BSES Yamuna Power Limited

New Technology Initiatives

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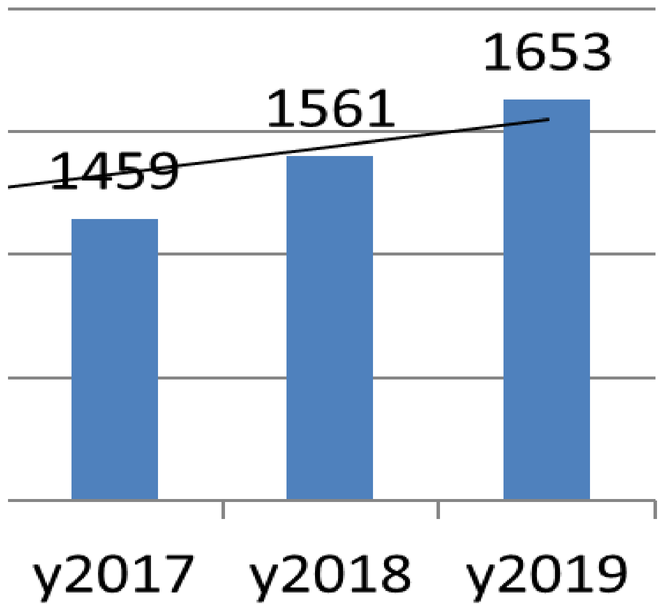
Peak Demand Trend



•Peak power demand reached all time high of 1653 MW for FY 19-20 under BYPL license area.

•Demand expected to increase further with greater urbanization, population increase, rising incomes, and improving standards of living

