

“Blockchain in the Power Sector: Powering Disruption by Empowering Trust”

Digitalisation ushering a new solar era | Use of Block-chain technology for energy trading



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Ms. Sweta Malik
Dr. Shashank Vyas
Er. Alekhya Datta

“Trust is the highest form of efficiency”

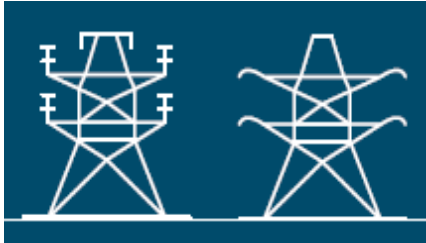
Somebody, sometime at some place

Rajesh Nambiar, IBM, Global Blockchain Congress 2018

Power system: Centralized to Decentralized



Carbon-intensive



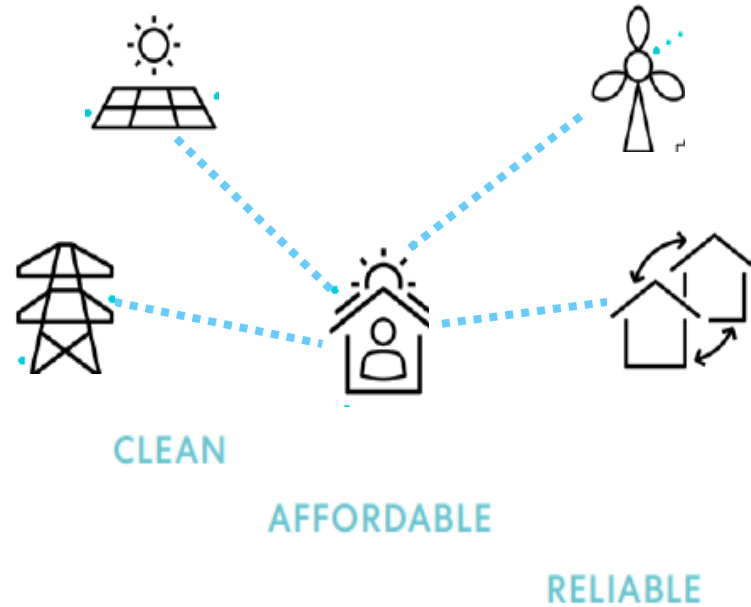
Inefficient & Transmission Losses



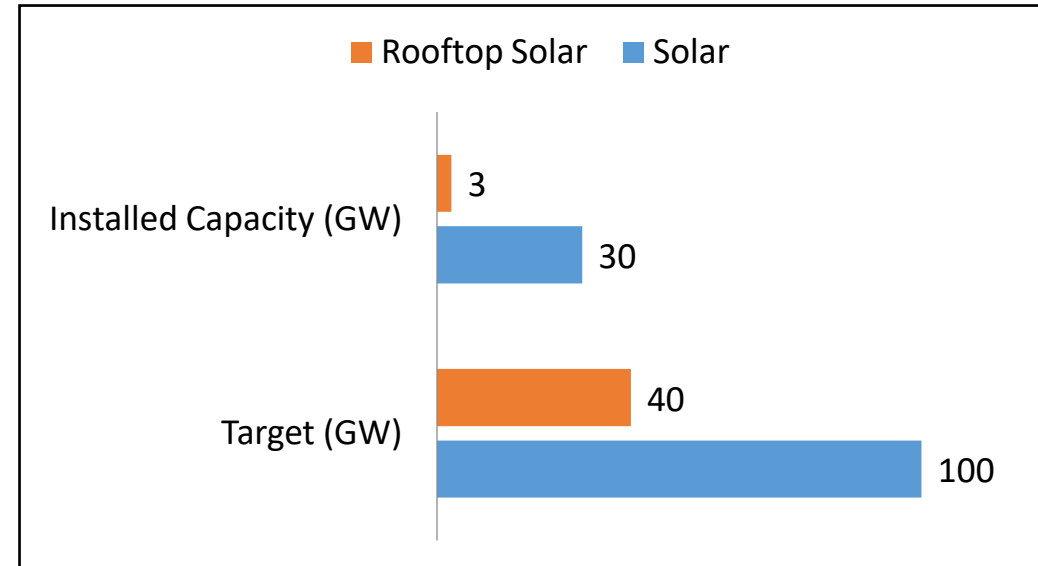
