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Neuhoff, Karsten et al.

Research Report Local marketplaces

Suggested Citation: Neuhoff, Karsten et al. (2025) : Local marketplaces, Deutsches Institut für Wirtschaftsforschung, Berlin

This Version is available at: https://hdl.handle.net/10419/314371

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Future Power Markets Platform – Report March 2025

Local marketplaces

Karsten Neuhoff (DIW Berlin), Seabron Adamson (Boston College), Martin Bichler (TU Munich), Franziska Klaucke (DIW Berlin), Klaus Mindrup (Energiedialog 2050), Luis Olmos (Comillas Pontifical University), Anthony Papavasiliou (National Technical University of Athens), Konstantin Staschus, Leon Stolle (DIW Berlin), Silvia Vitiello (Joint Research Centre of the European Commission in Ispra)¹

- Local price signals are necessary in the electricity market to give demand side flexibility the incentives to resolve network congestion rather than escalate it.
- Local marketplaces bring price signals to consumers. This encourages market integration of flexibility, building on experience from local flexibility markets and energy communities,
- Local marketplaces are linked by a clearing algorithm that efficiently allocates available transmission capacity, building on nodal pricing experience in US, Canada, Chile, and New Zealand.
- Local electricity cost differences are addressed, for example using the tripartite electricity contract. Local prices are required for efficient operation, not for guiding location of demand.

Why is a reform of uniform national spot-prices necessary?

The generation connected to Europe's transmission and distribution networks is increasing with wind and solar deployment by a factor of four to five. The capacity of load and storage is increasing at the same scale with the electrification of heating, transport and industrial processes. It is impossible to multiply the grid capacity at the same scale. Already now, grid expansion costs until 2037 in Germany are estimated to be 420 billion Euroⁱ.

To reduce the need to expand the grid, local price signals are required to balance, whenever transmission constraints are binding, supply and demand at local level. Thus demand, production and storage contribute to an efficient and secure market outcome respecting the constraints of the available transmission capacity.

The local prices will differ far less on average across the year than in individual hours.ⁱⁱ This is because the different wind- and solar production patterns cancel each other out across a year. The remaining uncertainty about these price differences is, however, disconcerting for investors. They could hold up investments in renewable projects and electrification projects in heat and industry. Hence an integral part of any market design reform must be a mechanism to hedge local price risks, using for example financial transmission rights or a triparty energy contract (renewable energy pool).

¹ The opinions expressed in the manuscript are those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission. The Commission cannot be held responsible for any use which may be made of the information contained therein.

Why is a reform of uniform national spot prices urgent?

Four recent developments increase the costs and risks of maintaining uniform national spot prices:

First, because of increasing network congestion the need for costly redispatch increases. E.g. in Germany, costs amounted to 2-4 billion per yearⁱⁱⁱ, resulting in increased grid fees of 5-10 €/MWh.

Second, with the widespread introduction of smart meters and flexible electricity tariffs, a growing proportion of electricity customers will react to the wholesale electricity price for example when charging cars, other batteries or heat storage. This has the potential to exacerbate bottleneck situations in many cases if the uniform price zone is maintained.^{iv}

Third, as TSOs constrain price responsive demand side flexibility to avoid escalating congestion risks, e.g. by preventing the grid connection of batteries, customers will increasingly pursue (semi-)self-sufficiency strategies when investing in and operating storage systems. The operational protocols and their software updates are difficult to predict and can thus result in unexpected load changes that can put system security at risk.

Finally, as the redispatch is done centrally by transmission system operators, the interactions with an increasing number of customers make the electricity system more vulnerable to cyber-attacks.



Figure 1: Status quo in EU electricity markets. Complex environment for electricity producers and consumers with interfaces to wholesale-, balancing- and ancillary service markets and redispatch mechanism.

How would local marketplaces deliver local price signals?

Everyone knows farmer's markets. This is where young and old can sell their local products and meet their needs. Farmer's markets don't operate in isolation - if the regional supply is too limited, traders bring in goods from further afield. If local produce exceeds local demand, it is marketed nationwide.

Local marketplaces for electricity would work in a similar way. In every city and rural region, a virtual marketplace allows producers and citizens to market their electricity production and meet their demand at the local market price. When a lot of wind or solar power is being generated locally, the local price falls. Then it is particularly worthwhile to charge electric cars, heat storage systems with heat pumps and other flexibility options. If the local price rises, electricity customers will use the stored energy.

All local marketplaces are connected to the transmission grid and are therefore interconnected. The grid operators and the electricity exchange have a joint mandate as organizers of the national marketplace to use existing transmission capacity to route electricity from local marketplaces with low prices to local marketplaces with higher prices. In times with sufficient transmission capacity, this results in the same market price on all local marketplaces.

