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by EDF and KIT

Contrasting countertrading mechanisms: market effects between Germany and Denmark West

ENERDAY, 9 April 2021

Introduction

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Market Integration

Increasing European integration

Energy transition

Phase-out of coal and nuclear, RES deployment affect grid congestions

(Delayed) internal grid expansion

Affects internal congestions which in turn affect cross-border congestions and cross-border trade

70% minRAM

At least 70% cross-zonal capacity available for cross-zonal trade. Could foster the use of redispatch and countertrading

Cross-border Congestions

Cross-border congestions affect market outcomes

Cross-border TSO Coordination

Coordinate the use of remedial actions in capacity calculation to facilitate efficient capacity allocation and avoid unnecessary curtailments of cross-border capacities

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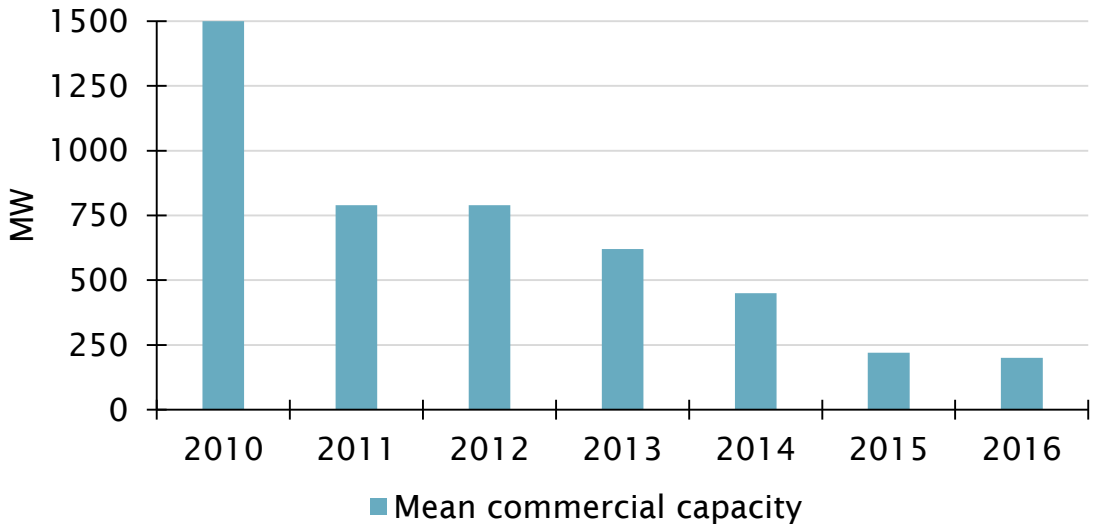
Background

EU Antitrust case

- In 2018 the European Commission investigated cross-border capacity limits between Germany and Denmark

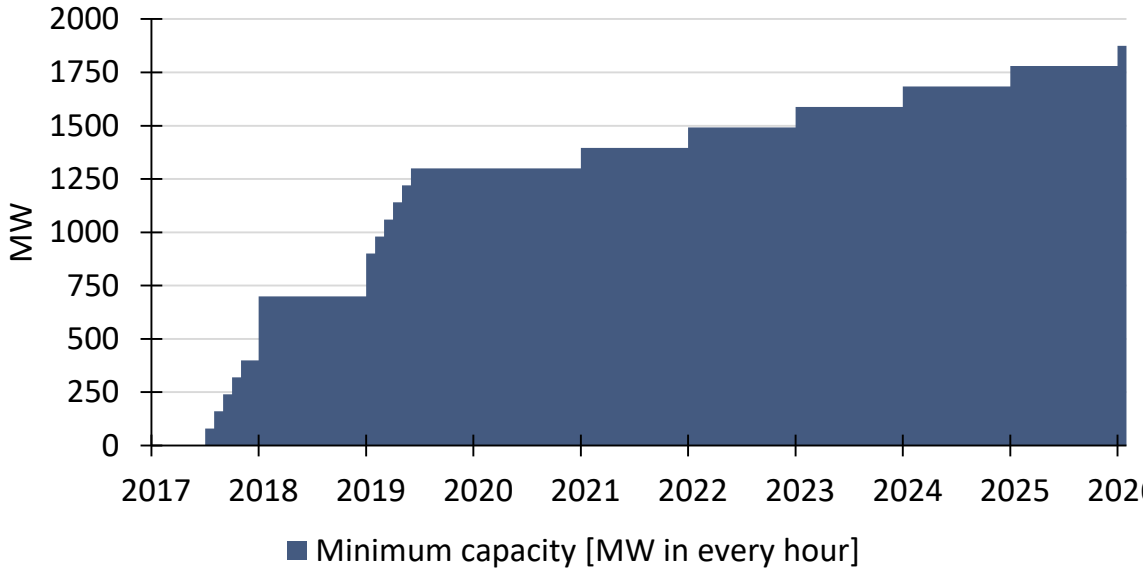
Annual average commercial capacity on the DE-DK1 interconnector in the southbound direction[1]



German-Danish Joint declaration

- Agreement on guaranteed minimum available hourly capacities between DE and DK West on the DA market using countertrading

Required minimum of import- and export capacities on DK1-DE[2]



[1] EC (2018) "CASE AT.40461-DE/DK Interconnector", Antitrust Procedure, Council Regulation (EC) 1/2003
[2] Source: Energinet & TenneT (2017): Final report - DK1-DE countertrade models impact assessment; Energinet (2021): Memo – Workshop II, Energinet (2019)

Background

Countertrading definition

"Countertrading … refers to the **zonal shift of net position** of the whole zone, achieved by **multiple units without considering their specific locations**."*

		Upward direction: ***Countertrading***	Upward direction: ***Redispatch***
Downward direction	**Net position type**		
Downward direction	***Countertrading***	• Cross-zonal counter-scheduling using countertrading	• Cross-zonal counter-scheduling using countertrading and redispatch
Downward direction	***Redispatch***	• Cross-zonal counter-scheduling using countertrading and redispatch	• Cross-zonal redispatch • Internal redispatch • External redispatch

* Kłos et al. (2020): Defining Transmission System Operators' Investment Shares for Phase-Shifting Transformers Used for Coordinated Redispatch

Introduction

Research questions

1. How are the countertrading processes implemented in DE and DK West?
2. Which drivers affect countertrading activation?
3. How does countertrading activation affect market results (prices for ID and special regulation)?

Agenda

Countertrading schemes

Contrasting approaches in DE and DK

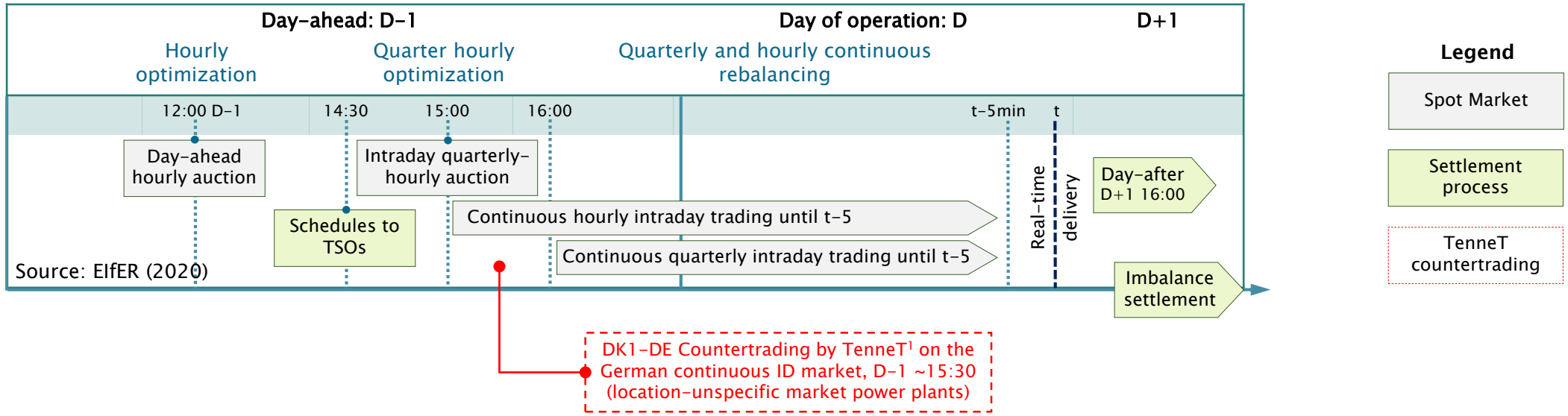
Countertrading design by TenneT

by EDF and KIT

Countertrading in the spot markets timeline

- A special workplace at TenneT trades volumes on the **German intraday market** after the countertrade volumes are known (at approximately D-1 15:30)[1]