Expensive & Distribution Losses



Changing from centralized system to Decentralized System



Integration of renewable energy into the grid



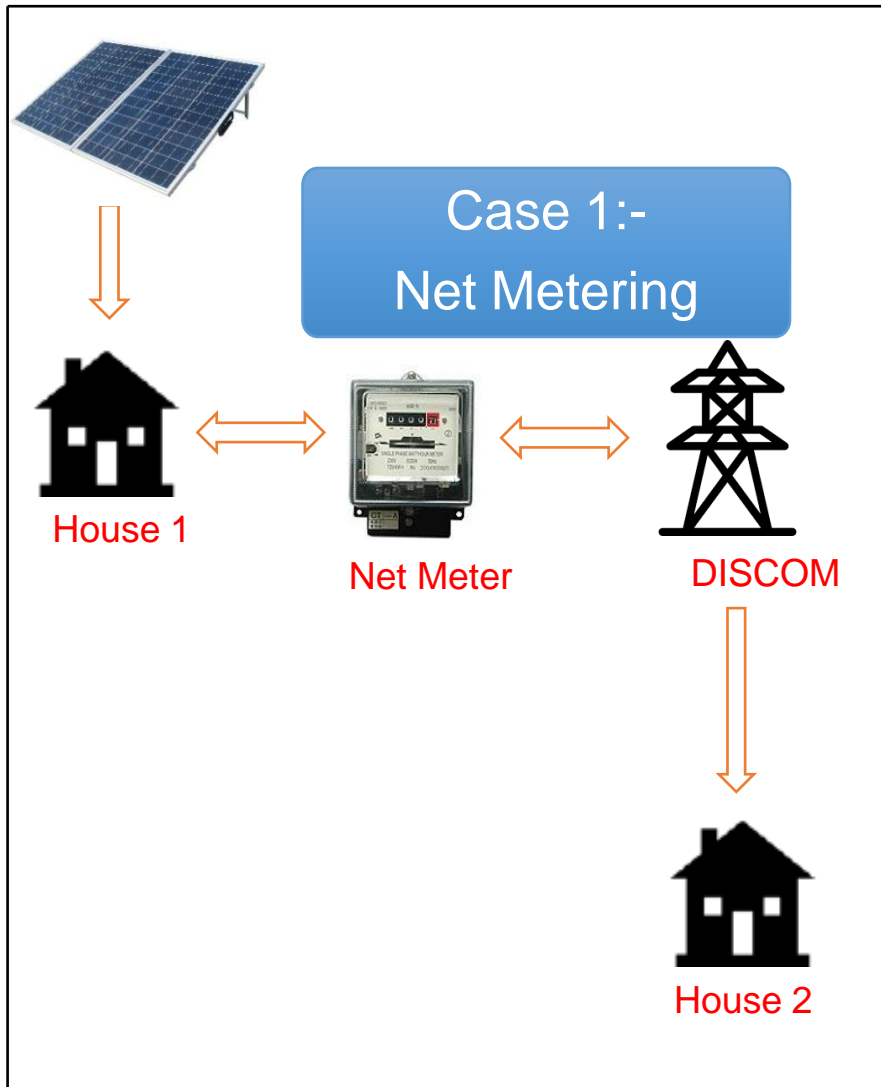
The 'new' power system and Blockchain technology: Parallels

- ▶ Smart grid paradigm: Inclusive of RE, EVs and distributed storage
- ▶ Blockchain: A Distributed Ledger ---- of records/transactions
- ▶ Potential Applications:
 - Manage Transactions ----- Energy trading among DER users (Trust/security)
 - Sharing of Assets – Private EV chargers – Look for chargers now (Moving over look for cabs)

But CAN IT DETECT POWER THEFT???

