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India Smart Grid Forum

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DISTRIBUTION UTILITY MEET DUM2022

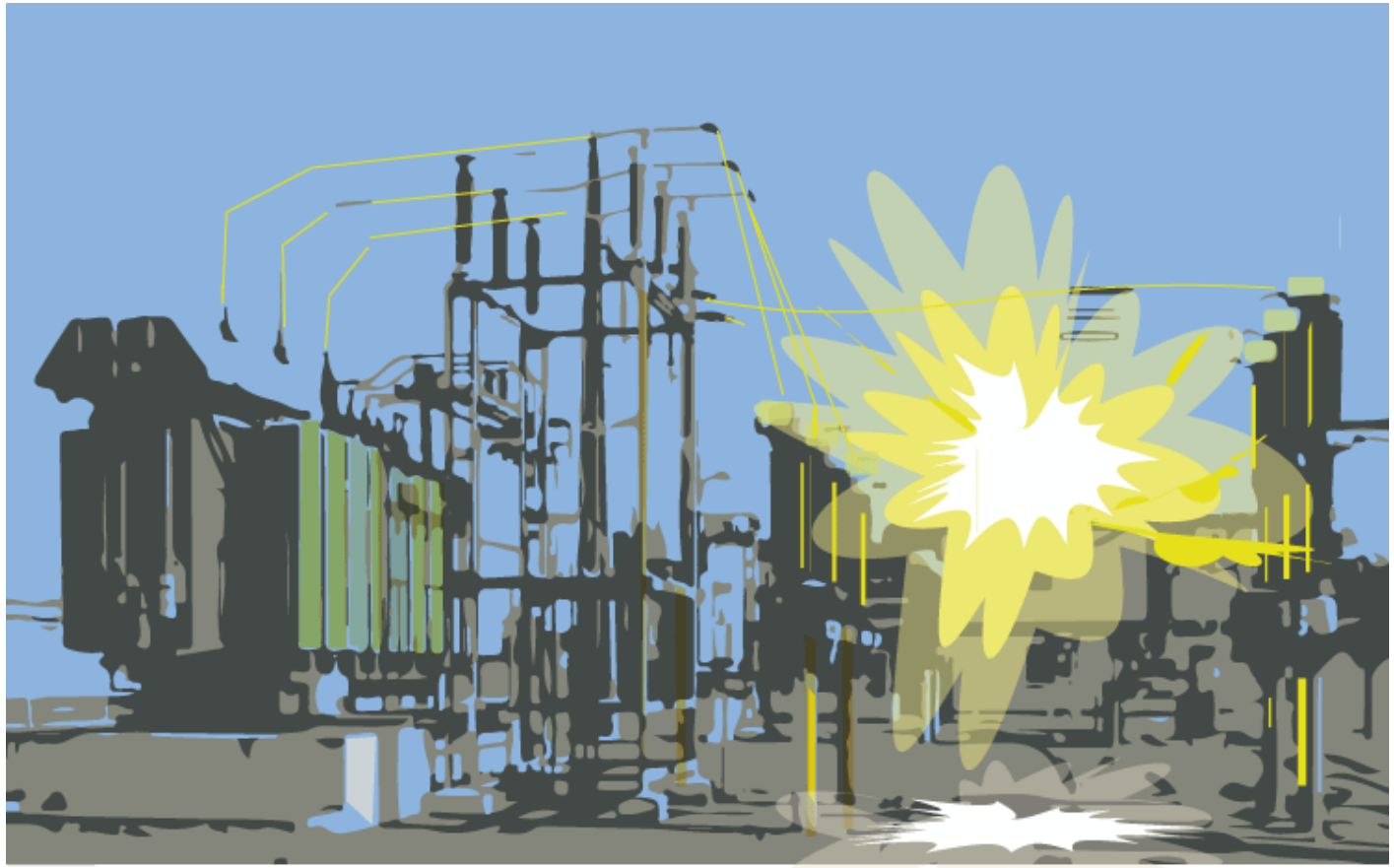
SESSION – 7: NEW AND EMERGING TECHNOLOGIES FOR ELECTRIC UTILITIES

18 NOVEMBER 2022| 16:00 ~ 17:30 (IST)

Anand Menon
Powerledger

INTRODUCTION

DERs bring grid problems



