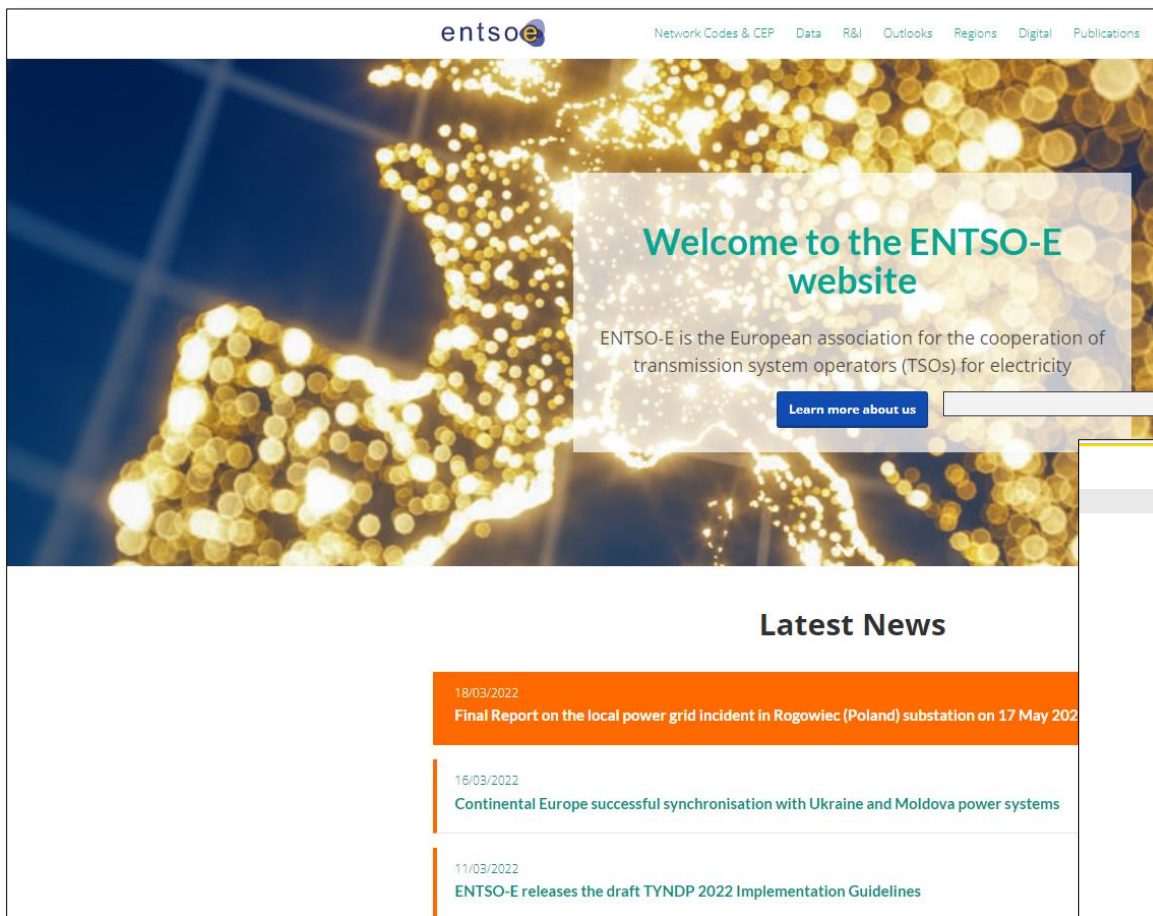


Where I work  
and what we do

entsoe  
Interconnected network  
of Continental Europe  
2019  
Scale 1 : 2 500 000



ENTSO-E System Operations Committee  
<https://www.entsoe.eu/about/system-operations/>



The screenshot shows the ENTSO-E homepage. At the top is the ENTSO-E logo and a navigation menu with links: Network Codes & CEP, Data, R&I, Outlooks, Regions, Digital, and Publications. Below the navigation is a large hero image of a map of Europe with glowing yellow nodes. Overlaid on this image is a white box with the text "Welcome to the ENTSO-E website" and "ENTSO-E is the European association for the cooperation of transmission system operators (TSOs) for electricity". Below this text is a blue button labeled "Learn more about us". At the bottom of the page, there is a "Latest News" section with three news items, each with a date and a title.

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Network Codes & CEP Data R&I Outlooks Regions Digital Publications