Spot market and TenneT countertrading schedule



[1] Energinet & TenneT (2017): DK1-DE Countertrade models impact assessment

Countertrading design by Energinet

Pricing, activation and settlement of bids

Order of precedence of mFRR activaiton[1]

Remaining unused bids

mFRR bids in DK1 from the Nordic balancing market (RPM)

Activated for balancing

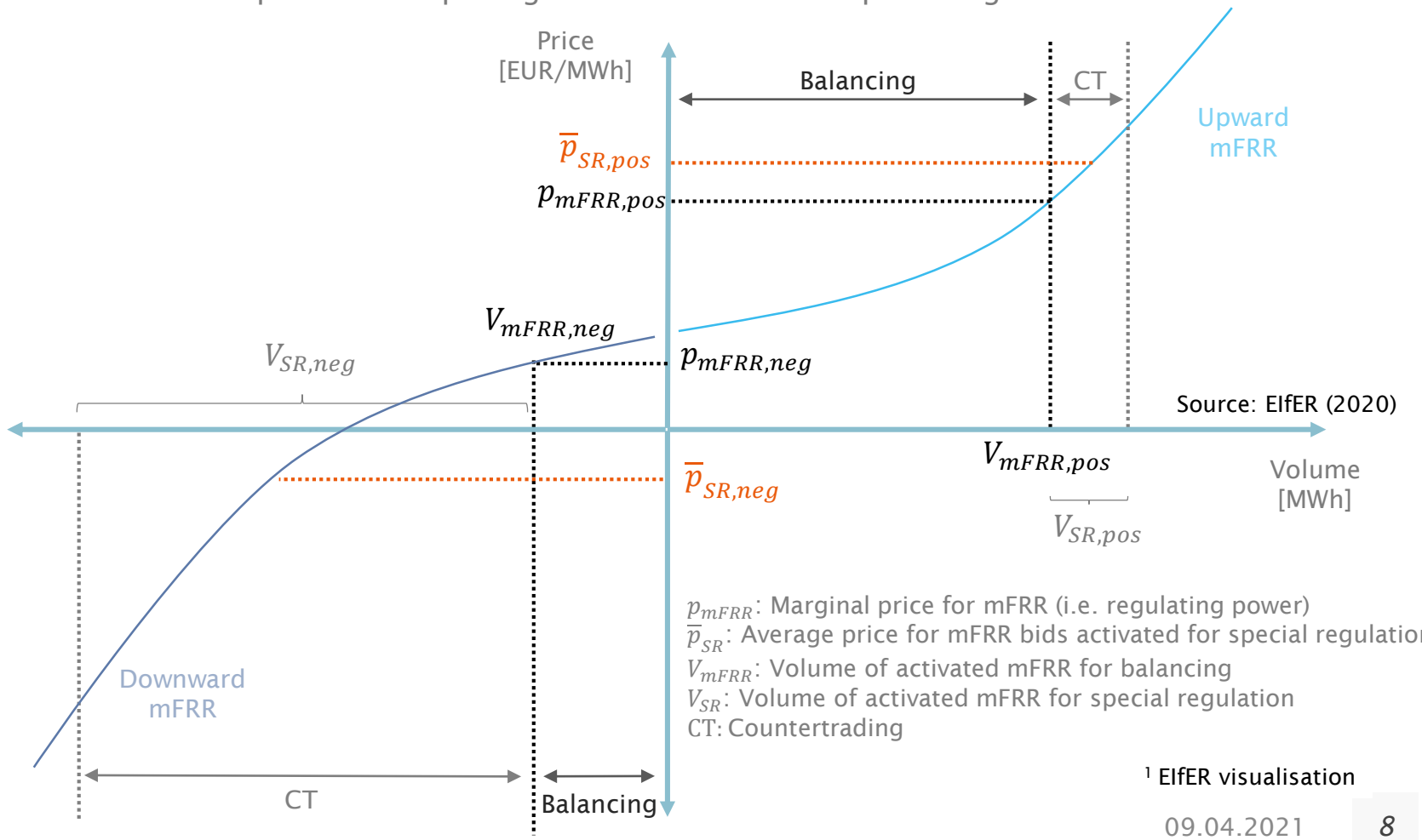
- **Marginal pricing**

Activated for special regulation

- **Pay-as-bid**
- Bids bypass the merit-order list, not affecting the RPM price nor imbalance prices

RPM = Regulated Power Market

Own interpretation on pricing of bids activated for special regulation[1]



p_{mFRR}: Marginal price for mFRR (i.e. regulating power)
$\overline{p}_{SR}$: Average price for mFRR bids activated for special regulation
V_{mFRR}: Volume of activated mFRR for balancing
V_{SR}: Volume of activated mFRR for special regulation
CT: Countertrading

