Complementarity of Residential, Industrial, and Municipal Participants in Local Energy Markets: a Real-Life Data Showcase

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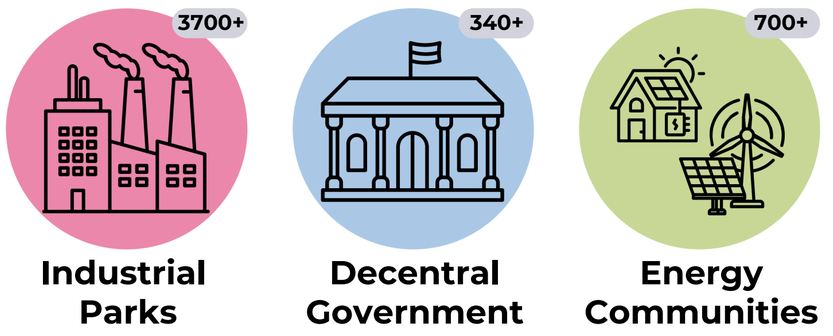
ENTRNCE

ENTRNCE (part of Dutch distribution system operator Alliander) operates a local energy trading platform. It provides a transparent, accessible trading infrastructure for Local Electricity Markets (LEMs) enabling energy communities, decentral governments, and industrial parks to trade energy directly and access, among others, wholesale markets.

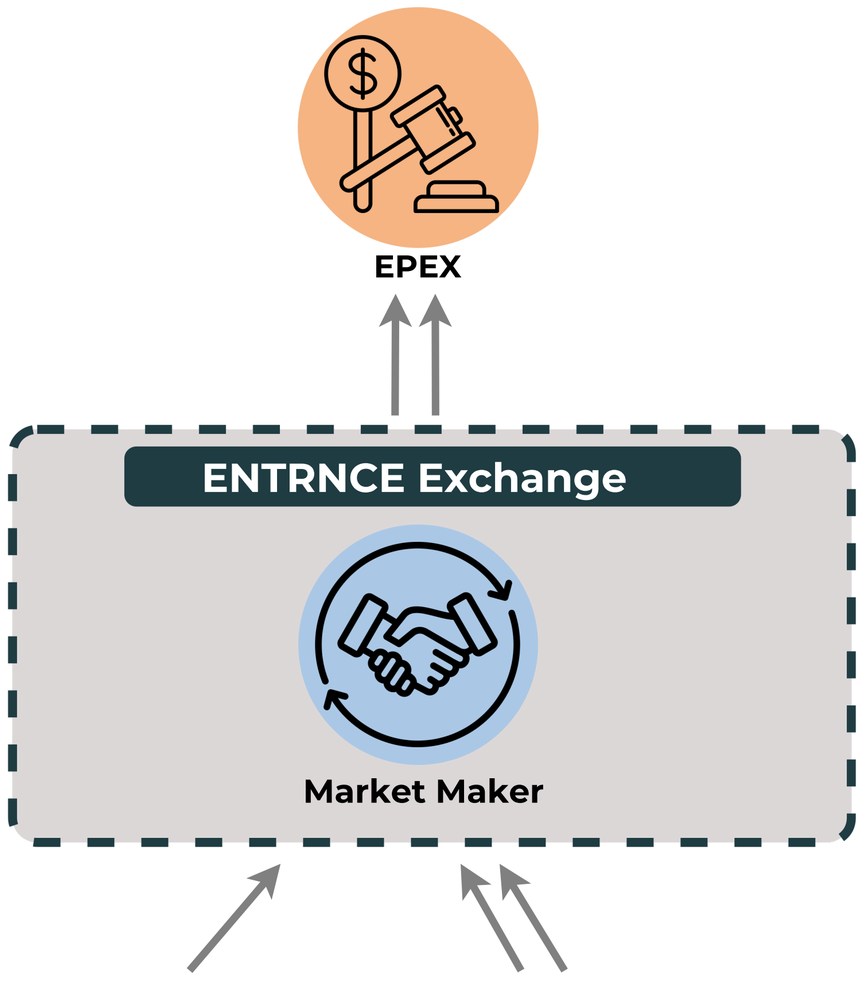
The Problem: Our Electricity Grid Is Under Pressure

As we rapidly adopt renewable technologies like solar panels, wind turbines, electric vehicles, and heat pumps, our local electricity grids are struggling to keep up. This growing demand is creating severe bottlenecks, known as grid congestion, which delay the transition to a greener energy system and cost both businesses and society dearly.



