Why the Sustainable Provision of Low Carbon Electricity Needs Hybrid Markets: The Conceptual Basics

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In a nutshell: Key questions and take-home messages

Why an evolution of electricity market design is necessary?

- **Why does an energy-only market (EOM) alone not provide satisfactory investment outcomes?**
  → ***various interrelated market failures, externalities and other issues***
- **Why the current EU market design is not up to the task?**
  → ***patchwork of uncoordinated ad hoc remedies***
- **What does deep decarbonization change?**
  → ***significantly exacerbates design issues***

What is a hybrid market?

- **What are its basic ingredients (possibly combined according to different recipes) ?**
  → ***long-term arrangements*** *allocated by* ***competitive procurements, a balanced dosage of long-term planning, short-term markets to guide dispatch, …***
- **Are hybrid markets a radical change?**
  → ***no, market design evolution (not revolution!):*** *more* ***coherent and holistic use of existing tools*** *alongside wholesale markets working as at present*
- **Do we know everything about hybrid markets?**
  → ***no, but this CEEM research initiative is expected to bring useful insights***

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Electricity: Five interlocking issues challenge energy-only market provision

- **Sustainable electricity supply poses five distinct but interrelated challenges to the hypothesis that decentralized decisions through market price signals will be sufficient to deliver welfare-optimal equilibria:**
  1. **Low storability and inelasticity of demand**
  2. **Security of supply externalities**
  3. **Climate externality**
  4. **Innovation and industrial externalities & social preferences for specific technologies**
  5. **Missing long-term hedging markets**

- **On its own, each issue may be amenable to specific *ad hoc* remedies.**
  Together, they challenge the idea that free market provision delivers first-best solutions, especially under deep decarbonization and energy transition trajectory.

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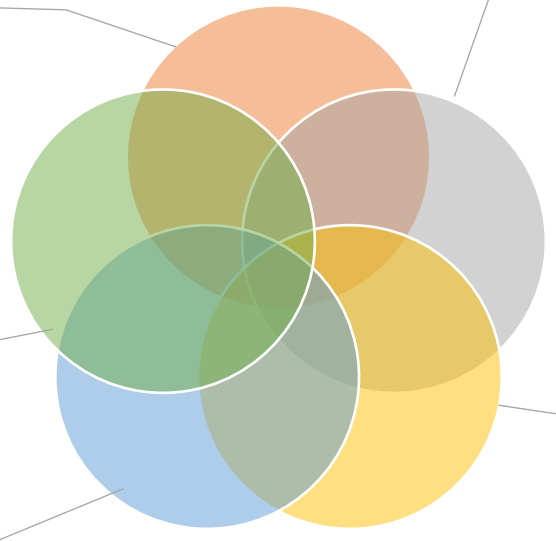
Issues challenging EOM and associated ad hoc remedies (illustration for the EU)



2# Security of supply externalities

The issue: SoS has public good features (wedge between private and socially optimal levels of capacity)

Illustration of *ad hoc* remedies: capacity mechanisms

Limits of the remedy:
- Capacity mechanisms best-suited for dispatchable generation (e.g., dispatchable gas fired plants)
- Some capacity mechanisms produce too volatile price signals to efficiently guide long term decisions

3# climate externality

The issue: climate change mitigation requires a transition to low-carbon generation technologies

Illustration of *ad hoc* remedies: EU ETS

Limits of the remedy:
- Historically, EU ETS has failed to convey robust, credible long-term investment signals (uncoordinated policy overlap kept ETS prices at moribund levels)
- MSR patch introduced to tackle historical oversupply, but long-term impact is uncertain and overlap with other policies has not been duly mitigated.

1# Low storability and inelasticity of demand

The issue: highly inelastic demand & limited cost-effective storage challenge standard market mechanics

Illustration of *ad hoc* remedies: dynamic pricing

Limits of remedy:
- Too volatile retail prices impact the risk profiles of consumers and downstream investments

4# Innovation, industrial & social externalities

The issue: insufficient market-based cost recovery for capacities built to internalize industrial & innovation externalities (e.g., learning by doing) and/or account for social preferences for specific technologies.

