



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

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ENTRNC (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.

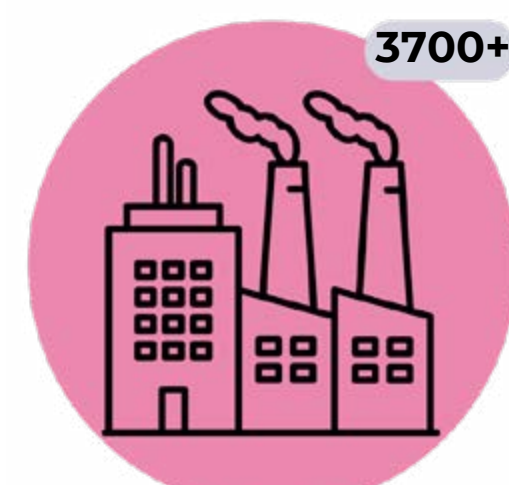
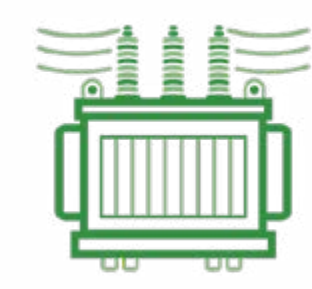
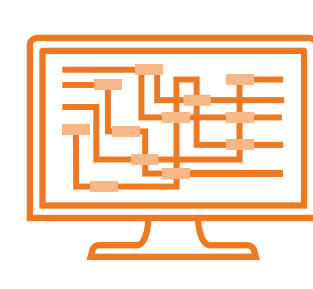
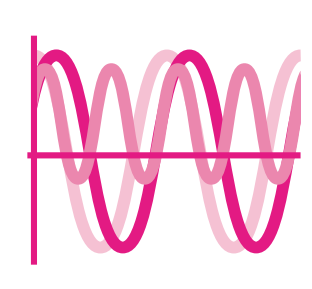
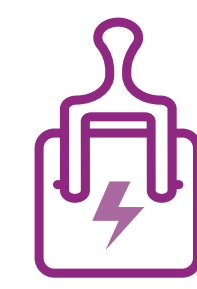
Introduction

- **Local Electricity Markets:** platforms that enable the trading of locally generated electricity among diverse market participants within the distribution grid
- **Impact of LEMs:** improve grid efficiency by aligning local production and demand, enhancing infrastructure utilization, and reducing congestion
- This study investigates how diverse energy profiles within local areas can be complementary in such markets, enhancing local trading potential and market liquidity

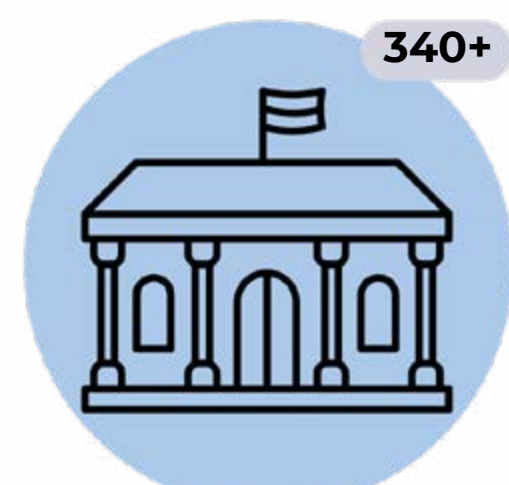
Method

Data Sources: real-life consumption and production data from market participants from the ENTRNC Exchange platform of the year 2024

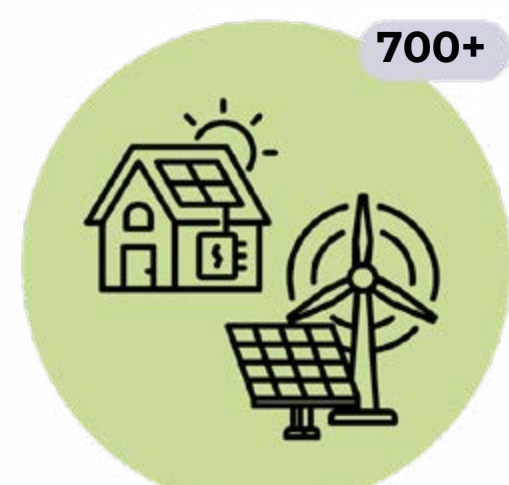
- **Decentral Governments:** Decentral governments, such as municipalities and water authorities, are local or regional entities with the autonomy to manage resources and address local needs
- **Industrial Parks:** An industrial area, business park, or trade park is a zone located within or outside the 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
- **Analysis:** Profile matching to determine local energy trading potential in simulated LEM scenario using Python



