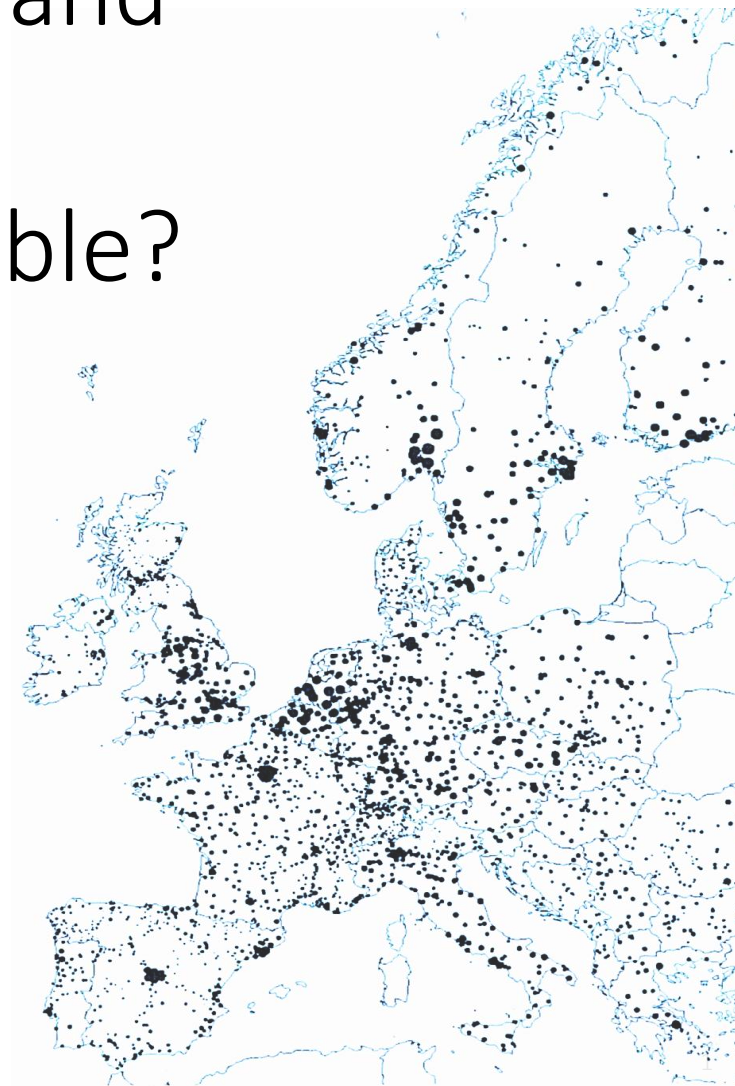


Inc-Dec bidding strategy

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

Lion Hirth
Ingmar Schlecht



Market-Based Redispatch in Zonal Electricity Markets

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

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Abstract – In zonal electricity markets, such as Europe’s, system operators relieve congested power lines within bidding zones using out-of-market measures. One such measure is “redispatching” power plants, i.e. increasing the output of one power station while decreasing the output of another. Traditionally, generators have often been legally obliged to participate in redispatch and were subsequently compensated by the system operator for costs incurred. In recent years, with increasing pressure on power grids, numerous proposals have been made, including one by the European Commission, to organize redispatch through voluntary markets. In this paper, we introduce a simple graphical model of a zonal spot market with a locational, voluntary redispatch market to show that such a market-based solution should not be used in this setting. We solve the model explicitly by determining optimal bidding strategies and Nash equilibrium prices. We show that market parties anticipate the redispatch market and bid strategically in the spot market – the so-called increase-decrease game. As a result, grid congestion is aggravated, producers extract windfall profits, financial markets are distorted, and perverse investment incentives emerge. Despite claims to the contrary, we show that such gaming is possible absent market power, i.e. if all generators ultimately bid marginal cost. At the root of the problem is inconsistent power market design: combining a regional with a locational market yields undue arbitrage opportunities that rational firms exploit. We conclude that such inconsistent market design should be avoided.