[1] ElfER visualisation

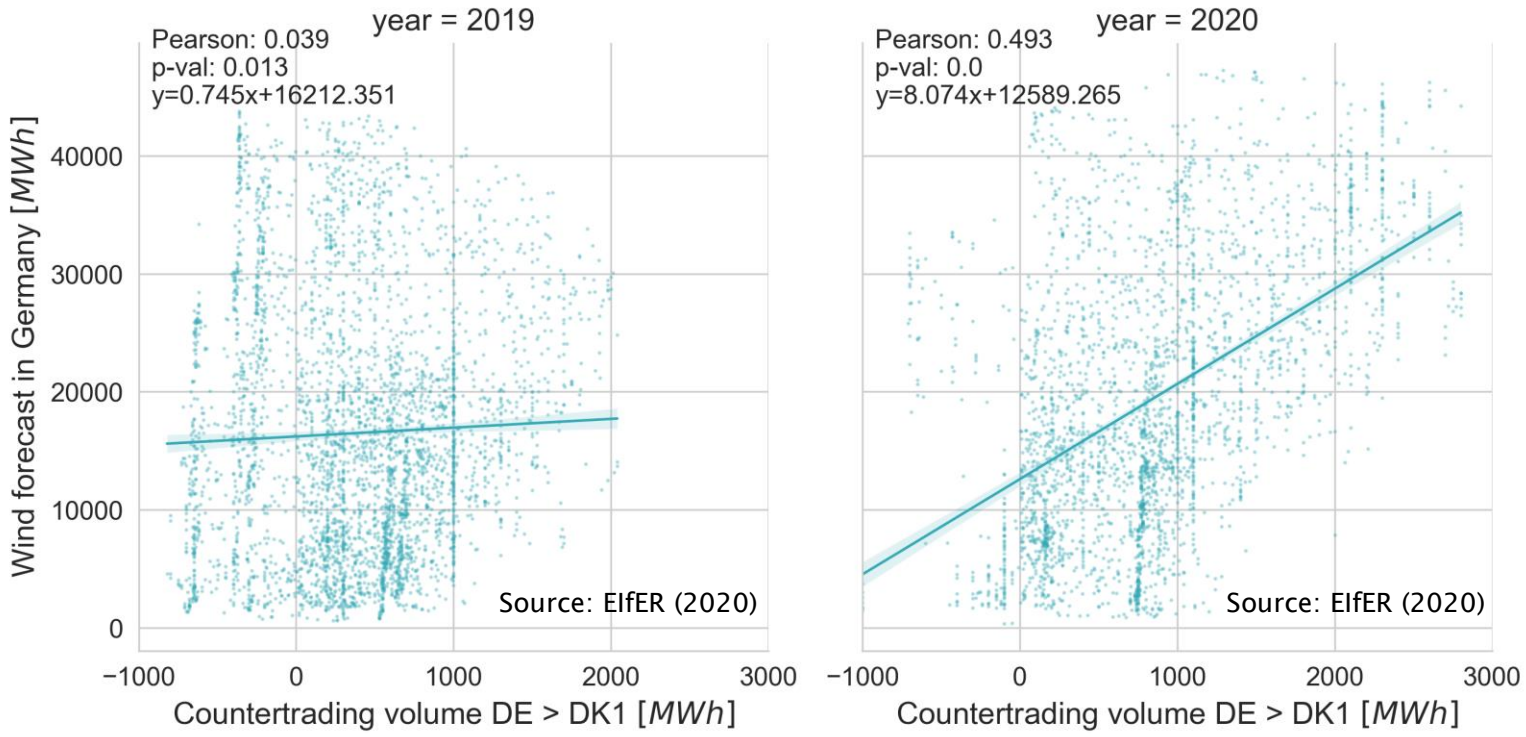
Results

Quantitative analysis

Analysis I: Impact of VRE on countertrading appearance

Wind feed-in forecast in Germany vs countertrading volumes

Correlation between a change in cross-border exchange due to countertrading in direction DE > DK1 and wind forecasts in Germany for 2019 and the first three quarters of 2020[1]



Conditions for the predominant countertrading case

- DE wind generation
- Scheduled DA flow: DK1→DE + DE internal congestion
- Countertrade against flow from DK1 to DE:
  1. TenneT buys ID volumes
  2. Energinet activates downward regulation
- Change in cross-border zonal exchange contrary to scheduled DA flow

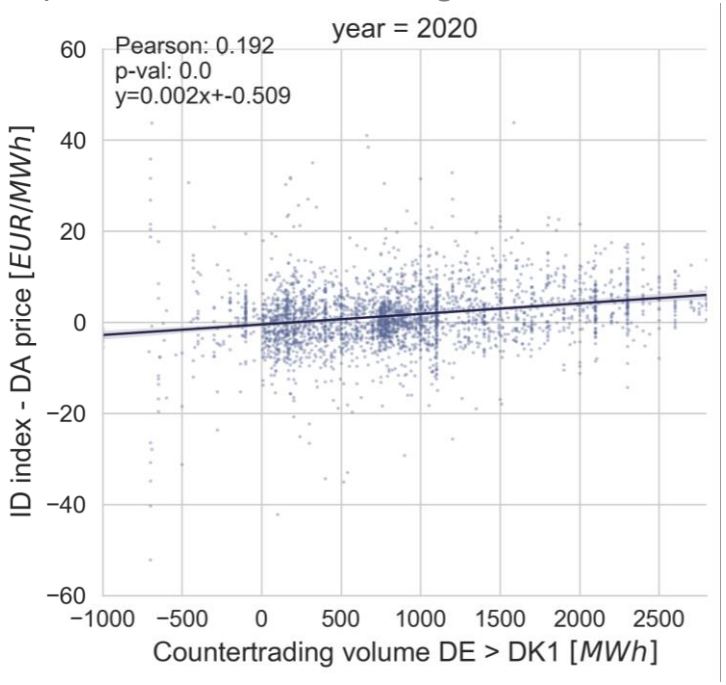
[1] EIfER visualisation based on data from ENTSO-E

Analysis II: Economic efficiency

Germany

- Data suggest that countertrading using the intraday market costs only **2-4 EUR/MWh** more than day-ahead market reference price

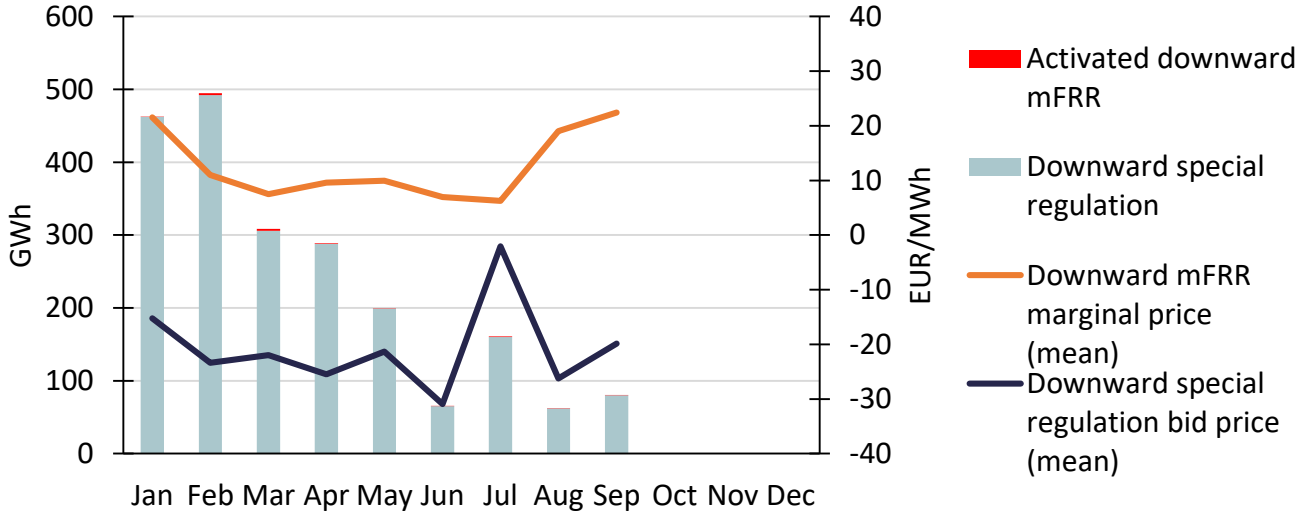
Price spreads and countertrading volumes in Germany[1]



Denmark West

- The **volumes for activated downward mFRR** for balancing energy are extremely low – this results in **positive marginal prices (BSP to TSO net payments)**
- In turn, most of downward mFRR is utilized for special regulation – this results in **negative average prices (TSO to BSP net payments)**

Volumes and costs in 2020 for special regulation and monthly average marginal prices for downward mFRR[2]



[1] EIfER visualisation based on data from ENTSO-E and EPEXSpot
[2] EIfER visualisation based on data from ENTSO-E and Energinet

Conclusion & outlook

Conclusion & outlook

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General remarks

- Various **coexisting definitions of countertrading**
- **Documentation** of countertrading process **could be improved**, both for DK1 and DE
- **Terminology is sometimes inconsistent** between different documents
- To the author's knowledge, **only monthly aggregated special regulation prices are public.** Finer resolution would be necessary to further inquire into the effect of countertrading in DK1 price dynamics

Results

- The dominant situation continues to be the **provision of downward regulation in DK1** with TenneT buying volumes in the ID market
- Results suggest that countertrading using the intraday market costs only around **2-4 EUR/MWh** more than day-ahead market

Outlook

- **Increasing importance of countertrading** in the framework of the European internal electricity market
- How does **Redispatch 2.0** in Germany affect countertrading volumes?
- **Energinet is leaving the current special regulation scheme** in favor of the use of an intraday market scheme

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Thank You

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Willaime, Q., 2019. Costly Remedial Actions Coordination.