If there is insufficient transmission capacity, price differences remain. The operator of the national marketplace buys electricity on favorable marketplaces and "transports" and sells it on marketplaces with higher prices if the transmission capacity allows. The introduction of local market prices thus generates revenue through efficient market incentives and grid utilization. These revenues should be used to protect electricity customers against the risk of their local market prices rising compared to the average price of all local marketplaces - as is common practice in liberalized markets with nodal pricing.



Figure 2: Local marketplaces provide a one stop interface based on a local price signal for customers (or their retailer) to the exchange, transmission- and distribution system operators.

Local market prices avoid the need for redispatch, which is currently necessary due to large pricing zones. Within these pricing zones market participants are granted the "right" to unlimited electricity transmission. If market participants use more transmission capacity than available, the grid operator has to "buy back" this capacity by redispatching generation down in the part of the zone with too much "export" and by redispatching generation up in the part of the zone with too much "import."

Without redispatch, there is no longer the need for an artificial separation of energy (before redispatch) and balancing market products (after redispatch), and instead energy can be traded until

Local marketplace

real time. This reduces complexity for system operation and customers and enhances efficiency and liquidity. This is not possible in the single price zone, as trading must end before real-time so that the grid operators still have time to address grid bottlenecks with redispatch measures afterwards. This is why the current regulations are also designed to ensure that players adhere to binding schedules to prevent the short-term utilization and therefore also remuneration of flexibility.

Furthermore, with local price signals, system operators also save the redispatch costs that arise, because the electricity market design issues "bad cheques" in the sense of guarantees for transmission capacity that is not even available. The cheques then must be bought back at high cost, that are subsequently recovered through increased grid tariffs.

The discussion illustrates that the introduction of local marketplaces affects all market participants. This is precisely the desired effect, as the energy transition from fossil to renewable electricity generation can only succeed if all market participants are involved, for example by tapping into economically viable flexibility potential and actively participating in the electricity market. Participants who behave semi-autonomously, such as households that optimize their own requirements independently of the electricity market with their own solar system and home storage, behave in a suboptimal way. By participating in the local electricity market, they can instead make better use of their flexibility potential, thereby benefiting financially and reducing overall system costs at the same time.

Local marketplaces with understandable prices based on local supply and demand, instead of a uniform national electricity price that is independent of regional wind and solar production, is an important step. It avoids the current conflict or mismatch between (1) a national price, which only considers the demand and supply curves while discarding internal network constraints, and (2) system security or network constraints through centralized actions by the system operators. Instead, local marketplaces integrate all important elements of the electricity system in one price signal (supply, demand and available network capacity). It hence creates unambiguous and consistent incentives for production, consumption and storage, e.g. to charge storage when local prices are low and to use storage when local prices are high, without the need for network operators to intervene in the market through upfront limitations or through redispatching.

Text box 1: Tripartite energy contracts (renewable energy pool) can provide a hedge against locational price differences.

It comprises auctions of long-term contracts to wind and solar projects to give them access to favorable financing conditions with predictable and secured revenues. These contracts are pooled and access to the pool is granted to consumers in exchange for a long-term commitment with a five-year notice period.

The tripartite contract ensures stable revenues for wind and solar generation and secures for participating consumers a predictable and stable price for a portfolio of wind- and solar power. This price can be harmonized within a country, by providing a hedge against the local marketplace price. This local specific hedge creates costs for the tripartite contract, if the prices in the local marketplaces where generation takes place are lower than the prices where demand is located. These costs for the tripartite contract should be covered by part of the congestion income created with introduction of local marketplaces.

For more information see Energy Journal (2025) Contracting Matters: Hedging Producers and Consumers with a Renewable Energy Pool, <u>https://doi.org/10.1177/01956574251325486</u>

What do local marketplaces mean for a ...

As described above, local marketplaces would be a beneficial implementation of local price signals, necessary for an electricity system with increasingly decentral (flexible) consumers and generation units. However, the sharp rethinking of market design would have several implications for stakeholders. Local marketplaces should thus be designed in a way that they are beneficial to all of them.

... electricity customer

Local marketplaces should enable efficient decisions on electricity generation, storage and electrification of industrial processes and heat generation. They strengthen the security of electricity supply and reduce electricity costs by giving the correct price signal for system friendly behavior. At a particular hour this may imply large price differences between different local marketplaces. Across the year a large part of these differences averages out. To address concerns about price differences, hedging instruments such as financial transmissions rights are used in markets that already employ local price signals. An alternative could be hedging within the framework of a tripartite energy contract (see text box 1).

Local marketplaces allow all small and medium-sized electricity customers and producers to decide in real time, based on a real-time price, how much electricity they want to demand or feed in at the respective real-time price.

