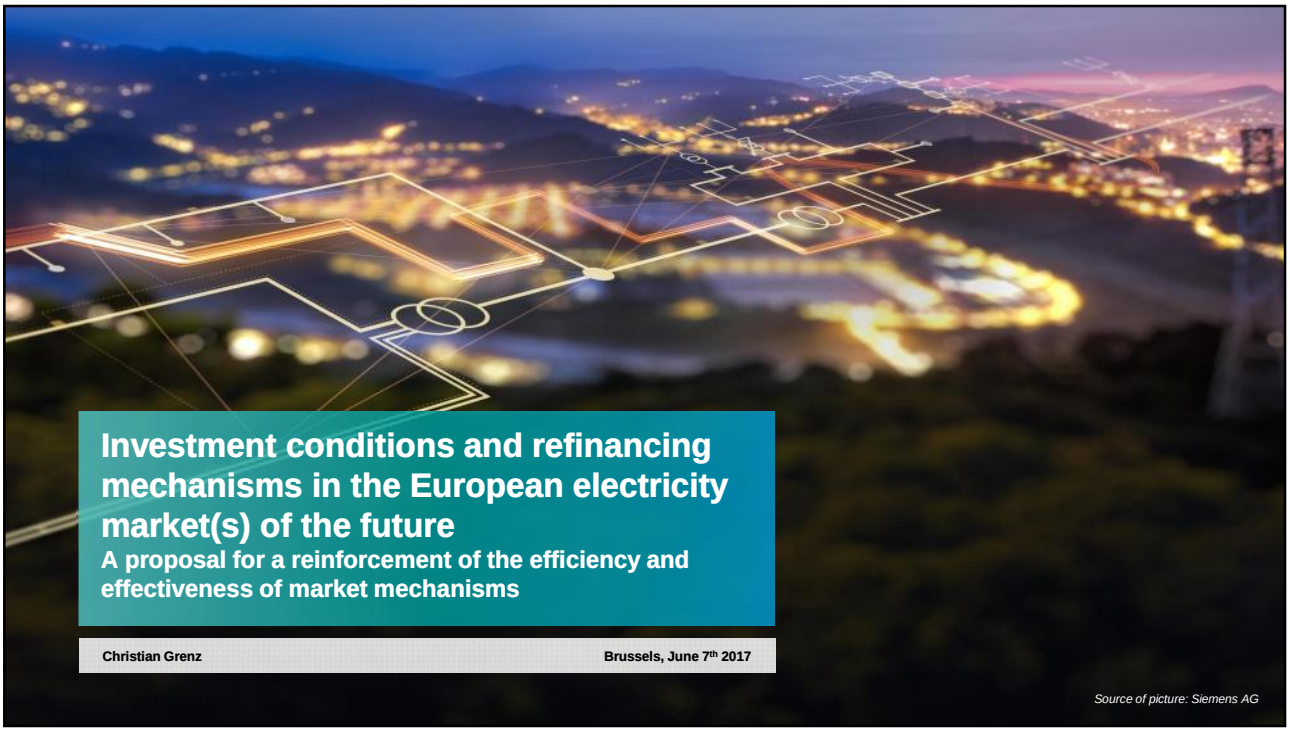


Investment conditions and refinancing mechanisms in the European electricity market(s) of the future

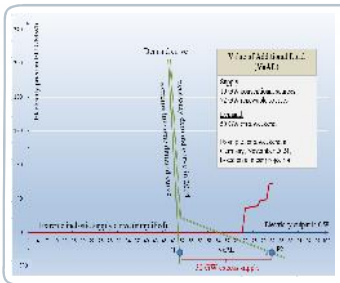
A proposal for a reinforcement of the efficiency and effectiveness of market mechanisms

Christian Grenz

Brussels, June 7th 2017

Source of picture: Siemens AG

The key observations in today's market design(s)

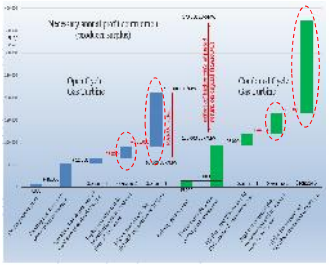


RES: near-zero marginal cost

- extremely flat merit order
- limited elasticity of supply
- no market price signals for investments in generation capacity

lower risk = lower capital cost

- capital cost one of the largest contributors to LCOE
- investments based on price spikes highly risky
- cost of price spikes could be multiple of the cost of RSM/CRM