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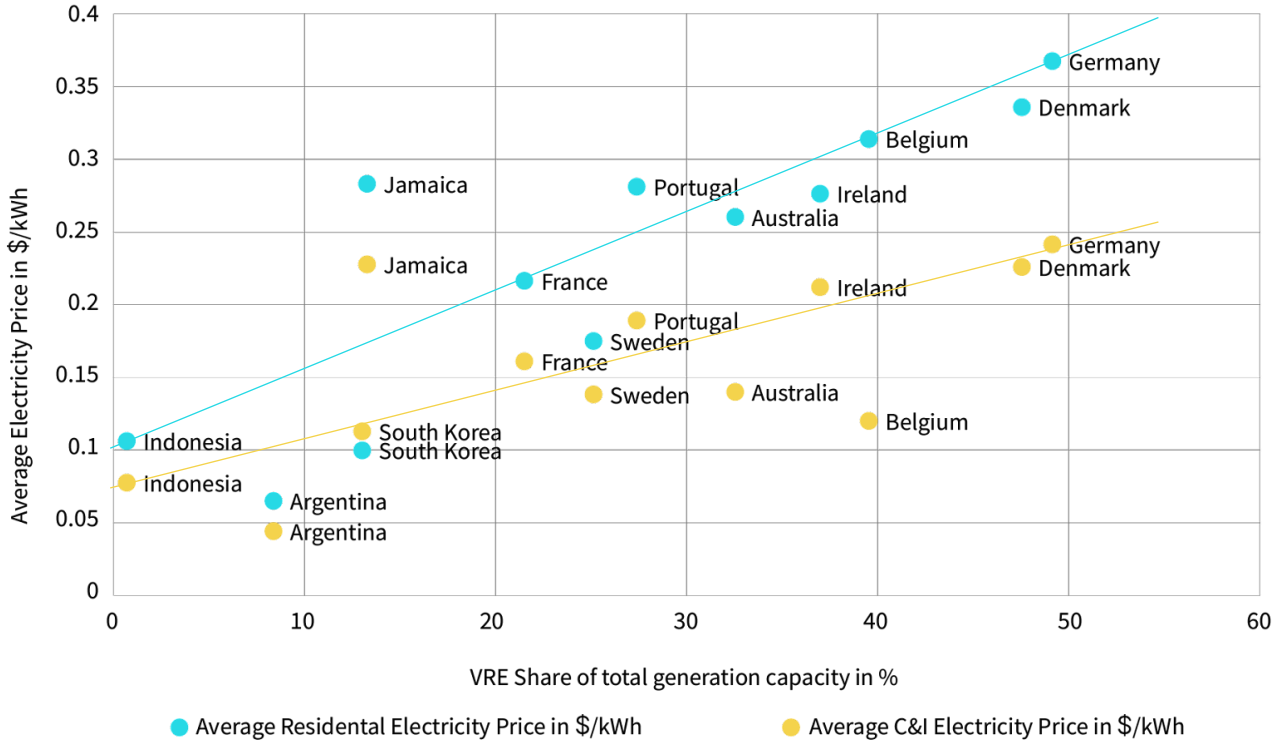
Average retail price vs VRE generation capacity

Network upgrades to solve the time and space problem resulting in higher tariffs



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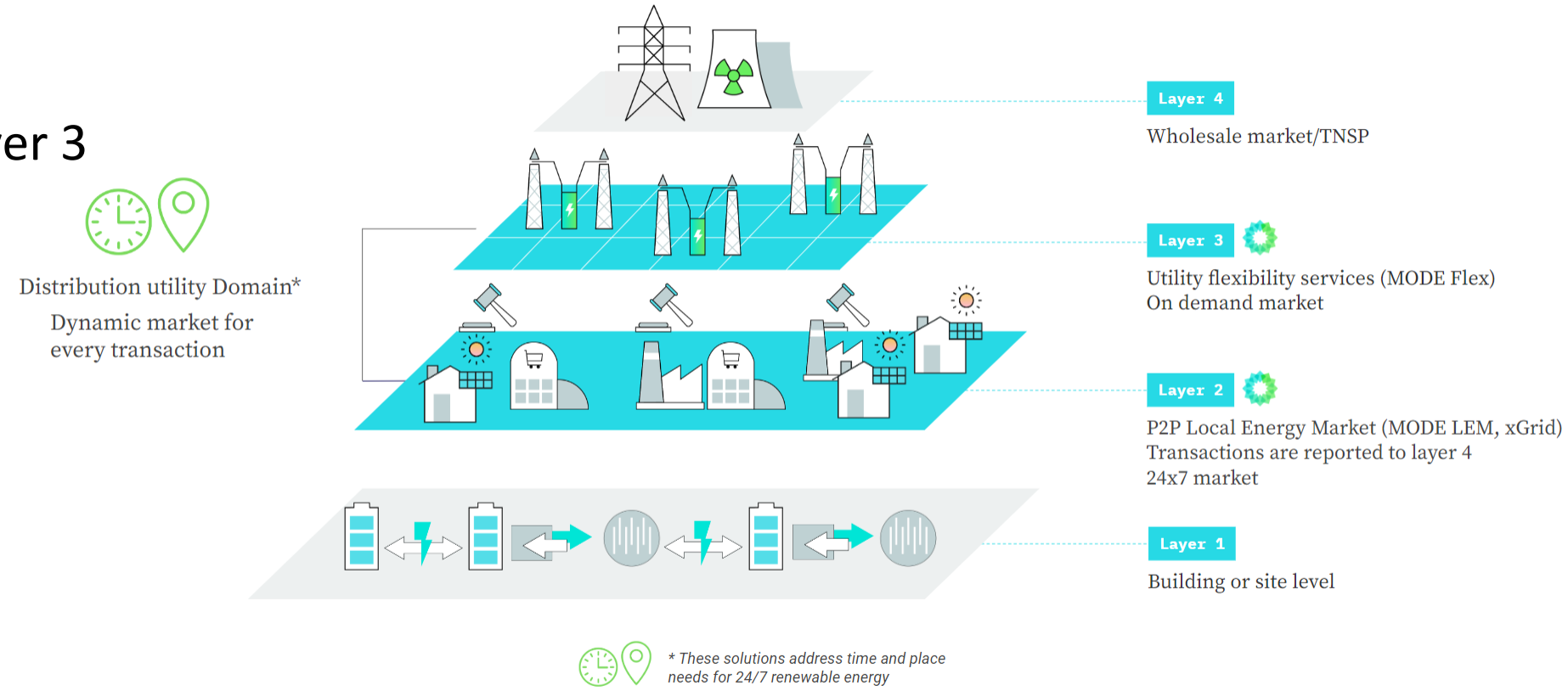
Emerging Transactive energy landscape - Two additional market layers

