
# Quantifying The Worst-Case Impact of Strategic Bidding on a Redispatch Market

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# Outline

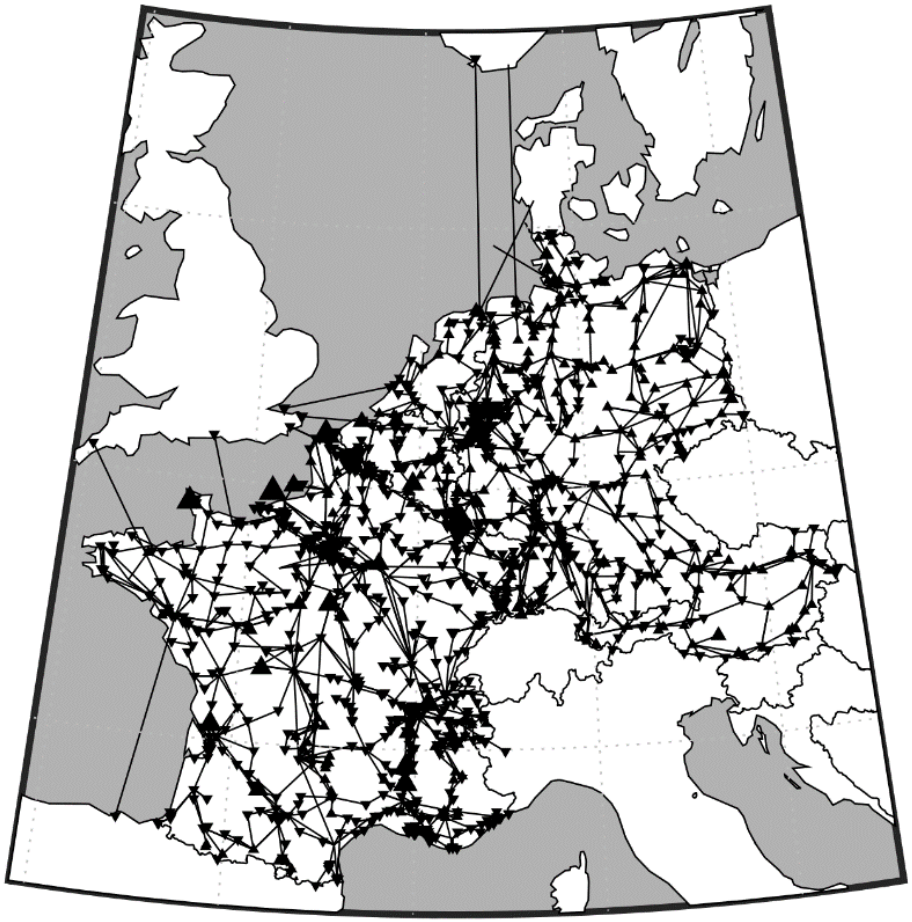
# Motivation

- The merits of regional flexibility markets are being debated in Germany
- Multiple projects aiming to implement congestion management on the distribution level
- Big debate about the „gameability" of these markets