•Excess peak demand may at times necessitate purchase of expensive power

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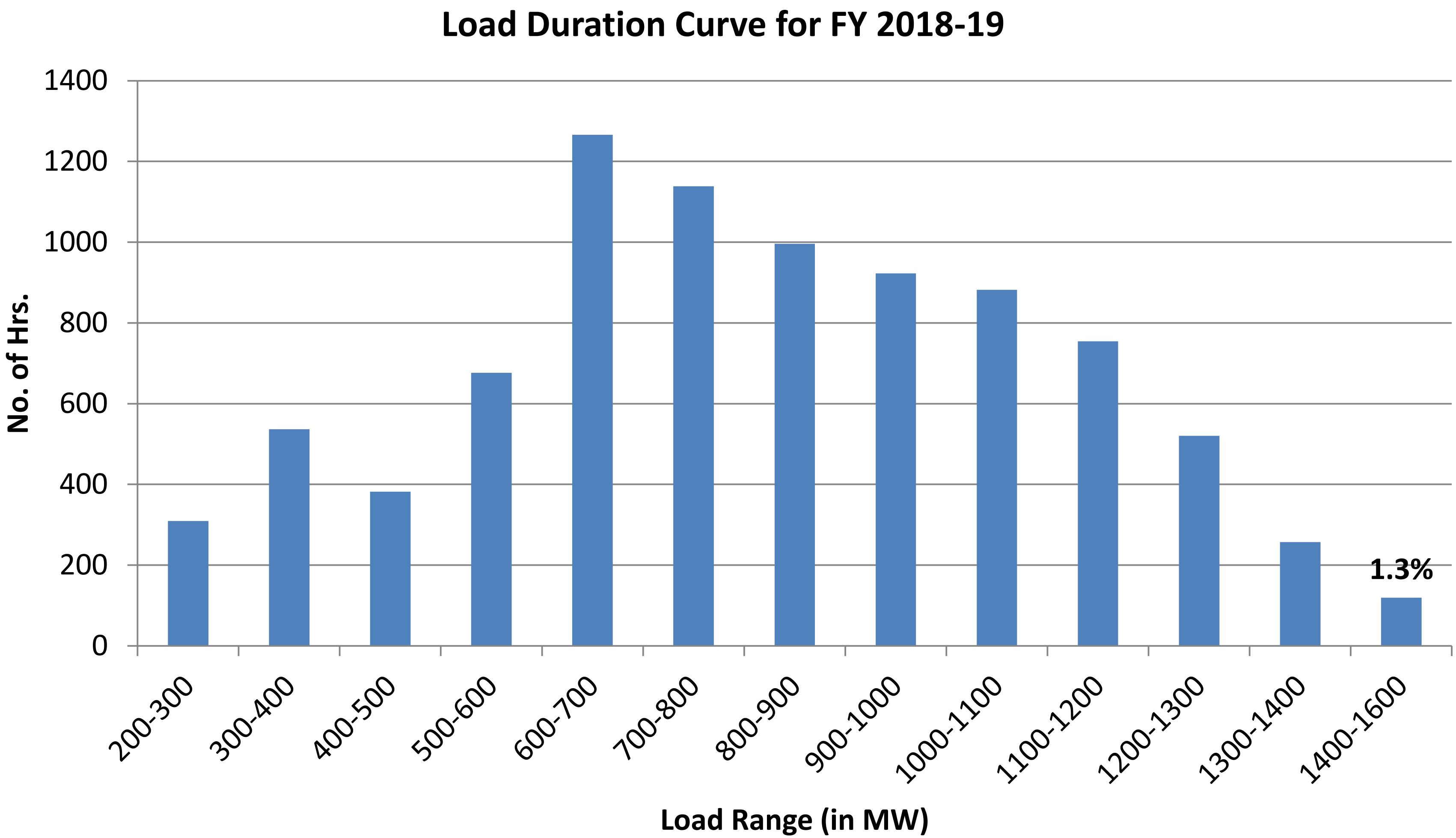
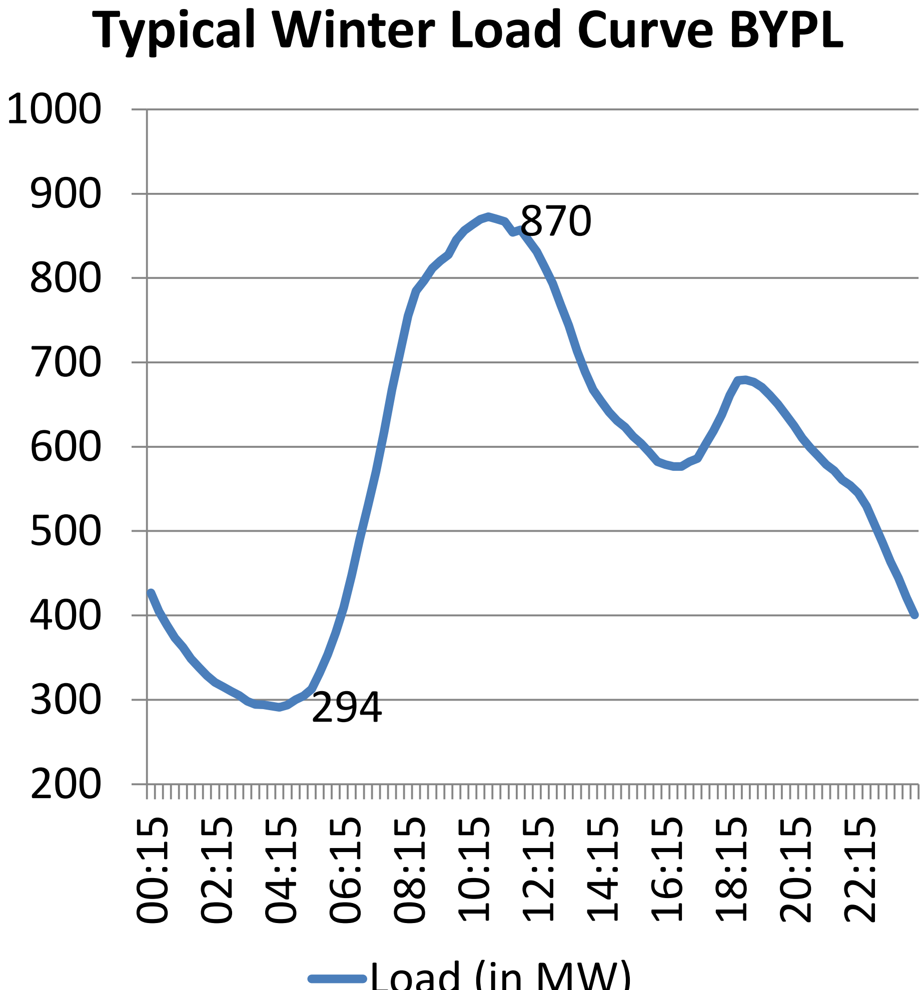
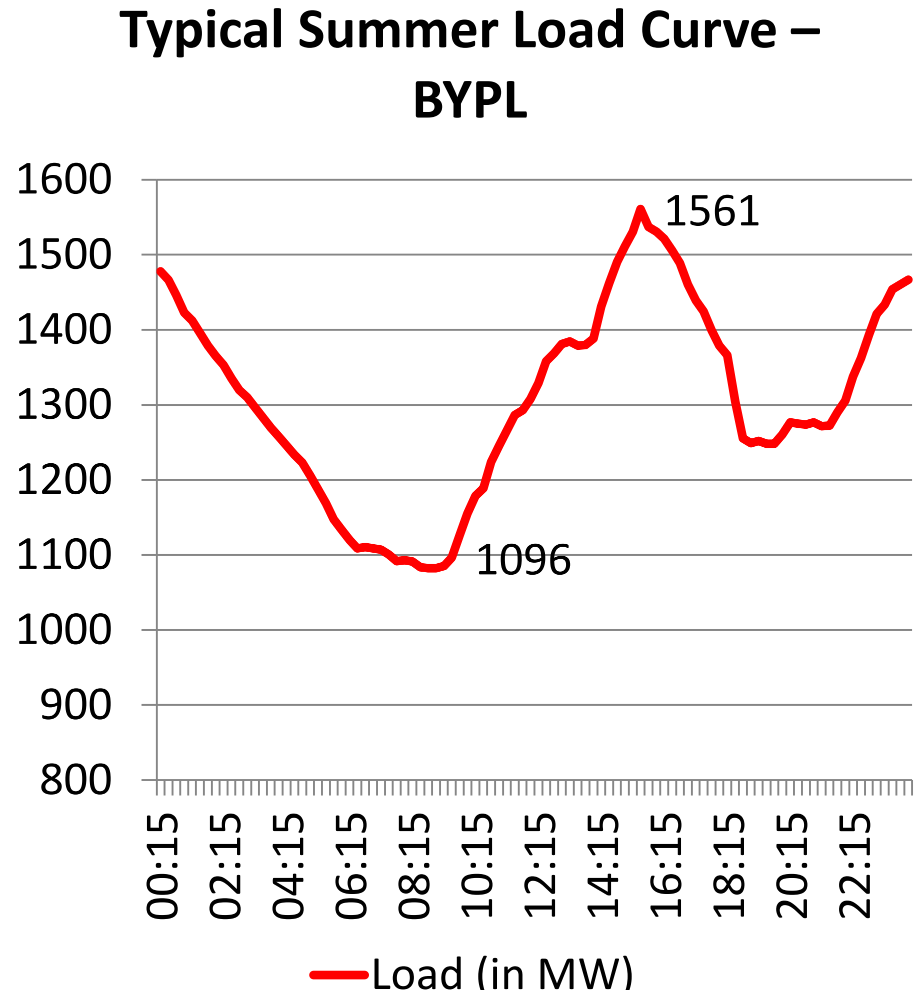
Load Duration Curve - BYPL