Increased Layer 2 reduces the flex requirement in Layer 3



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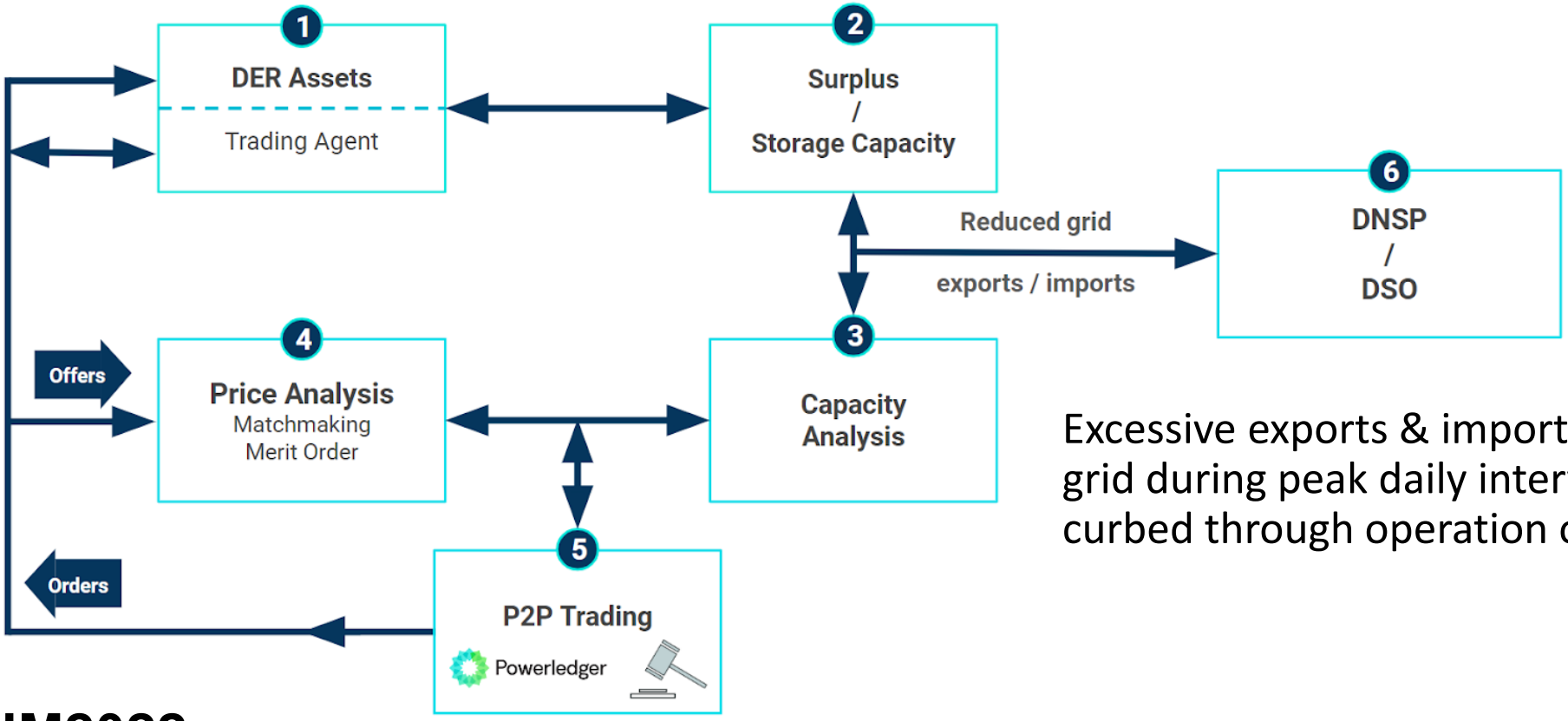
LEM – Local Energy Markets



Excessive exports & imports from the grid during peak daily intervals can be curbed through operation of the LEM

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LEM Fundamentals

- Typical three types of participants (residential or C&I)of LEM:
  - Consumers, also with increasing EV charging
  - Prosumers with solar PV
  - Prosumers with solar PV and BESS
- All LEM participants stand to gain, however prosumer with BESS gains the most (the payback for a 3.3kW/12Wh battery can be reduced from 9-10 years to 6.5 years.
- Buyers bid in the LEM at buy rates lower than their tariff rate, while sellers bid at rates above prevailing FiT.
- LEM offers a new revenue stream for owners of rooftop solar and BESS.
- With a LEM, there is less energy supplied from superior grid (wholesale market generators).
- A LEM is run by a distribution utility (many timers with a retailer partner).
- LEM expands the hosting capacity.

