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# Utility perspective on Demand flexibility & Energy positive Buildings/ Campuses


## Speaker: Munish Sharma

***Team Lead ESG***

*BSES Rajdhani Power Ltd.*

# Contents

- ❑ PROFILING (BSES Discoms)
- ❑ PROBLEM GENESIS
- ❑ SYSTEM FLEXIBILITY
- ❑ DISCOM CONTEXT & TYPICAL PEBs
- ❑ AVAILABLE STRATEGIES
- ❑ SOLUTIONS USED AT BRPL (DSM, EV, BESS, ADR, BEE, EWER)
- ❑ DISCOM ADVOCACY IN ECBC
- ❑ KEY TAKE AWAYS

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# Key Statistics


- BSES caters to 2/3rd of Delhi and is a JV between Reliance Infrastructure Ltd. (51%) & Delhi Govt. (49%)

| Parameter | BRPL | BYPL | BSES Group |
|---|---|---|---|
| Distribution Area (sq.km.) | 750 | 200 | 950 |
| Consumers (Million) | 3.07 | 1.98 | 5.05 |
| Peak Demand (MW) | 3,389 | 1,662 | 4,873 |
| Sales (MU) | 11,386 | 6,471 | 17,857 |
| AT&C Loss (%) * | 6.87 | 7.27 | 7.03 |

*• Data as of March 2023*
** Provisional; subject to DERC approval*

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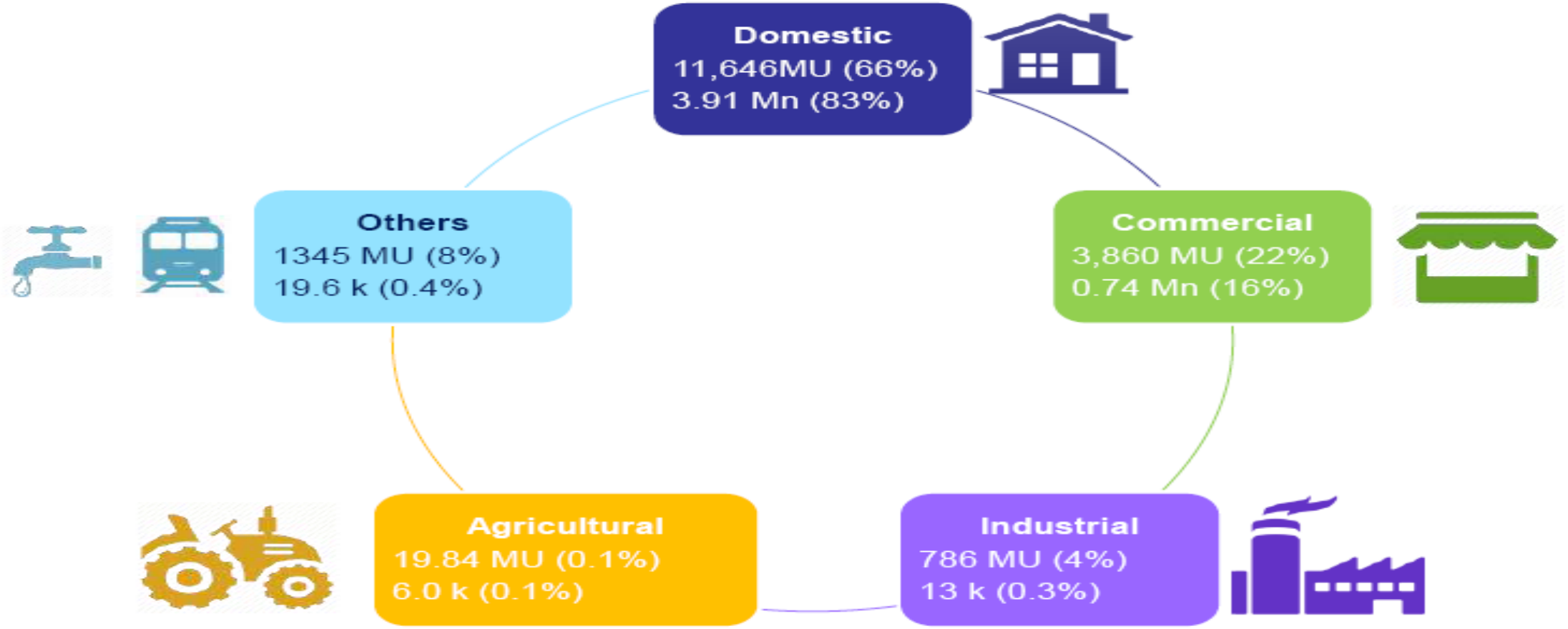
# Customer profile