Well, Yes but get your metering & communication infrastructure Up and Ready

Net Metering v/s Peer to Peer (P2P) Trading (Power Flow):-

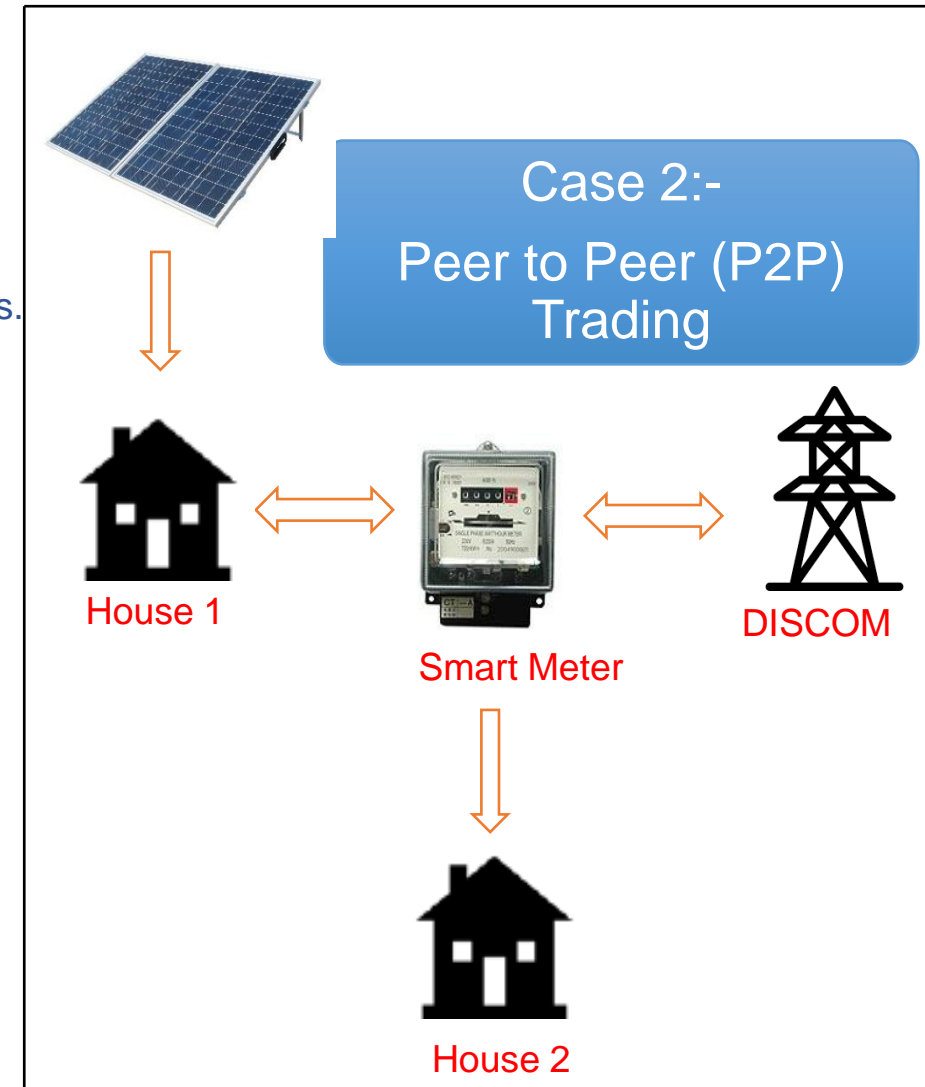


DISCOM:-

- ▶ Low AT&C losses.
- ▶ Demand gets completed locally.
- ▶ Transaction fee given by the peers.