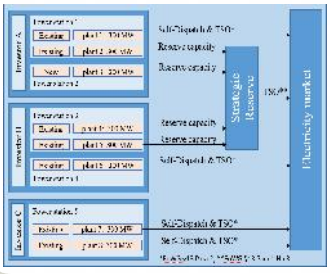


market price setting mechanism

risk-adjusted capital cost

distortion of competition & distribution effects

increase in flexibility & integration of RES

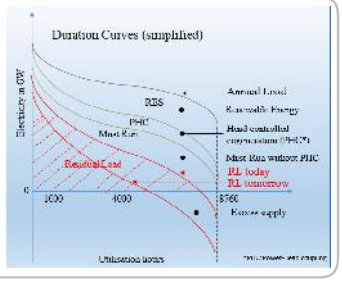


- reduce complexity of interventions, avoid redistribution
- prohibition of self-dispatch highly inefficient
- auctions based on LCOE as possible basis; key metrics would be easy to adopt

reinforce market mechanisms

- reduce must-run capacity to the minimum
- improve balancing effects between markets
- stimulate new business models (storage & conversion, service bundling & platforms)

flexibility is the crucial factor



Handout 1

The evolution from today's market design(s) to the future

	Renewable Energy Sources (RES)	Backup Capacity Sources (BCS)
Status Quo • complex patchwork of revenue stabilization mechanisms (RSM)	• RSM (FIT, CfD, REC) for all electricity generated in a specific number of years (in principle) • remuneration independent from the demand and outside of the market price-setting mechanism • technology-specific tailored auctions	• RSM (CRM) are independent from the market development as well as the operational efficiency and flexibility (in principle) • missing compatibility with interconnected market designs • market distortions and unintended distribution effects
Redesign • LCOE based capacity auctions for specific time periods / needs	• RSM for a certain number of full load hours (FLH) in pre-defined time periods; tailored auctions to address specific time periods, e.g. unlimited, off-peak and on-peak or low and high season • duty of delivery for the contracted FLH • FLH fed into the grid will reduce the contracted remuneration	• RSM for a certain number of FLH; tailored auctions to address specific needs and to gain access to the full market potential (key-criteria's: response time, performance period, lead-time and term) • index-based remuneration mechanism • self-dispatched capacity will reduce the contracted remuneration
Characteristics • market-consistent • highly competitive • easy to implement • little administration	• bid submission based on self-determined LCOEs in EUR/MWh • recovery of the elasticity of supply: strong incentive to offer the generated electricity at a price equal or higher than the contracted price (establishment of a LCOE based merit order) • stimulation of system integration and flexibility: market-driven incentives for new business models and ongoing performance enhancements	• bid submission based on self-determined LCOEs in EUR/MWh • compatible with interconnected market designs plus mitigation of market distortions and distribution effects: strong incentive for a self-dispatch at a price equal or higher than the contracted price plus the own marginal cost • strong incentives for efficiency and flexibility enhancements • stimulation of new business models / cross-sector revenues

a sustainable and highly competitive design for clean energy and increase in flexibility

The key characteristics of the new market design(s)

Framework for investments in RES

- capacity-based auctions for specific time periods
- RSM for a certain number of full load hours
- predictable revenue = lower risk = lower capital cost
- stimulation of system integration and flexibility
- incentives for ongoing performance improvements
- integration of the market price setting mechanisms
- public funding most likely reduced to zero

Market mechanisms driven by

LCOE

based merit order

Framework for investments in BCS

- capacity-based auctions for specific needs
- RSM for a certain number of full load hours
- predictable revenue = lower risk = lower capital cost
- stimulation of cross-sector business and flexibility
- incentives for ongoing performance improvements
- ongoing control of optimized BCS portfolio
- public funding most likely optimized

Investment opportunities and threats

- Digitalisation, network integration, big data and artificial intelligence may change the business model of system operators on a large scale.
- Infrastructure investments separated from system operations could become true (state-of-the-art infrastructure for AIS operation solutions).
- Disruptive innovations and new business models (new technologies, added value services, platforms, demand response and decentralised solutions).