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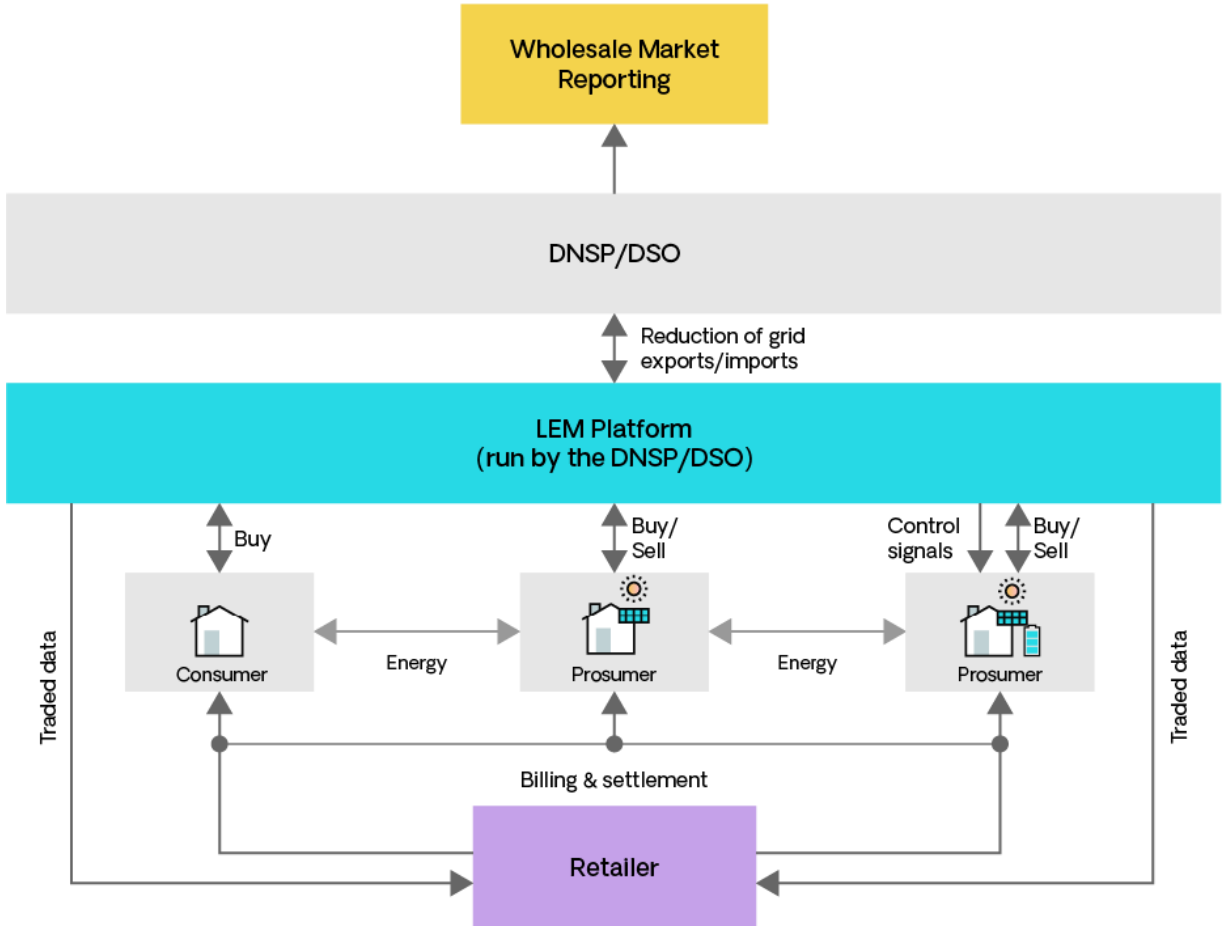
LEM Architecture and Stakeholders



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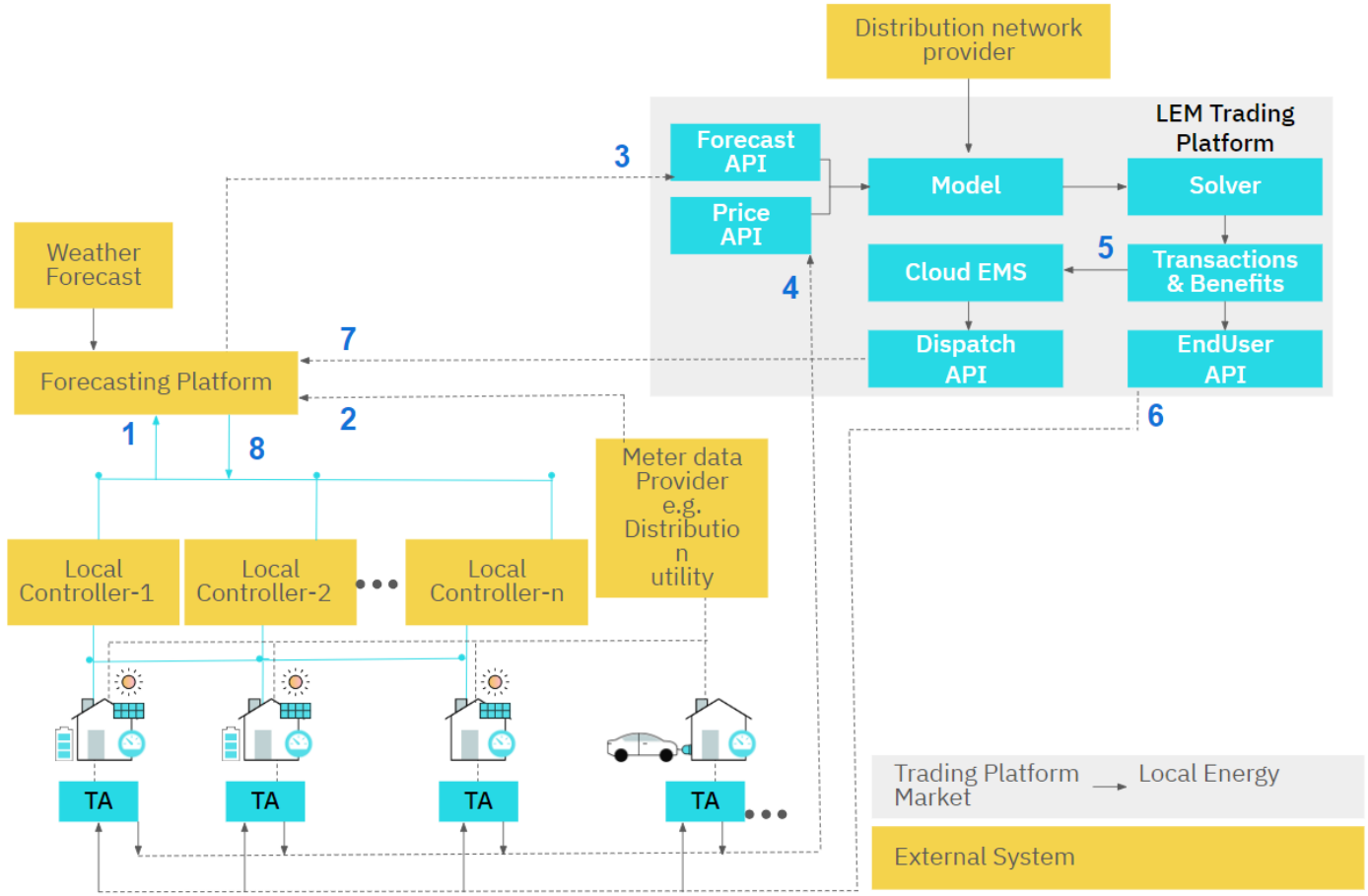
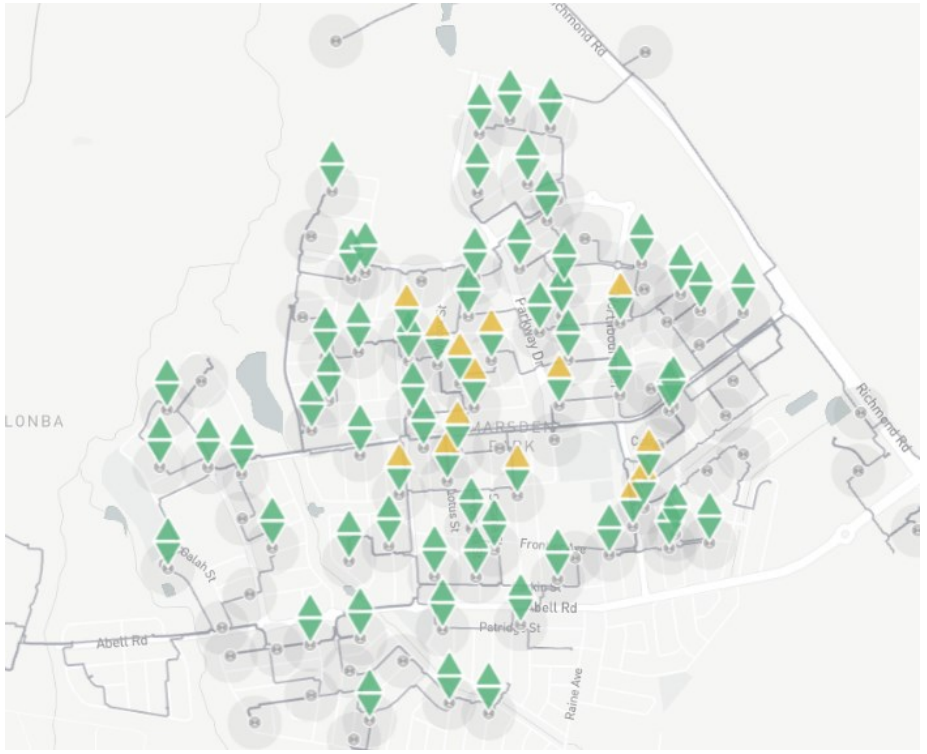
LEM Architecture and Stakeholders