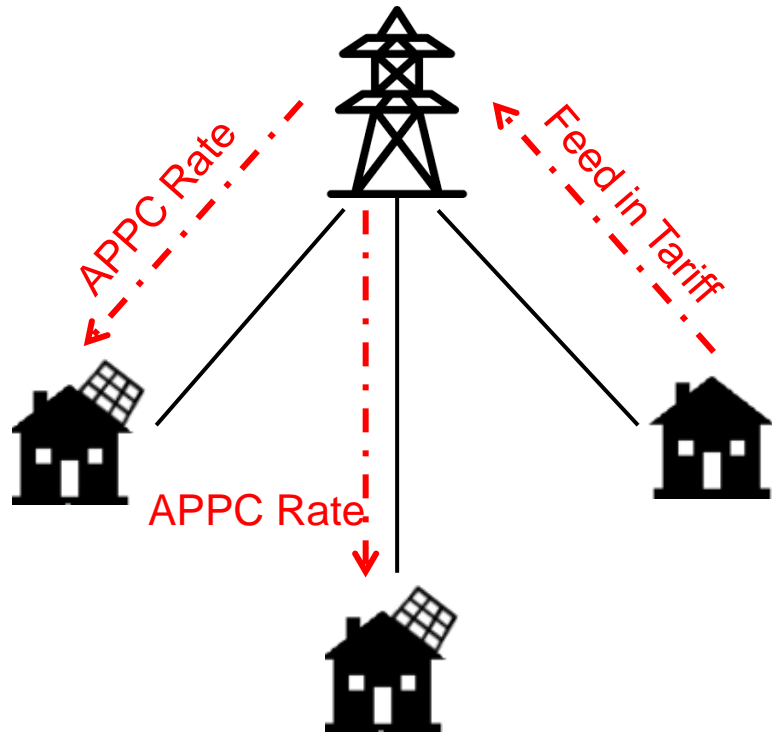
Peers:-

- ▶ Trade Energy within community.
- ▶ Cheaper than Retail tariff.
- ▶ Instant Payment