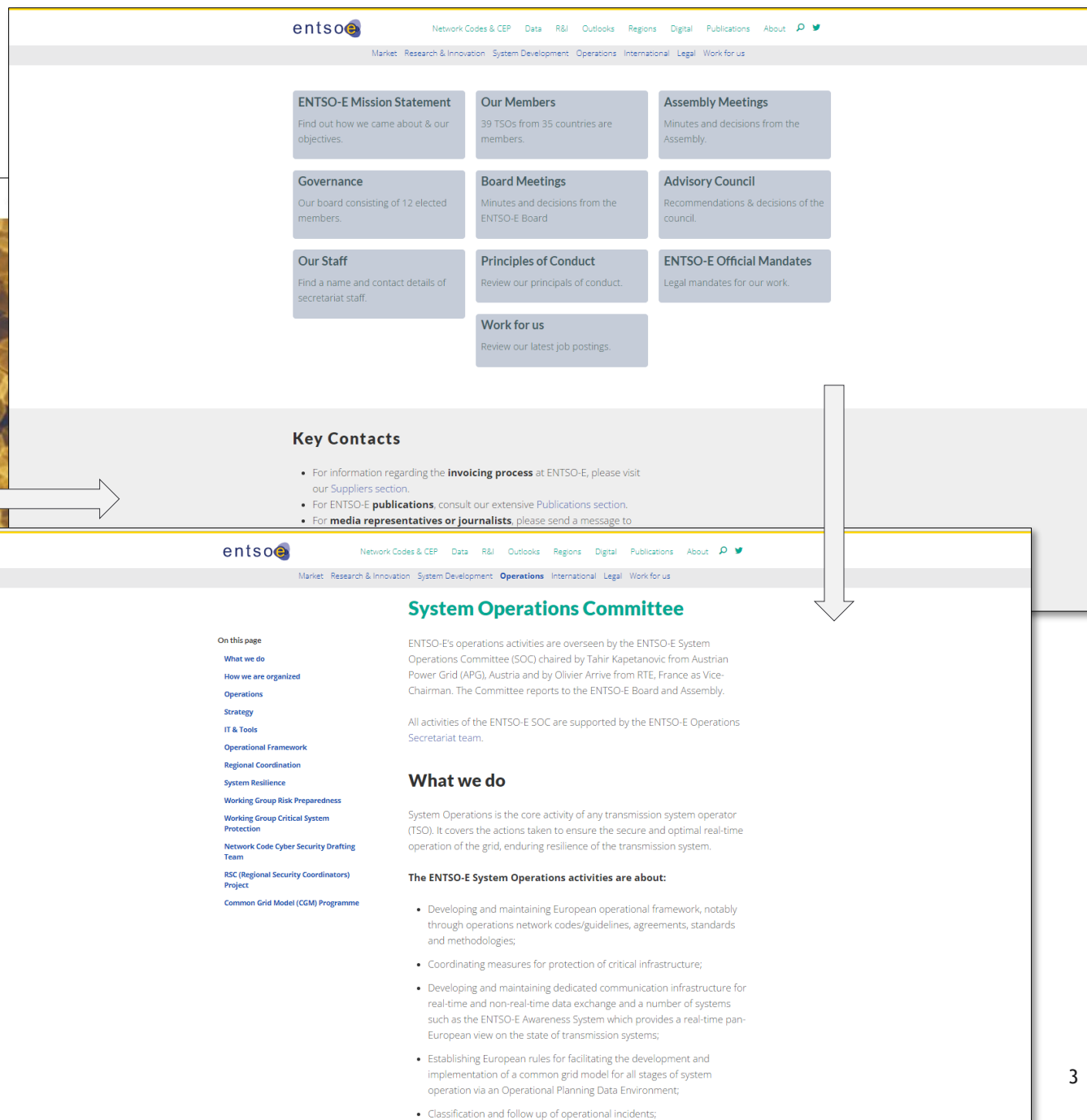
## Welcome to the ENTSO-E website

ENTSO-E is the European association for the cooperation of transmission system operators (TSOs) for electricity

[Learn more about us](#)

### Latest News

- 18/03/2022  
**Final Report on the local power grid incident in Rogowiec (Poland) substation on 17 May 2022**
- 16/03/2022  
**Continental Europe successful synchronisation with Ukraine and Moldova power systems**
- 11/03/2022  
**ENTSO-E releases the draft TYNDP 2022 Implementation Guidelines**



The screenshot shows two pages from the ENTSO-E website. The top page is the "Key Contacts" page, which features a grid of links to various sections: ENTSO-E Mission Statement, Our Members, Assembly Meetings, Governance, Board Meetings, Advisory Council, Our Staff, Principles of Conduct, and ENTSO-E Official Mandates. Below this grid is a "Key Contacts" section with a list of links for more information. The bottom page is the "System Operations Committee" page, which features a sidebar with a list of links and a main content area with text and a list of activities.

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Network Codes & CEP Data R&I Outlooks Regions Digital Publications About

Market Research & Innovation System Development Operations International Legal Work for us

**ENTSO-E Mission Statement**  
Find out how we came about & our objectives.

**Our Members**  
39 TSOs from 35 countries are members.

**Assembly Meetings**  
Minutes and decisions from the Assembly.

**Governance**  
Our board consisting of 12 elected members.

**Board Meetings**  
Minutes and decisions from the ENTSO-E Board.

**Advisory Council**  
Recommendations & decisions of the council.

**Our Staff**  
Find a name and contact details of secretariat staff.

**Principles of Conduct**  
Review our principals of conduct.

**ENTSO-E Official Mandates**  
Legal mandates for our work.

**Work for us**  
Review our latest job postings.

### Key Contacts

- For information regarding the **invoicing process** at ENTSO-E, please visit our **Suppliers** section.
- For **ENTSO-E publications**, consult our extensive **Publications** section.
- For **media representatives or journalists**, please send a message to

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Market Research & Innovation System Development **Operations** International Legal Work for us

## System Operations Committee

ENTSO-E's operations activities are overseen by the ENTSO-E System Operations Committee (SOC) chaired by Tahir Kapetanovic from Austrian Power Grid (APG), Austria and by Olivier Arrive from RTE, France as Vice-Chairman. The Committee reports to the ENTSO-E Board and Assembly.

All activities of the ENTSO-E SOC are supported by the ENTSO-E Operations Secretariat team.

### What we do

System Operations is the core activity of any transmission system operator (TSO). It covers the actions taken to ensure the secure and optimal real-time operation of the grid, enduring resilience of the transmission system.

**The ENTSO-E System Operations activities are about:**

- Developing and maintaining European operational framework, notably through operations network codes/guidelines, agreements, standards and methodologies;
- Coordinating measures for protection of critical infrastructure;
- Developing and maintaining dedicated communication infrastructure for real-time and non-real-time data exchange and a number of systems such as the ENTSO-E Awareness System which provides a real-time pan-European view on the state of transmission systems;
- Establishing European rules for facilitating the development and implementation of a common grid model for all stages of system operation via an Operational Planning Data Environment;
- Classification and follow up of operational incidents;

# Highlights

- The Change (*„Energy Change“, „Energiewende“*)
- Recent incidents / disturbances
- Lessons learned & recommendations