1.Controller collects individual prosumers values of BESS SOC and PV generation output, and sends to forecasting platform (FP).
2.Meter data provider collects smart meter data from each of the participants and sends to FP.
3.FP aggregates all forecasted data (BESS SOC, PV generation and Load) and sends together to trading platform (TP) for energy trading.
4.Trading agents (TA) collect all buy and sell offers from all the participants and send to TP via Price API for execution of trading.
5.TP performs all the formulation and optimization based on input from FP, TA and dynamic operating envelope (DOE). TP executes the contracts through its match-making mechanism and sends signal to cloud EMS.
6.TP informs the executed contracts via EndUser API to the awarded participants through TA.
7.Cloud EMS sends dispatch signal (sequence for energy trading) via Dispatch API to FP.
8.FP interfaces with all the controllers and sends signal to all individual prosumers to turn ON or OFF their inverters to START or STOP the energy trading with network.

LEM – Everyone wins

- Distribution utilities defer CapEx for network augmentation and reduce need for flexibility services, and maintains network income.
- Reduced exports to the grid help to maintain minimum operation demand.
- Participants without solar, with solar and batteries, all have reduced bills.
- Retailers maintain their margins.



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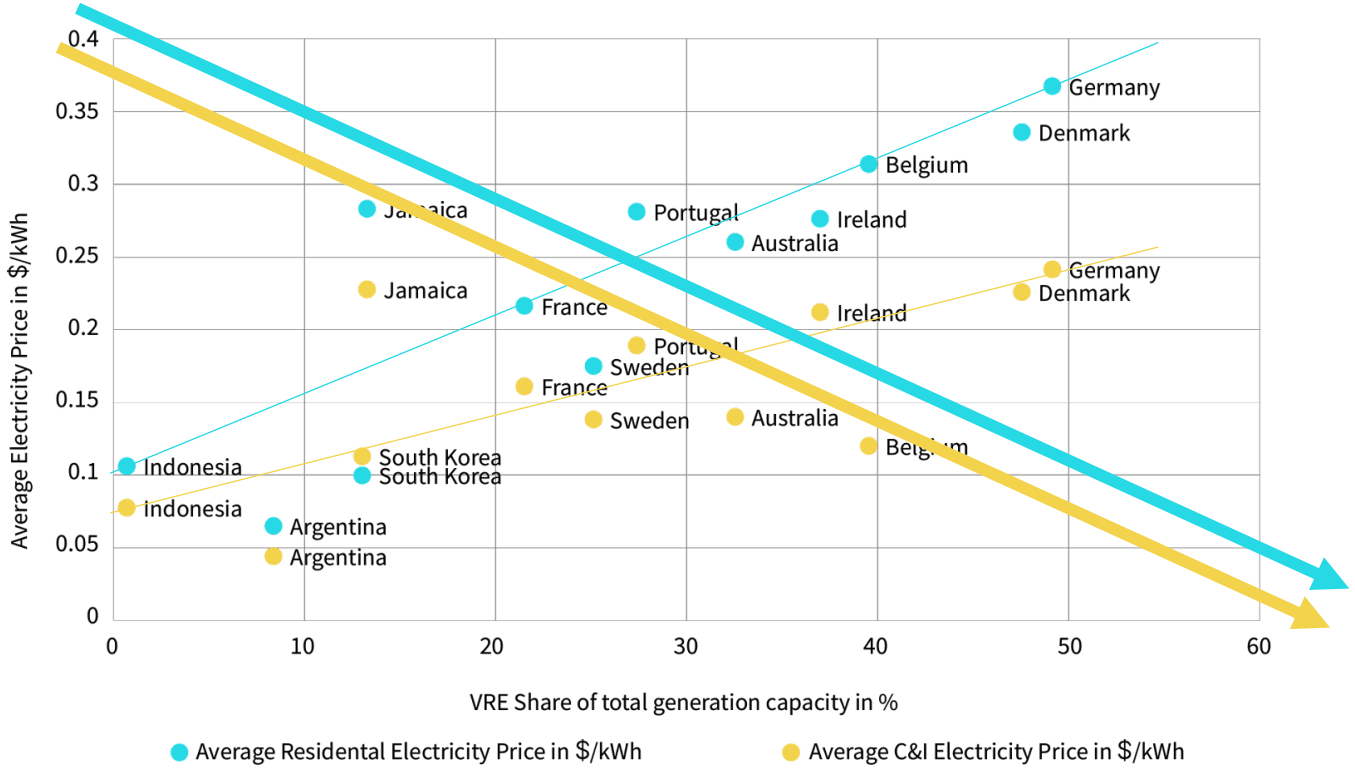
Could a LEM reverse the relationship where everyone wins?