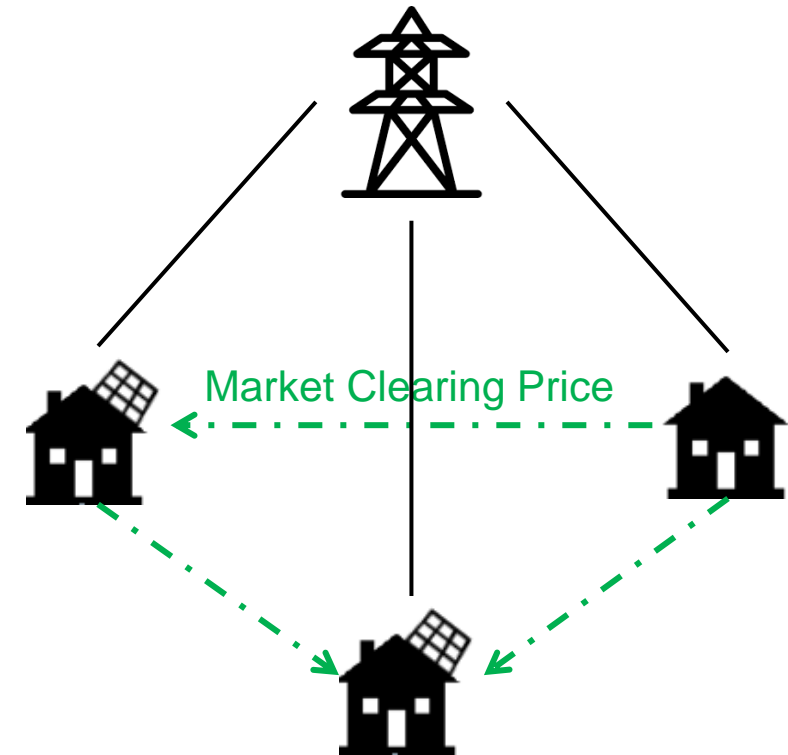


Net Metering v/s Peer to Peer (P2P) Trading (Cash Flow):-

Case 1:-
Net Metering

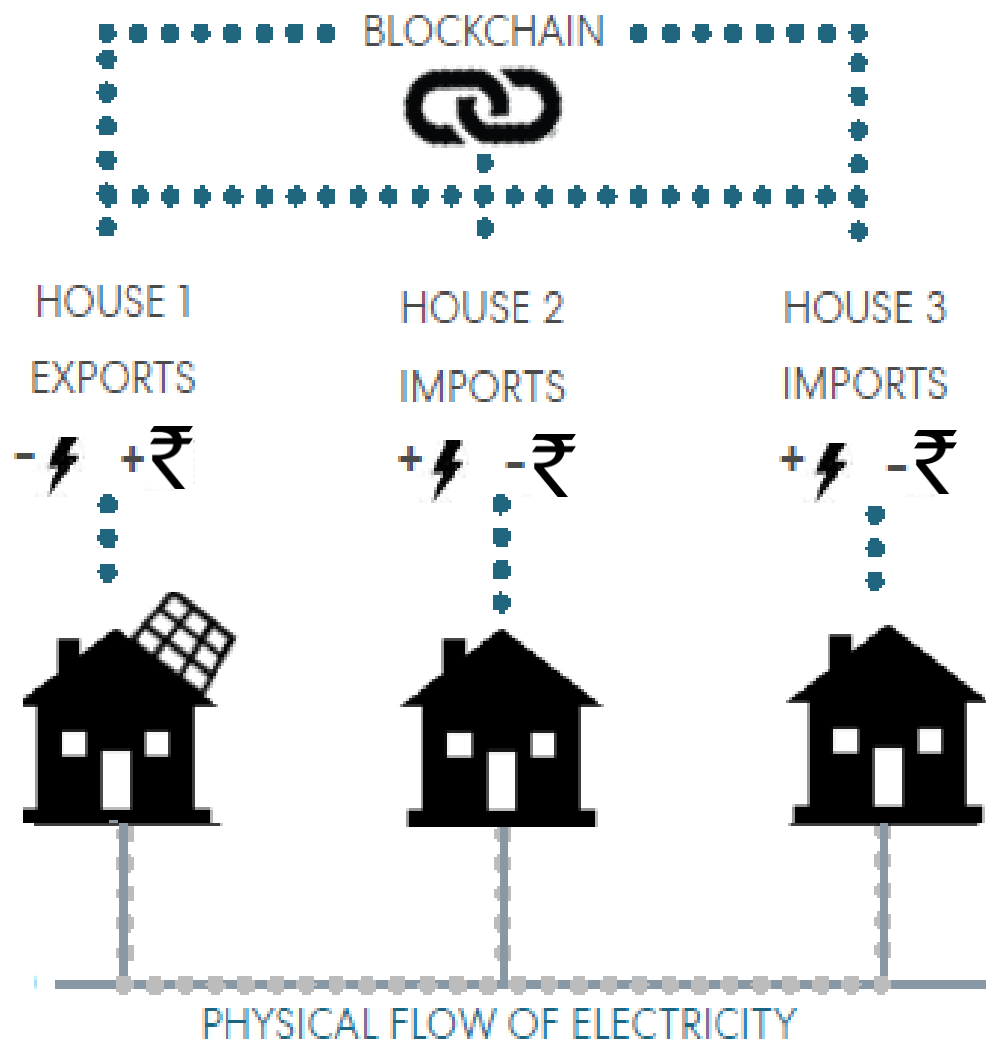


Case 2:-
Peer to Peer (P2P)
Trading



---> Cash Flow
—— Physical Infrastructure

Peer to Peer (P2P) Energy Trading



- Enables prosumers to receive instant payment from renewable energy
- Customers can buy cheaper renewable energy
- Competitive advantage for innovative retailers
- Transparent, secure and instant electricity transactions by Distributed Ledger Technology
- Better return for excess energy as compared to supplying it to grid.
- Allows for more informed usage decisions

TERI's efforts in Blockchain for the power distribution: Demonstration

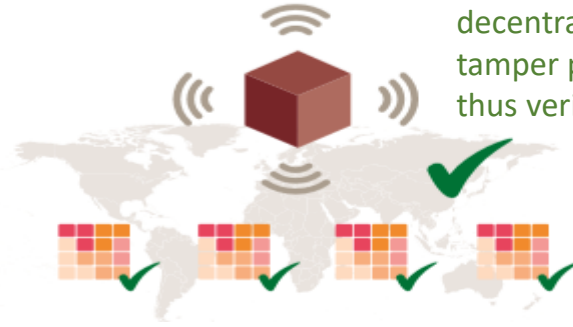
A consumer and a prosumer agree a transaction



The transaction is combined with other transactions made during the same timestamp to create a new block.