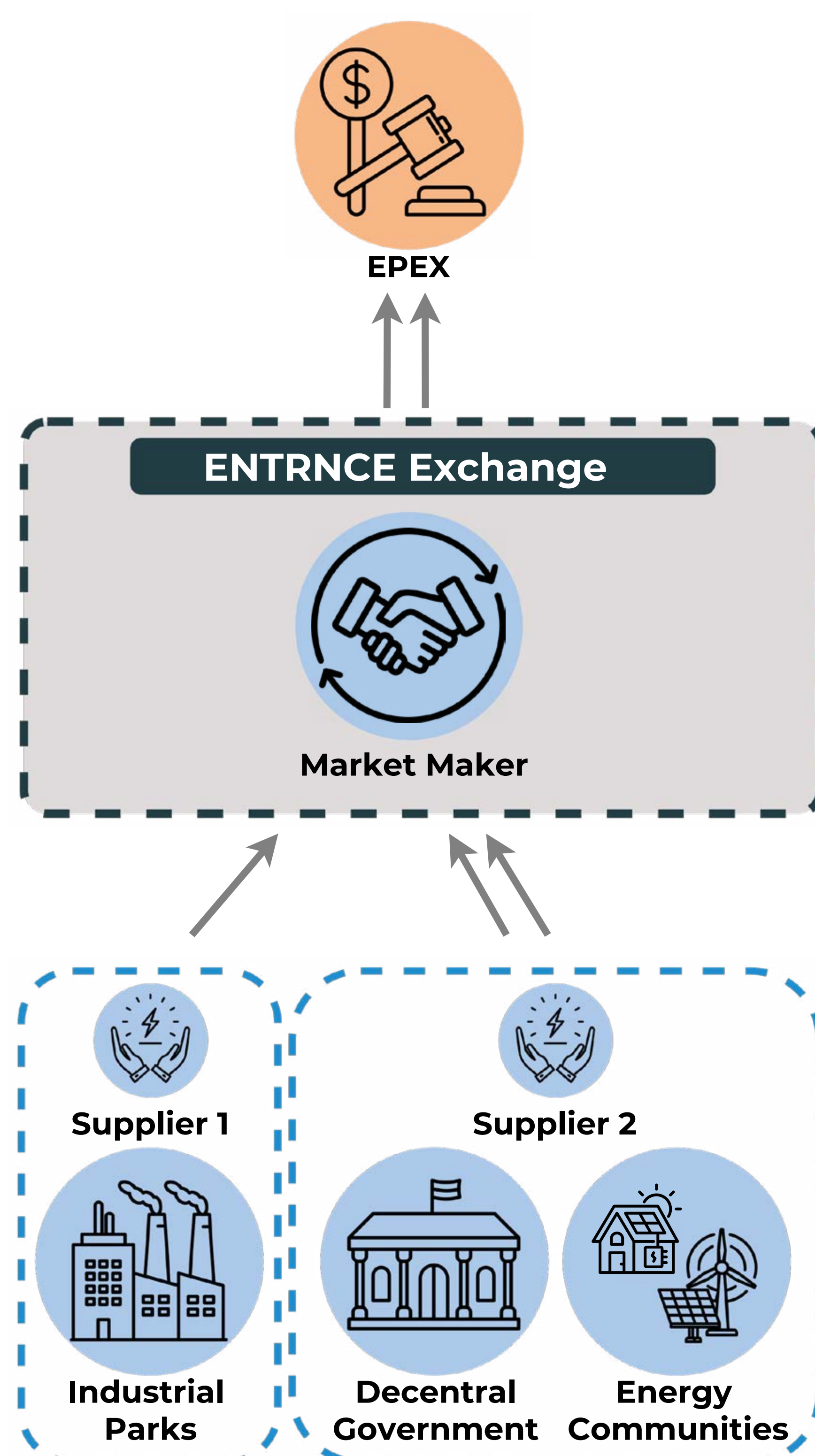
Industrial Parks



Decentral Government



Energy Communities



Results

Local Trading Volumes (2024)