• *Data as on March 2023*

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# Peak demand trend

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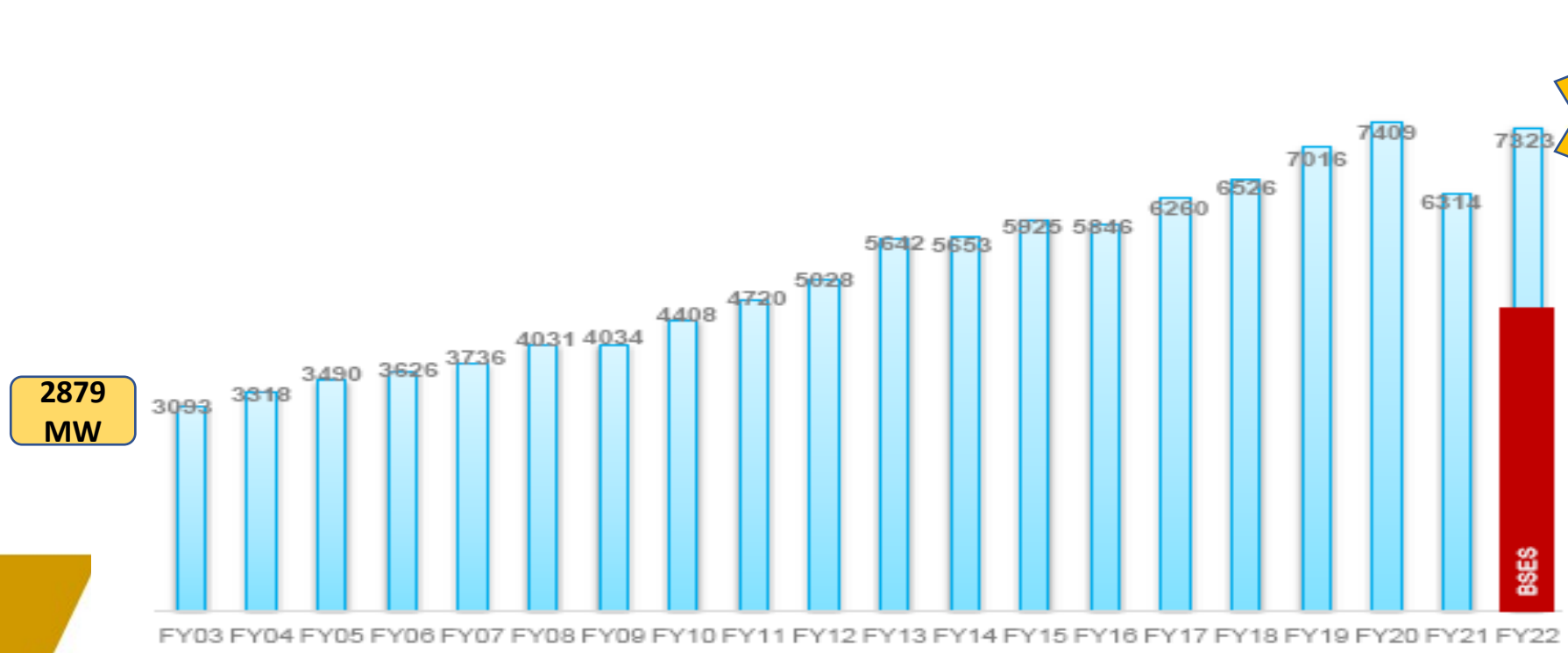
## BSES successfully serves 66% of Delhi demand