Annex

Background

Background

“Pushing congestions to the border”

EU Antitrust case:

- “When calculating the commercial capacity on the DE-DK1 interconnector TenneT establishes a strong link between the amount of commercial capacity made available and the level of wind production in Germany.”[1]
- “TenneT limits the commercial capacity (NTC) on the DE-DK1 interconnector when the domestic wind-based electricity production is high.”[1]

NTC table for capacity at the DE-DK1 interconnector[1]

Wind strength from	Wind strength to	Southbound capacity at DK-DE
0 MW	500 MW	950
501 MW	1000 MW	650
1001 MW	2000 MW	250
2001 MW	3000 MW	50
3001 MW	4000 MW	0
4001 MW	5000 MW	0
5001 MW	6000 MW	0
6001 MW	7000 MW	0
7001 MW	8000 MW	0
8001 MW	9000 MW	0
9001 MW	10000 MW	0

[1] EC (2018) “CASE AT.40461-DE/DK Interconnector”, Antitrust Procedure, Council Regulation (EC) 1/2003

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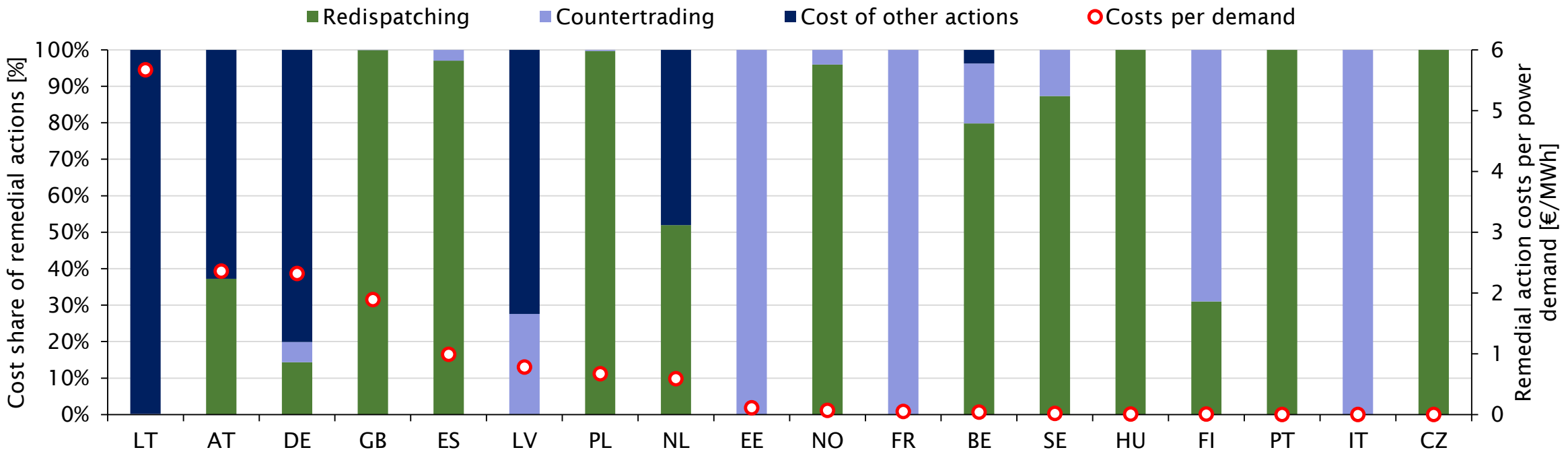
Role of countertrading as a congestion management measures

- Use of remedial congestion management actions is very heterogeneous within Europe
- Remedial action costs per demand volume strongly vary in-between countries

Country-comparison of congestion management costs



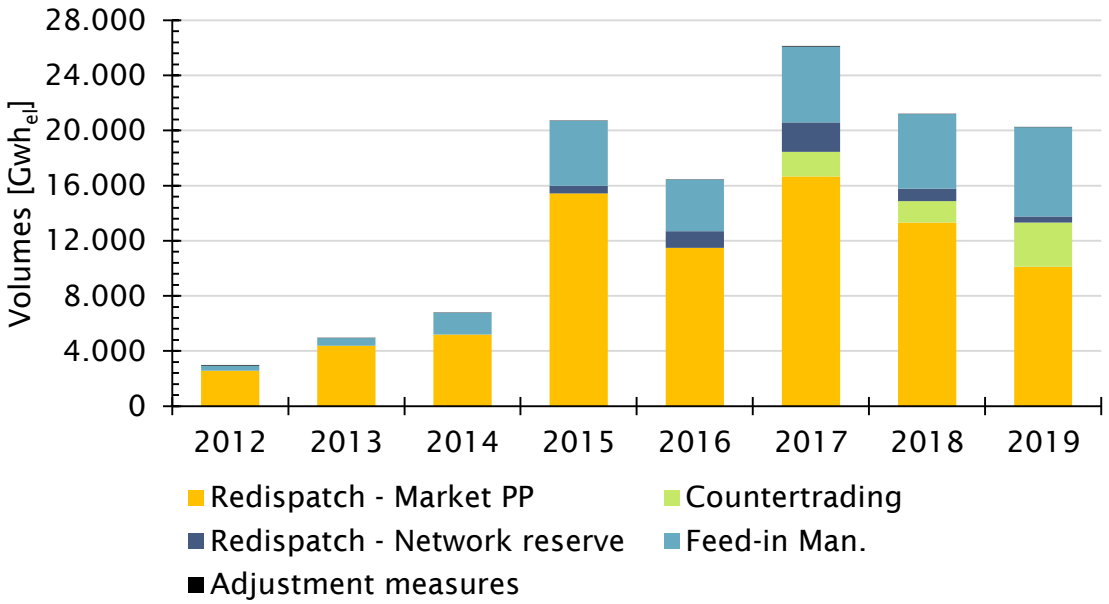
Source: ElfER visualisation based on ACER & CEER (2020): ACER Market Monitoring Report 2019

Background

Role of countertrading as a congestion management measure

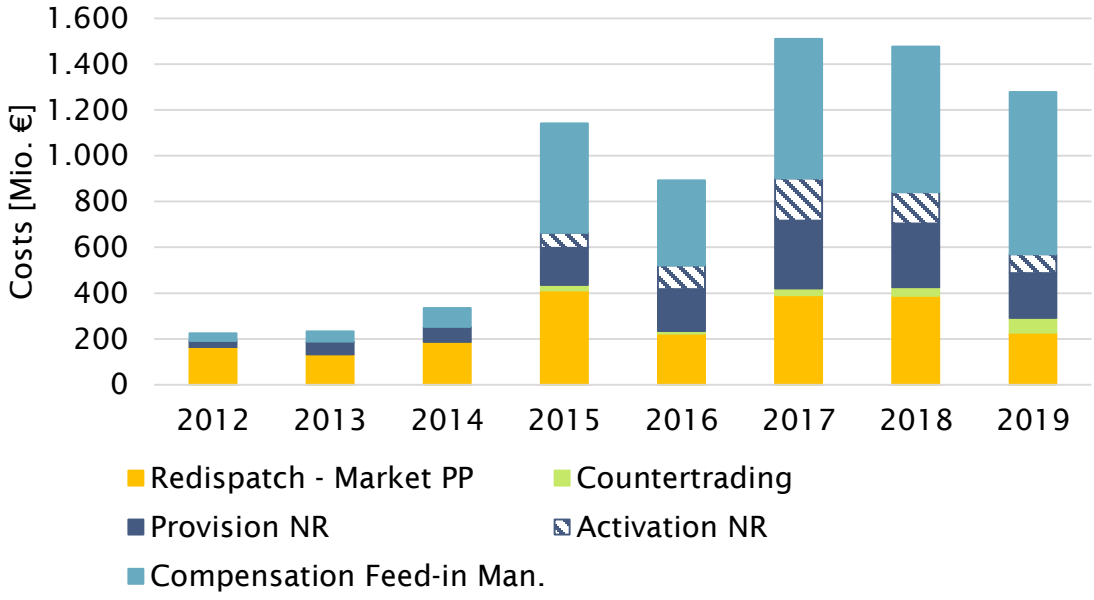
- Strong increase of countertrading volumes in 2019
- Before 2017 countertrading was not reported separately from redispatch by the BNetzA[1]