This paper builds on research undertaken with Consentec, Connect Energy Economics, Ecofys, Fraunhofer ISI and Stiftung Umweltenergierecht in the project “Untersuchung zur Beschaffung von Redispatch” for the Federal German Ministry of Economic Affairs and Energy (No. 055/17). Project findings are published as Neon & Consentec (2018) and Connect Energy Economics (2018). This paper does not constitute a project deliverable. We thank Kristin Walter, Nils Saniter, Christoph Maurer, Bernd Tersteegen, Marco Nicolosi, Barbara Burstedde, Markus Graebig, Eva Schmid, Frauke Thies, Simeon Hagspiel, Samuel Glisman, Anselm Eicke, Tarun Khanna, Christoph Neumann, Catrin Jung-Draschil, Bernhard Hasche, Fabio Genese, Charles Payement, Fabian Joas, Gerard Doorman, Philip Baker, Julia Radecke, Joseph Hefele, and Rebecca Lordan-Perret for inspiring discussions and helpful comments.



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

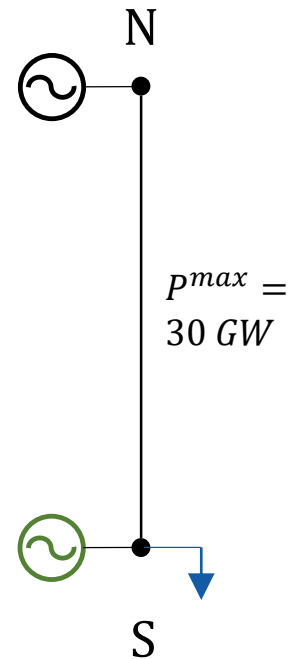
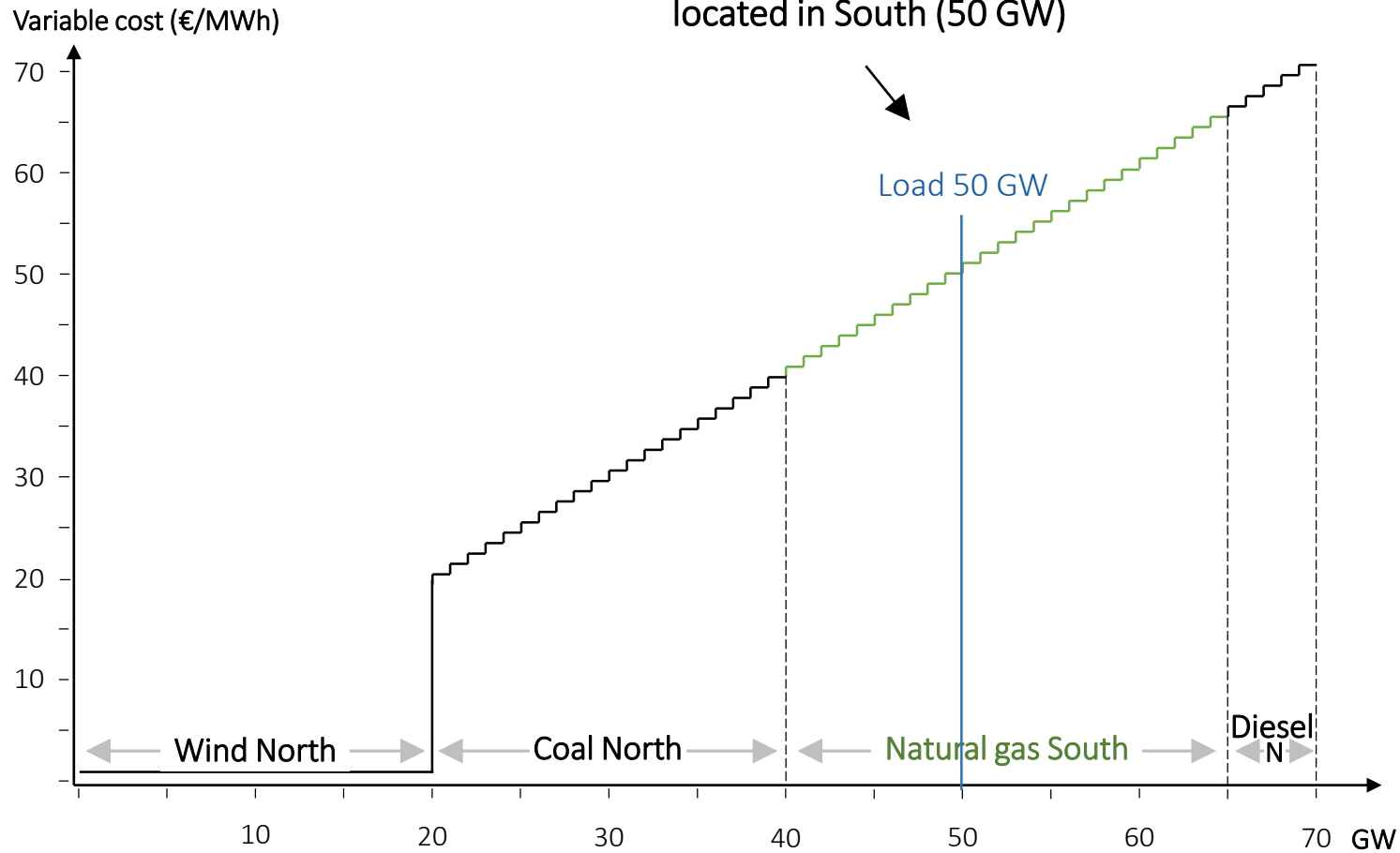
Generators in the South