Peak loading conditions are observed for approx 1.3 % of time in a year

Typical Summer and Winter Load Curves





As can be seen peak load in winter is approx three times that of minimum load and in summers it is roughly 1.5 times

Need for New Technologies

- Necessary to test new technologies and processes for managing peak conditions and bringing resilience to the network:
  - Energy Storage
  - DR DSM measures
  - Energy Efficiency
  - Distributed Energy Resources
- BYPL has initiated projects involving **Energy Storage Systems** to test it for serving various requirements
- ESS can add to resilience of electricity grids
- ESS can find applications in power sector in following areas:
  - Load management
  - Increased operational flexibility
  - T&D loss reduction leading to environmental gains
  - Improved power quality and reliability
  - Reduction in Capex

Energy Storage Initiatives - BYPL

To mitigate the increasing peak demand conditions along with issues related to space constraints for system augmentation, BYPL has initiated following projects

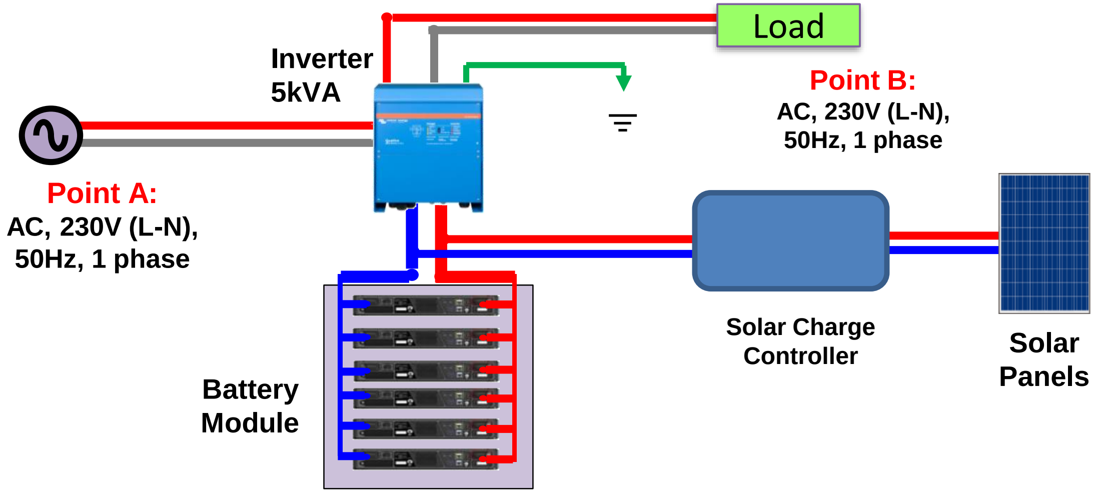
- ESS at 11 kV Substation Level – 1 MWHr (combined capacity)
- Grid Tied Energy Storage with Solar Roof top - Microgrid in collaboration with **Panasonic**

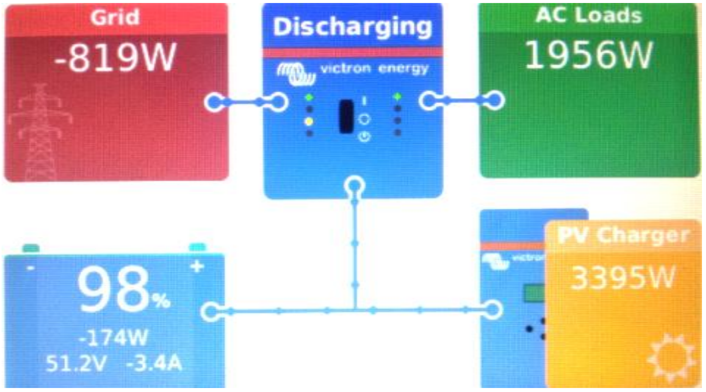
Energy Storage Systems at 11kV Sub-stations

- Steady growth forecasted for peak demand, there is a requirement of reducing peak demand at the source to reduce potential stress on the grid and balancing the intermittency of solar generation.
- Li-Ion based Energy Storage System is being installed at five DT locations BYPL license area
- Each system would have a energy storage of 200 kWhr with peak capacity of 100 KVA
- The project is expected to help in the following areas:
  - Decongestion of the LT side of the distribution network
    - large-scale batteries installed at appropriate substations would help mitigate the congestion and thus help BYPL to postpone or suspend the reinforcement of the network.
  - Maintaining load curve
  - Emergency power supply for protection and control equipment
  - Dealing with space constraints as it is increasingly difficult to arrange land for network augmentation
  - Savings on account of avoidance of loss of revenue and penalties for non-provision of power
  - Improving reliability on critical loads

Urban Microgrid in Collaboration with Panasonic

- Four grid tied Li-Ion based Energy Storage along with renewable energy Systems installed at BYPL offices – behind the meter installation
- The Energy Storage system would be fed both from the Grid, Solar rooftop system
- Project would help Leverage renewable power generation for RPO and help simulate larger applications for DR , thus managing peak demand and hence reducing need for augmentation
- The system would have in built BMS capable of monitoring/controlling the energy storage system as per the required threshold values including remote operation.