Evolution of congestion management volumes in Germany[1]



- Countertrading costs have just a minor role in overall congestion management costs in Germany

Evolution of congestion management costs in Germany



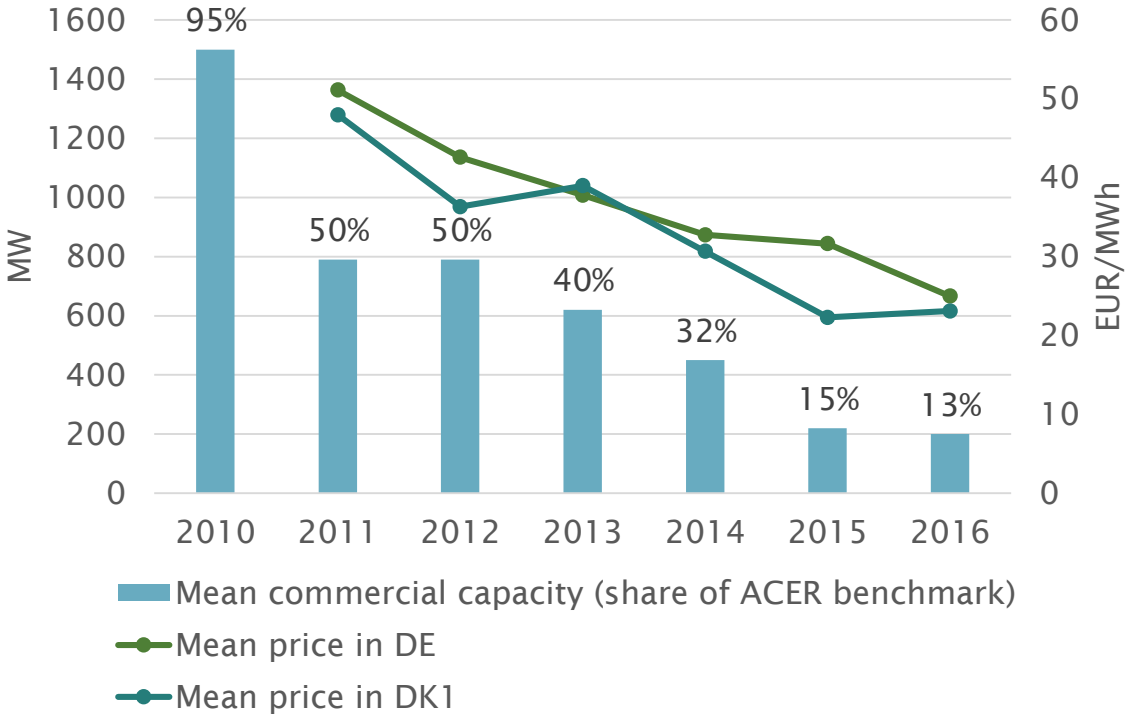
Source: ElfER visualisation based on BNetzA - Monitoring Report and BNetzA – Netz- und Systemsicherheitsmaßnahmen
[1]Minor inconsistencies may occur towards countertrading and redispatch volumes due to separate reporting by BNetzA

Background

Antitrust procedure: DE/DK Interconnector

- **Heavily curtailed interconnector**
  - » Only 13 % of benchmark capacity calculated by ACER in the first half of 2016
  - » Capacity limited 100% of the hours between 2015 and the first half of 2016 with TenneT as the limiting TSO in all cases
- **Barrier for price convergence**
  - » The annual average spot price in DK1 remained generally lower than in Germany. The limitation of trading possibilities caused more expensive plants to run in Germany to meet local demand instead of cheaper power plants from Denmark.

Annual average commercial capacity on the DE-DK1 interconnector in the southbound direction and annual average wholesale prices in DE and DK1[1]



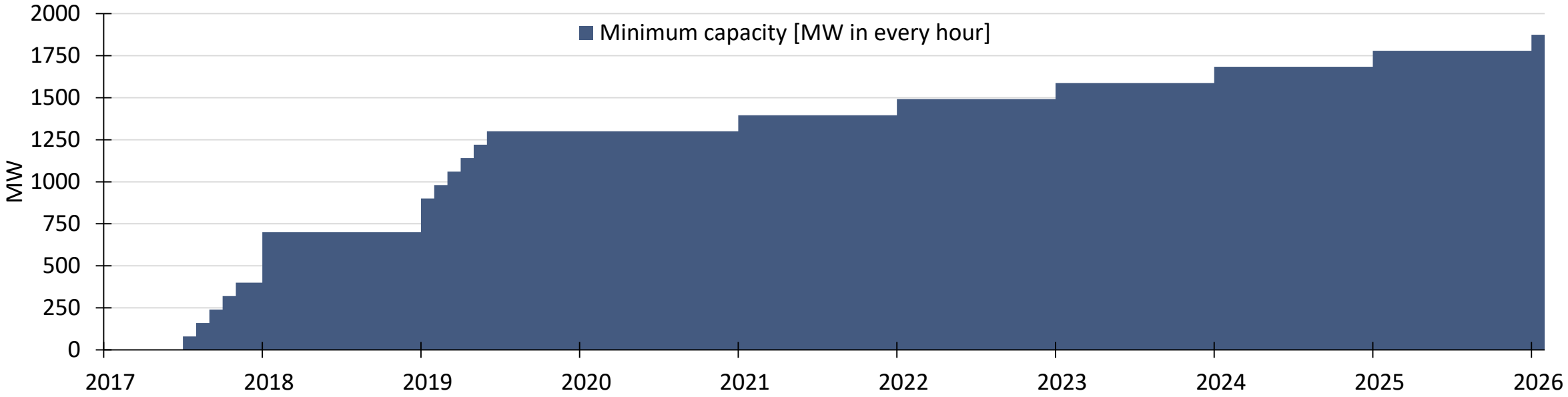
[1] EC (2018) "CASE AT.40461-DE/DK Interconnector", Antitrust Procedure, Council Regulation (EC) 1/2003

Background

Joint declaration 3rd July 2017

- Aim to gradually increase the capacity between Denmark West (DK1) and Germany (DE) available to the day-ahead market by securing a minimum of available hourly import and export capacity (referred to as minimum capacities) in each hour on the interconnector
- During this interim period, the cross-border electricity trade capacity available for the market shall be increased in a stepwise approach

Required minimum of import- and export capacities on DK1-DE



Source: Energinet & TenneT (2017): Final report - DK1-DE countertrade models impact assessment; Energinet (2021): Memo – Workshop II, Energinet (2019)

Annex

Countertrading schemes

Countertrading design DK1-DE

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Countertrading as one remedial action of congestion management

Different categories of DE-DK countertrading (and redispatch) activation

Situation	Germany	Denmark West	Locational dispatch modification
• Countertrade against **scheduled flow DK1→DE** • Change in cross-border zonal exchange DE→DK1, contrary to scheduled flow • Energinet cannot export or TenneT cannot import (internal congestion)	1. TenneT **buys volumes** on the German continuous ID market[1] **(**at approximately D-1 15:30)[5] unless it affects already existing congestions. Compensation of limited flow from DK1. 2. In these cases (existing internal congestions), specific generators are instructed to adjust their set points (**upward redispatch**).[4]	1. Energinet **uses excess generation from Germany to cover upward regulation requirements** if any (either in Denmark or the other Nordic countries)[1] 2. Only after **activate special downward regulation**[1,2]	• Indirect (Direct locational dispatch only in case of specific generators instructions by TenneT)
• Countertrade against **scheduled flow DE→DK1** • Change in cross-border zonal exchange DK1→DE, contrary to scheduled flow • TenneT cannot export or Energinet cannot import (internal congestion)	1. TenneT **sells volumes** on the German continuous ID market[1] at approximately D-1 15:30)[5] unless it affects already existing congestions. 2. In these cases (existing internal congestions), specific generators are instructed to adjust their set points (**downward redispatch**).[4]	1. Energinet **covers downward regulation requirements** if any (either in Denmark or the other Nordic countries)[3] 2. Only then **activate special upward regulation**[3,2]. Compensation of limited flow from DE.	• Indirect (Direct locational dispatch only in case of specific generators instructions by TenneT)