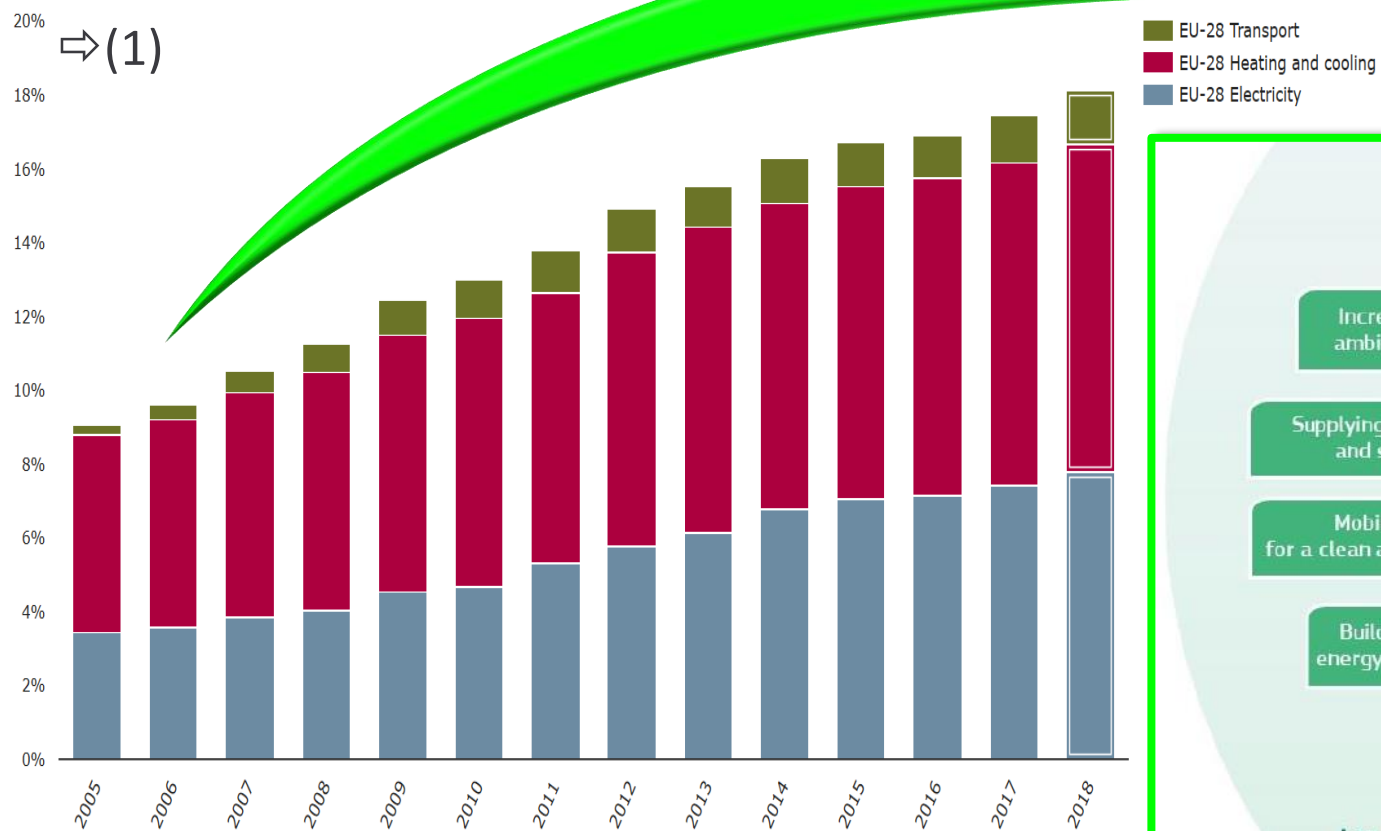
# Highlights

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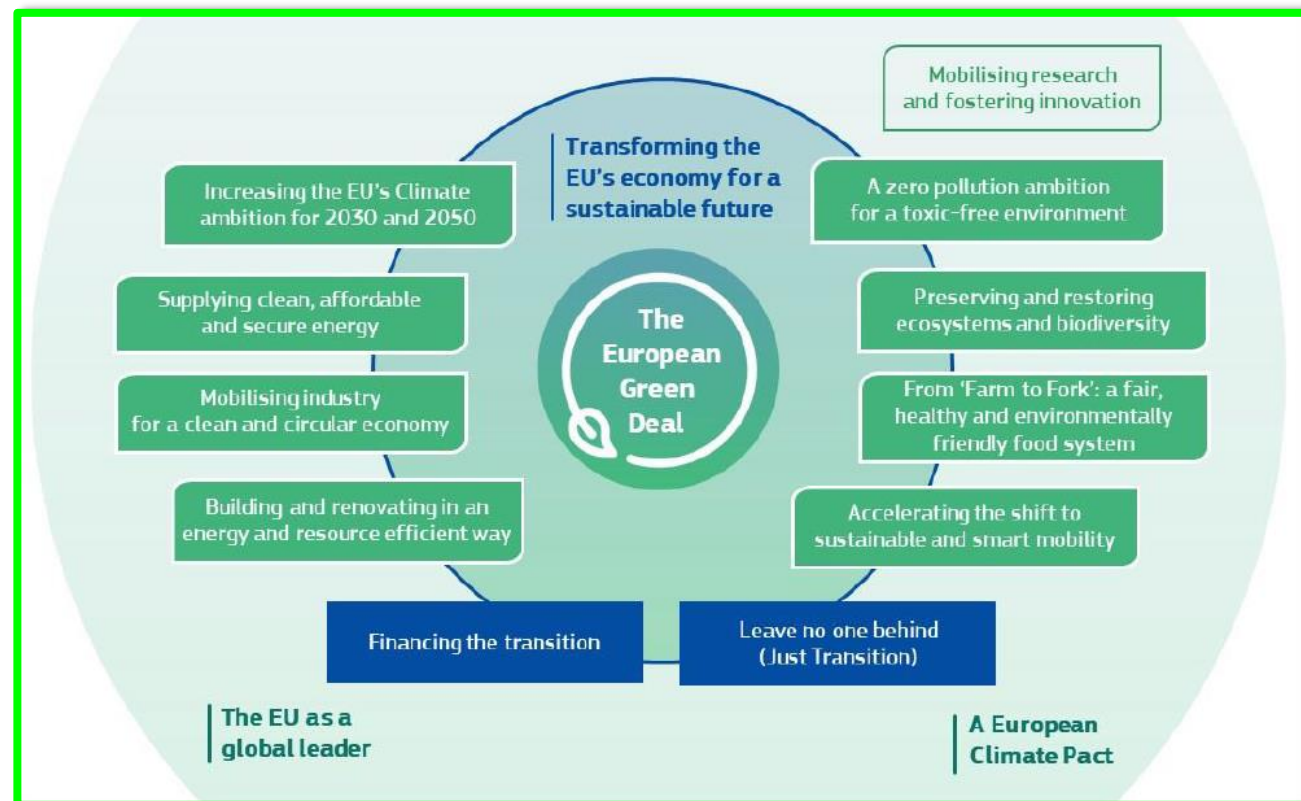
# The Change and the European Green Deal