Local Electricity Markets

Local Electricity Markets (LEMs) are a solution to this problem. These markets allow neighbors (households, businesses, or local governments) to buy and sell electricity directly with each other within the distribution network while staying within capacity constraints. The concept is to match locally produced and consumed energy while not exceeding the capacity of the local grid. This way LEMs offer a cost-effective way to manage congestion without upgrading physical infrastructure and allow local participants to financially benefit.



What We Studied

This study investigates how diverse energy profiles within local areas can be complementary in such markets, enhancing local trading potential and market liquidity

Data Sources

Real-life consumption and production data from market participants from the ENTRNCE Trader platform of the year 2024

- Decentral Governments: Decentral governments, such as municipalities and water authorities, are local or regional entities with the autonomy to manage resources and address local needs
- Industrial Parks: An industrial area, business park, or trade park is a zone located within or outside the built- up area of a city or village, primarily intended for the establishment of commercial enterprises
- Energy Communities: An energy community is a legal entity that conducts activities in the energy market for the benefit of its members

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Key Findings: There's Real Potential
Our analysis revealed some exciting insights:

- There is complementarity between the energy profiles of different local participants. For example, government buildings often use energy 24/7, while industrial parks may generate wind energy at night, and households mainly produce solar energy during the day. When combined, these patterns create opportunities for local trading.
- Local trading is especially prevalent in the winter and at night, when solar power is limited. During these times, wind energy from industrial sites can help meet local demand.
- There is a lot of untapped energy trade potential. For example, only about 10% of nighttime energy use is currently met with local sources. By placing more wind turbines this can be increased to higher percentages, as wind has a very optimal complementarity.
- Solar power presents unique challenges. Since many participants generate solar energy at the same time, there's often too much supply during the day leading to energy being wasted or exported. This makes diversifying participants even more important to balance the system.

Why It Matters: The Business Case for LEMs
Local Electricity Markets can allow for:

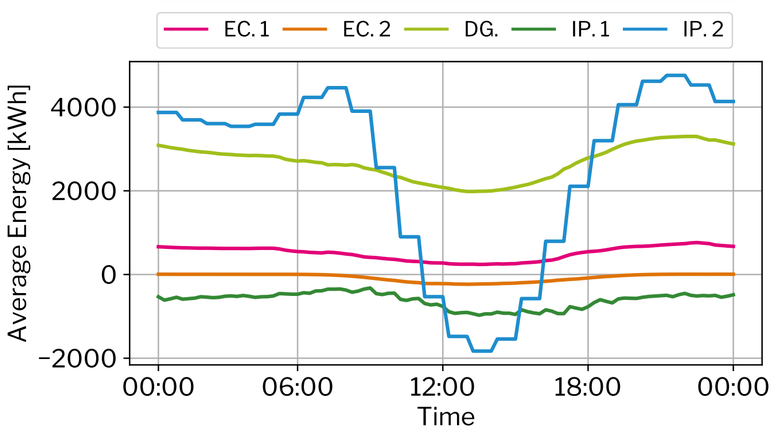
- Participants can start trading energy become active prosumers instead of passive consumers.
- Financial gains can fund further investment, such as adding storage or realising local energy generation.
- Over time, increased awareness and participation will help match supply and demand even better, amplifying the benefits and activitaing a local 'flywheel effect'.

And crucially, for grid operators, LEMs offer a cost-effective way to manage congestion without upgrading infrastructure, which is a very costly and time intensive process.

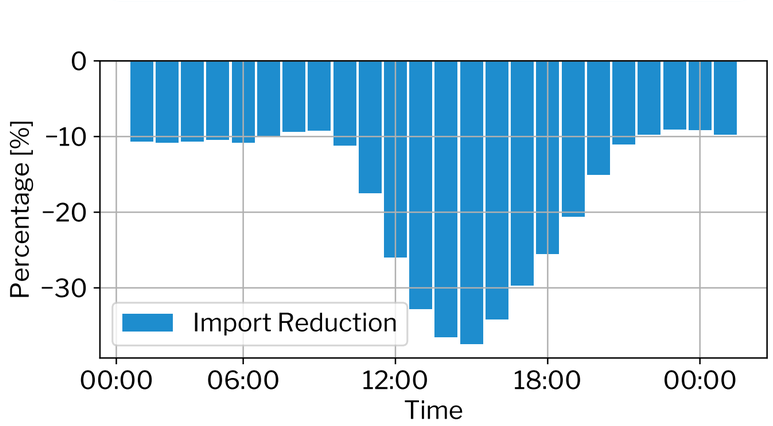
The Bottom Line
Local Electricity Markets aren't just a technical experiment they're a practical, scalable way to make our energy systems smarter, more resilient, and more sustainable. Our study confirms that when the right mix of participants work together, local trading can work in the real world not just in theory.