Source: EIfER, own summary

[1] Energinet & TenneT (2019): DK1-DE COUNTERTRADE FOLLOWING JOINT DECLARATION 2018, Chapter 8.3 & 5.1
[2] "When this platform is put into operation, and activation and settlement of regulating power for various purposes is automated, it can be assumed that Norwegian and Swedish players and plants will participate in special regulation on equal terms with Danish players and plants."
[3] own understanding and interpretation
[4] "In Germany, the Intraday market will be used, unless it affects already existing congestions. In these cases, specific Generators are instructed to adjust their set points." CCR Hansa (2018): Report assessing the progressive coordination and harmonisation of mechanisms and agreements for redispatching and countertrading in accordance with EU Regulation 1222/2015 article 35(3)
[5] Energinet & TenneT (2017): DK1-DE Countertrade models impact assessment

Countertrading design by TenneT

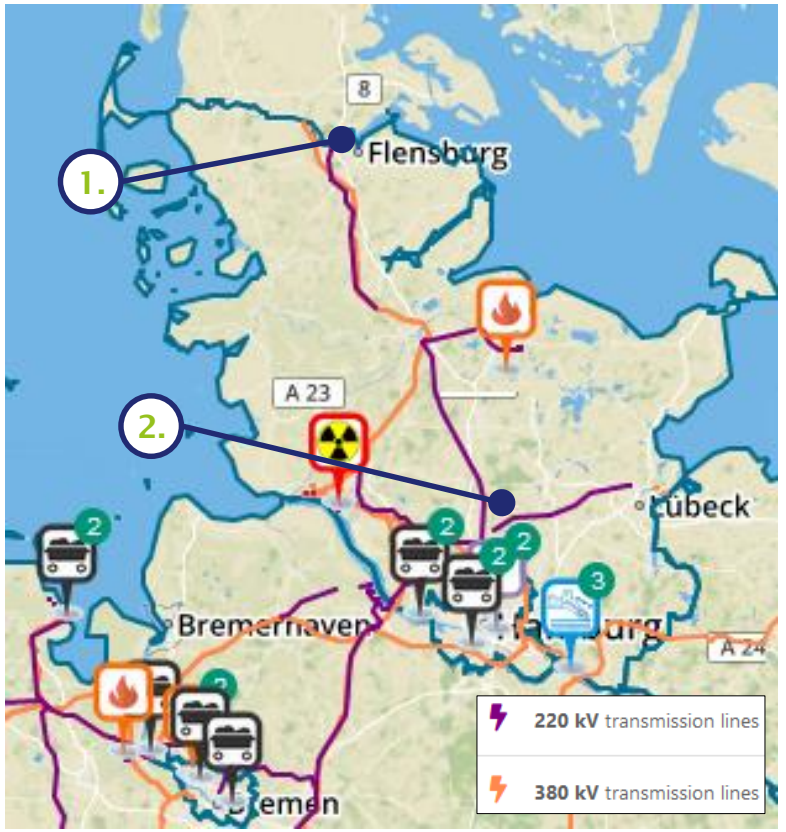
by EDF and KIT

Why is countertrading almost only used on the German-Danish border?

- **Countertrading is location-unspecific** and does not aim for a dispatch intervention of concrete power plant in order to solve grid congestions. “For this reason, countertrading measures are primarily suitable for bottleneck situations in which, for **network topological reasons**, no activation of specific power plants is necessary.”[1]
- Location-specific dispatch intervention (redispatch) is not necessary since the Danish-German AC connector is special in terms of topology[2]:
  1. “Since the border has a one-to-one correspondence between power plants and physics, it is possible to perform a countertrade and have full physical effectiveness.”
  2. “The critical network elements in TenneT’s control area for the border DK1-DE are located in the area around Hamburg. Since there is **strongly limited [dispatchable] production capacity north of Hamburg** available, there is only a low risk of activating this capacity with intraday countertrading what is also proved by the experience from recent years.
- “This implies that the additional upward and downward regulation required in Germany can be **purchased at the intraday market**.”

[1] Bundesnetzagentur (2020): Monitoring report 2019
[2] Energinet & TenneT (2017): DK1-DE Countertrade models impact assessment
[3] https://energy-charts.info/

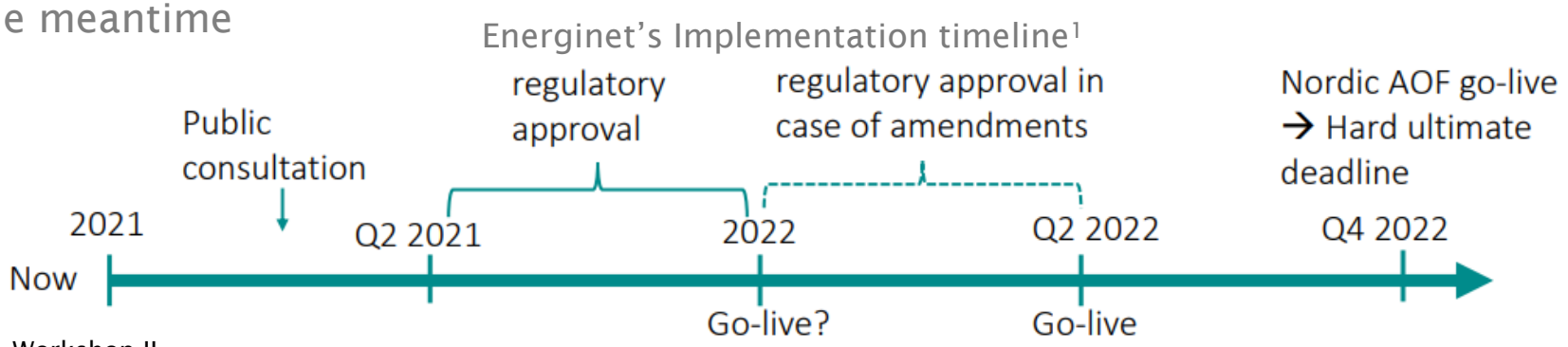
Grid and power plant topology[3]



Countertrading design DK1-DE

Energinet favours introducing an intraday countertrading model

- Energinet hold "Workshop 2 on alternative countertrade models" on 14th January 2021 favoring continuous ID
- Energinet interprets the EBGL that it "imply that Energinet can neither withhold, modify bids nor declare them unavailable to use the bids for countertrade in a special regulation model … after joining MARI."[1]
- "In the Nordic Balancing Model, an optimization activation function (Nordic AOF) is expected to be implemented in Q4 2022. The Nordic AOF will closely mirror the MARI platform leaving **very little time after the optimization cycle to activate bids**. Continuing the current special regulation model after go-live of the Nordic AOF would all-else-equal imply that all activation with respect to special regulation would need to be processed in this very short timeframe."[1]
- "Countertrade: Intraday Model Design Online Meeting" was held on 20th April 2021 and ID design draft was published in the meantime



[1] Energinet (2021): Memo – Workshop II
[2] Energinet (2021): Workshop 2 A new countertrade model

Model summary

Model summary

Country	System security	Cost-effectiveness	Market access	Effect of arbitrage	Transparency
Germany	• Liquid continuous ID market able to provide sufficient downward and upward regulation	• Transaction costs: No extra operational costs for TenneT to manage special workplace for trading in intraday market. Already in place for other purposes, e.g. due to direct marketing for FiT power plants	• All participants in the XBID	• Incentive for market participants to bid more production/less consumption in the day-ahead timeframe in order to offer this production and/or consumption for upward and/or downward regulation later	• Follow European legislation such as REMIT
Denmark	• Still some risk of insufficient bids as only DK1	• Some implementation costs as additional investments in IT systems are needed • Additional operational costs in Energinet control center and settlement department	• Only DK1 participants • Wind cannot participate in capacity auction	• Additional incentive for consumption BRPs to speculate in lower imbalance prices as additional imbalance netting might be applied • High incentive for production BRPs, when they are selected in the capacity auction.	• Reduced transparency (marginal vs. pay as bid activation and imbalance netting)