The key characteristics of the index-based remuneration mechanism for BCS

Capacity Auction	Backup Capacity Sources		
	two or more simultaneous tailored auctions to address specific needs and to gain access to the full market potential		
Bidding process	Two-step		
	Step 1: Bids have to include a reliable capacity plus a price in EUR/MWh for a given number of FLH p.a. (a process as in the PJM-RPM, multiple bids allowed).	Step 2: As in the first bidding phase but only with the pre-qualified bidders for each tailored auction. The price cap and the tendered capacity in each auction are determined by the aggregate bid curves in the first bidding phase.	
General criteria	Index based remuneration mechanism		
	• Self-dispatched capacity will reduce the remuneration under the secured contract. • Cross-sector revenues will not reduce the remuneration under the secured contract. • The remuneration for capacity called by the system operator refers to (i) the Clean Spark Spread Index, (ii) a reference efficiency and (iii) reference price indices (Phelix for electricity, NCG for gas, EU-ETS for CO_2-certificates).		
Pre-qualification criteria (tailored)	Short time periods (example)	Long time periods (example)	Long time periods (example)
	Minimum capacity: 1 MW Response time: < 30 minutes Performance period: max. 2 hours Performance hours: up to 500 hours p.a. Lead time: up to 1 year Contract term: up to 3 years	Minimum capacity: 10 MW Response time: < 1 hour Performance period: unlimited Performance hours: up to 2000 hours p.a. Lead time: up to 3 years Contract term: up to 20 years	Minimum capacity: 10 MW Response time: < 4 hours Performance period: unlimited Performance hours: up to 4000 hours p.a. Lead time: 1 year Contract term: 2 years
Targeted flexibility	Capacity with limited performance and warranty periods	Capacity with unlimited performance and warranty periods and a long lifetime	Capacity with low capital service and a short lead-time
	demand response, trading platforms, prosumer, hydro plants, small-scale engines and turbines, storage solutions	hydro plants, new large-scale engines and turbines with high efficiency and flexibility	fully or partially written-off power plants with low marginal cost

Example for a backup capacity remuneration calculation

For the provision of capacity (no utilisation through the system operator)

remuneration = contracted capacity x (unused contracted performance hours – self-dispatched capacity) x contracted price

For the utilisation of capacity (dispatch through the system operator)

remuneration = contracted capacity x used contracted performance hours x (contracted price – weighted average Clean Spark Spread$_\eta$)

= contracted capacity x used contracted performance hours x (CSS (Auction) – CSS (Market)$_\eta$)

if CSS (Auction) < CSS (Market)$_\eta$: Remuneration = 0 (e.g. in peak load time periods)

if CSS (Auction) > CSS (Market)$_\eta$: Remuneration > 0 (e.g. for Redispatch)

Example:

Assumption	
Contracted capacity:	1000 MW
Contracted price (CSS(Auction)):	50 EUR/MWh
Contracted performance hours:	2000 hours
Dispatch through system operator:	500 hours
Self-dispatch:	1000 hours
Weighted average CSS (Market)$_\eta$:	10 EUR/MWh

Remuneration	
Provision:	1000 MW x (1500h – 1.000h) x 50 EUR/MWh
Utilisation:	1000 MW x 500h x (50 – 10 EUR/MWh)
Marginal cost:	1000 MW x 500h x (reference fuel price + CO_2-certificate price)$_\eta$
Total:	Provision + utilisation + marginal cost$_{\text{(tender reference cost – actual cost)}}$
Total:	EUR 25 mln + EUR 20 mln + marginal cost$_{\text{(tender reference cost – actual cost)}}$
Total:	EUR 45 mln + (marginal cost for 500 FLH)$_{\text{(tender reference cost – actual cost)}}$

The contracted price reflects the self-determined annual fix cost of electricity (fix COE) divided by the number of contracted performance hours (levelized). In our example, the contracted bidder would have a strong incentive to offer the contracted capacity for a price equal or higher than the contracted price (50 EUR/MWh) plus its own marginal cost (variable COE) being together the levelized cost of electricity (LCOE) .

CSS = Clean Spark Spread / FLH = Full Load Hours / Ƞ = Reference efficiency / Reference fuel price and CO_2-certificate price in EUR/MWh

The future is now

Thank you for your attention!
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Source of the picture: Siemens AG

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Education

Electrical Engineer

Business Degree (Diplom-Kaufmann) in International Business Administration (Germany, Great Britain)

Professional Experience

20+ years work experience in Project & Export Finance globally, especially in the Telecom, Industry and Energy Business. In recent years the focus was on large offshore wind farms, gas-fired power stations and transmission lines.

Special Expertise & Responsibilities

Expert in electricity market designs, auction mechanisms, public funding programs for renewable energy sources and capacity remuneration mechanisms.

Since 2014: Working on a thesis in economics focusing on investment incentives in deregulated electricity market with a continuously growing share of fluctuating renewable energy sources.