Electricity customers can thus fully utilize their flexibility options on the market. All they need is information on the locational real-time price and the forecasts for the future real-time price. This simplifies the communication requirements compared to the existing electricity market design, which requires a great deal of coordination between electricity customers, suppliers, transmission system operators and, in some cases, distribution system operators for demand flexibility. All these interfaces represent potential cyber security risks.

In an electricity system with local electricity prices, the average costs for all electricity customers are reduced, as more efficient power plant operation and targeted flexibility in the electricity system can be developed and utilized thanks to local incentives. This also reduces the need for grid expansion.

To the extent possible, it should be ensured that costs not only on average decline for customers, but also avoided that any customer faces cost increases. Electricity customers can (continue to) hedge their electricity costs or have them hedged by their supplier. For example, the price can be hedged for the volume of electricity usually required.^v This avoids cost risks when electricity prices rise. The real-time prices are only paid for deviations from the forecast demand or are paid for savings compared to the forecast demand.

... distribution system operator

Distribution system operators are given an important task with the implementation of local marketplaces: they can host the local marketplace for their respective area. They have room for maneuvering, depending on their motivation, capacity and needs in local congestion management.

• They can in a minimalist version only publish the local market price in real time and with forecasts for the next 24 hours. Market participants or their retailer would then continue to submit bids on the respective national trading platform, albeit with an additional specification of the location of the production or demand.

• Alternatively local marketplaces could accept bids from local producers or electricity customers and pass these on to the national electricity platform. Clearing would always reside at the national or supra-national platform to allow the clearing algorithm to also consider available transmission grid capacities.

Local marketplaces could also create opportunities for the cost-efficient management of constraints in the distribution system. Local marketplace operators could be granted the right to use bids submitted to the local marketplace to resolve distribution grid bottlenecks, if they can demonstrate non-discriminatory and secure operation of this time-critical process.^{vi}

... retailer

Retailers will continue to be the point of contact and contractual partner for electricity customers. They manage the interfaces to the grid and electricity market and offer customized risk management. However, their task is shifting as the energy transition progresses:

With the growing importance of flexibility for electricity customers, retailers are becoming an important enabler for the implementation of flexibility options - from identifying the potential, to support with investments, to support with the mostly automated use.

Retailers can offer electricity customers customized risk management. They have and will enhance the expertise to complement electricity price hedging with wind and solar products (for example from the RE pool they manage on behalf of their customer). As wind and solar products are simple and standardized, the focus of the work and margin will shift to risk management for flexibility requirements.

Potential price differences can develop at different local marketplaces. In principle, this would require retailers to make different offers to electricity customers in different regions. This is already common practice in countries like Germany where distribution grid fees vary regionally.

... renewable generator

Local electricity prices allow wind and solar energy to be used more extensively, as the scarce grid capacity can be utilized much better. Firstly, because production and demand respond to a real-time price rather than to a combination of zonal day ahead, redispatch regulation and incentives and potential dynamic grid fees, and can thus be predicted more accurately. Secondly, local prices give all flexibility options incentives to behave in a grid-friendly manner, which enables greater utilization.

However, the revenues for individual renewable energy projects could be reduced if the local electricity price falls more sharply than the average electricity price at times of high local wind or solar production.

A solution for new installations results from the requirements of the EU Electricity Market Directive. The protection of electricity producers against low electricity prices with the sliding market premium can only be continued from 2027 if it is supplemented by a double-sided protection of electricity customers against high electricity prices.^{vii} It is the evolution towards a so-called 2-sided contract for differences (CfD) that could be tendered as part of a tripartite contract (renewable energy pool). Winning bidders could be awarded a contract that hedges their production against the local electricity price. This would protect them against local price risks if congestion revenue that arises if wind- and solar power production in a low price zone is transmitted to load at a high price location is granted to the tripartite contract to hedge the producers and customers against this price difference. A comparable hedge against local electricity price risks is also possible for existing installations. Across Europe, many existing installations are hedged with public support mechanisms against the national wholesale price, either with contracts for differences or sliding market premia. If local prices are introduced, it will matter for projects what price will serve as reference prices for determining the contract for difference or sliding market premium. The associated risks and opportunities will need to be resolved in the interests of the common good and a fair balance of interests.

The introduction of local prices means that when grid congestion occurs, the grid operators receive congestion revenues instead of the previous redispatch costs. These revenues can be used to hedge customers and renewable projects against local electricity prices.

... investor in flexibility

Industry, heat suppliers, and households have large and cost-effective flexibility potentials. These include the timing of charging electric cars, heat storages for buildings, and industrial storages of process heat or electricity intensive basic materials like aluminum. They allow a flexibilization of industrial electricity demand. With the price signal from the local marketplace, every electricity customer can use this storage efficiently, generally with the help of energy management systems that charge and use the storage in response to local market prices, based on the user's wishes (e.g. "when do I need the car").