Source: EIfER (2020), own understanding

Countertrading at the DK1-DE border

by EDF and KIT

Ensuring minimum capacities and managing congestions

- An agreement exists between 50Hertz and Energinet to use countertrade at the **DE-DK2** border in case of a disturbance of the Kontek cable or its equipment. However, most countertrading is performed by TenneT and Energinet at the **DE-DK1** border

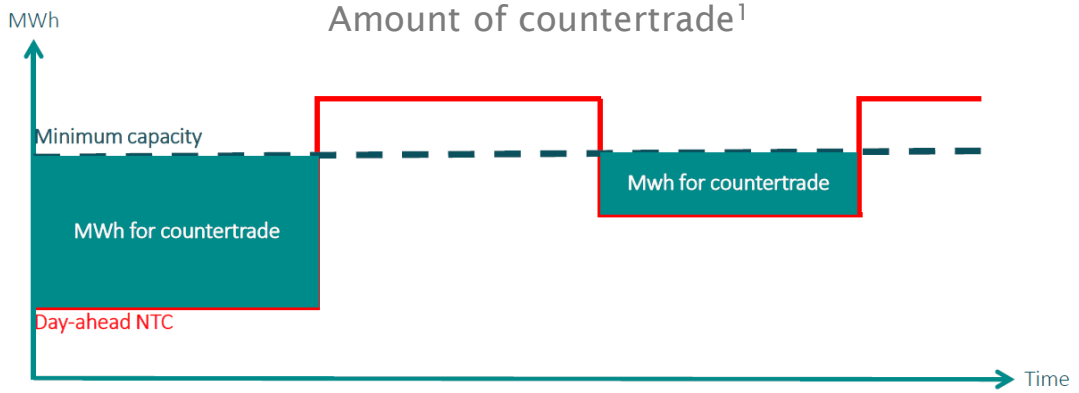
TenneT and Energinet calculate available NTC in both directions

Lowest NTC is chosen

At least the minimum capacity requirement is offered to the market. Countertrading used to ensure this

If the scheduled flow creates **congestions** additional countertrade is necessary

Amount of countertrade[1]



$$C^{ct} = C^{DA} = max\left(NTC; C^{min}\right)$$

NTC: Day-ahead Net Transfer Capacity
C^{DA}: Day-ahead capacity
C^{min}: Minimum capacity required

$$C^{ct} = max\left((PTR^{nom} + F^{DA}) - C^{DA}; 0\right)$$

C^{ct}: Countertrade capacity
PTR^{nom}: Nominated power transmission rights
F^{DA}: Day-ahead flow

[1] CCR Hansa (2020): Linnemann Nielsen (2017) DK1-DE/LU: Minimum capacities from Joint Declaration

Countertrading design by TenneT

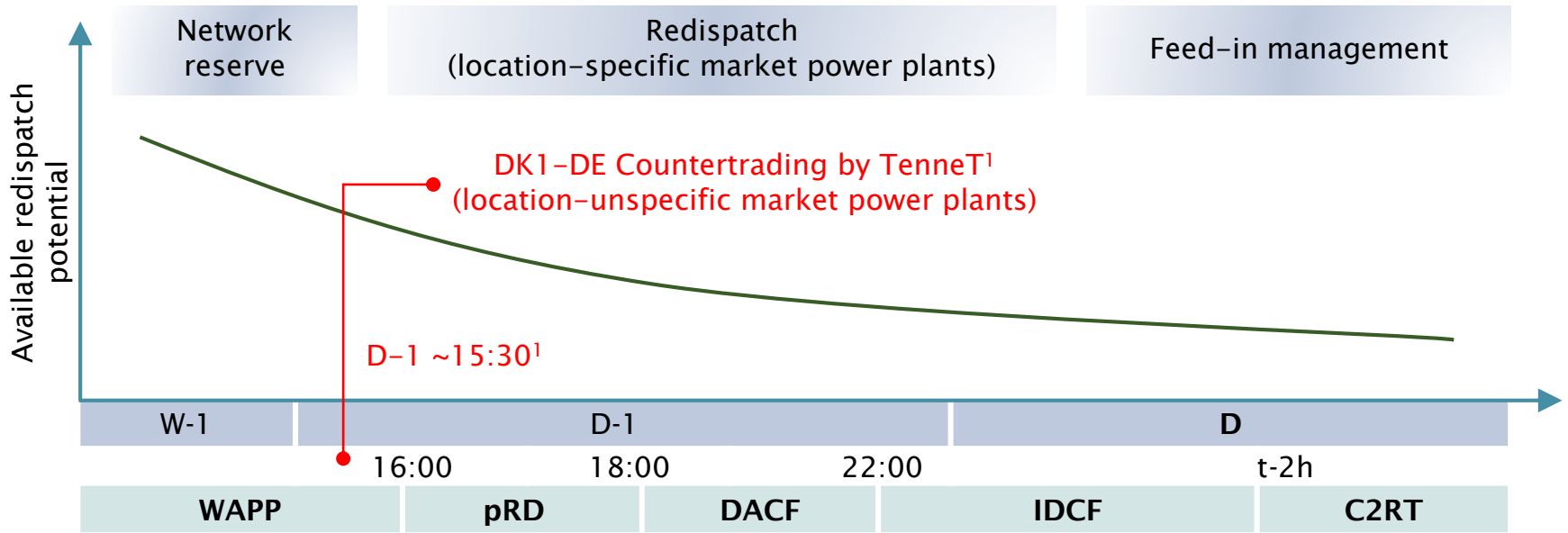
Countertrading in the congestion management timeline

- A special workplace at TenneT trades volumes on the **German intraday market** after the countertrade volumes are known (at approximately D-1 15:30)[1]

Legal activation sequence

1. Network-related measures
2. Market-related measures (Redispatch)
3. Use of additional reserves
4. Emergency measures (among others curtailment conventional and EEG/CHP units)

Schedule of congestion management measures[2]



WAPP – Week Ahead Planning Process
pRD – Preventive Redispatch Process
DACF – Day Ahead Congestion Forecast
IDCF – Intraday Congestion Forecast
C2RT – Close to Real Time

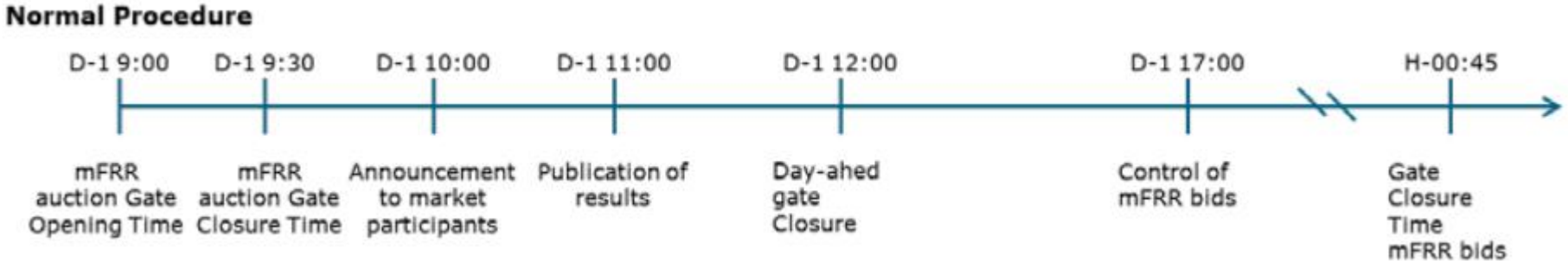
[1] Energinet & TenneT (2017): DK1-DE Countertrade models impact assessment
[2] Adopted from 50Hertz(2019): Status und Ausblick Engpassmanagement & 50Hertz(2019): Redispatch and Curtailment to Manage Grid Integration