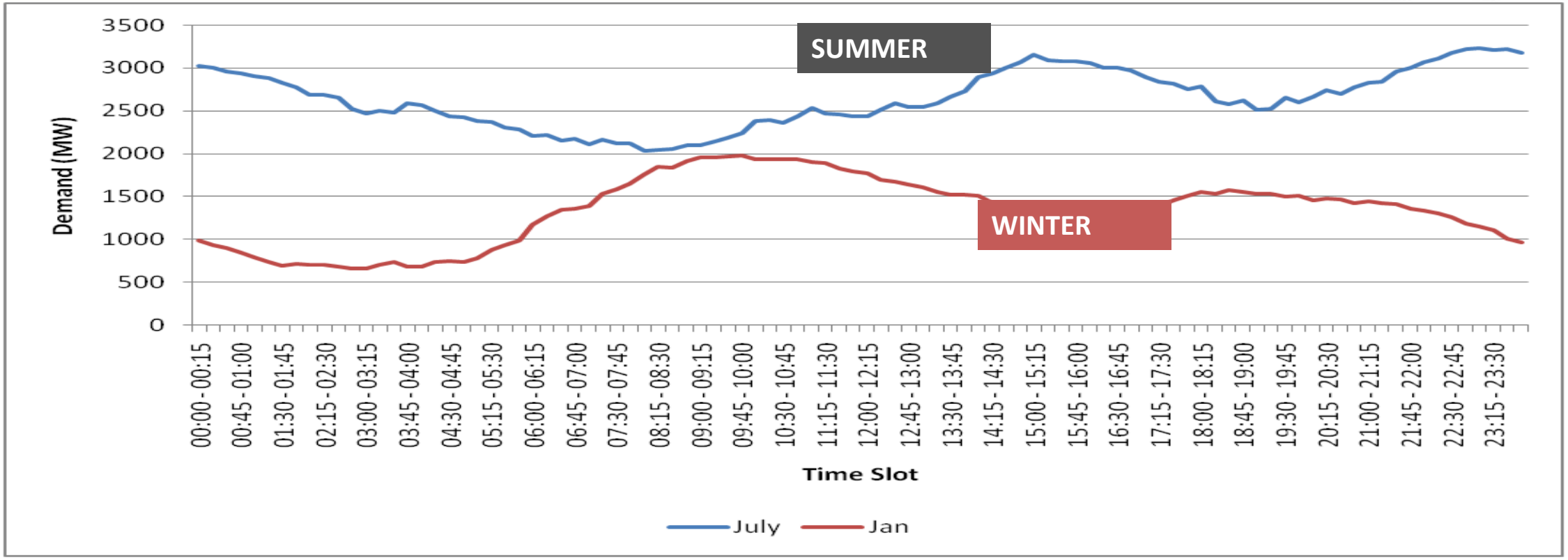

**Delhi touched 7K MW** from 2,879 MW in 2002

**Delhi Power Demand is:**

- *2 times of Mumbai*
- *3 times of Kolkata*
- *4 times of Chennai*

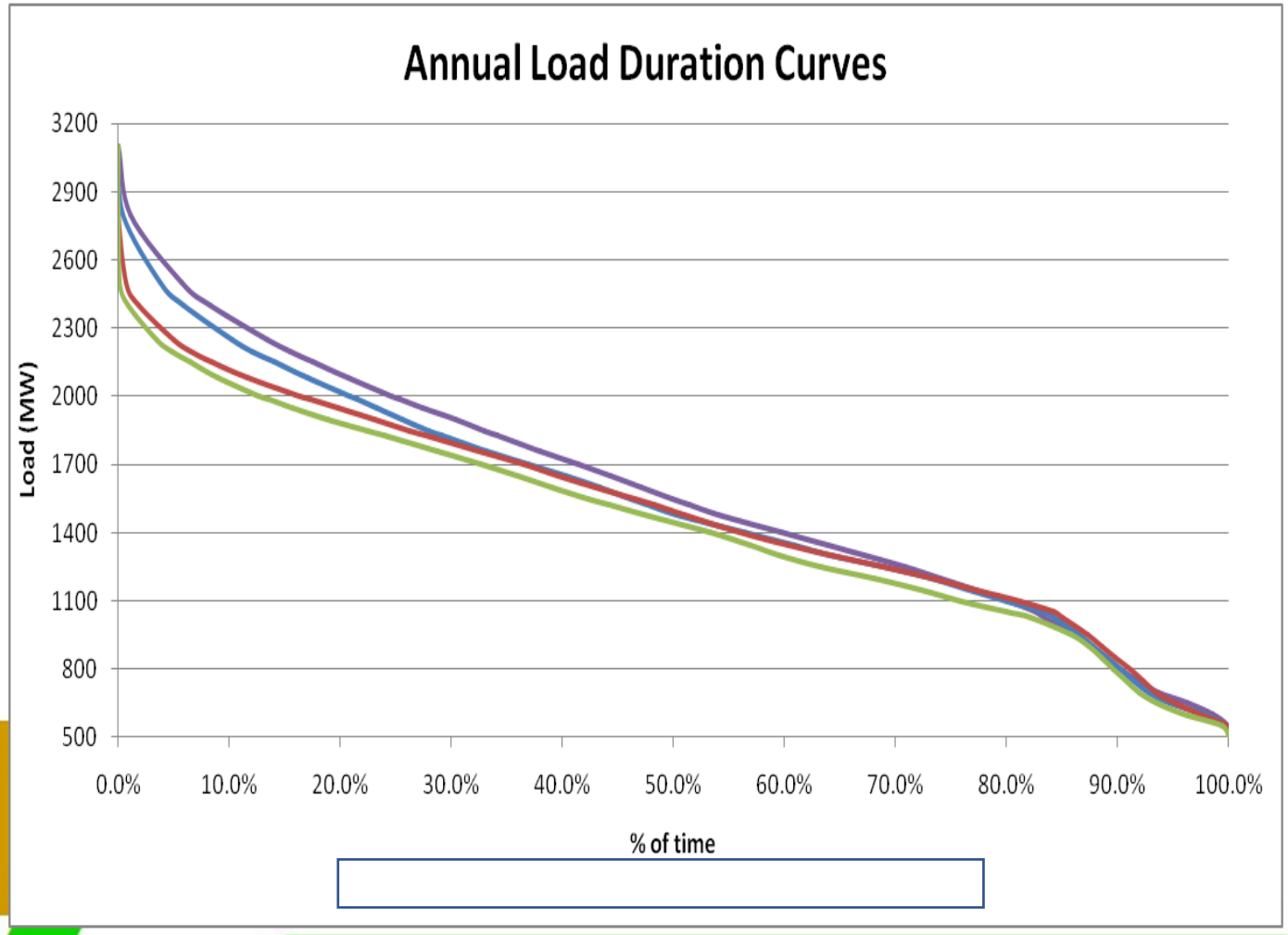
## Peak load of Delhi grown to ~2.7 times of 2002 demand

# Non-coincident Daily Load Curves
## *(Seasonal Impact)*




- Large seasonal and diurnal variation in demand
- Yearly variation in demand ~ 2600 MW
- Grid Infrastructure is sized to meet the highest peak, despite the demand varying diurnally and seasonally.
- Results in system inefficiencies, underutilization of assets and low load factors.

# Load Duration Curve (BRPL)




- PEAK load increasing at faster pace than the BASE load.
- Out of 8760 Hrs - Top 8-12% capacity is used for ~100 hrs only.
- Rs 2 Cr/ MW required by Discom for additional capacity.
- Manage these 100 Odd Hrs… can reduce peak capacity by 8-12%.