- Significant energy volumes can be traded between energy communities, industrial parks, and decentral governments
- Winter and nighttime show high potential for local wind energy use
- Solar energy is harder to match locally due to abundance and production peaks not aligning with demand

Reduction in Wholesale Dependency

- Winter months: up to 100% of energy retained
- Summer months: retention drops to ~40%, due to solar overproduction

Daily Trends

- Import reduction highest at night (low solar, high complementarity)
- Export increases for solar peak hours (10h–18h)

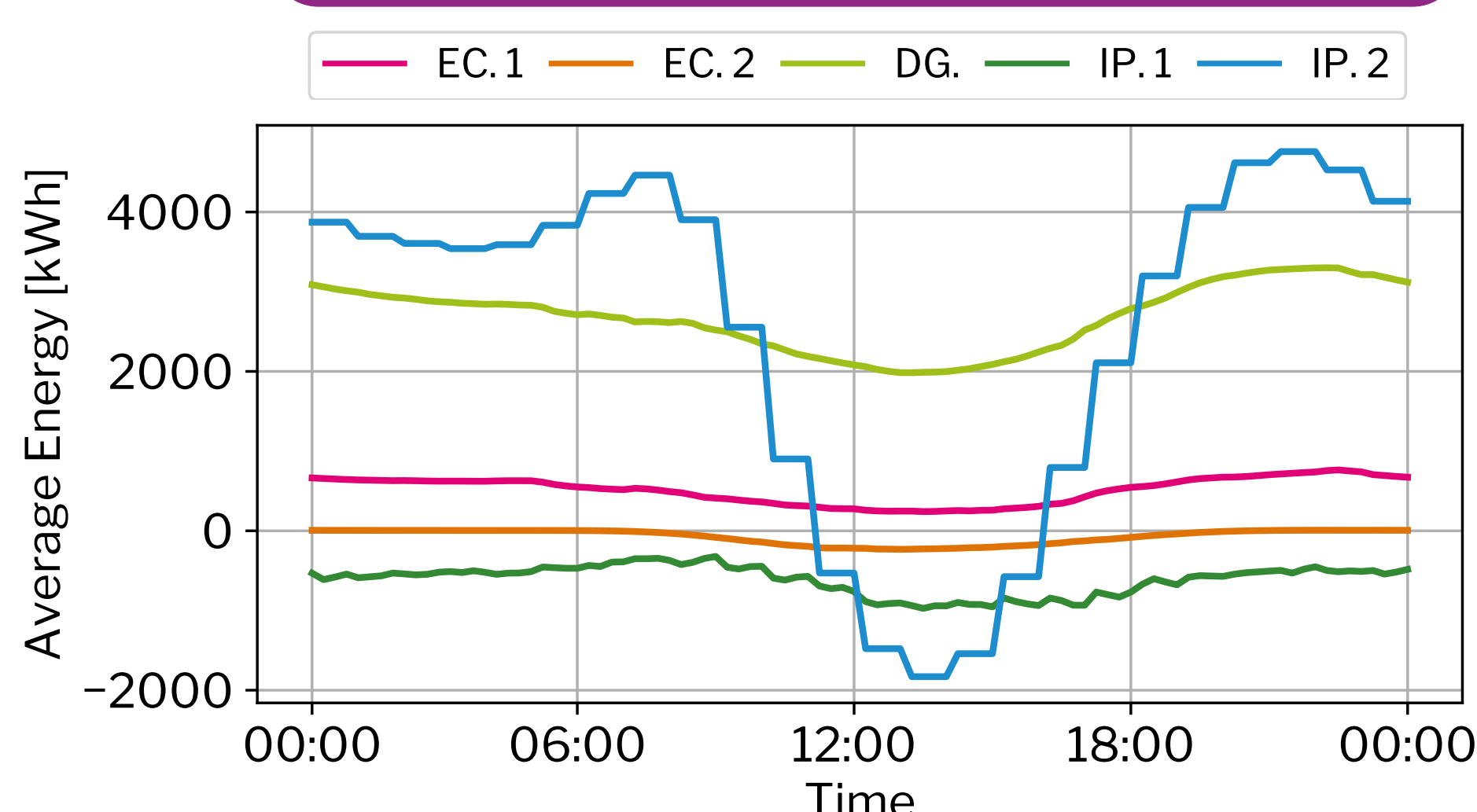
Role of Participant Types

- **Decentral Governments:** stable 24h consumption, ideal LEM anchor.
- **Industrial Parks:** wind generation fills night demand, enabling trade
- **Energy Communities:** residential profiles with modest peaks in the morning and evening, well-suited to absorb solar during partial overlap but face limitations in peak alignment, adds diversity and liquidity to the LEM