- 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)

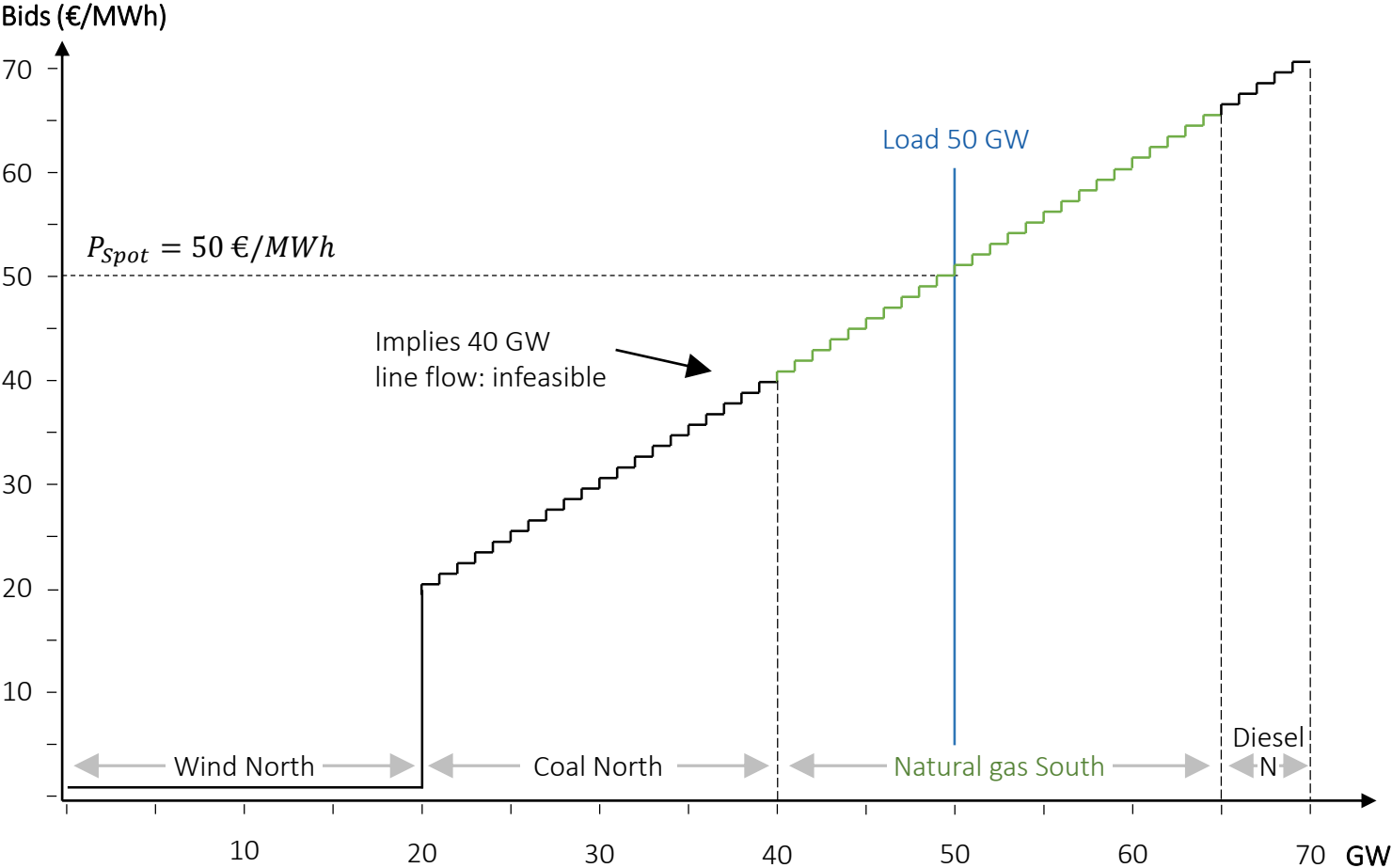
Model setup