There are still challenges ahead, from regulatory hurdles to ensuring everyone benefits financially. But the potential is clear: with the right setup, LEMs can turn congestion from a costly obstacle into a shared opportunity.

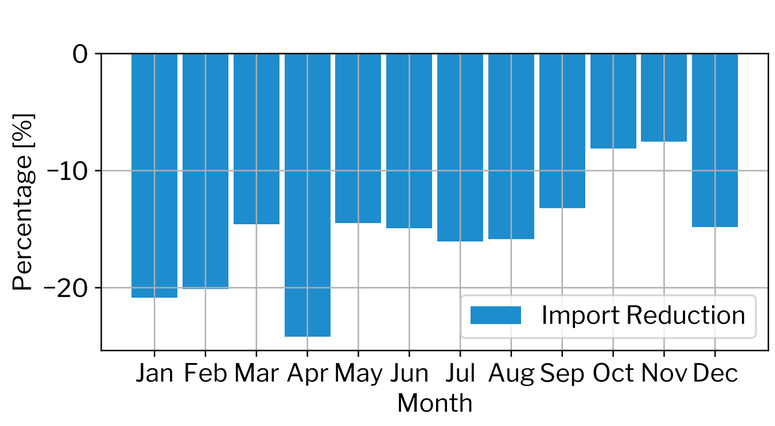
Profiles used in the analysis

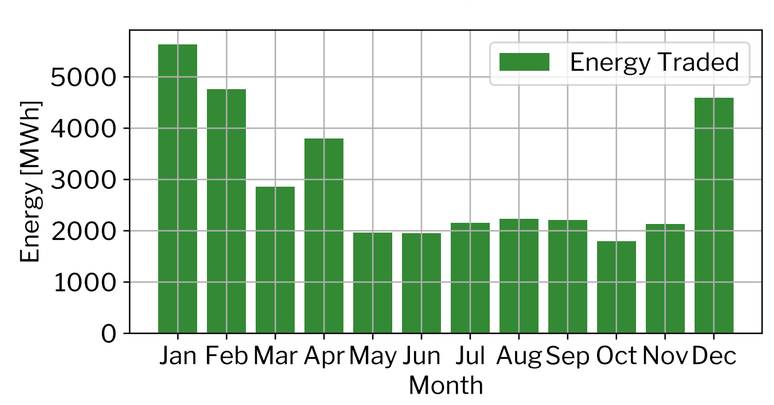


Average daily energy import reduction

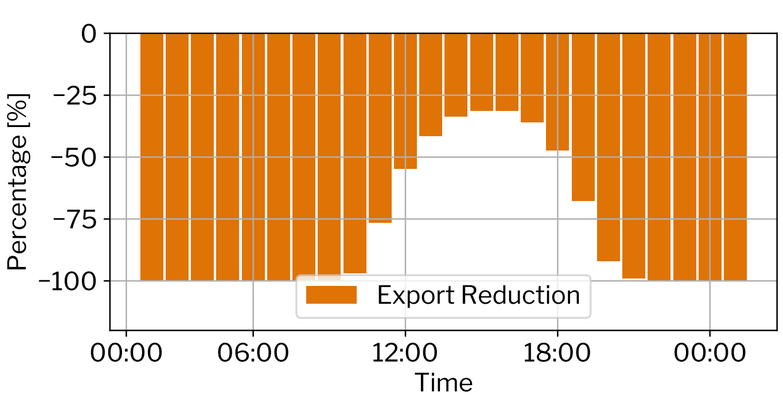


Average monthly energy import reduction

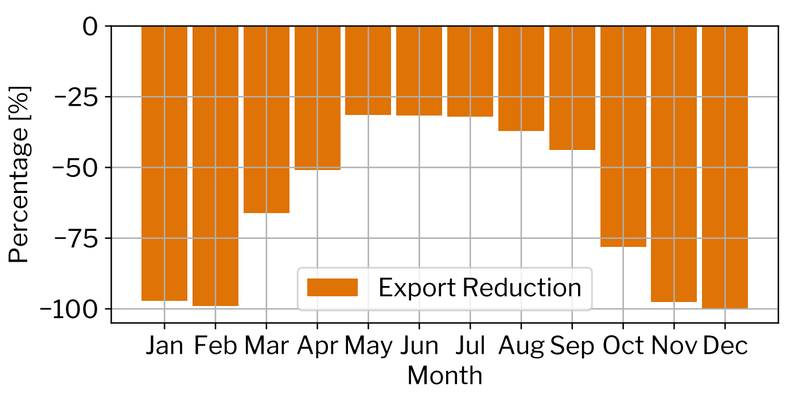




Energy traded in Exchange per month



Average daily energy export reduction



Average monthly energy export reduction