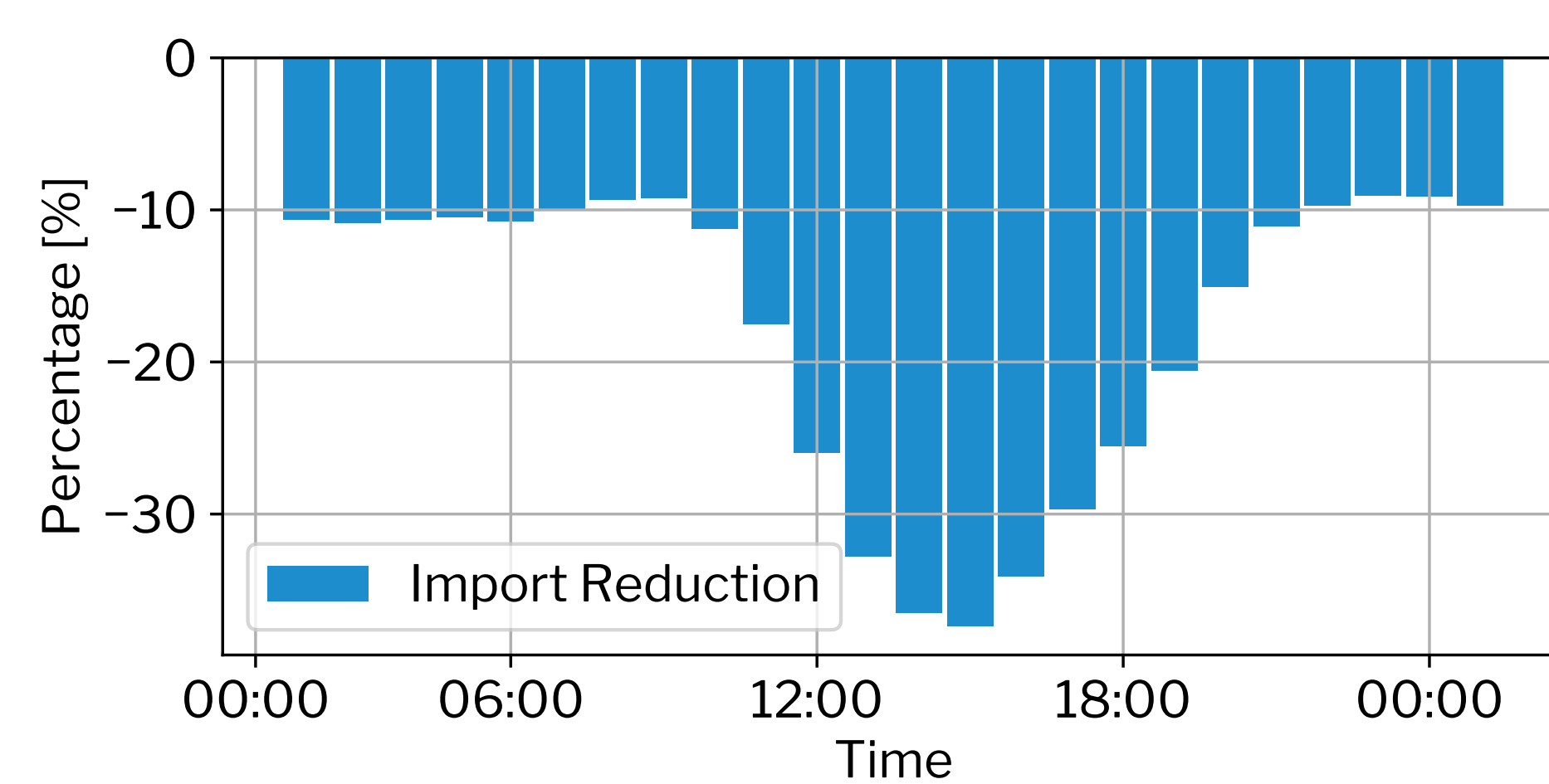
Conclusion

- Diverse participant types show strong complementarity in energy profiles.
- Local trading is feasible under real-world conditions, particularly due to:
 - Wind energy retention by consistent consumers (e.g. government facilities)
 - Lower solar trading potential due to profile overlap across all participant types
- Implementing a LEM can:
 - Increase locally traded volumes
 - Support passive congestion management
 - Offer sufficient market liquidity to justify investment
- Next steps: Align LEM benefits with financial incentives to accelerate adoption and unlock system value, investigate local impact