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

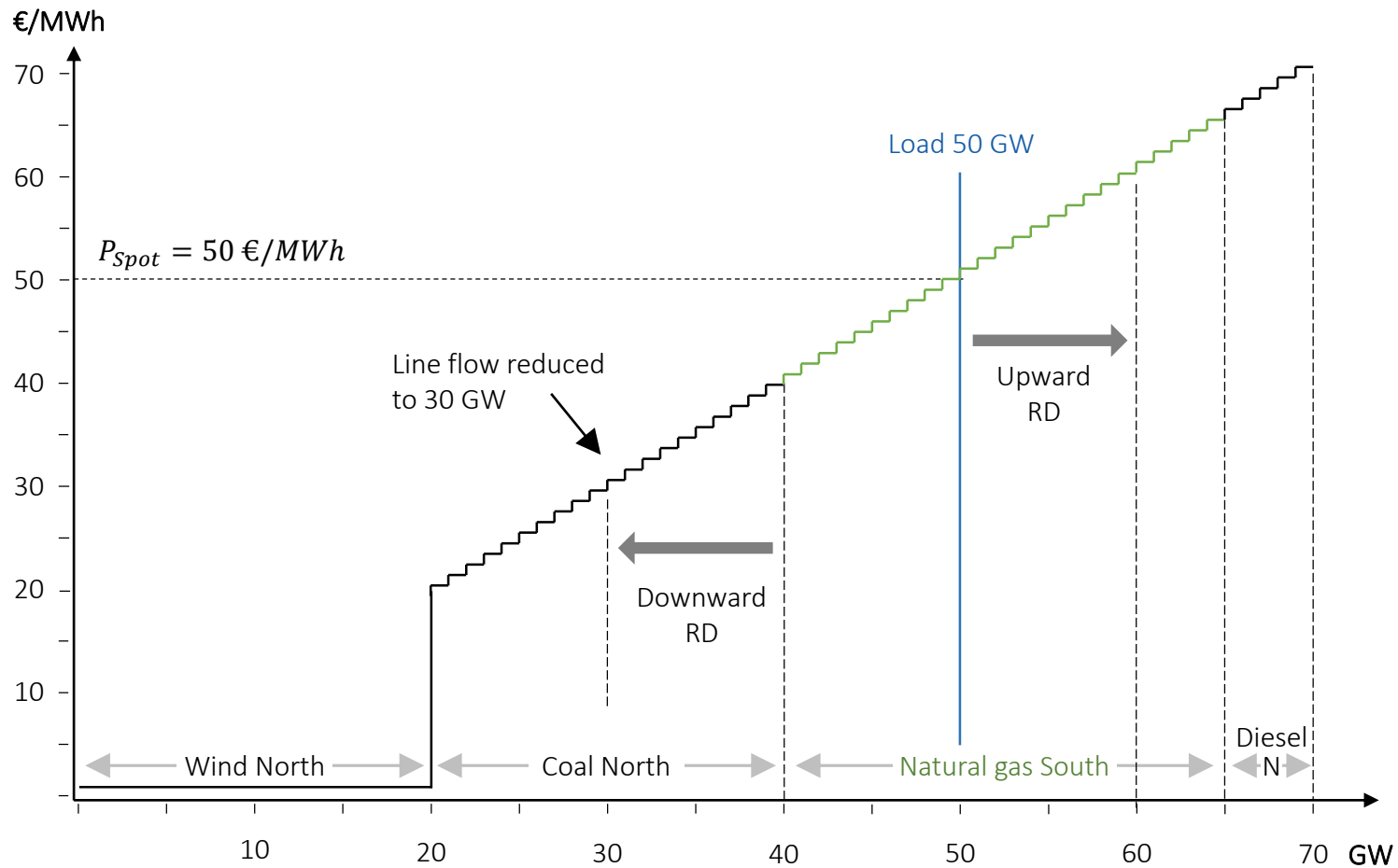