Network upgrades to solve the time and space problem resulting in higher tariffs



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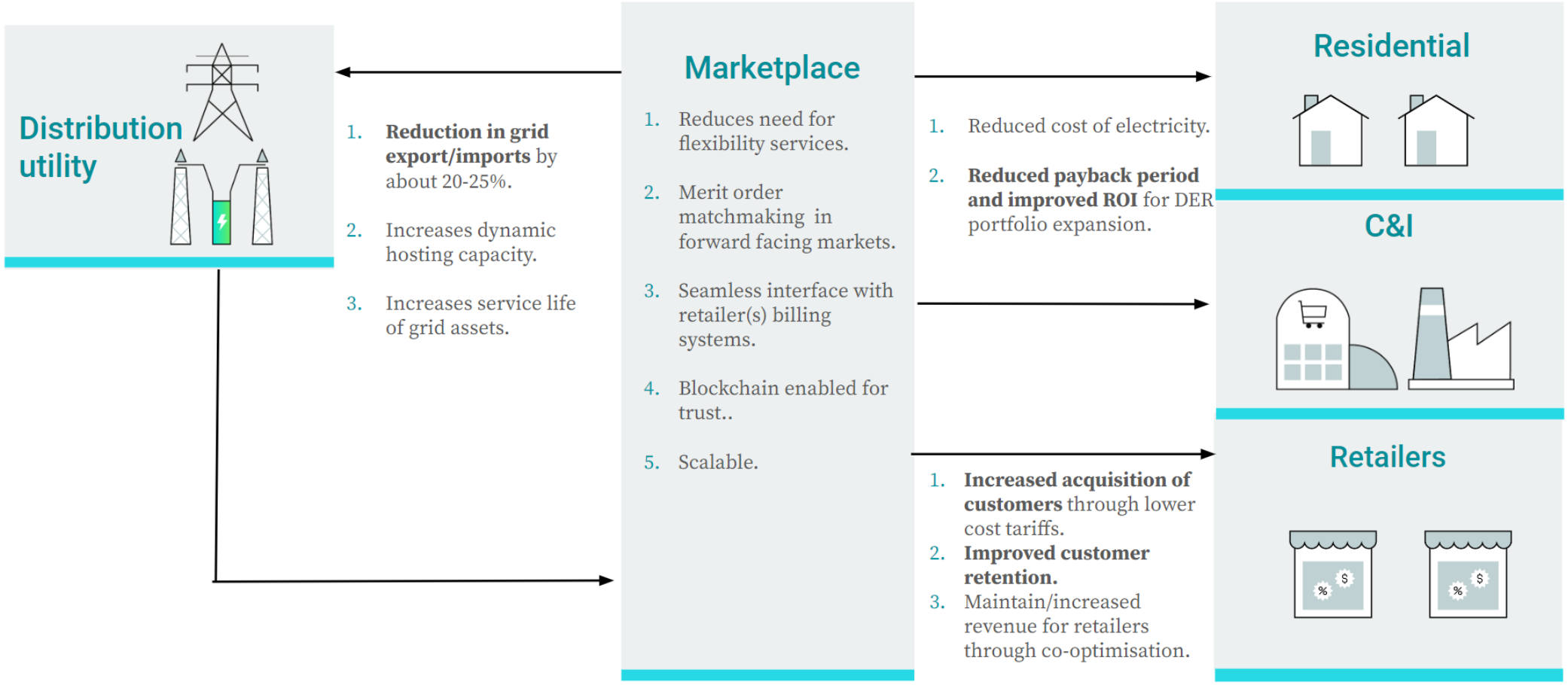
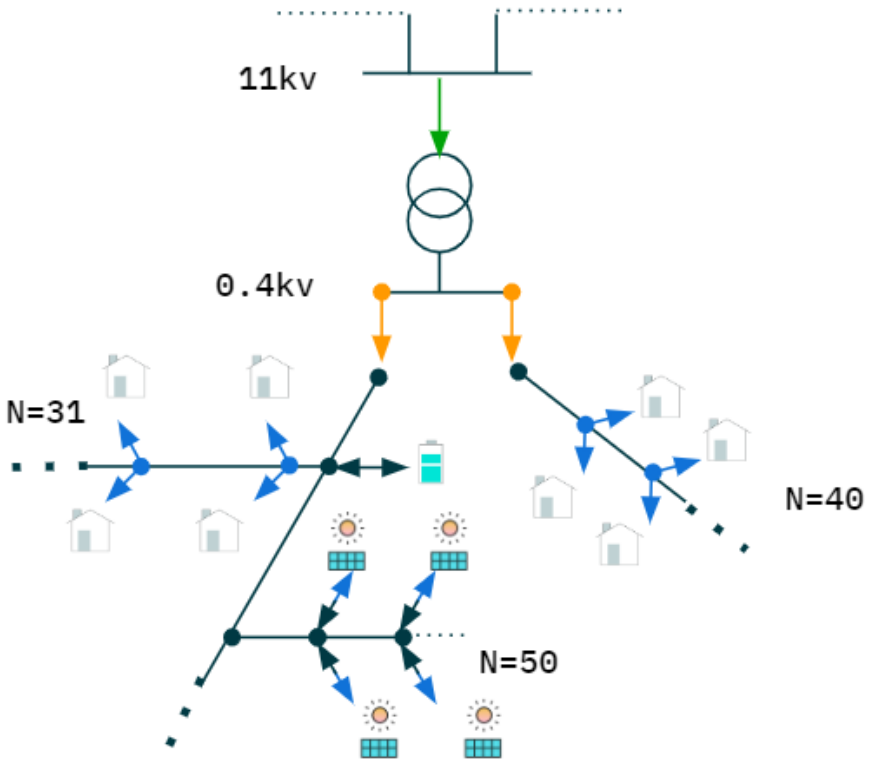
LEM – what is in it for all stakeholders