Energy Flow Snapshot

System Locations	PV Capacity	Battery capacity
MVR Business Office	7Kwp	10.4kWh
PKT-C Mayur Vihar	3Kwp	5.2kWh
Trilokpuri Dispensary	3Kwp	5.2kWh
Sadar O&M	3Kwp	5.2kWh

Installation Locations

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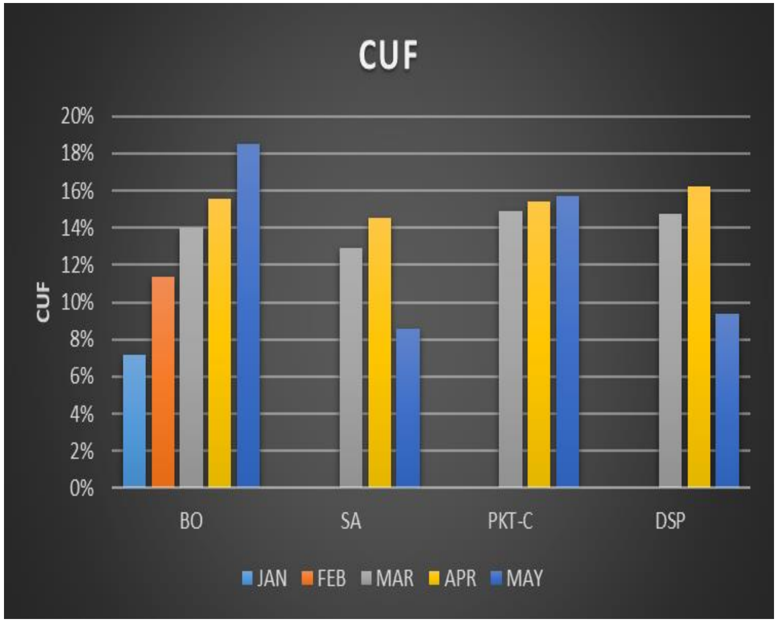
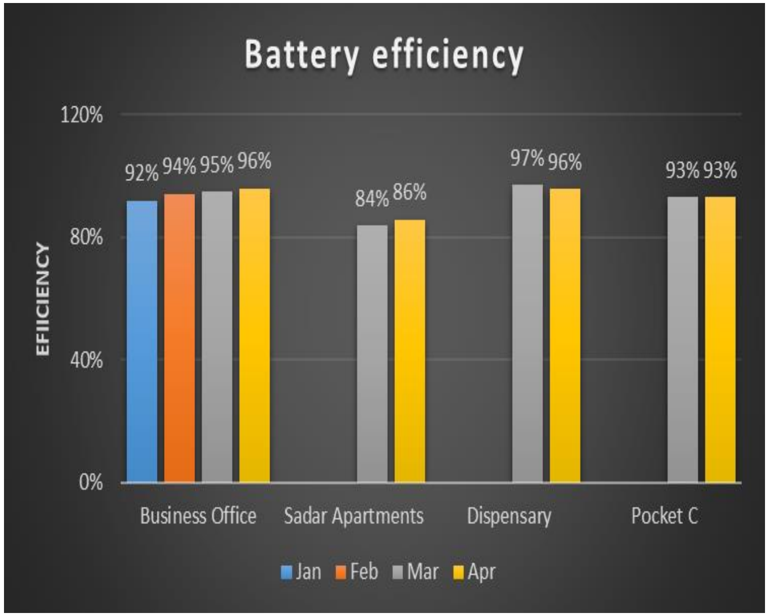
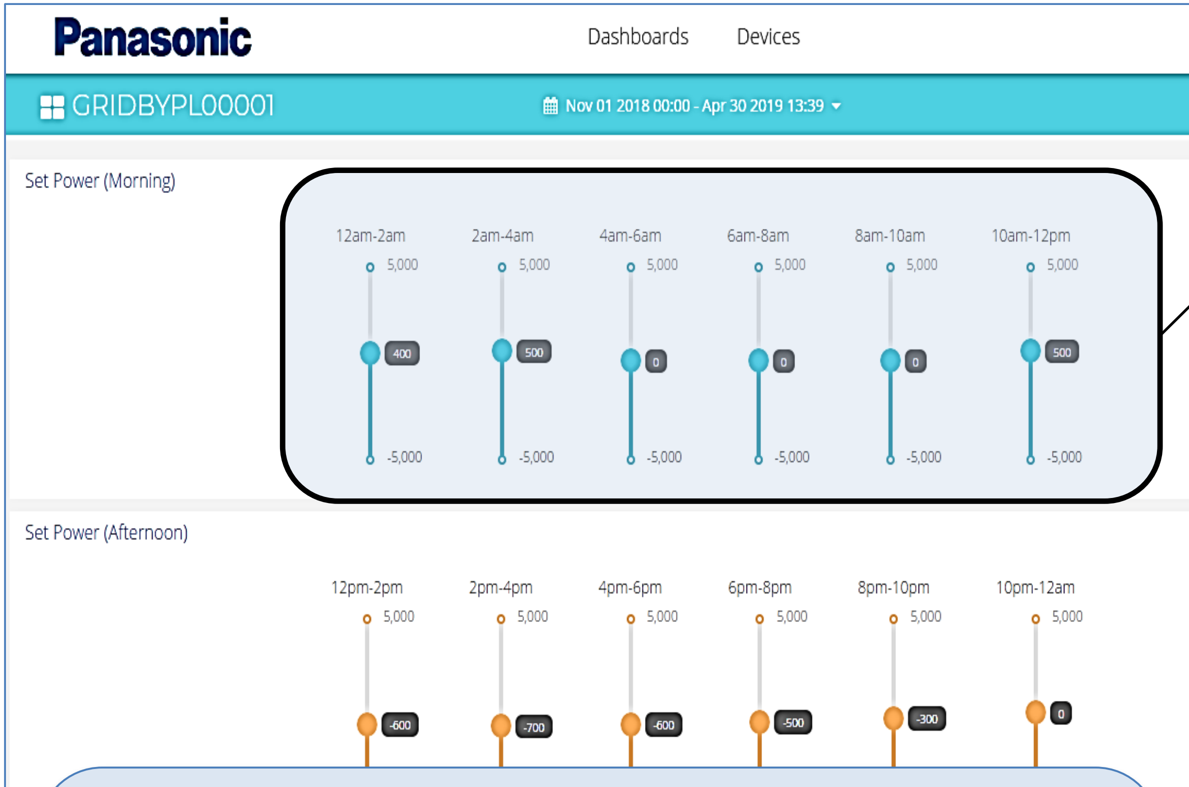
Deployment Results