Regulatory redispatch

Spot market

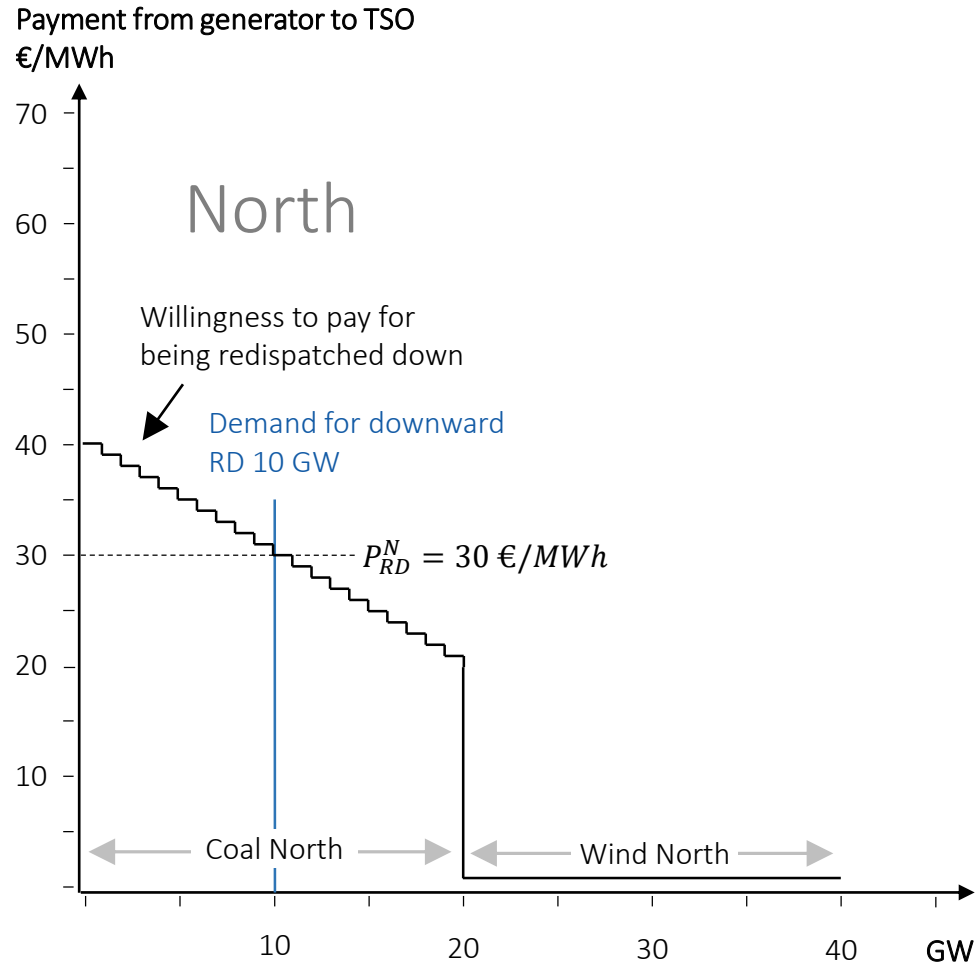
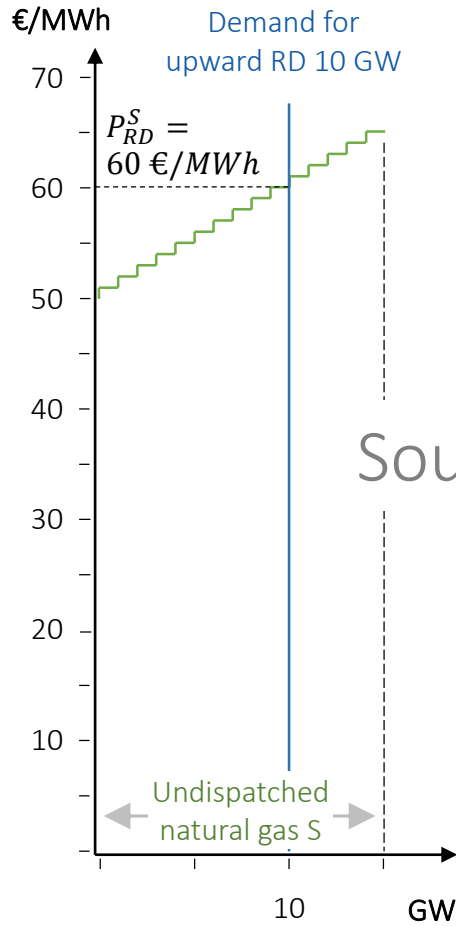