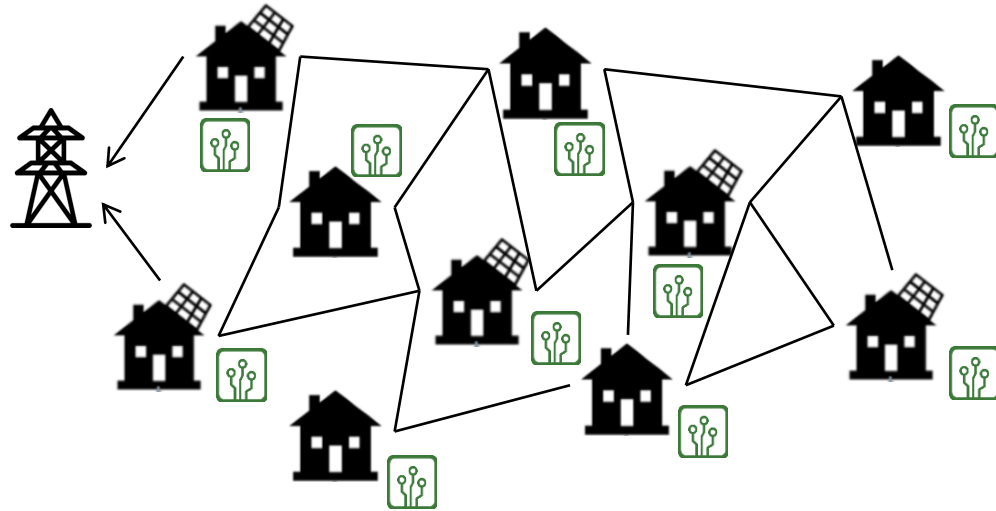
The data block is stored in decentralized network in a tamper proof manner and thus verified by other peers



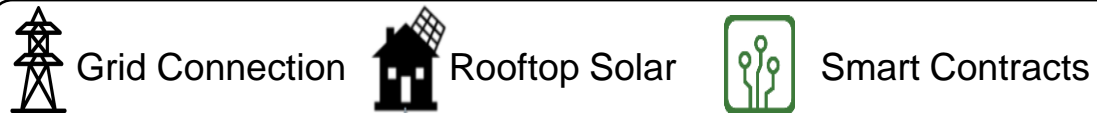
The verified block joins with previous other blocks.



Transaction is completed and payment is done.



PoC for Blockchain based P2P trading



Smart Contracts & Energy Tokens:-

- Rules/algorithms which can signal the system
- Initiate certain transactions
- Payments in the microgrid between peers
- Manage Grid Congestion
- Balance between supply and Demand
- Network Flows