- Overall battery efficiency is around 92%. Excluding SA site, efficiency is around 95%.
- SA site has larger average load than solar generation, thus battery utilization is quite low. This was purposely kept to see the performance of system at different loading conditions
- Battery contributes 34% (PK-C), 24%(BO), 8.5%(SA), 30% (DSP) of the total demand.
- Grid demand reduced by 74% during peak hours.
- Self sufficiency stands at 65% (for BO), 80% (for PKT and DSP) and 22% (for SA) sites.



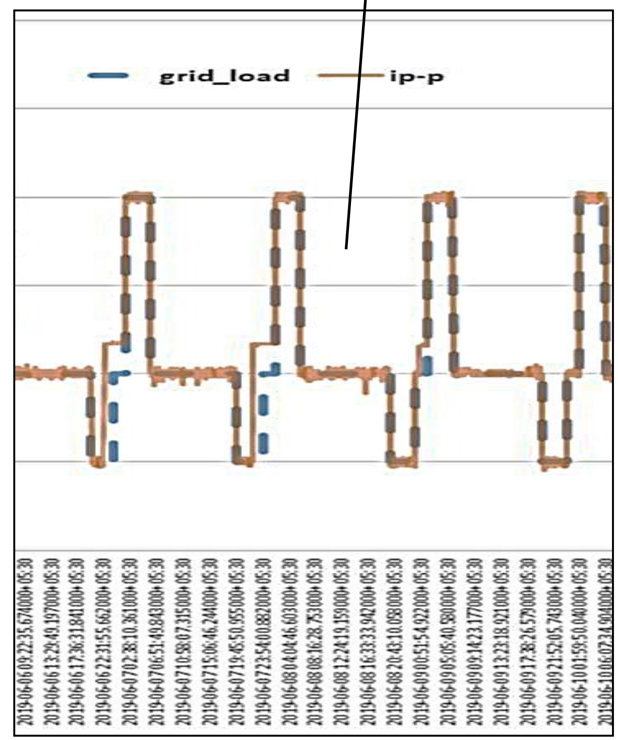


Dashboard : Utility Scheduling



Set point Control

Actual grid power is following the set point



- Interface with utility SCADA
- Temporal charge/discharge set point
- Integrates multiple microgrids across network
- Visualization of key performance indicators
- Advanced Demand Response (DR) support

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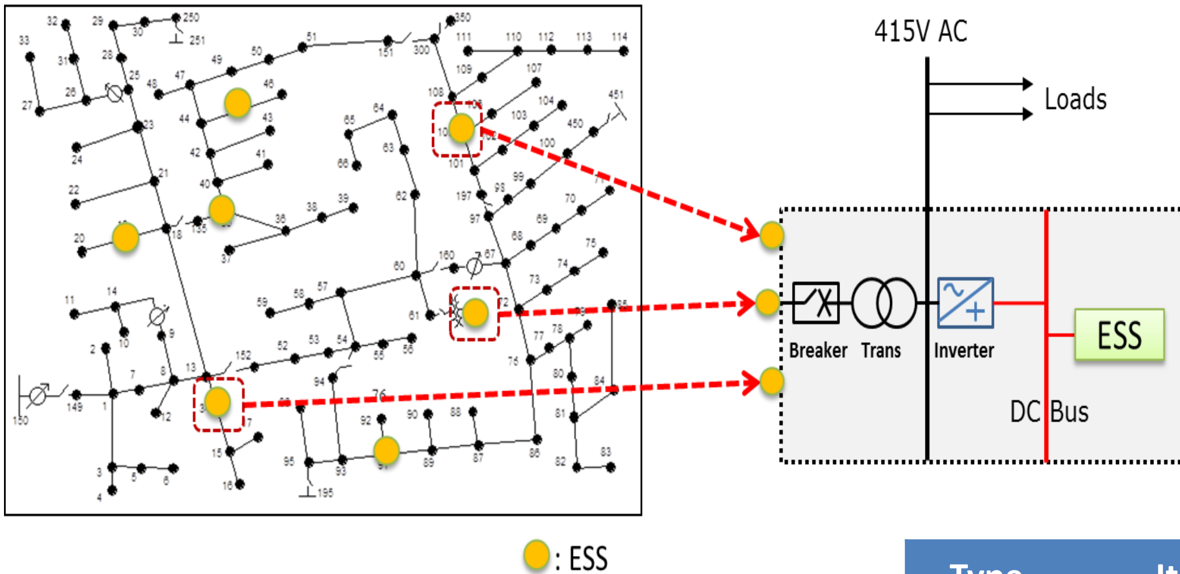
Distributed Storage: Network Area



- Nearly 3800 Distribution Transformer (DT) of nearly 2900MVA capacity
- Nearly 15000 LT feeders to consumers; 5868km of LT lines. Average, 400m per LT feeder.
- Distributed Storage would be placed **specifically at the hot spots**, spatially located to optimize the network.
- Storage would predominantly be charged from the solar

