Inc-Dec bidding strategy

Market-based redispatch and zonal electricity markets: Fundamentally incompatible?

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Market-Based Redispacth in Zonal Electricity Markets

Inc-Dec Gaming as a Consequence of Inconsistent Power Market Design (not Market Power)

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Just updated: http://hdl.handle.net/10419/194292

Working paper: http://hdl.handle.net/10419/194292
This presentation

Focus

• Bidding strategy when combining spot with redispatch market
• Applied game theory

Not in focus:

• Pros and cons of regulatory redispatch and/or market-based redispatch
Inc-dec gaming in a nutshell

Our redispatch market setup
• First (zonal) spot market, then (nodal) redispatch market (RDM)
• All markets are voluntary, subject to uniform pricing, competitive (no market power)
• Single hour; two nodes: oversupplied North and scarce South

Generators in the North
• Anticipate participation in market for ramping down – if they are available (producing)
• Bid below variable cost in spot to participate in that market → aggravate congestion

Generators in the South
• Anticipate they will be paid for ramping up – if they are available (i.e., not producing)
• Bid above variable cost (“withhold capacity”) → aggravate congestion

→ Generators have an incentive for strategic bidding (not marginal cost)
Model setup

Assumption: All load is located in South (50 GW)

Variable cost (€/MWh)

Load 50 GW

\[ p_{max} = 30 \text{ GW} \]
Regulatory redispatch
Spot market

$P_{\text{Spot}} = 50 \, \text{€/MWh}$

Implies 40 GW line flow: infeasible

Load 50 GW
Regulatory redispatch

\( P_{\text{Spot}} = 50 \, \text{€/MWh} \)

Line flow reduced to 30 GW

Upward RD

Downward RD

Load 50 GW

Wind North

Coal North

Natural gas South

Diesel

Market-based redispatch in zonal electricity markets
Without anticipation
Market-based redispatch (without anticipation)

\[ P_{RD}^S = 60 \, \text{€/MWh} \]

Demand for upward RD 10 GW

\[ P_{RD}^N = 30 \, \text{€/MWh} \]

Demand for downward RD 10 GW

Payment from generator to TSO

North

Willingness to pay for being redispatched down

Undispatched natural gas S

Coal North

Wind North

South
With anticipation
Spot market (with anticipation)

$P_{\text{Spot}} = 60 \, \text{€/MWh}$

Load 50 GW

Coal N

Coal N

Diesel N

Natural gas South

Market-based redispatch in zonal electricity markets
Spot market (with anticipation): Optimal bidding

- **Load 50 GW**
  - Cheaper natural gas bids 60 €/MWh, anticipating that this is how much they could earn (opportunity).
  - More expensive natural gas bid own variable cost.

- **All remaining generation in the North (coal and diesel) bid 30 €/MWh, anticipating that this is how much they would need to pay the TSO to redispatch them down.**

- **Cheap coal plants bid true variable cost.**

- **Wind bids true variable costs (1 €/MWh) as this will guarantee dispatch and bears no risks.**

- **Implies 45 GW line flow.**

**Market-based redispatch in zonal electricity markets**
Redispatch market (with anticipation)

**South**
- Demand for upward RD 15 GW
- Undispatched nat gas S

**North**
- Demand for downward RD 15 GW
- Diesel North
- Coal North
- Wind North

- $P_{RD}^S = 60 \text{ €/MWh}$
- $P_{RD}^N = 30 \text{ €/MWh}$
What do we learn?
Consequences from inc-dec strategy

Congestion is aggravated
• Higher redispatch volume

Windfall profits
• Profits of generators increase, consumers pay significantly more (through grid charge)

Problematic for financial markets
• Hedging based on spot markets no longer possible (RDM will become relevant market)

Perverse investment incentives
• “Ghost” plants which are built to never produce

Two market stages with differing locational resolution: Inconsistent
• Feedback effects: Spot is not independent from redispatch market
Requirements for inc-dec strategy

No market power needed
- Arbitrage strategy even atomistically small actors can exert
- Therefore: Fostering competition is not a solution to inc-dec gaming

Not illegal
- Actors price-in opportunities – comparable to balancing market
- No balancing responsibilities are violated
- Even if algorithms could detect inc-dec strategy, sanctioning would be difficult

All forms are affected
- Loads can also bid strategically
- Local flex-markets: Potentially even worse in distribution grids
- Pay-as bid is no solution

Some foresight of congestion required
- Currently in Germany: high degree of anticipation due to structural congestion
- Each call-up is an opportunity to learn and calibrate: 8760 opportunities a year
Existing literature and historic cases

We are not the first to note this

- Holmberg & Lazarczyk (2015), ...
- Our contribution: simple example, mechanisms clearly outlined, comprehensive discussion of consequences, related to policy debate

California

- Inc-dec gaming contributed to the energy crisis 2000/01, rolling blackouts
- Introduced nodal pricing in 2009

Great Britain

- Inc-dec gaming at Scottish-English border
- “Transmission Constraint License Condition” introduced in 2012, similar to cost-based RD
BMWi project “Beschaffung von Redispatch”
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