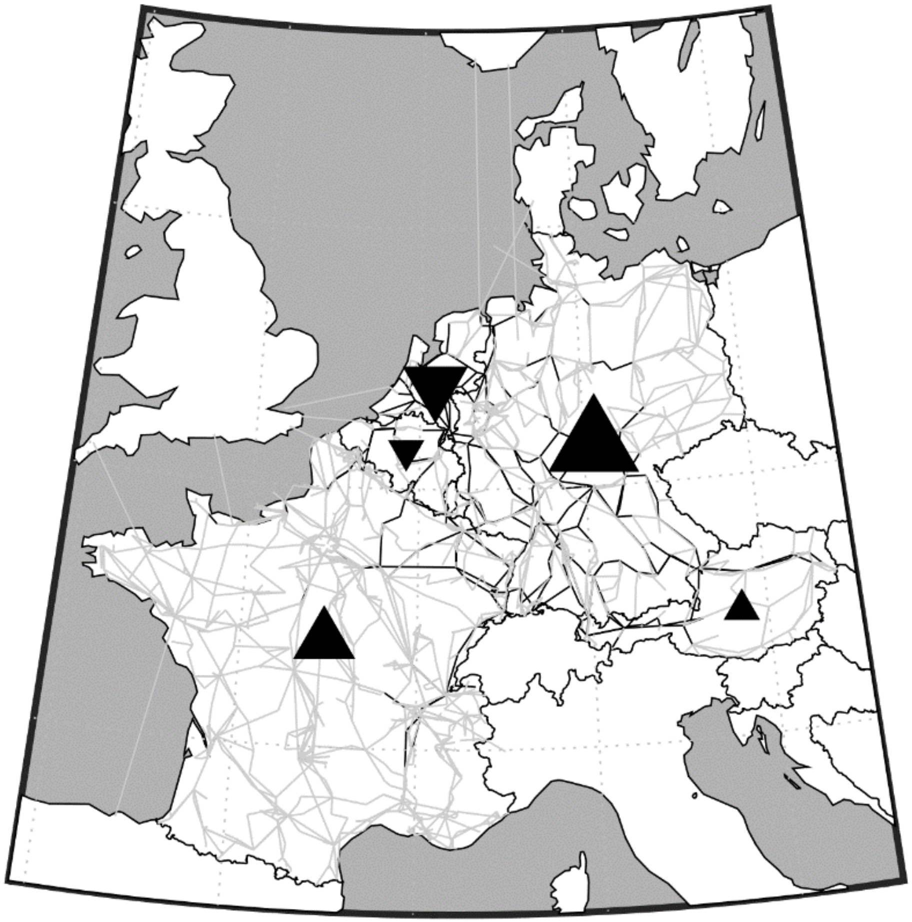
Why regional flexibility markets?

- distribution grids are no longer expected to absorb peak infeed from renewables
- growing amount of decentral flexibilities in the system
  - hard to manage in the existing, cost based redispatch system