Agent Bidding Strategies

- Random Bidding Strategy
- Preference Bidding Strategy



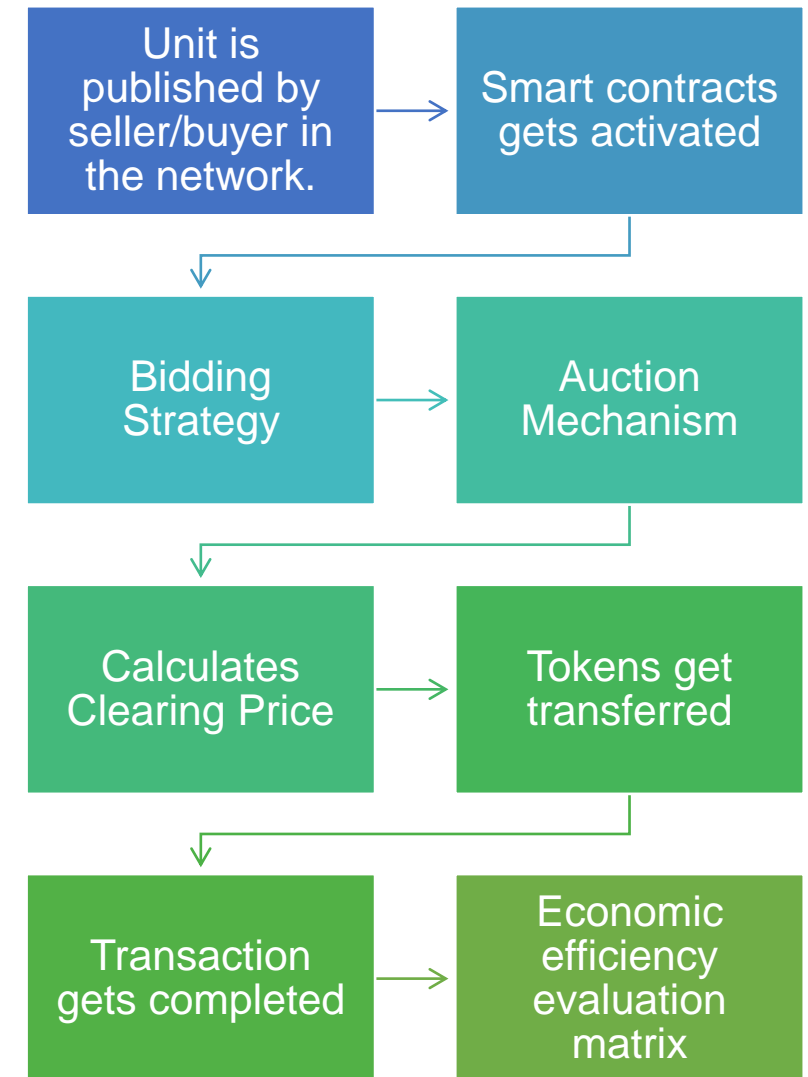
Auction Mechanism

- Discriminatory k-DA
- Uniform k-DA



Economic Efficiency Evaluation Matrix

- Percentage of kWh Sold
- Percentage of kWh Bought
- Percentage of Household cleared



TERI's PoC: Screenshots



Discom

Heat Map



● Production ● Consumption

Search

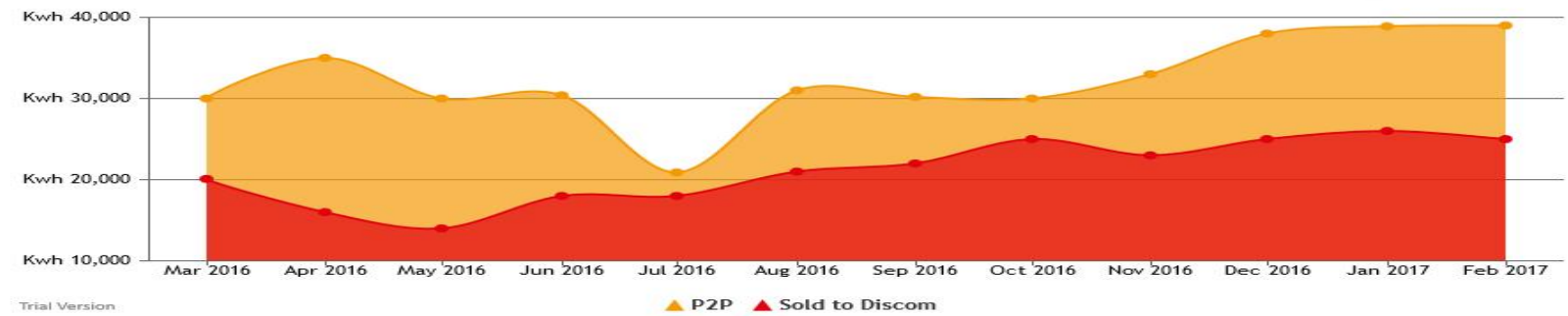
2000 Kwh
Total Excess Units

3000 Kwh
Token Settlements

1500 Kwh
Incentives to Discom

Trades

Last 30 Days



TERI's PoC: Screenshots

teri Prosumer

System Configuration

Upper Limit:

Lower Limit:

Sold to discome under:

Max slots to Settle in a consumption:

Submit

Overview

Total Tokens: **4500**

+ Add Tokens

Last 30 Days

- Bought Unit
- Sale Unit
- Settlement Pending

Last 10

Latest Transaction

S. No.	Meter ID	Transaction Type	Token's	Transaction	Timestamp
1.	17237FR	CONSUME	-10	tanr6666222	10:15PM, 01-05-2019
2.	137FR	PUBLISH	-150	tanr6666222	10:15PM, 01-05-2019
3.	10237FR	SETTLEMENT	-50	tanr6666222	10:15PM, 01-05-2019