# Power Portfolio (MW)

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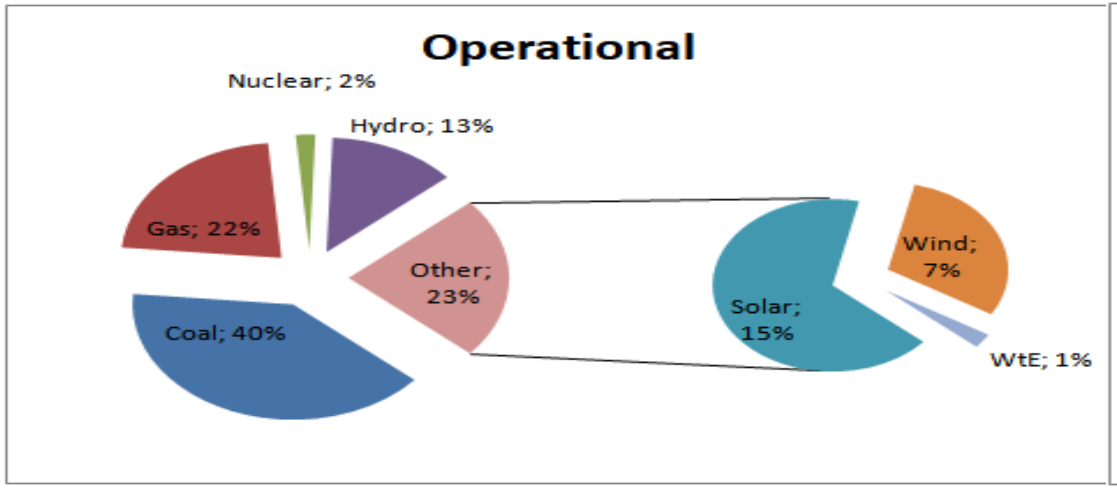
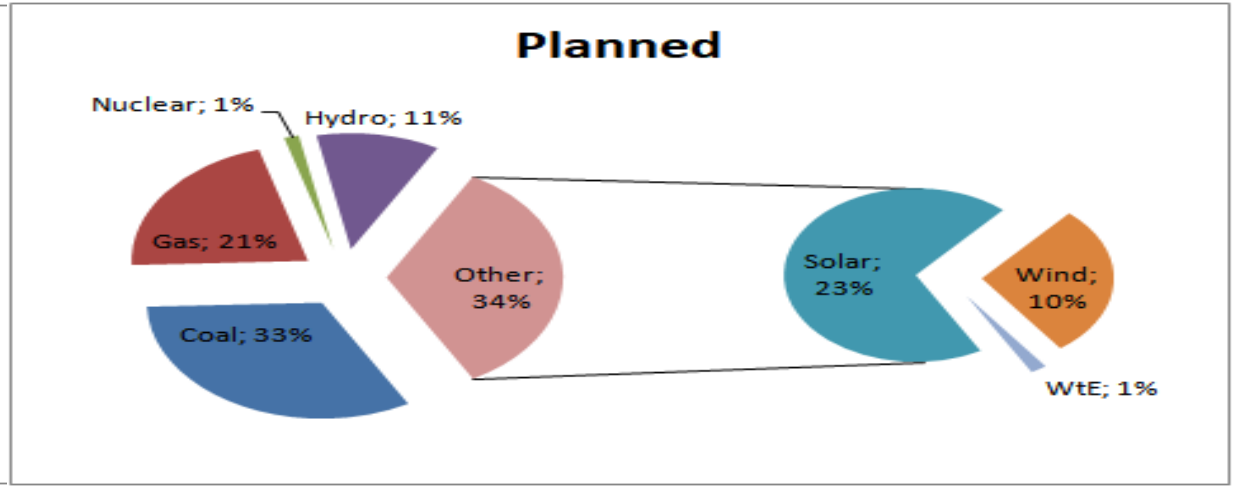
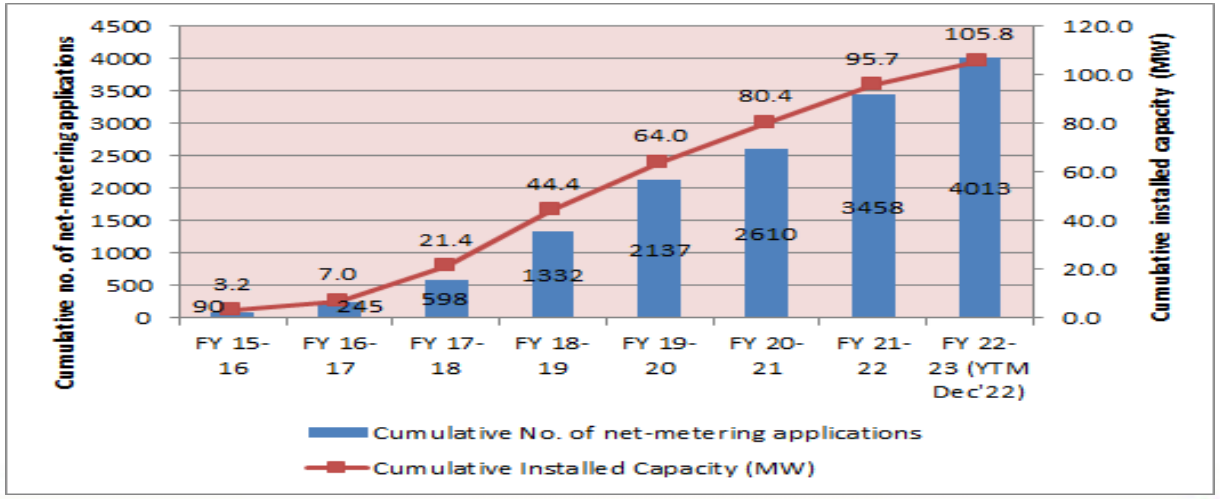



- RE Transition Strategy: Renewable to make ~ 50% of power portfolio
- Necessitates balancing power – flexible resource
- Over 136 MW of RTS already embedded into BSES network so far.