# Bigger markets make redispatch necessary

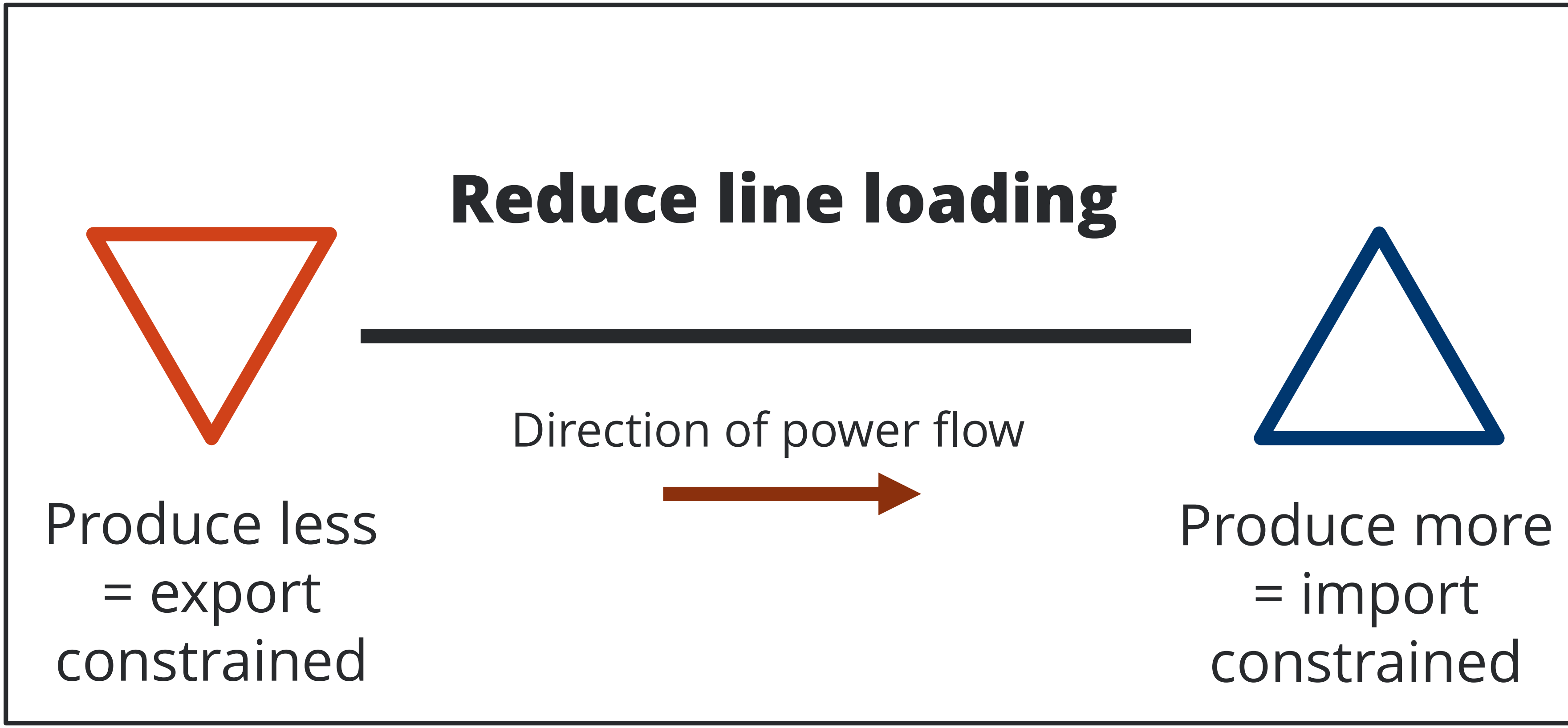


Actual detail of electricity grid



Representation of the grid in zonal setting

# Basic principle of redispatching



# Outline

# Basic Assumptions

- Redispatch market is active after Day-Ahead market
- Participants are free to bid what they want (as they are now)
- Grid operator performs redispatch in the most cost effective way possible

# Competing for redispatch – what is the problem?

## INC-DEC Gaming

- If grid operator wants units to **increase production**
  - it has to offer a higher price than in the spot market → if the spot market price was enough, units would already be producing
- If grid operator wants units to **decrease production** (same as increasing demand)
  - it has to sell energy at a lower price than in the spot market → same reasoning as before

**Result:**

- Export constrained regions (where production is decreased) get the opportunity to **buy energy for a lower price** than in the spot market
- Import constrained regions (where production is increased) get the opportunity to **sell energy for a higher price** than in spot market

# What do smart market participants do?

**Why not wait for the redispatch market to buy energy cheap / sell it for more?**

- Units in import constrained nodes:
  - know that they can sell their energy for more money in the redispatch market

    → redispatch market sets benchmark price (opportunity costs) for these units even in the spot market
- Units in export constrained nodes:
  - know that they can buy energy at a low price in the redispatch market

    → they lower their bid to the expected price in the redispatch market

**This makes congestions worse!**

- Production in export constrained nodes increases
  - units know they can buy back the energy cheap in the redispatch market (even if production is not profitable at spot market prices)
- Production in import constrained nodes decreases
  - units wait for better prices in the redispatch market

# INC-DEC Gaming

INC-DEC Gaming = INCrease DECrease Gaming

Increase production in spot market
Decrease production in redispatch market
(and get paid for it)

**Another way to look at it:**

Create congestions in order to get paid to resolve them

# Main research question: How bad can it get?

If every market participant has perfect anticipation and fully utilizes its knowledge to bid strategically:

- what are the effects on congestions? (and consequently redispatch volumes)
- what is the effect on consumer prices?
- how are generator rents affected?

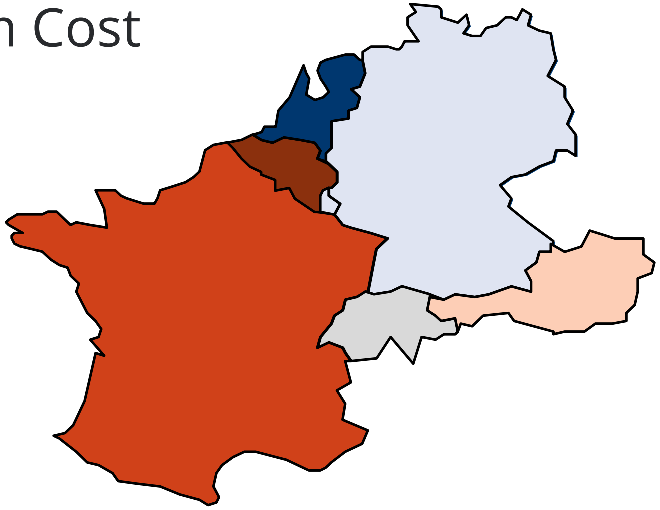
# Outline

# Our model

## What do we model?

- CWE + Switzerland = Austria, Belgium, France, Germany, Netherlands, Switzerland
- Grid model with nodal resolution (220 kV and above)
- Zonal clearing with flow-based market coupling
- Redispatch with nodal resolution