Local marketplaces allow households and companies to decide autonomously how they want to react to the current and forecasted local electricity prices (also referred to as implicit flexibility). They no longer need to bid for adjustments of their net demand. This reduces cyber security and other operational risks that are currently involved if the energy management system actively engages in external trading.

The use of battery storage systems is currently based solely on the wholesale price without taking the grid situation into account. As a result, grid connections cannot be realized to the desired extent delaying or preventing storage investments. Only through local markets can these investments be incentivized to be realized at system-friendly locations and thus reduce electricity costs for everyone.

As local market prices remunerate the joint contribution of the storage facility to energy balancing and to the avoidance or reduction of congestion in the electricity grid, the profitability of the storage facility increases. At the same time, the regulatory uncertainties that arise when congestion management is carried out through centralized control (redispatch) instead of local market prices are eliminated. Together, this strengthens the investment environment for economically viable storage facilities, while the required total storage capacity can be provided more cost-effectively with demand side solutions so that the overall costs fall for all customers.

... transmission system operator and power exchange

Close cooperation or integration between transmission system operators, with their expertise in operation, redispatch and balancing energy markets, and a national electricity exchange is necessary for the implementation of the national marketplace, in which the local marketplaces are anchored. These national marketplaces, or marketplaces of groups of countries, would closely cooperate with their neighbors.

This can be based on international experience with locational marginal pricing (LMP, often also called nodal pricing model) and with cooperation between neighboring regions with locational marginal pricing. The necessary software is marketed worldwide by three major providers - interestingly, all

with European origins. The implementation has always been successful, so that Locational Marginal Pricing was neither abolished nor discussed after its introduction.

International practice is that an Independent System Operator (ISO) integrates the function of grid operation with the exchange for short-term electricity trading (lead time to real time). In Europe, transmission grids are independent of other parts of the energy system, so the independence of transmission grid operation from transmission grid ownership would not be necessary for the introduction of local pricing. A national marketplace can therefore also emerge from cooperation between the transmission system operator and the electricity exchange.

With local marketplaces, there is no need for a redispatch after the end of the trading phase. This means that adjustments of positions are possible until real time in response to the real time price signal. The local marketplace applies to deviations from physically or financially hedged positions from the day-ahead auction. If well designed, these underlying hedging instruments will not distort an efficient operation and can also reduce market power distortions.^{viii}

There are no inconsistencies between the energy market, redispatch and balancing energy prices, meaning that market players only react to the market price and not to additional requirements. International experience shows that this makes it easy to predict the reaction of market participants to the price signal. Together with the savings in redispatch measures, this reduces the need for manual market interventions, the need for coordination and the resulting error and thus system risks.

Bids can be submitted directly to the national marketplace if they specify the local marketplace where production or demand is planned. Bids can therefore be submitted via both the local marketplace and the national marketplace.

The local marketplaces could be designed with very different levels of detail. Starting with just a website that displays the current and forecast local electricity price for the next 24 hours, through to a trading platform on which bids can be submitted and settled ("cleared").

The discussion shows that the change involves close cooperation or integration between power exchanges and grid operators. Various European power exchanges are already present in markets with nodal prices and can build on this experience.

ⁱ Kölschbach Ortego, A., J. Steitz (2024): Kapitalengpässe lösen, Netzkosten reduzieren – Effekte staatlicher Beteiligungen auf den Stromnetzausbau, Fachtext, Dezernat Zukunft e.v. Berlin.

ⁱⁱ Johannes Knörr, Martin Bichler, Teodora Dobos (2024) Zonal vs. Nodal Pricing: An Analysis of Different Pricing Rules in the German Day-Ahead Market, arXiv:2403.09265

ⁱⁱⁱ https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/more-coordination-needed-renewable-deployment-prevent-grid-congestion-2024-05-27_en

^{iv} The optimization of batteries for self-consumption entails system risks if the optimization algorithms or target functions are changed. This can lead to unexpected fluctuations in electricity demand, with a synchronized update amounting to several GW. This exceeds the resilience of the electricity system.

^v Winzer, C., Ramírez-Molina, H., Hirth, L., & Schlecht, I. (2024). Profile contracts for electricity retail customers. *Energy Policy*, *195*, 114358.

^{vi} https://www.diw.de/documents/dokumentenarchiv/17/diw_01.c.913920.de/fpm_report_how-can-nodal-pricing-engage-consumers_2024_2-final.pdf

vii Page 72, https://data.consilium.europa.eu/doc/document/PE-1-2024-INIT/de/pdf

^{viii} Joskow P. and J. Tirole (2000) Transmission rights and market power on electricity networks, RAND Journal of Economics, Vol. 31, No 3. pp. 450-487