TradeRES
New Markets Design & Models for 100% Renewable Power Systems

Policy Brief

Recommendations for electricity market trading in a ~100% renewable power system

TradeRES project had the objective to develop and test innovative electricity market designs across Europe that can meet society's needs in a near 100% renewable power system.

Summary

A long-term sustainable market design needs to provide efficient operational and investment incentives for an electricity system that is characterized by a high share of *variable renewable energy sources* (vRES). This future electricity system is highly integrated with sectors such as heating and cooling as well as transportation and needs to provide efficient incentives for the participation of all demand, from households to industrial consumers. It needs to provide security of supply by ensuring sufficient controllable electricity generation capacity without becoming too costly. It needs to limit price risks for: i) investors, so that the cost of capital does not become too high, and ii) consumers, so that they are not exposed to unmanageable swings in their energy expenses.

Syntheses of main recommendations:

- Enable closer-to-real-time trading in the different markets;
- Incentivize the active and strategic participation of vRES players in different electricity markets and expand participation to Aggregated and Smaller Players;
- Articulate the timings of vRES power forecast systems and electricity markets;
- Implement Dynamic Procurement of Balancing Power;
- Include renewable-friendly clearing mechanisms in Continuous Intraday Markets (IDM) and adapt Ancillary Services to enable the full participation of vRES players;
- Implement imbalance settlement mechanisms that reflect the true costs of these services;
- Design effective retribution schemes (e.g., Contracts for Difference - CfDs) that contribute to de-risk vRES investments;
- Capacity Remuneration Mechanisms are needed, during and after the energy transition;
- Adopt Grid Enhanced Technologies as Dynamic Line Rating for overhead power lines as enablers for the integration of vRES and electricity markets harmonization;
- Create effective and levelized markets across all energy vectors and networks;
- Expose end-users to real-time wholesale market prices, while designing safety mechanisms for protection against high prices;
- Distribution system operators (DSOs) and Local Energy Communities (LECs) may play a critical role with increasing decentralized vRES generation and electrification.

Overview of research

The lessons learned throughout the project are detailed in several project deliverables including the experiments and validation of case studies as well as the feedback of the stakeholders enrolled in TradeRES activities. Based on the models developed, analyses were carried out within the case studies that focused on complementary aspects of national and regional electricity markets, and different spatial scales, from local markets to pan-European trade. The outcome of the analysis performed is synthetised in the current recommendations.

Main recommendations

The main recommendations for future electricity market trading in a near 100% renewable power system emphasize the need for various changes. First, **enabling closer-to-real-time trading by transitioning from a traditional Day-Ahead Market (DAM) to a 6-hour Period-Ahead Market (PAM)** could minimize power forecast errors, market distortions, real-time balancing needs, and penalties.

Reconsidering the current Intraday Continuous Market (IDM) design is necessary due to the uncertainty associated with vRES generation and the vRES-unfriendly clearing mechanisms.

If properly implemented, an **active and strategic participation of market players can enhance vRES market-based remuneration through diversified revenue streams** with the participation across multiple markets, such as day-ahead, intraday, and balancing. The **procurement of balancing power should be dynamically assessed** according to expected net loads and deviations. Opening these services to smaller and aggregated players can incentivize more participation from vRES players, distributed resources, energy storage and consumers, not only contributes for reducing imbalances, as it is critical for their overall market performance. An **imbalance settlement mechanism** that fairly reflects the true costs of these services is also necessary.

Support schemes to de-risk vRES investments must be identified, with some of the Contract for Difference (CfD) designs offering a balanced approach by ensuring stable revenues for investors while controlling support costs for end consumers. However, the design of CfDs - namely the two-way CfDs or the promising production-independent versions - requires careful attention to avoid dispatch and/or price distortions.

Accurate vRES power forecast systems are a key enabler for trading in a nearly 100% renewable electric power system. Enhancing their accuracy requires the **inclusion of tailored novel sets of meteorological data** rather than relying solely on generalized models.

Given the high penetration of vRES, electrification, and **increasing demand-side management and flexibility**, the volatility in retail markets may rise significantly, making locational aspects crucial for adjusting consumption to production. **Fully indexed tariffs** should be implemented to provide the right locational price signals closer to real-time, indexed to local generation and grid costs, with appropriate weight on congestion management prices to avoid local congestion.

Capacity Remuneration Mechanisms are needed both during and after the energy transition, based on the demand for capacity by final consumers, including households and SMEs, providing them with a price hedge (insurance).

Increasing the transmission capacity of market interconnecting transmission lines or using dynamic line rating (DLR) is important to reduce market splitting between zones, promoting price harmonization. **DLR assessing** overhead power lines in real-time **can also contribute to reduction of vRES curtailments** and integration of new renewable generators without the need for constructing new lines.

Efficient markets are essential across all energy networks to balance supply and demand and utilize flexibility adequately. Active electric loads in sector coupling can support energy flexibility if they are exposed to real-time pricing. Distribution System Operators (DSOs) can **develop products to incentivize consumers to avoid local congestion.** These products should signal the limited availability in a cost-effective way, while respecting grid limitations during congestions, which may not coincide with peak loads.

Market structures should **prioritize seamless integration between Local Energy Markets and wholesale markets**, utilizing aggregators to represent smaller energy communities effectively. Expanding dynamic pricing mechanisms to include all market participants, from large consumers to small consumers and prosumers, is essential. Such an approach would incentivize demand response and align local energy use with real-time market signals, enhancing the overall efficiency of the energy system.

Strategic investment in renewable energy generation and energy storage must be actively promoted through **targeted regulatory measures**.

In conclusion, the recommendations of TradeRES project aim to create a resilient, efficient, and balanced future electricity market capable of integrating a near 100% renewable power system, enhancing investment security, market participation, and system reliability.

Associated publications

Recommendations for market trading in a ~100% power system, TradeRES Deliverable 6.5, October 2024 (available at https://traderes.eu/deliverables/, accessed, 30.Nov.2024).

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