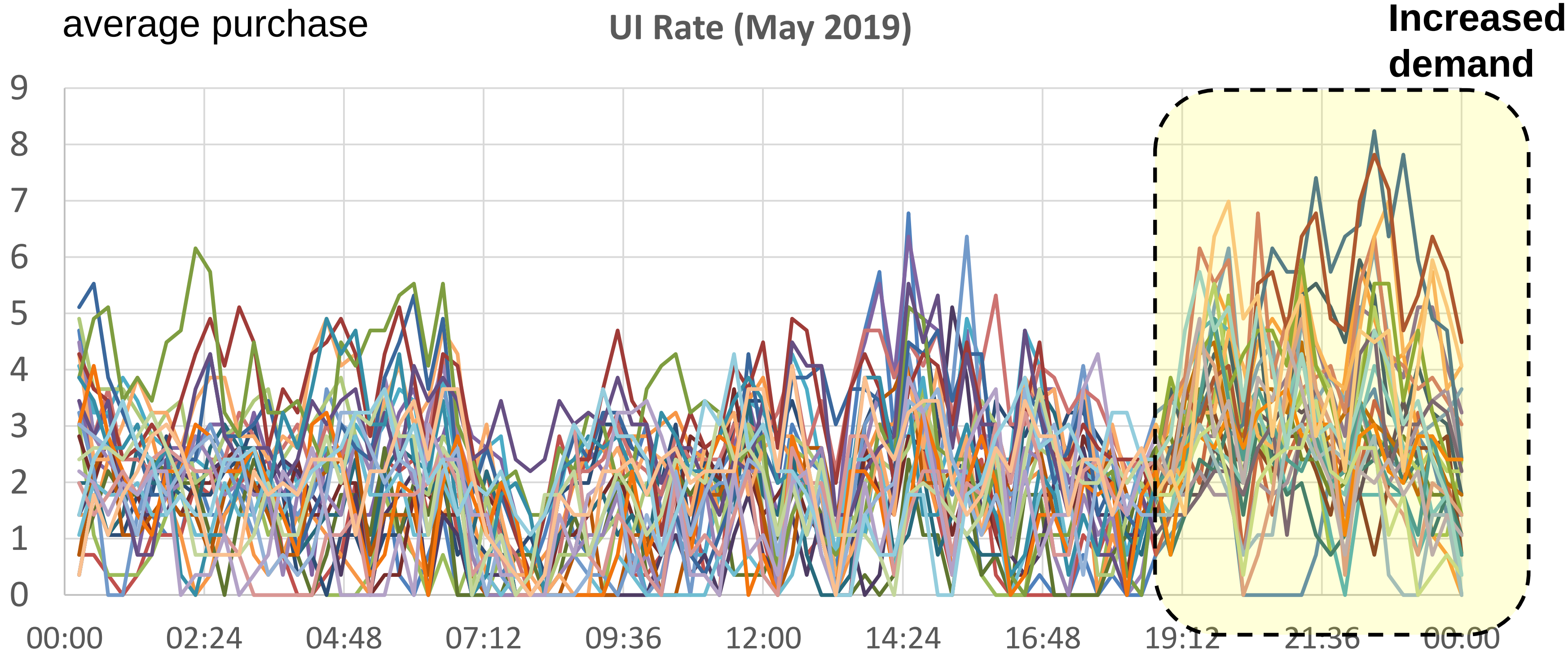
Type	Item	Value	Unit
Single microgrid	Power rating	5	kW
	Energy Storage	10	kWh
	Solar PV	5	kWp
Utility Network	Nos. of location	200	
	Total power available	1000	kW
	Total storage available	2000	kWh
	TotalSolar PV	1000	kWp

Power Purchase Reduction

- Utility uses various methods such as base capacity, banking and peak power for meeting its demand throughout year.
- Banking and peaking are the short term measures to ensure adequate quantum for future load demand.
- With **dispatchable** distributed storage, a part of this contracted power can be reduced leading to benefit which
- Based on the average fixed cost of PPA/MW, the PPA reduction potential equivalent to installed capacity was accessed.
- The values were normalized to calculate benefit for per unit of energy storage.