Regulatory redispatch



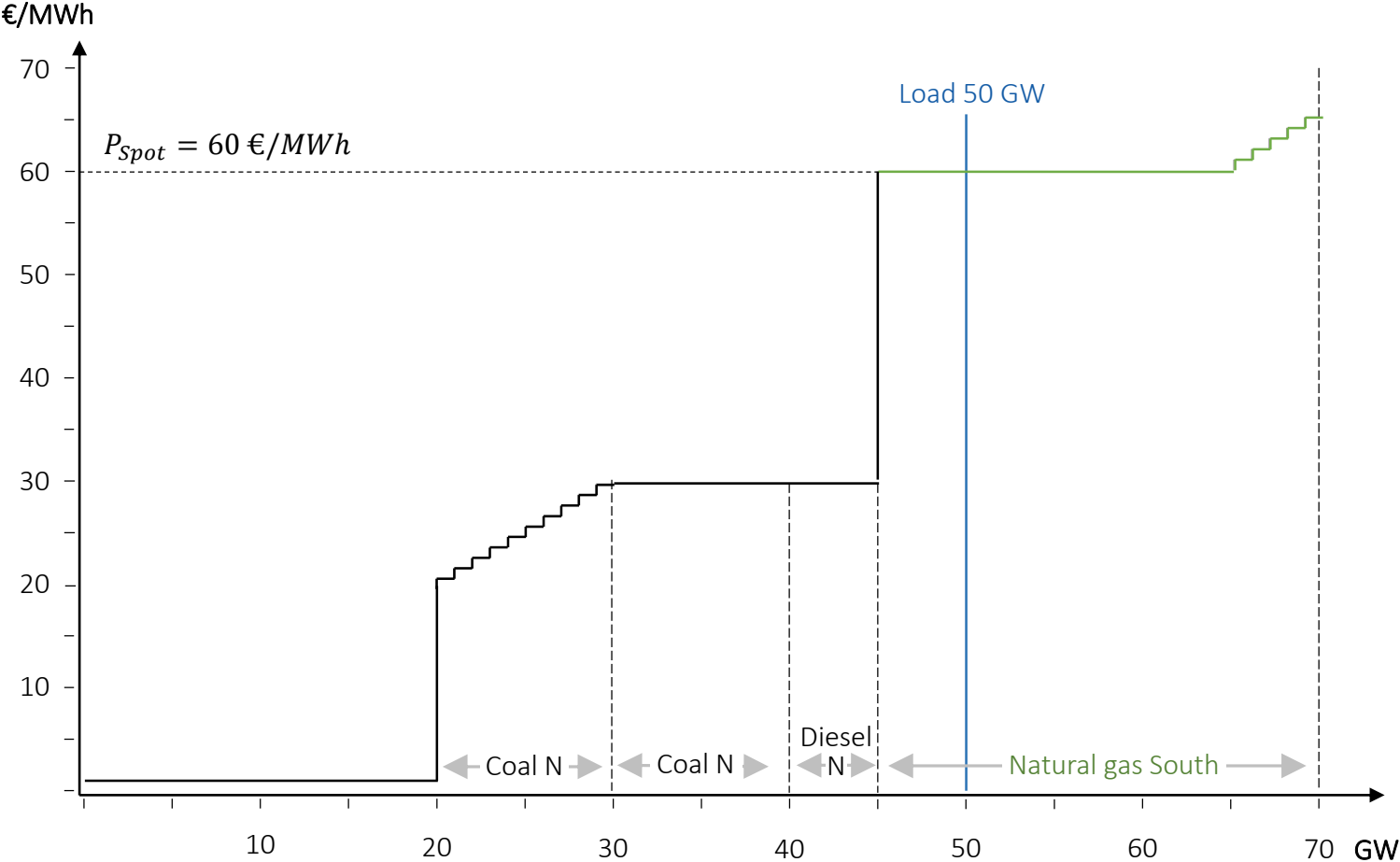
Without anticipation

Market-based redispatch (without anticipation)