Chart – Share of renewable energy in gross final energy consumption



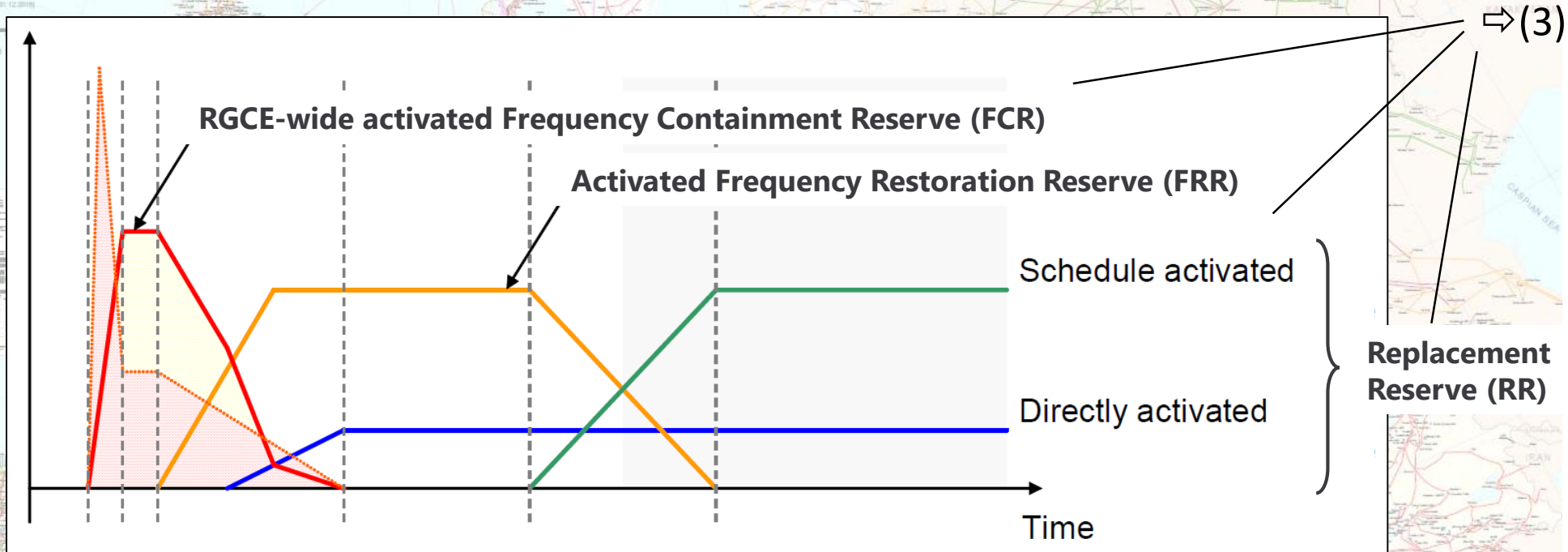
European Green Deal (2019)

⇒ (2)



# The roots: Continental European load-frequency control

entsoe  
Interconnected network  
of Continental Europe  
2019  
(as of 30.12.2019)



An old and proven concept (since late 1950-ies ⇒(4)) has demonstrated its adequate responsiveness, robustness AND has undergone substantial evolution ever since

# Highlights

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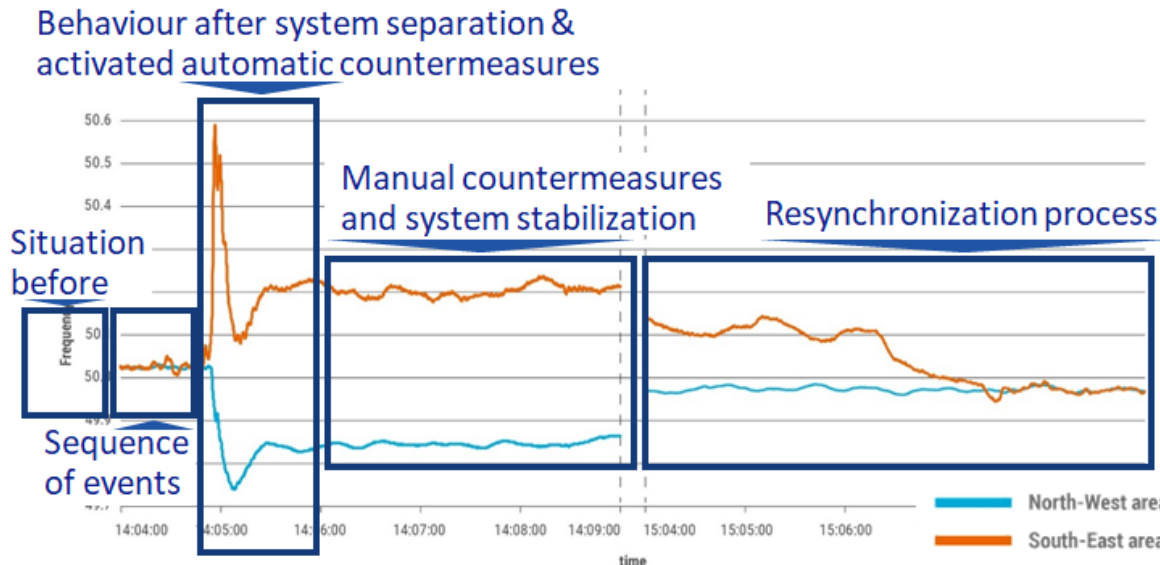