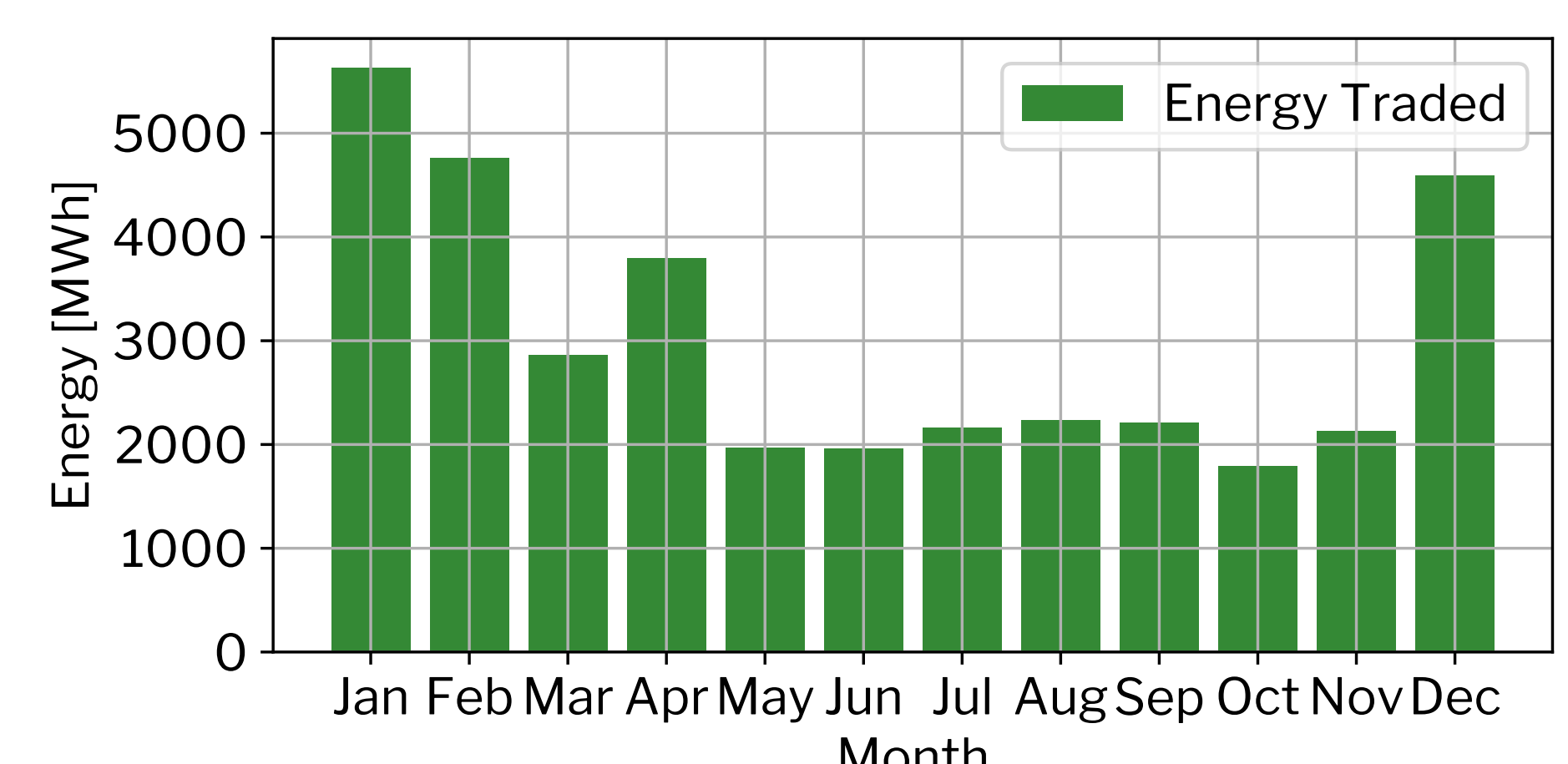