UI/DSM benefit

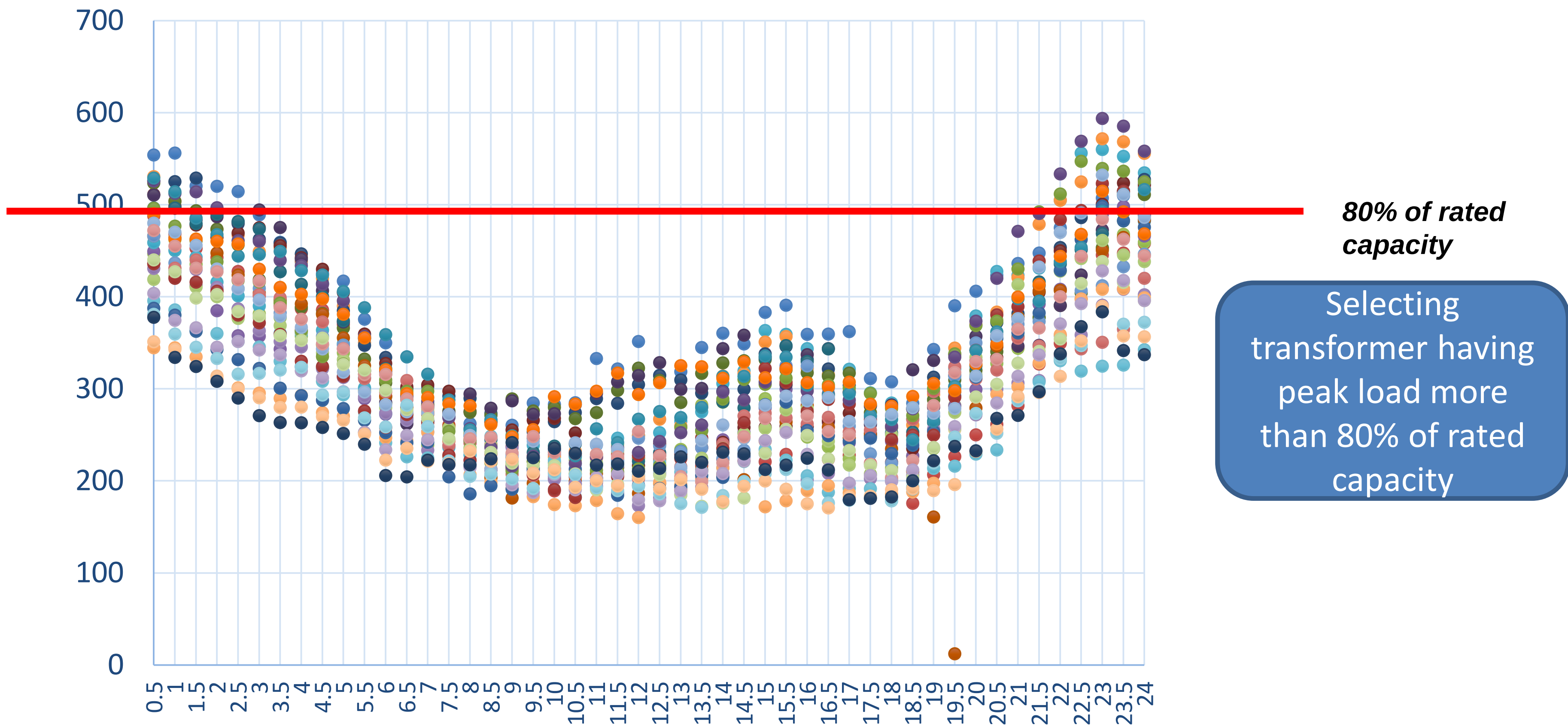
- ➢ Utility uses UI mechanism to make up for the final deviation in scheduled vs actual power.
- ➢ Could be effectively used with storage to leverage the differential price of UI vs average purchase



- Based on the prevalent UI rates for specific use hours, the potential for energy storage is estimated.
- The values were normalized to calculate benefit for per unit of energy storage.

DT Augmentation

- Below Graph shows Load Pattern of an actual Distribution Transformer (DT)
- **"Peak Load"** typically occurs once or twice during a day – depending on seasonality
- Duration of "Peak Load" is Typically **1 to 2 hours.**
- This phenomena may further worsen due to Renewables or EV charging in near future.



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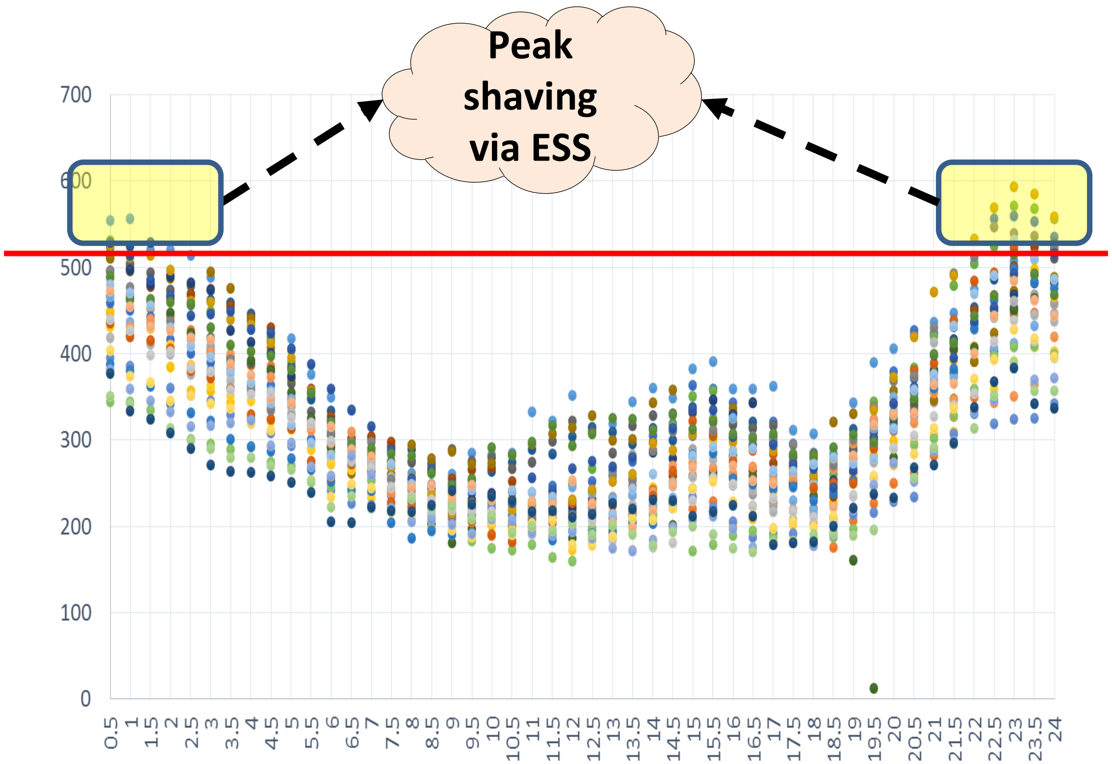
DT Augmentation