- Optimization Problem: Minimization of System Cost
- ~1200 Generators



# How to model anticipation?

| Getting the anticipated values | |
|---|---|
| Zonal Clearing | Redispatch |

# Outline

# First results

**Zonal clearing:**

- Payments to generators increase by 8 million Euros (basically nothing)
- Rents to generators decrease by 500 million Euros
- Increase in congestions after zonal clearing: 250%

**Redispatch:**

- Payments to generators increase by 180 million Euros (+44%)
- This corresponds to an extra charge of 0.18€/MWh to customers
- Rents to generators increase by 672 million Euros
- Increase in redispatching volume: +48% (29 TWh per direction)

# What do the results mean?

- Although congestions increase by 250%, redispatching volume only increases by 48%
  - remedial actions can affect many different congestions
- The increase in congestions does not tell the whole story:
  - we assume perfect coordination by the grid operator
  - would a grid operator be able to deal with such a heavy increase?
- The effect on consumer prices should be relatively mild
  - only 18ct/MWh in this worst case scenario

**Next steps:**

- Include the effect of uncertainty in the analysis → no perfect anticipation
- Find a way to limit redispatch quantities while preserving realistic prices

# How to get realistic prices while limiting redispatch quantities?

Not working:

- introduce penalty on costs for all generators, so that no ex-post optimization takes place
  - shadow prices are distorted
- calculating redispatch with high volume penalties → use volume as constraint in actual run
  - volume constraint becomes the binding constraint → no usable shadow prices

Maybe working:

- allow redispatch only on units whose sensitivity on congestion is above a certain threshold
  - Problem: How to simulate anticipation?
  - Which lines are congested depends on the zonal clearing
  - Anticipated prices in the zonal clearing depend on which lines are congested

# The winners and losers of INC-DEC Gaming

Who wins compared to no strategic bidding?

- units on import constrained nodes that would have produced after the spot market
- units on export constrained nodes that would not have produced after the spot market

Who loses compared to no strategic bidding?

- There is no escape:
  - INC-DEC Gaming can destroy prices for cheap units
    → payments to generators in the zonal clearing decrease slightly
- No matter if they game or not:
  - units can lose money compared to a situation where nobody games