Countertrading design by Energinet

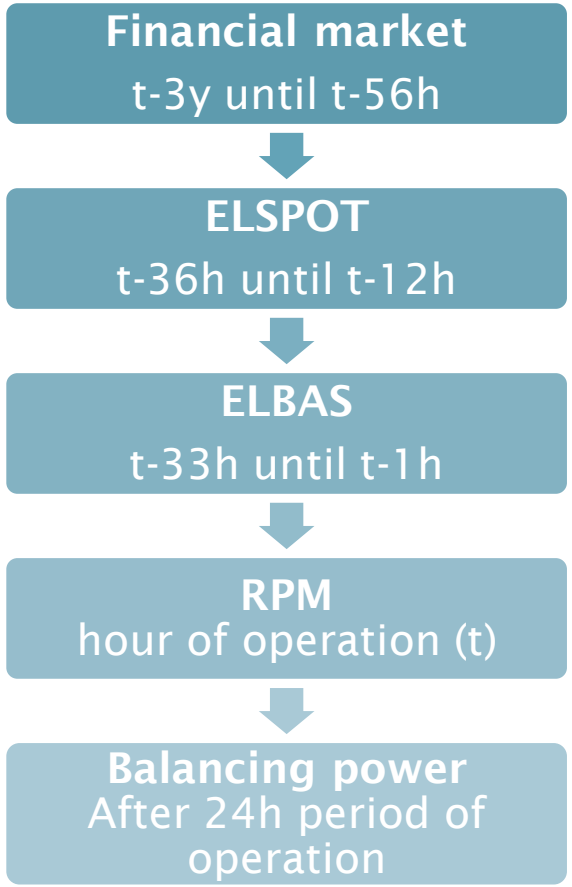
Special regulation is currently use to provide countertrade volumes

- The scheme used in DK1 is **Special regulation with optional capacity auctions**
- Makes use of bids on the Nordic **Regulation Power Market (RPM)**, selected from the **merit-order list (NOIS-list).** By doing so, these bids are said to be selected for **special regulation.**
- Bids selected consist on **mFRR bids in DK1** as other Nordic TSOs do not participate in this scheme and as there is no free capacity available on the DK1-DK2 connection

Process for mFRR bids in the Nordic regulating power market



General timeline for the Nordic Power Market[1]



[1] ENTSO-E (2014): Pilot 5: The Nordic Regulating Power Market
[2] Energinet (2017): Memo - WORKSHOP ON THE DANISH-GERMAN BORDER (DK1-DE), 7th September 2017

Annex

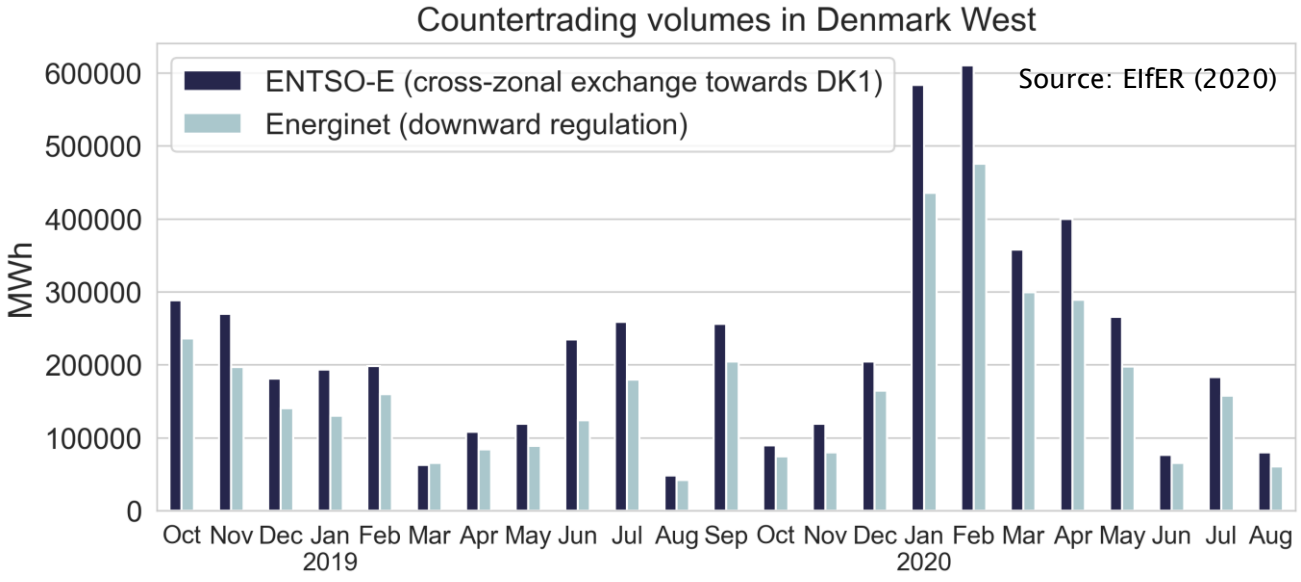
Data & results

Data sources

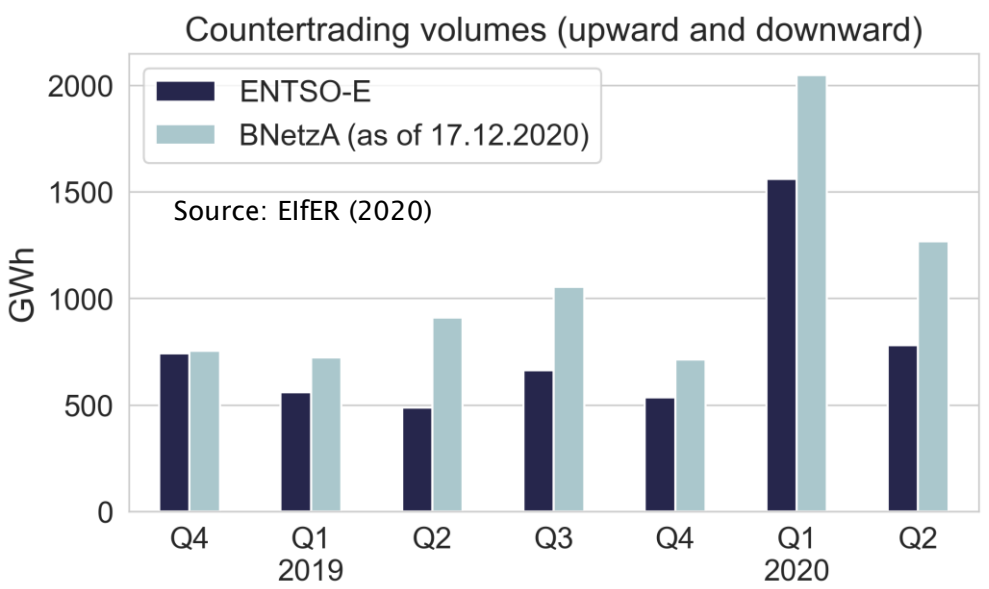
Data published from different sources

- Data from ENTSO-E Transparency Platform, Energinet and EPEXSpot is used
  - Prices for special regulation only as aggregated figures
  - Differences can be seen when comparing with other publications by Energinet and the German Federal Network Agency (BNetzA) → Probably due to volumes used for imbalance netting in the Nordics

Comparison between countertrading volumes published by ENTSO-E and Energinet[1]



Comparison between countertrading volumes published by ENTSO-E and BNetzA[2]



[1] EIfER visualisation based on data from Energinet and ENTSO-E
[2] EIfER visualisation based on data from BNetzA and ENTSO-E