Illustration of *ad hoc* remedies: RES support schemes (e.g., FiT)

Limits of the remedy:
- Distortions on short term markets (negative prices)
- Sunk costs for assets built before RES policies and increased uncertainty for unsupported market segment

5# Missing long-term hedging markets

The issue: electricity related markets do not spontaneously produce enough/adequate long term hedging instruments implying 'too high' a capital cost (incomplete financial market)

Illustration of *ad hoc* remedies: RES supports schemes based on long-term contracts (e.g., FiP/CfD)

Limits of the remedy:
- RES support schemes based on LT contracts tackle the issue for RES (but not for all low carbon technologies)

Diagnosis: Patchwork of *ad hoc* remedies lacks coherency

- **Energy-only markets fall short of conveying effective long-term investment signals and producing outcomes in line with different policy objectives**
- **Issues have been addressed independently of one another with the introduction of various *ad hoc* remedies (e.g., EU ETS, capacity mechanisms, RES support schemes)**
- **Failure and uncoordinated implementation of *ad hoc* remedies have created additional issues of their own → need to have "remedies for the remedies" (e.g., MSR)**
- **Incoherence of and unintended interactions between *ad hoc* remedies have strong impact on the energy mix outcome and costs**

Deep decarbonization significantly exacerbates issues

Three main channels through which exacerbating factors materialize:

Security of supply in VRE-dominated systems

- Deep decarbonization implies large-scale VRE deployment → intensifies SoS externalities
- Market remuneration of capacity needed for SoS is increasingly challenging
- Need to rethink traditional approach to ensuring SoS: no longer tenable to assume statistical independency due to VRE auto-correlation

Investment, uncertainty and capital cost

- Significant capital-intensive investments needed (both upstream and downstream) → capital cost becomes main driver of total electricity costs
- Capital-intensive assets strongly affected by unhedgeable risks → higher capital cost
- Unprecedentedly high level of uncertainty
  - Rents necessary to recover the costs are concentrated on a limited number of hours and so more and more random and volatile
  - Future wholesale price distributions are deeply uncertain (e.g. which future mix?)

Political willingness to be in the driving seat

- States need to achieve a double objective in a timely manner: (1) low-carbon electricity mix and (2) electrification of final consumption
- Markets do not explicitly account for national specificities (innovation externalities or social preferences) → proliferation of uncoordinated *ad hoc* remedies to achieve policy targets
- Deep decarbonization intensifies these concerns without a market design overhaul that clarifies the roles of market and society/policymakers

Deep decarbonization magnifies long-term incompatibility between sustainable electricity provision and markets based on short-term price signals, complemented by an incoherent superposition of uncoordinated *ad hoc* remedies

Instead of a collection of *ad hoc* remedies: Hybrid markets (1/2)

- Hence the need for a market design evolution (not revolution!) combining what works well today (short-term markets to guide dispatch) with other coherently designed instruments to ensure fixed cost recovery for low-carbon technologies differently than through energy sales at marginal cost
- A hybrid market is a coherent combination of centralized and decentralized economic tools that has the potential to overcome the structural weaknesses of competitive marginal cost pricing (the five challenges!) to finance long-term investment in electricity markets in a context of deep decarbonization
- Theory would suggest technology-neutral auctions/bidding for long-term support for each kW of firm & carbon free capacity. In practice, different lifetimes, risk profiles, system values and social preferences suggest *sui generis* measures for each technology

Instead of a collection of *ad hoc* remedies: Hybrid markets (2/2)

- **A hybrid market would typically combine a competitive short-term energy market with several coherent long-term instruments**
  - **Long-term arrangements and competitive procurement:** *To better share risks and reduce the cost of capital, hybrid markets should include some forms of long-term contracts or arrangements (e.g., CfD, hybrid RAB) to ensure full cost recovery for needed investments, e.g. via fixed-price contracts or top-ups to revenues from competitive dispatch determined either by regulation or competitive auctions.*
  - **A certain dose of long-term planning:** *Hybrid markets should be consistent with some kind of regulatory planning process to ensure coordination of policies and targets built as a resilience tool to manage the trade-off between uncertainty of long-run decarbonization paths and visibility that investors need.*
  - **Upstream-downstream articulation mechanism:** *Hybrid markets should also include a mechanism articulating downstream revenue collection and upstream cost recovery. This mechanism should in principle allocate costs between consumers in an efficient, equitable and socially acceptable manner.*
- **Providing insights on how to design and implement hybrid markets is one of the main objectives of this CEEM transversal research initiative.**

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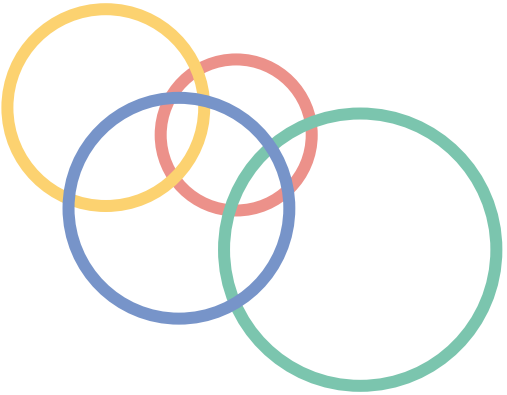

Thank you!