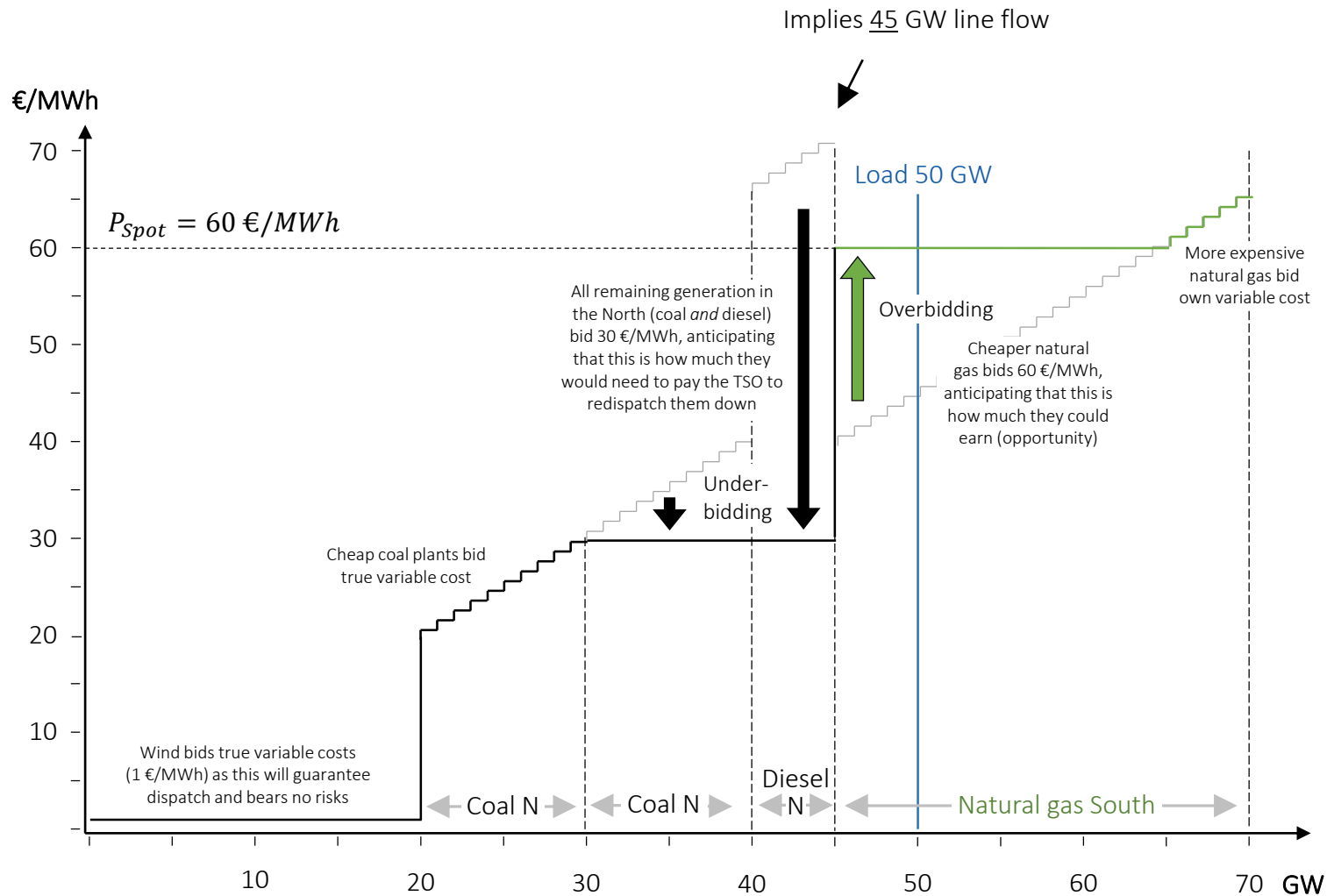


With anticipation

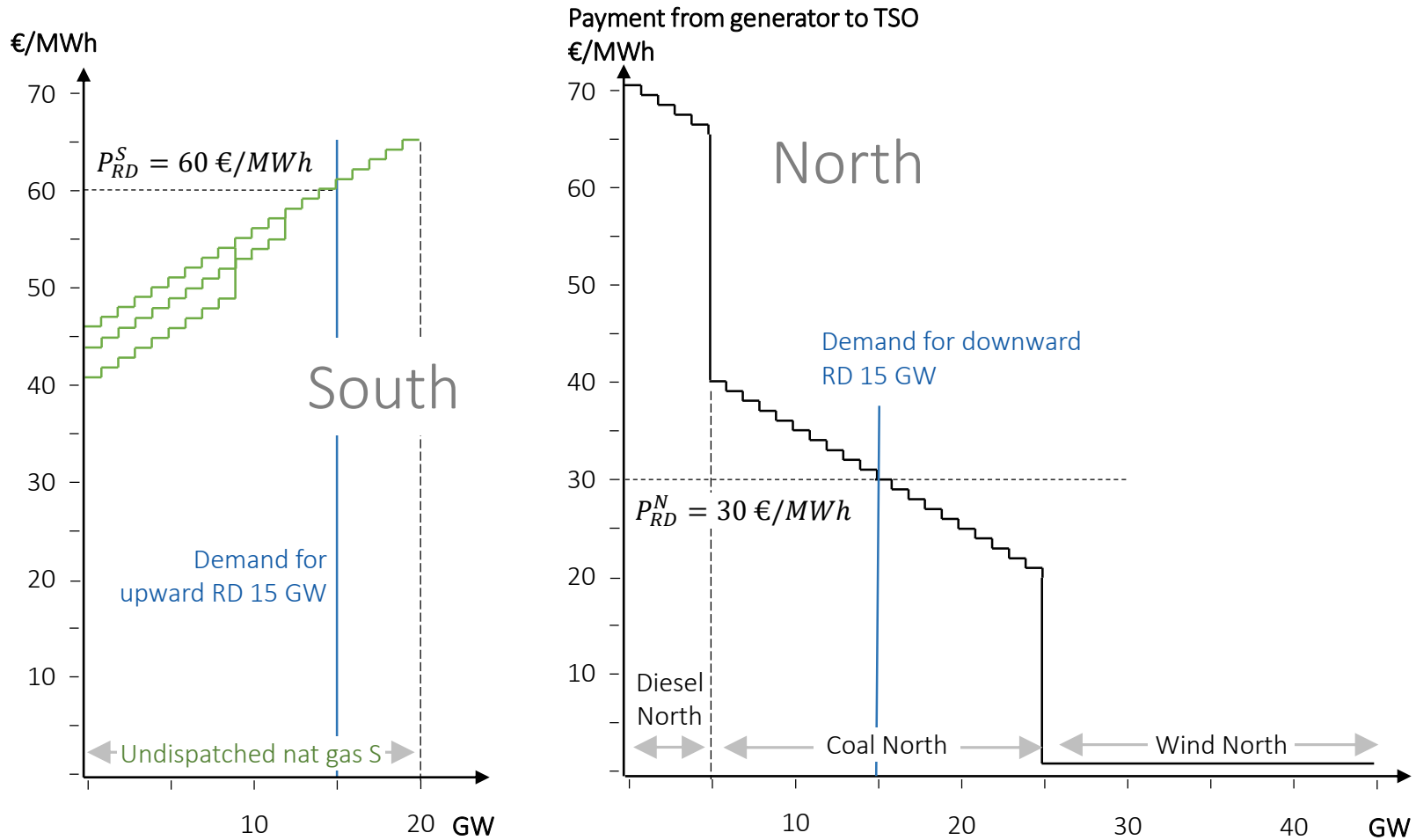
Spot market (with anticipation)



Spot market (with anticipation): Optimal bidding



Redispatch market (with anticipation)



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

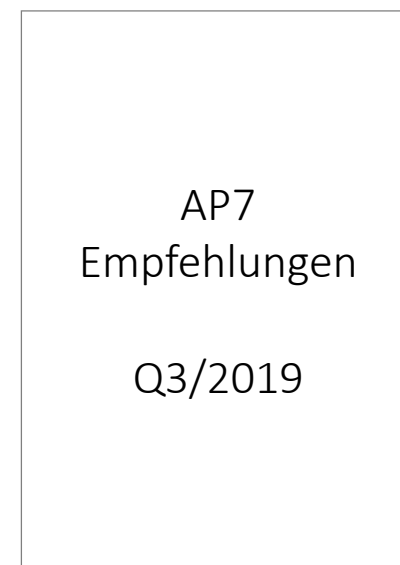
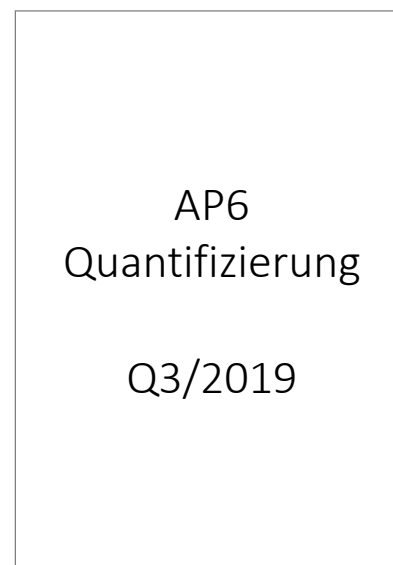
California

- Inc-dec gaming contributed to the energy crisis 2000/01, rolling blackouts
- Introduced nodal pricing in 2009
- Hogan (1999, 2001), Brunekreeft et al. (2005), CAISO (2005), Hobbs (2010)

Great Britain

- Inc-dec gaming at Scottish-English border
- “Transmission Constraint License Condition” introduced in 2012, similar to cost-based RD
- Ofgem (2012, 2018) Konstantinidis & Strbac (2015)

BMW project “Beschaffung von Redispatch”



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