# System separation & restoration 08. January 2021 ⇒ (5)

Topics of special interest include inter alia

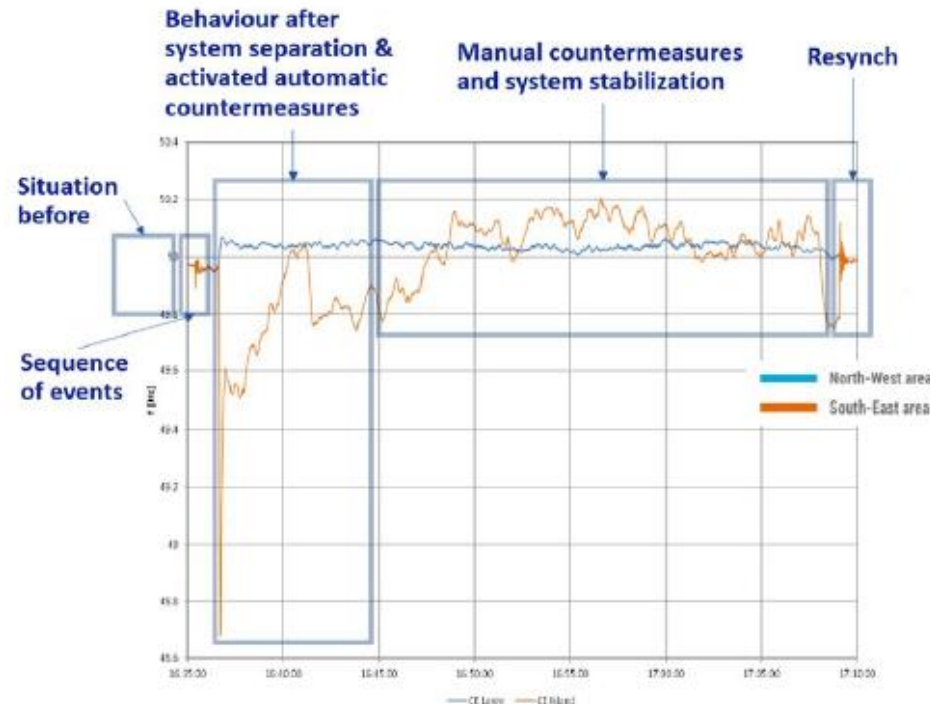
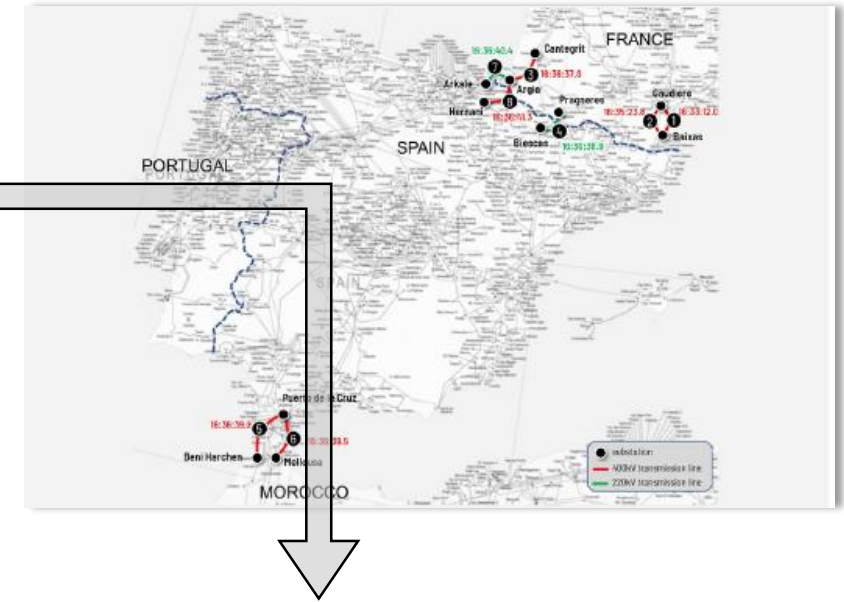
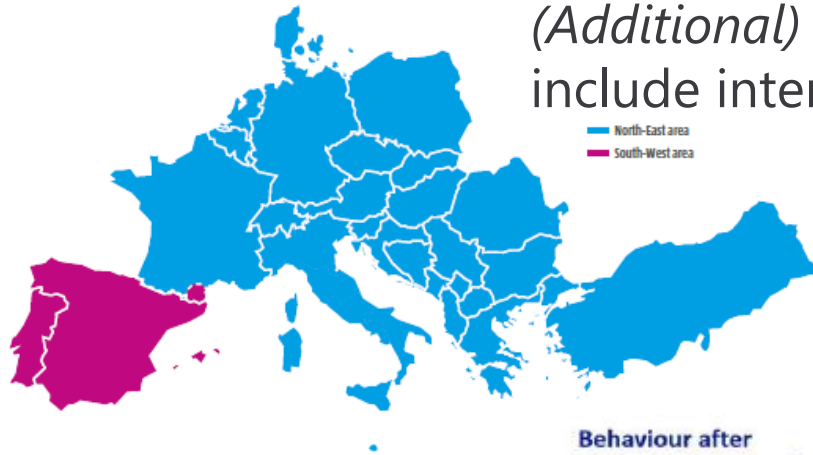


- Steady-state security / standards
- Angular stability
- Heavy continent-wide flows
- Grid (in)adequacy
- Regional coordination (security analysis & capacity calculation) in SEE



# System separation & restoration 24. July 2021 ⇒ (6)

(Additional) topics of special interest include inter alia



- Communication in case of environmental hazards
- System defense including Special Protection Schemes
- TSO-DSO coordination,
- Fault-ride through for all (!)

# Highlights

- The Change (*„Energy Change“, „Energiewende“*)
- Recent incidents / disturbances
- Lessons learned & recommendations



# Lessons learned

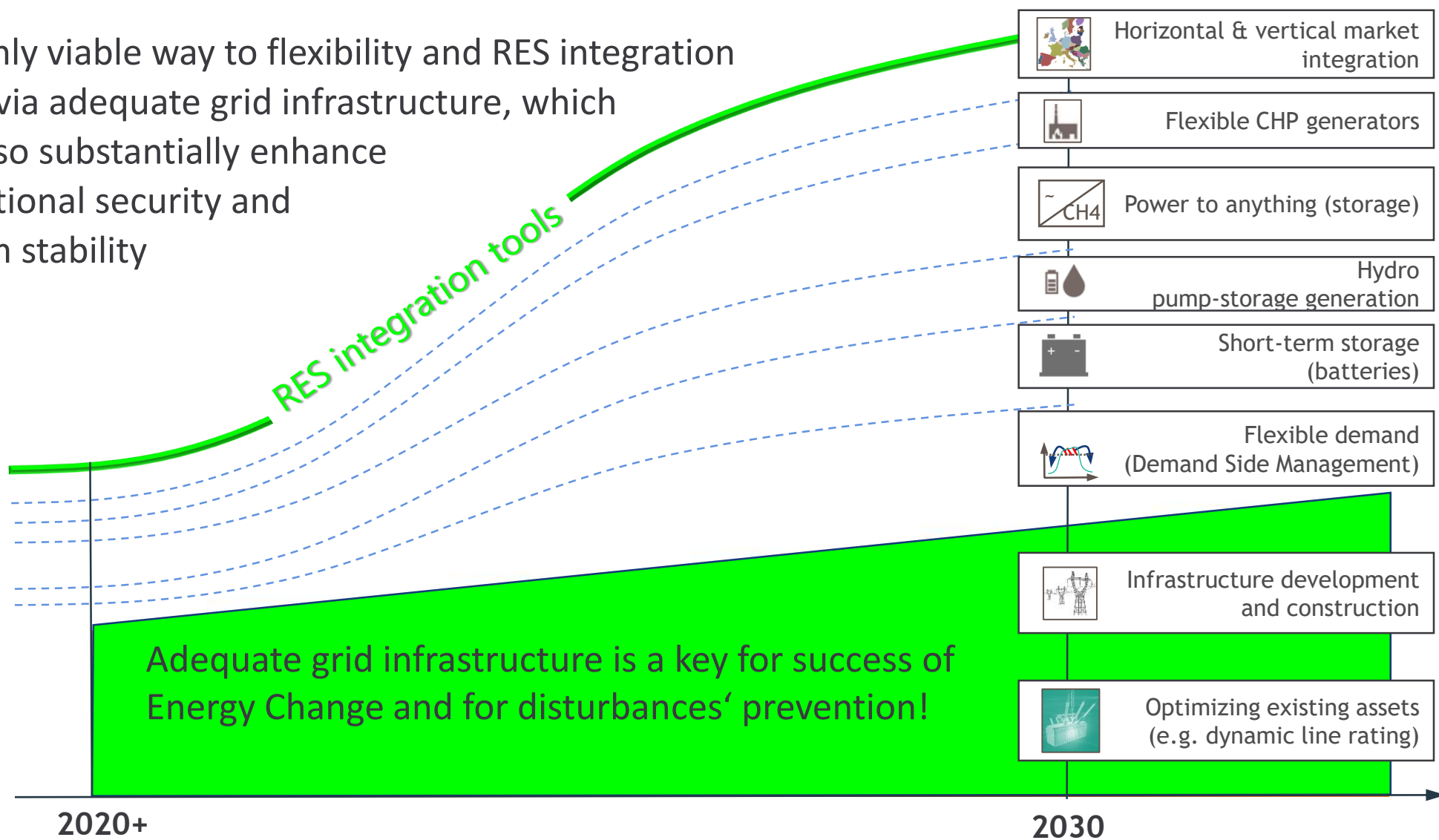
- Island-operation AND black-start capability
- Provision of all necessary restoration services must be evenly distributed and adequately supplied throughout the synchronous areas, control areas and generation park
- No exemption of RES today, even less in the future („100%“)
- Stability / inertia is essential for system survival during disturbances and synchronous machines are indispensable for that
- Continent-wide flows & RES volatility must be counteracted by new ancillary services
- Timely information to TSOs in case of natural hazard / fire / others
- Fault-ride through capability / obligation for ALL generators connected to the grid