Back-up slides

1. Low storability and inelasticity of demand

- **The issue**
  - As cost-effective storage is in limited supply, electricity generation remains akin to infrastructure-based service provision with highly inelastic demand. Normal market's mechanics are challenged.
- **The ad hoc remedies**
  - Opening markets (energy, capacity, ancillary services) to storage and demand response.
  - Subsidies for demand response.
  - Dynamic tariffs.
- **Limits of remedies**
  - Industrial demand response remains a bright spot, but the opportunity costs for demand modulation by residential consumers are too high. Too volatile dynamic tariffs considerably modify the risk profiles of consumers and may impact downstream investments.
  - The economics of storage are complicated as profitability is a function of power/energy trade-off, the time horizon and the variance of electricity prices (the higher the better). Uncertainties abound. Long-term seasonal storage remains elusive.

2. Security of Supply externalities

- **The issue**
  - Security of supply externalities in the case of involuntary curtailment under VOLL-pricing; wedge between private and socially optimal levels of capacity; electricity considered merit or public good
- **The ad hoc remedies**
  - Capacity markets hoping that private and social optimality will coincide
- **Limits of remedies**
  - Capacity markets best-suited for dispatchable generation (e.g., carbon-emitting gas-fired plants). Contribution of some low carbon technologies (e.g., RES) or storage to security of supply is not always easy to assess.
  - Some capacity markets produce too volatile price signals. First because economic fundamentals of capacity price may considerably vary over the time (e.g., anticipated availability of power fleet or capacity obligation). Auction formats, regulatory changes (e.g., diesel generators), technological or behavioural changes (e.g., demand response) can also cause volatile prices if supply and demand are inelastic over relevant timeframes.

3. Climate externality

- **The issue**
  - Climate change mitigation requires transitioning to low-carbon generation technologies
- **The ad hoc remedies**
  - EU ETS instituted as the cornerstone of EU climate policy package
  - Along with “companion” renewables & energy efficiency policies (e.g., RES support schemes)
- **Limits of remedies**
  - Historically, EU ETS has failed to convey robust, credible long-term investment signals
    - In reality, companion policies have been the main low-carbon investment drivers!
    - Uncoordinated policy overlap and interactions kept ETS prices at moribund levels
  - MSR introduced to tackle historical oversupply and improve supply-side responsiveness
    - MSR contributed to price rally (now 50€/t) but price outlook remains uncertain
    - MSR-induced supply impacts are uncertain (in the long term) and convoluted
    - MSR may not improve synergies with complementary policies (e.g., RES, phaseout)

4. Innovation & industrial externalities and social preferences

- **The issue**
  - In principle, the electricity market ensures full cost recovery of generation mix produced by a long-term decentralized equilibrium (given cost and demand fundamentals).
  - Technology capacity targets justified by industrial or innovation externalities (e.g., learning by doing) or by well-defined social preference for specific technologies (e.g., RES) may imply “overcapacity” (w.r.t the decentralized equilibrium) and result in insufficient cost recovery.
  - This is particularly true for VRE where value sharply declines due to auto-correlation (i.e. cannibalization). In pure market setup: revenues decrease would limit VRE entry at lower, economically optimal levels.
- **The ad hoc remedies**
  - RES support schemes (preferential feed-in tariffs; technology-specific auctions);
- **Limits of remedies**
  - Increased uncertainty for unsupported market segment; Sunk costs for assets built before RES expansion policies.
  - Potential distortions of some supports on short term markets (e.g., negative prices).

5. Missing long term hedging markets

- **The issue**
  - Electricity related markets do not spontaneously produce enough/adequate long-term hedging instruments (incomplete financial markets) implying a high capital cost.
  - Forward power markets suffer from poor liquidity beyond two years, as uncertainties are large and too “deep/unknown” (as opposed to “risky/known”) to be hedged.
  - This is particularly important for capital intensive long-lived assets (e.g., low carbon capacity) with high uncertainty created in part by (actual or potential) political interference.
- **The ad hoc remedies**
  - Self-insurance (size, vertical integration,..), capacity markets, RES support schemes (FiT, FiP, CfD, etc.)
- **Limits of remedies**
  - Different forms of self-insurance seem rather insufficient to solve the issue.
  - Capacity markets with multi-year contracts are best-suited for carbon-emitting gas-fired generation but not for capital-intensive low carbon assets.
  - RES support schemes based on LT contracts tackle the issue for RES (but not for all low carbon technologies).