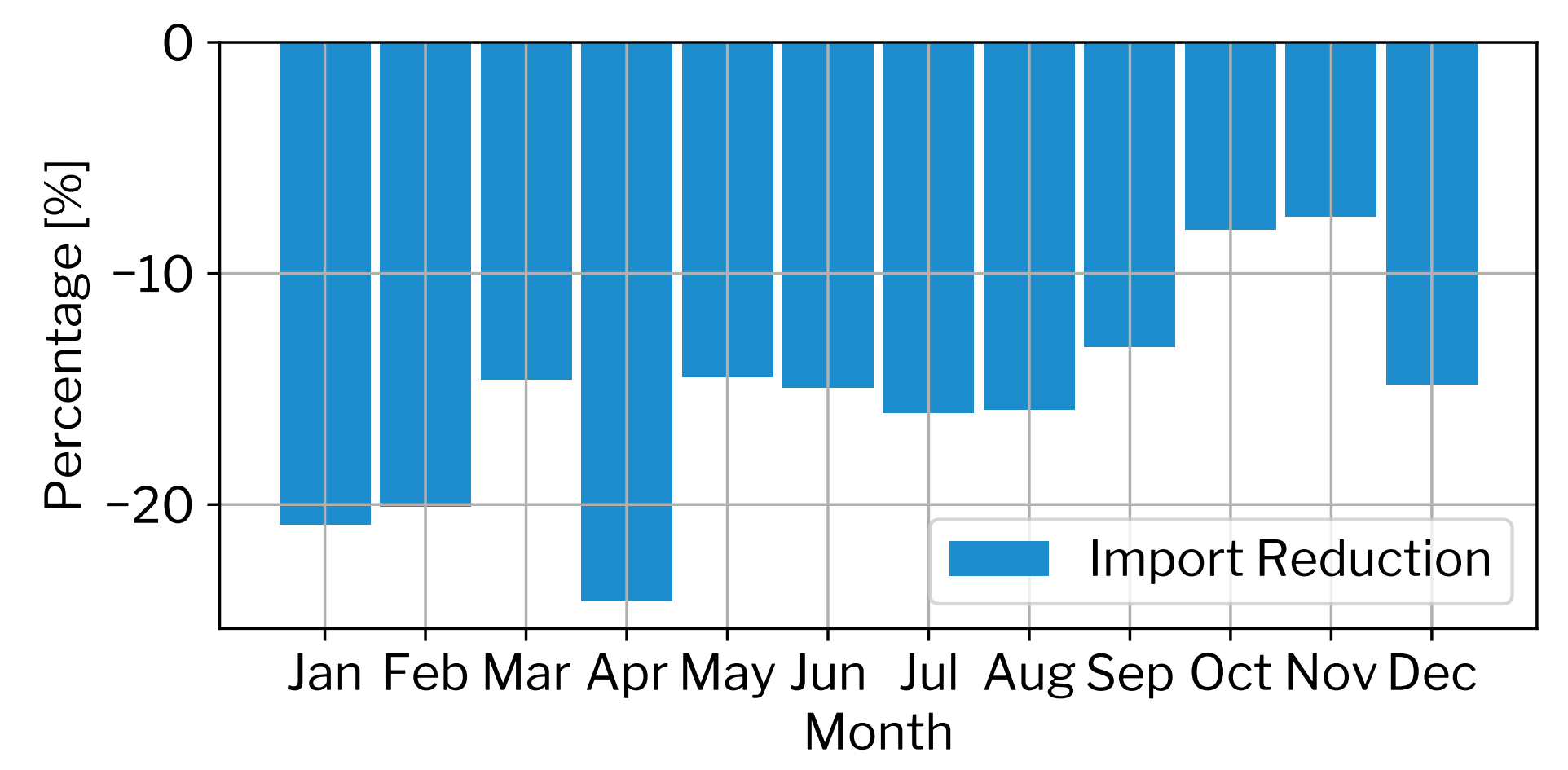
Profiles used in the analysis