## Good practice with RES ...

- Equal rights AND equal obligations as conventional generation
  - Keep the balance at all times
  - Contribute to steady state system security → balancing and redispatch
  - Contribute to system stability → ensure / contract sufficient inertia
- Incentives AND competition for provision of all ancillary services
- RES support schemes with key features: market-friendly, supportive for the right technology, transparent, non-discriminatory, self-regulating, and above all favourable for market maturity
- Global goals, regional / national schemes and implementations
- No compromise in terms of operational security

## ... and infrastructure!

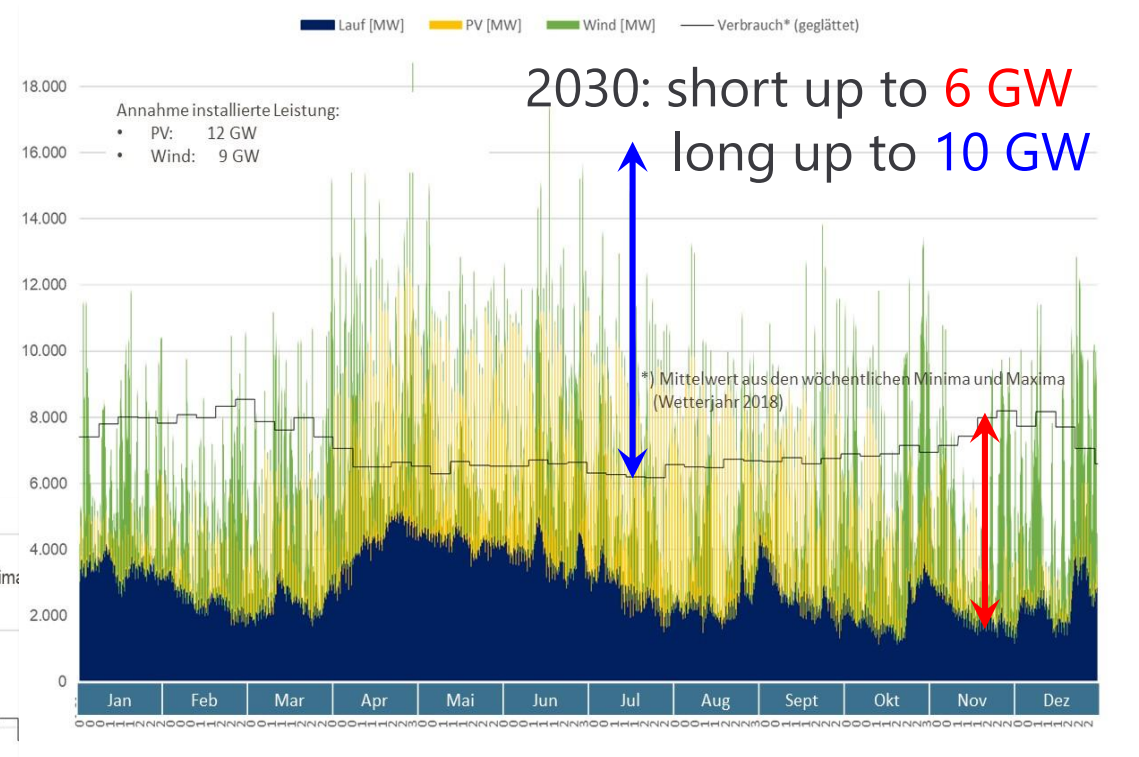
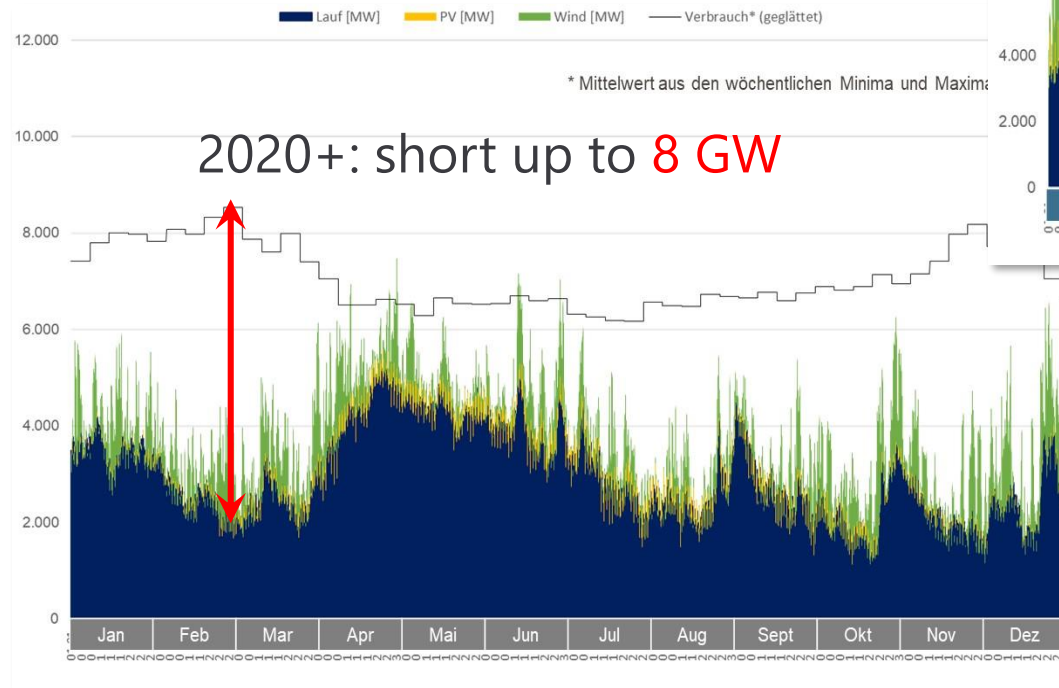
The only viable way to flexibility and RES integration leads via adequate grid infrastructure, which will also substantially enhance operational security and system stability