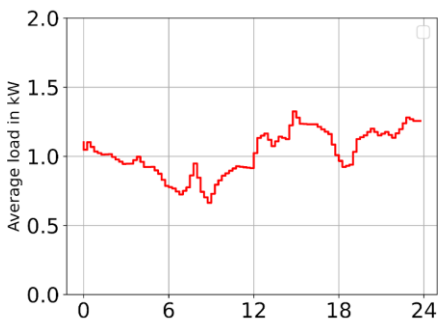
LEM Model Study based on typical load Profiles



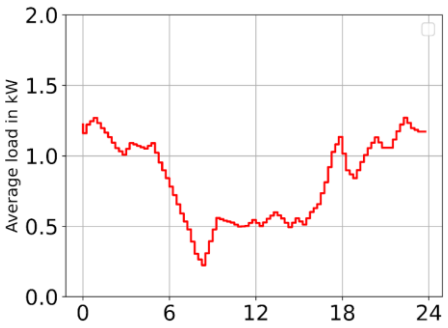
Assumptions

- Utility data of 122 participants with 71 consumers and 51 prosumers.
- Profile shows the values after PV consumption.
- *R_BESS: 3.3 kW / 12.5 kWh per prosumer
- Installed PV capacity: Average 6 kWp per prosumer
- 24 hours load profile is one of generic day in May

Consumers



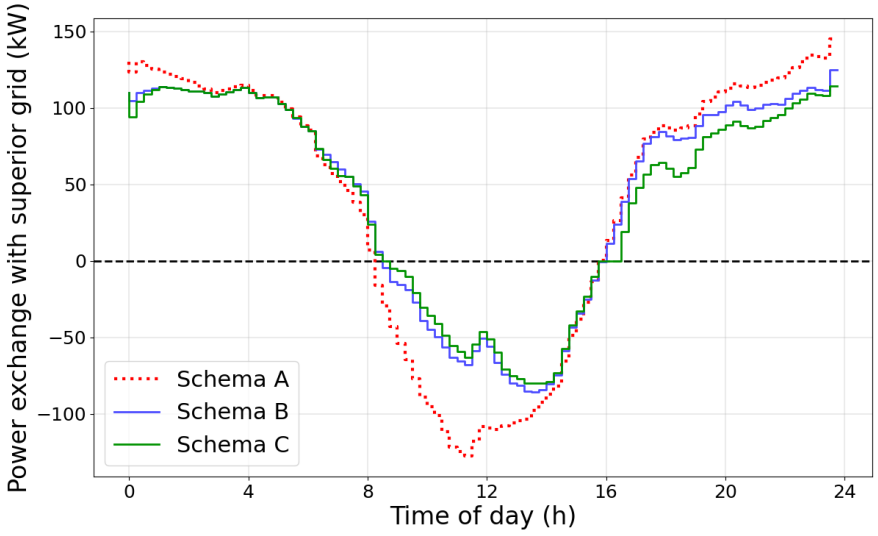
Prosumers



Simulation Model Results

Schema A: NEM + ToU + PV
Schema B: NEM + ToU + PV + R_BESS (Self-Consumption)
Schema C: NEM + ToU + PV+ R_BESS (P2P Trade)

•Schema A vs B, a reduction of export peak 33 % during midday, and evening peak is 13 %.
•Schema A vs C, a reduction of export peak 37 % during midday, and evening peak is 21 %.



Participant daily electricity cost reduction (energy only)

	Consumer	Prosumer (PV)	Prosumer (PV + BESS)
B vs C	2.5%	11%	25%

•LEM trading (C) increases the **self-sufficiency** of the local area by **~24 %** with respect to BAU (A):
  •BAU (A): **15.1 %**
  •LEM (C): **39.6 %**
•The reduction in energy usage cost for consumers is a result of the small difference of grid buy rate and LEM buy rate.

Assumptions
•Minimizing the Objective Function (REPCs*) for 122 participants.
•Analysis is based on utility data of 122 consumers with 71 consumers and 51 prosumers.
•26 prosumers with PV only, and 25 prosumers with PV and R_BESS.
•ToU: Peak hours 3pm to 9pm, off-peak hours 9pm to 7am, shoulder hours 7am to 3pm.
•P2P_selling_price: >3 c/kWh and <10 c/kWh (excl. network fees (paid by buyer));
P2P_buying_price: >23 c/kWh and <30 c/kWh (incl. 20 c/kWh network fees);
FiT: 3 c/kWh; Grid_electricty_price: 30 c/kWh.