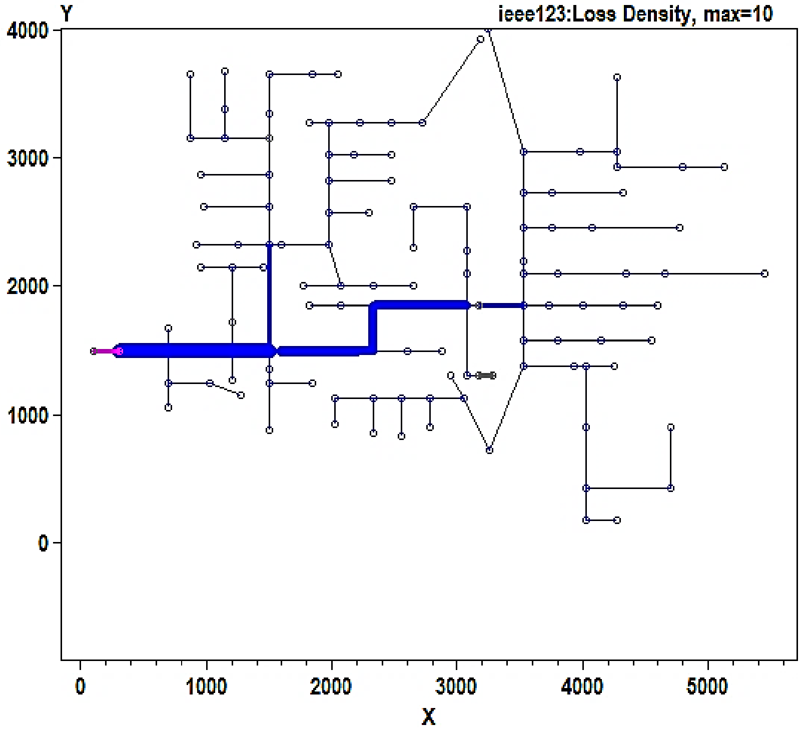


- Li-ion Battery system for grid Support at Distribution Transformer (DT)
- "Peak Load Shaving" via ESS
- Renewable Energy Integration
- EV Charging Support for Grid

- Based on the interest saving on the Capex deferral which is taken for 3 years.
- Based on the interest cost saving and using Net Present Value (NPV) to calculate the current saving.
- Distributing several microgrids on a DT, 10% of the peak capacity, benefit of energy storage is calculated.

DT Loss reduction (high loss pockets)

- If used for peak shifting application storage can reduce the losses associated with network after the DT.
- Based on the transformer audit report, for residential sector an average **15% to 25%**
- Most of the services would be complementary. E.g. loss reduction and peak shifting can be employed simultaneously



- Taking 10% of the DT capacity as the microgrids installed downstream
- Reduction in peak load from 90% to 80%
- Using the loading criteria as a tool for loss calculation, an assessment on the reduction of losses due to peak shaving of DT is done.

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Upstream Transmission charges and losses reduction

- With the ability reduce demand storage would lead to lesser transmission losses penalty
- Would be major benefit for the Zone. Upstream loss reduction can be effectively shared by other utilities as well.

- Using the transmission loss charges and quantum of allocated power for the utility area, an assessment of loss reduction per unit installed energy storage is done.

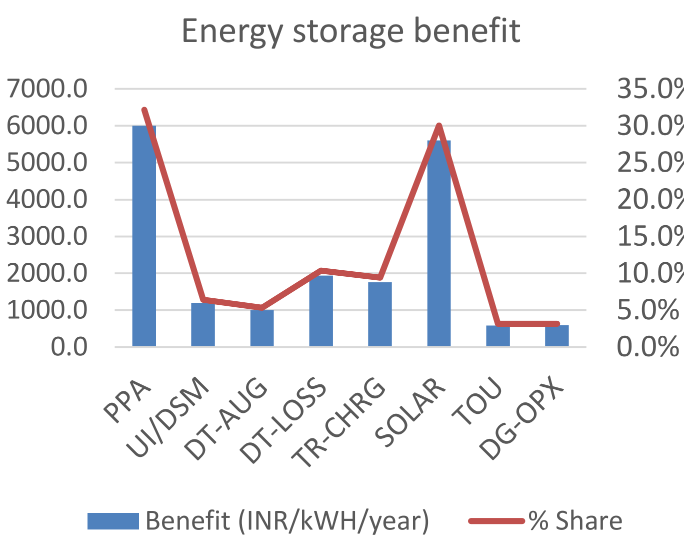
Solar energy generation, TOU, and DG mitigation

- Solar energy would reduce the dependence on the grid. DC coupled, solar generation even in case of grid outage.
- TOU tariff design helps in demand side management. Peak and off peak tariff.
- Power outage, reduced DG expenses due to energy storage

- Using the POC results for **solar generation,** total energy generated per unit installed energy storage **,**
- **TOD tariff:** As per the latest tariff order and assuming 100% penetration of commercial segment.
- Using the **average DG runtime**, total energy generated/saved was calculated to arrive at benefit per unit installed storage

Summary and Conclusion

Type	Item	Benefit (INR/kWh/year)	% Share	Total	%
Utility	PPA	6000.0	32.2%	11884.03	**63.7%**
	UI/DSM	1197.2	6.4%		
	DT-AUG	994.7	5.3%		
	DT-LOSS	1936.9	10.4%		
	TR-CHRG	1755.2	9.4%		
Consumer	SOLAR	5606.4	30.0%	6778.05	**36.3%**
	TOU	584.0	3.1%		
	DG-OPX	587.7	3.1%		
	Simple Payback	**5.25**		**Years**	



- Nearly 80% benefits can be directly attributed to utility requirement.
- Consumers would provide **ready to use infra** for implementation. Suitable financial design based on consumer category need to be promoted.

Thank You…

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Website : www.bsesdelhi.com