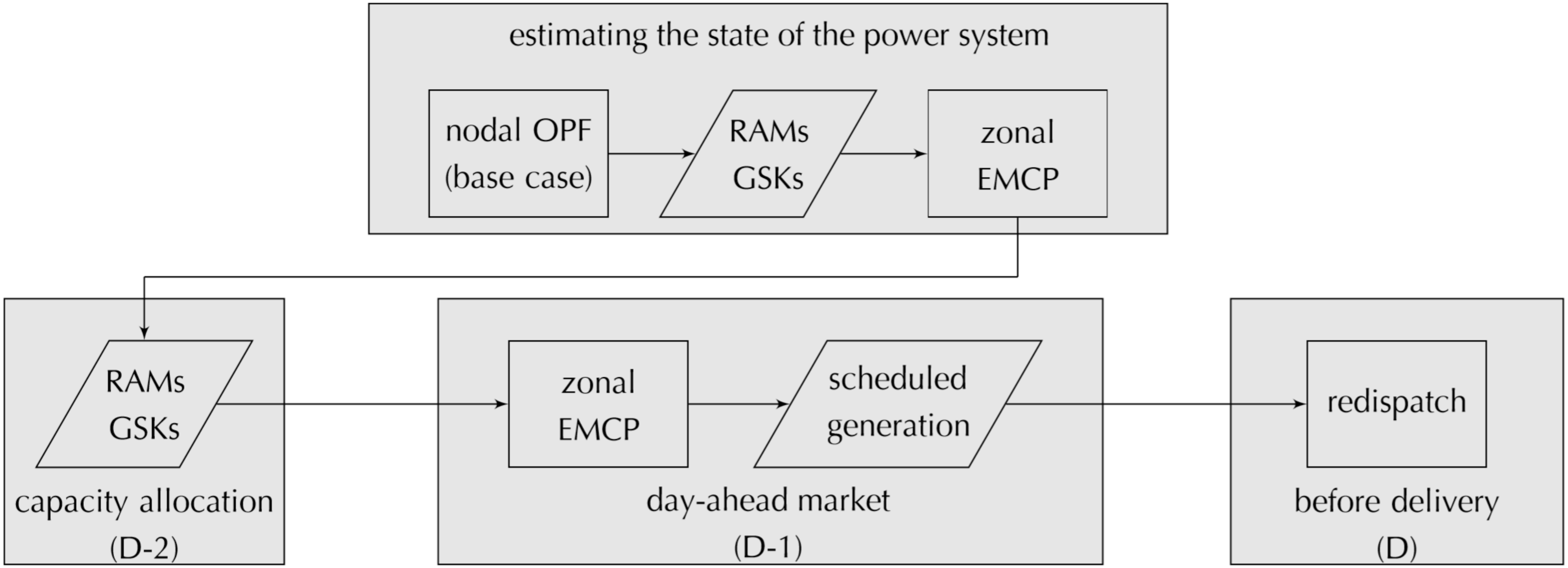
# Conclusions

- *Worst Case* impact of INC-DEC gaming:
  - volume of congestions more than doubles
  - redispatch volumes increase by half
- INC-DEC gaming is a real-world concern
- Uncertainties should be taken into account for further analyses
- Monetary impact is manageable
- If security concerns can be handled: trade-off might be worth it
  - if especially demand-side flexibilities can be included

# Limitations

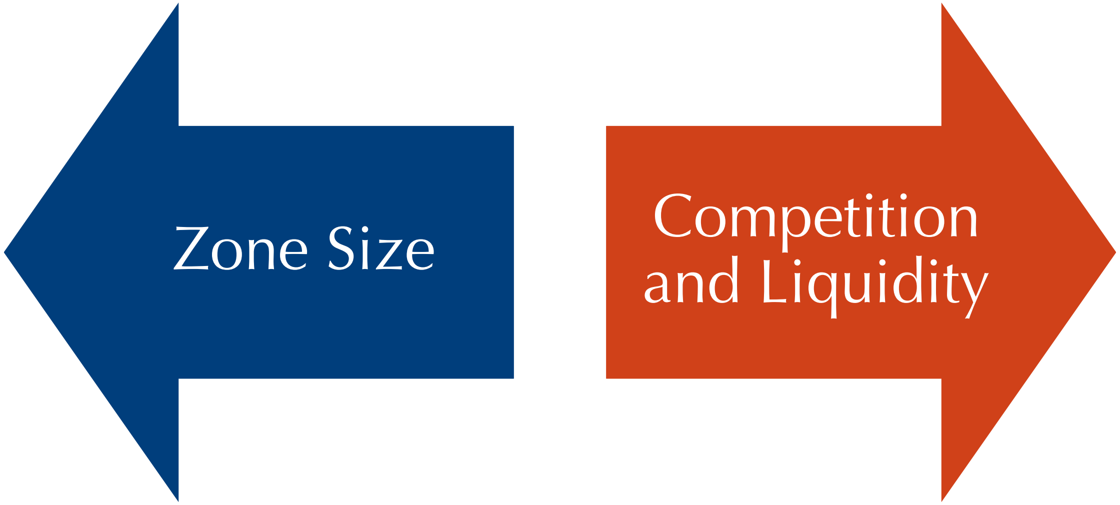
- Very high redispatching volume
  - Reason: No penalties for volumes → the zonal solution is "optimized" to the nodal solution
  - centrally optimized CWE-wide redispatch
- No phase shifting transformers or HVDC
  - Inclusion should reduce the effect
- Worst case assessment: Uncertainties are not considered
  - Consideration of uncertainties should reduce the effect
- No decentral flexibilities
  - strategic bidding only by large units
- no ramp up costs, minimum running times
  - Direction of impact unclear

# Process for a simulation run (without anticipation)



# Why redispatch?

## Motivation




| Smaller Zones<br>=<br>better representation of the grid | Bigger Zones<br>=<br>Increased Competition and Liquidity |
|---|---|

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need for redispatch

# Determining bids for zonal clearing with anticipation

**Basis:** Results from Redispatch after the first zonal clearing

- Prices from the first redispatch market are anticipated in the second zonal clearing

The decision whether to adjust bids depends on:

- the prices in the redispatch market
- what kind of redispatch occurs on any given node (upwards or downwards)

Bids are set to anticipated redispatch price if

- if price after redispatching is lower than marginal costs and redispatch is downwards
- if price after redispatching is higher than marginal costs and redispatch is upwards