Benefits of blockchain

Source of Trust

Verifiable audit trail

Platform agnostic to connect to multiple parties

Moving from Ethereum to Solana for volume, speed, security

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Why would a Power Utility want to do a LEM?

Simulation of household energy data shows:

A substantial reduction in grid exports and imports of nearly 25-30% and 6-10% respectively, with only an assumed average storage of 3.3 kW / 12 kWh at each prosumer's premise, without the need for a community battery.

Importantly, this reduction can be achieved **without altering** the current network fees.

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Response

Utilities could reduce the need for politically toxic solar curtailment but instead expand the DOEs by setting up a Local Energy Market (LEM) to:

1. Defer CapEx for grid augmentation
2. Offer a comprehensive lower cost Market-Grid solution encompassing grid DOE calculations with LEM.
3. Pursue a tariff re-structuring model. Regulators are open to this.
4. Create positive involvement between PV enthusiasts and the Utilities.

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THANK YOU

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Local Energy Markets

Q & A

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A blockchain enabled platform

Basing our technology on a blockchain gives some distinct advantages for current and future state

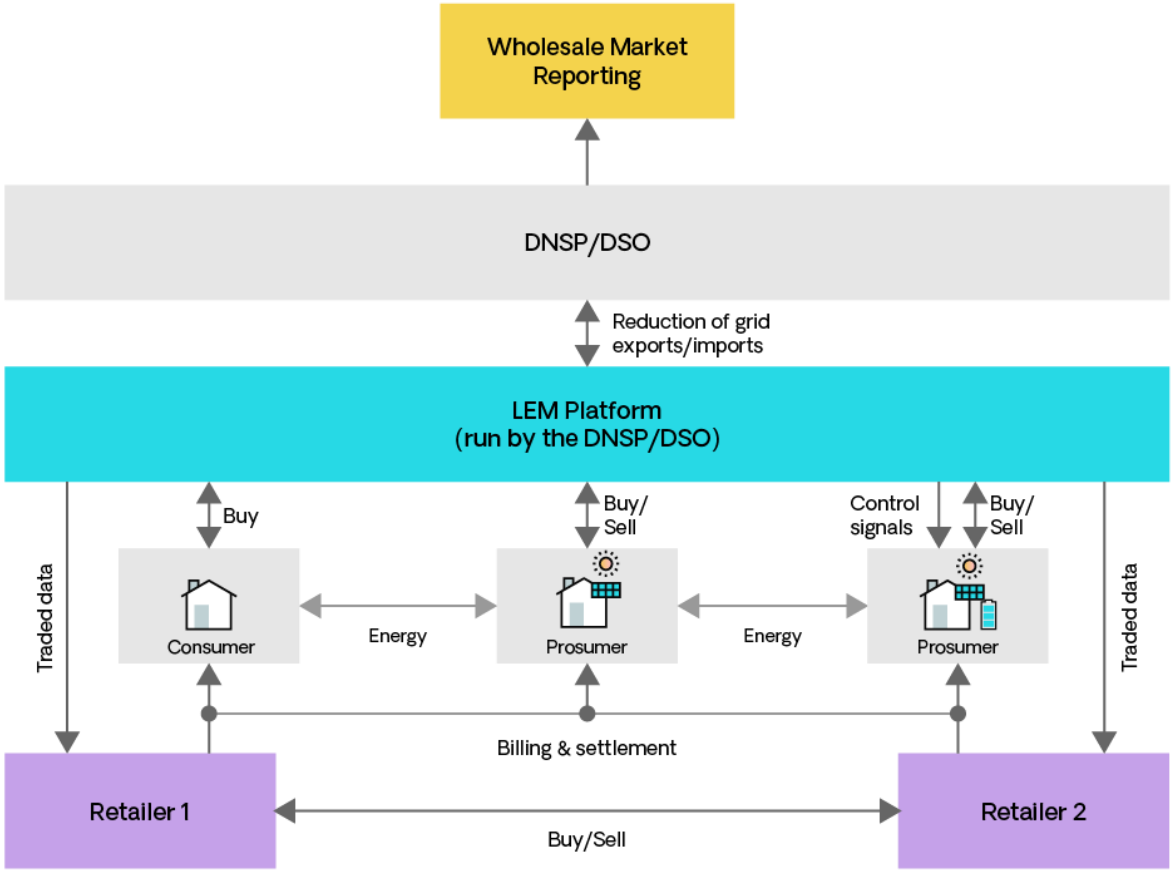
Energy Trading & Tracking

- Enables new local marketplaces for P2P energy trading to develop.
- Easier to trace, verify and choose energy sources.
- Enhanced product offering for retailers to attract and retain customers.
- Faster settlement from trading.
- Smart contracts can facilitate more complex transactions between multiple parties within the energy ecosystem e.g. virtual power plants.
- Smart contracts can optimise market for maximum value capture from all available income streams.
- Cross-retailer trading – facilitating a bigger and more bona fide distributed energy market.
- Optimization and balancing of energy load and demand.
- Enhanced auditing – encoded market records on the blockchain to create an immutable record of transactions.
- Granular reporting on energy use and transactions.

Renewable Energy Certificate Trading

- Future state: tokenisation of RECs so that when trading ownership and financial settlement takes place in one block, reducing counterparty settlement risk.
- Easier to trace and verify energy sources.
- Remove the need for a broker and connect buyers and sellers directly.
- Facilitating a bigger and more consolidated marketplace to trade a global or national REC portfolio.
- Enhanced auditing – encoded market records on the blockchain to create an immutable record of transactions which provides guaranteed verification of ownership.
- Remove risk of double selling of RECs.
- Relevant parties can verify the existence of transactions on the blockchain independently.

LEM Architecture and Stakeholders



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