# Add-on: a view from the centre of the Continent

Needed today in Austria to cover short positions and for operational security in the grid

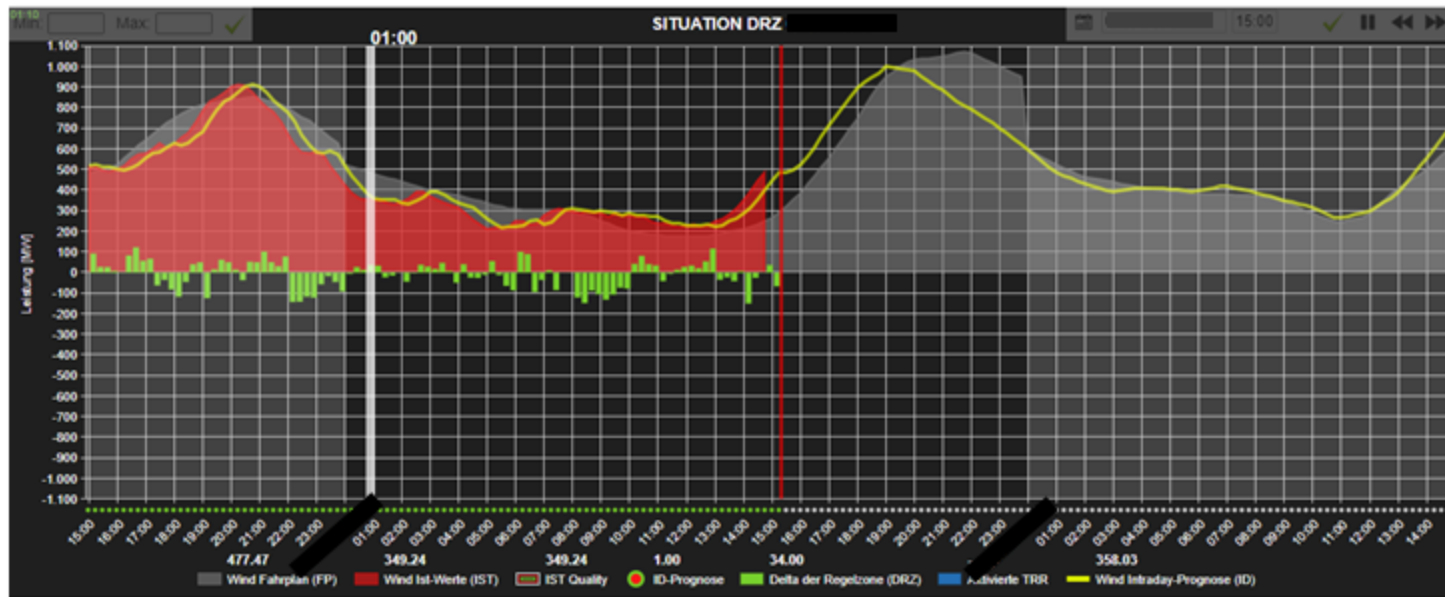
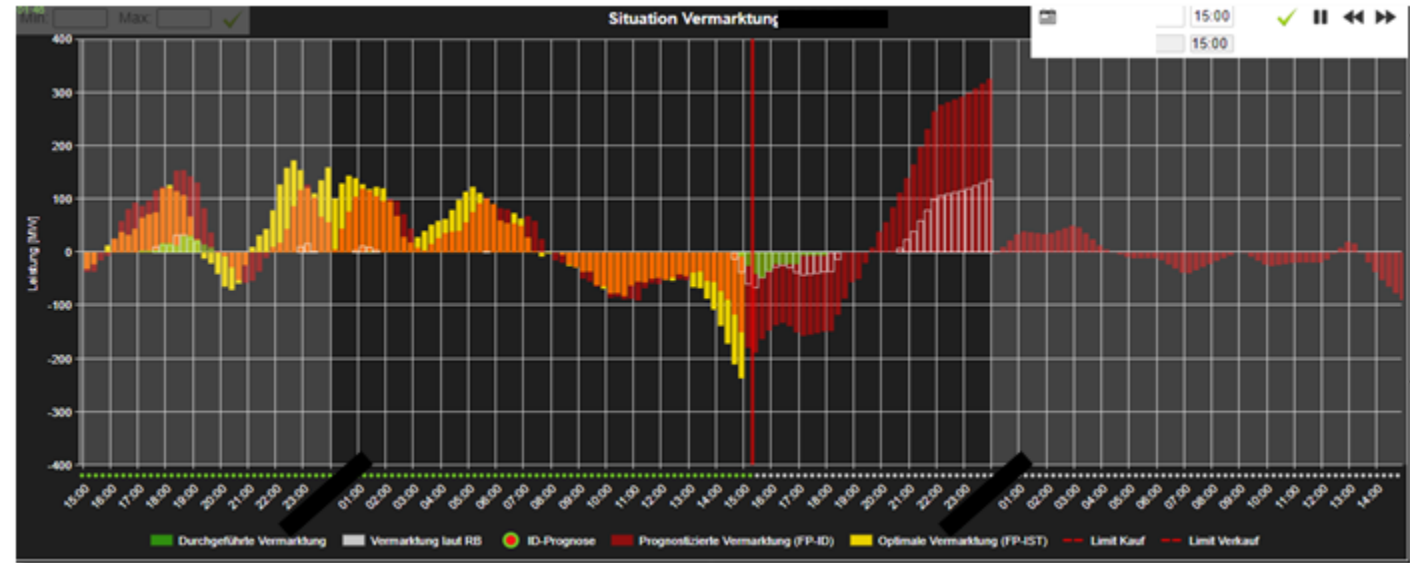


Needed tomorrow in Austria  
even more, to cover short  
AND long positions

# Trading volatility away

## The idea

- Trade-away differences between wind DA & ID forecast and (extrapolated) real-time infeed