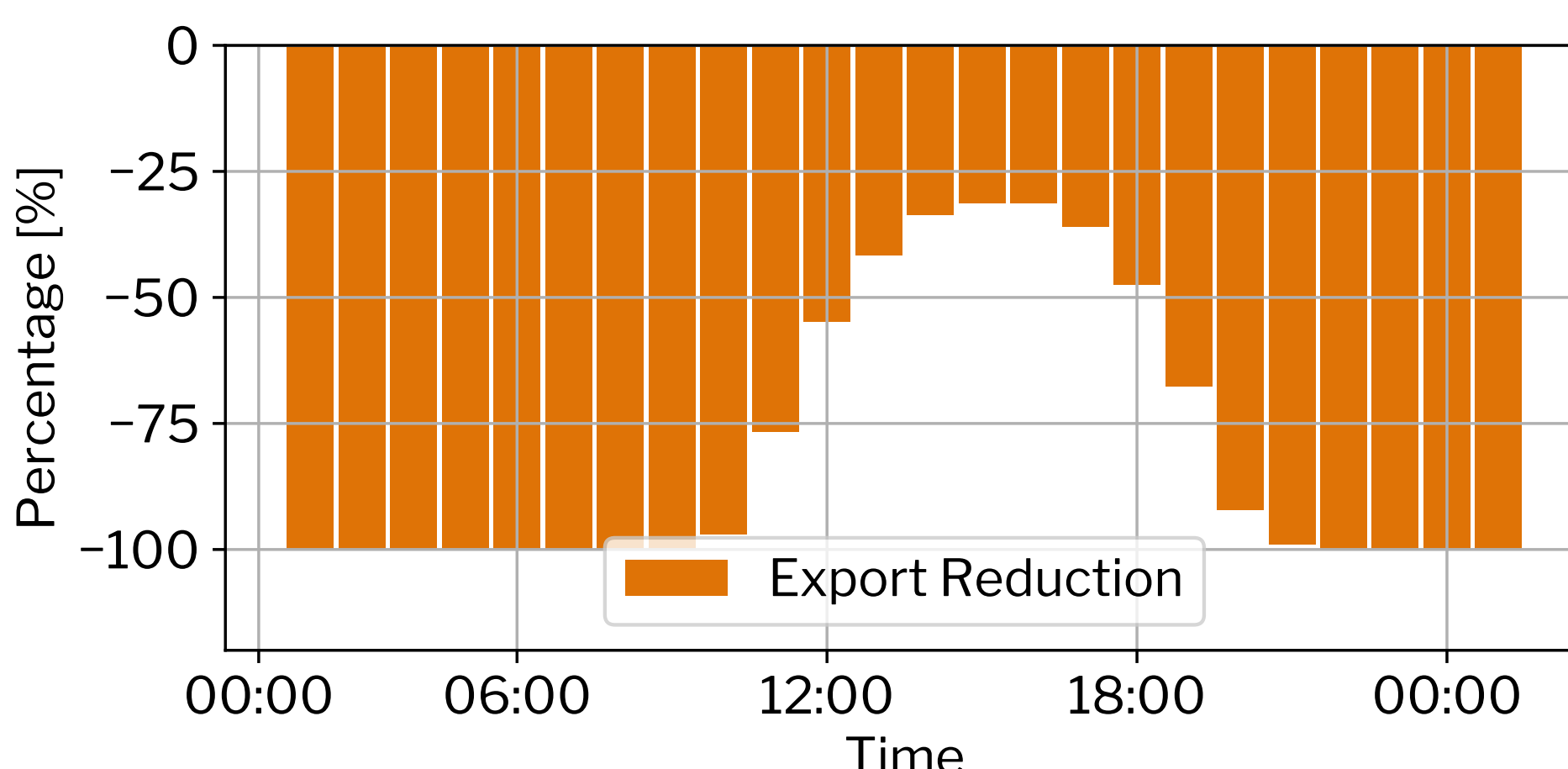
Average daily energy import reduction



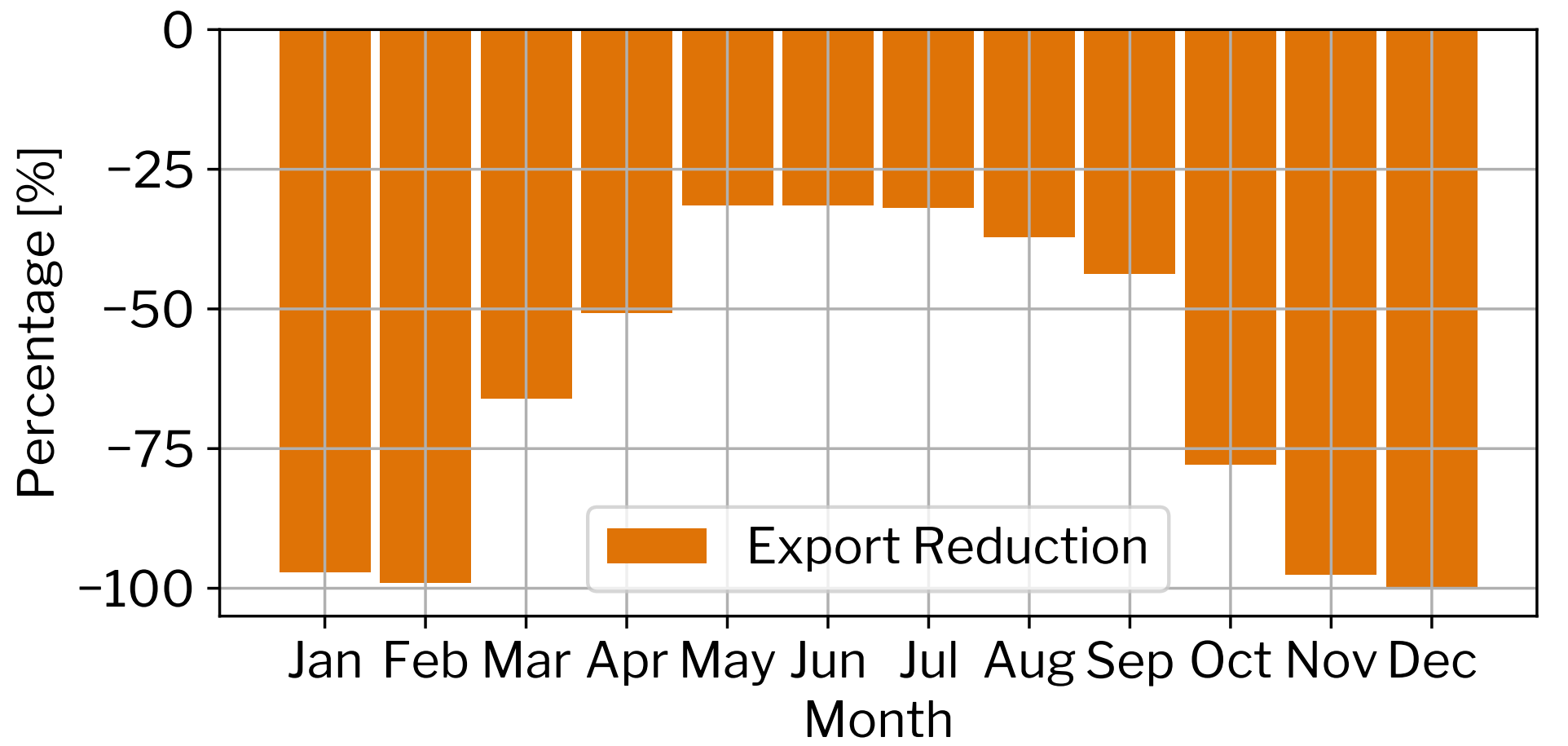
Average monthly energy import reduction



Energy traded in Exchange per month



Average daily energy export reduction



Average monthly energy export reduction