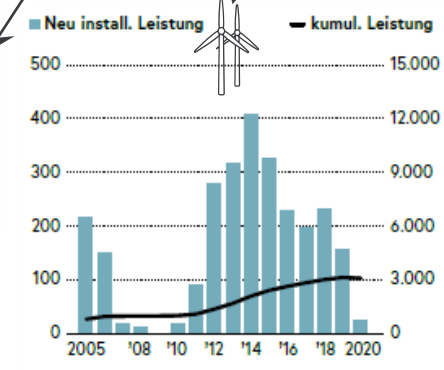
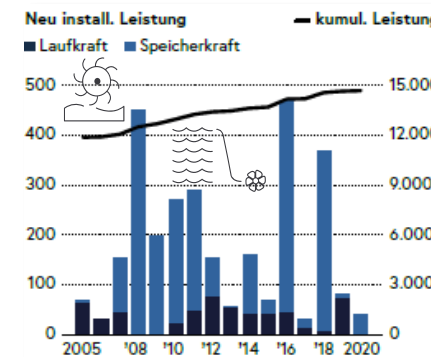
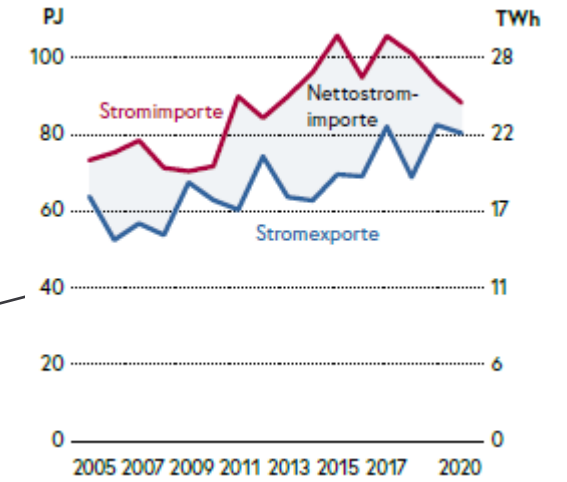
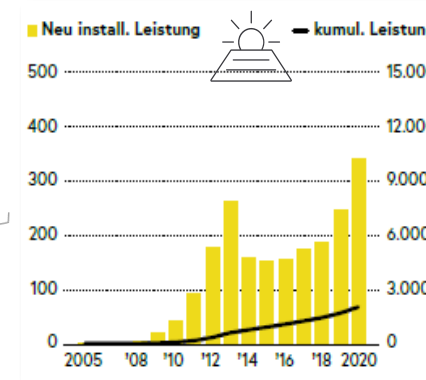
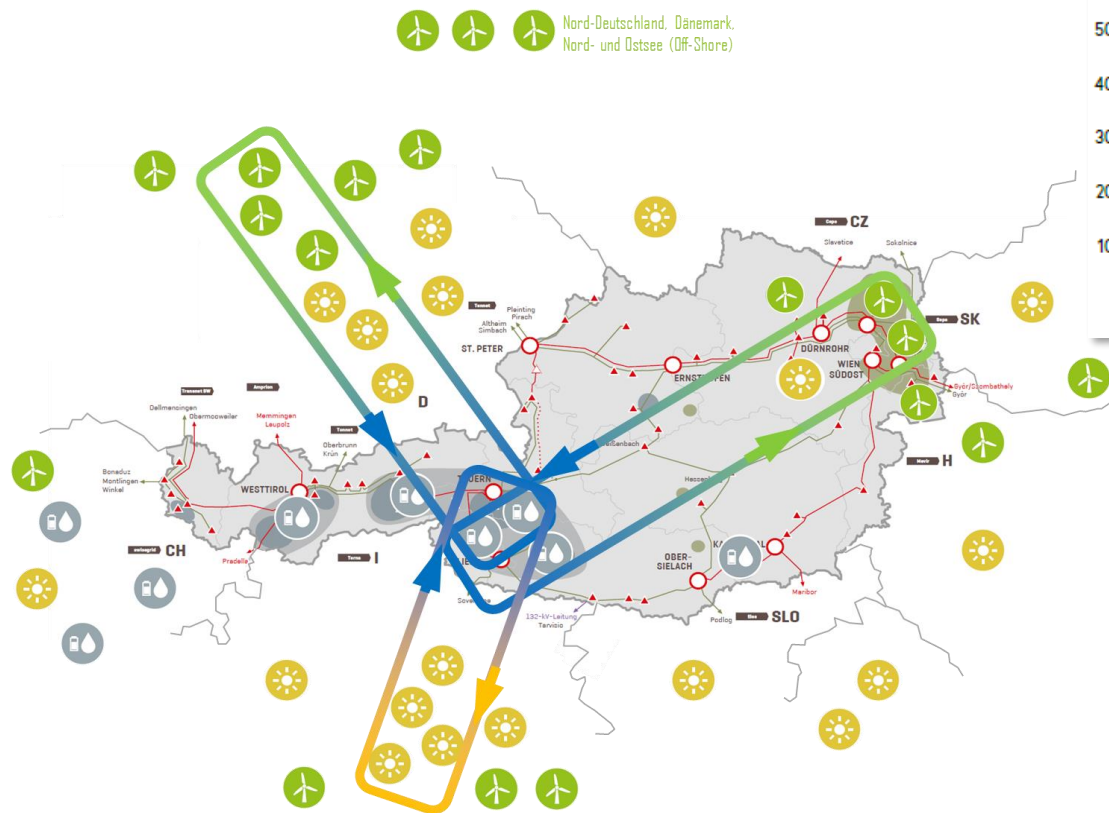


## The realization

- 24/7 trade at PEX, automatically run (algorithm and heuristics), supervised by control-room staff

# The future (!)

„Green battery“ of Austria (and ... parts ... of Europe)  $\Rightarrow$  (7)





# References & further reading

- (1) Share of RES in European consumption, <https://www.eea.europa.eu/data-and-maps/indicators/renewable-gross-final-energy-consumption-4/assessment-4>
- (2) The European Green Deal 2019, [https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF)
- (3) Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation („System Operation Guideline“, SO GL), <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R1485>
- (4) UCTE Operational Handbook (OH) Policy 1, [https://eepublicdownloads.entsoe.eu/clean-documents/pre2015/publications/ce/oh/Policy1\\_final.pdf](https://eepublicdownloads.entsoe.eu/clean-documents/pre2015/publications/ce/oh/Policy1_final.pdf)
- (5) System separation of the Continental Europe Synchronous Area on 8 January 2021 – final report: <https://www.entsoe.eu/news/2021/07/15/final-report-on-the-separation-of-the-continental-europe-power-system-on-8-january-2021/>
- (6) System separation of the Continental Europe Synchronous Area on 24 July 2021 – technical report, [https://eepublicdownloads.azureedge.net/clean-documents/SOC%20documents/SOC%20Reports/entso-e\\_CESysSep\\_210724\\_211112.pdf](https://eepublicdownloads.azureedge.net/clean-documents/SOC%20documents/SOC%20Reports/entso-e_CESysSep_210724_211112.pdf)
- (7) Energie in Österreich 2021, BMK, [https://www.bmk.gv.at/dam/jcr:bbe5cd73-a161-46fc-8c80-2eb5fc500acb/Energie\\_in\\_OE2021\\_UA.pdf](https://www.bmk.gv.at/dam/jcr:bbe5cd73-a161-46fc-8c80-2eb5fc500acb/Energie_in_OE2021_UA.pdf)

**Thank you for your attention!**

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