# Resilient Power System

***Flexibility of a power system refers to "the extent to which a power system can modify electricity production or consumption in response to variability, expected or otherwise".***

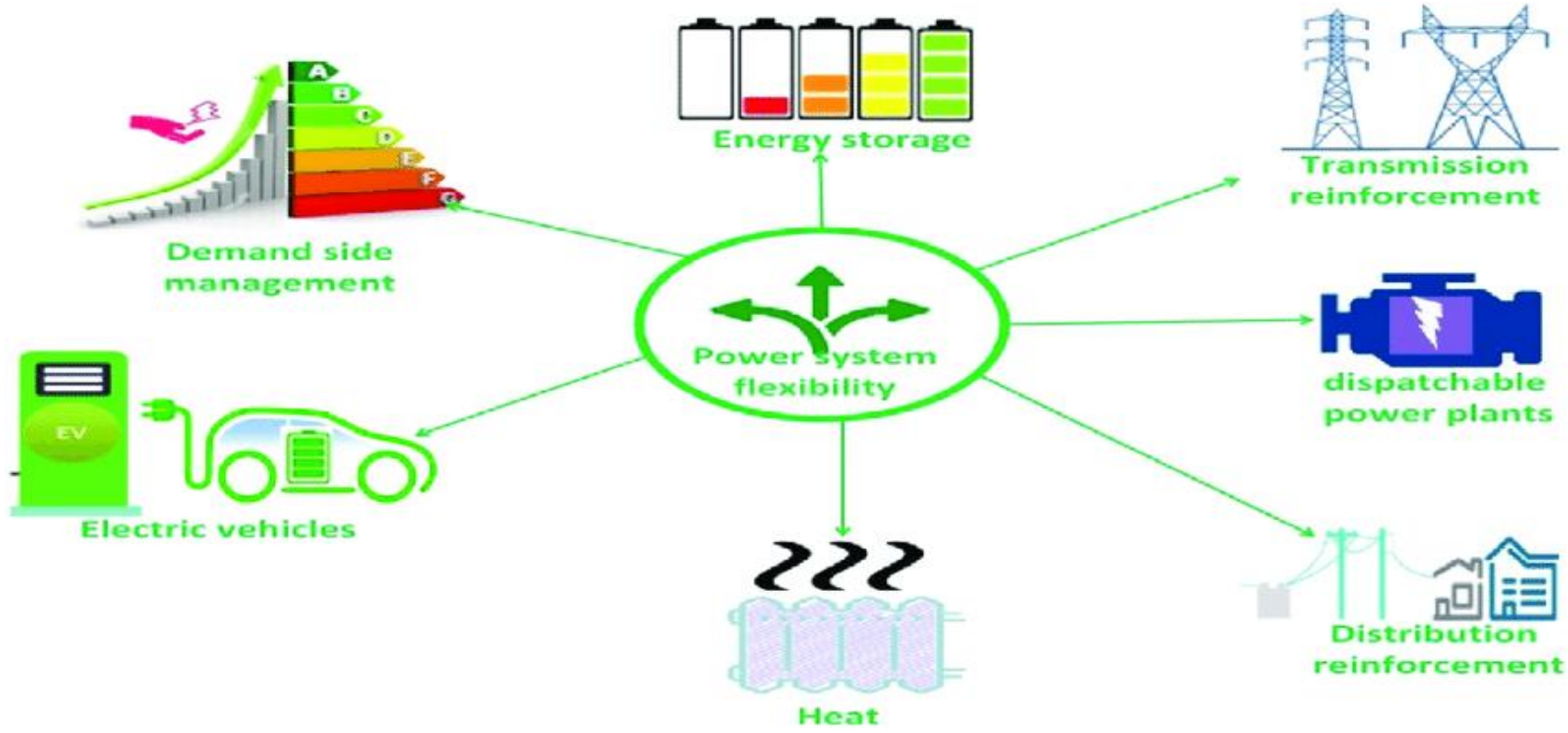
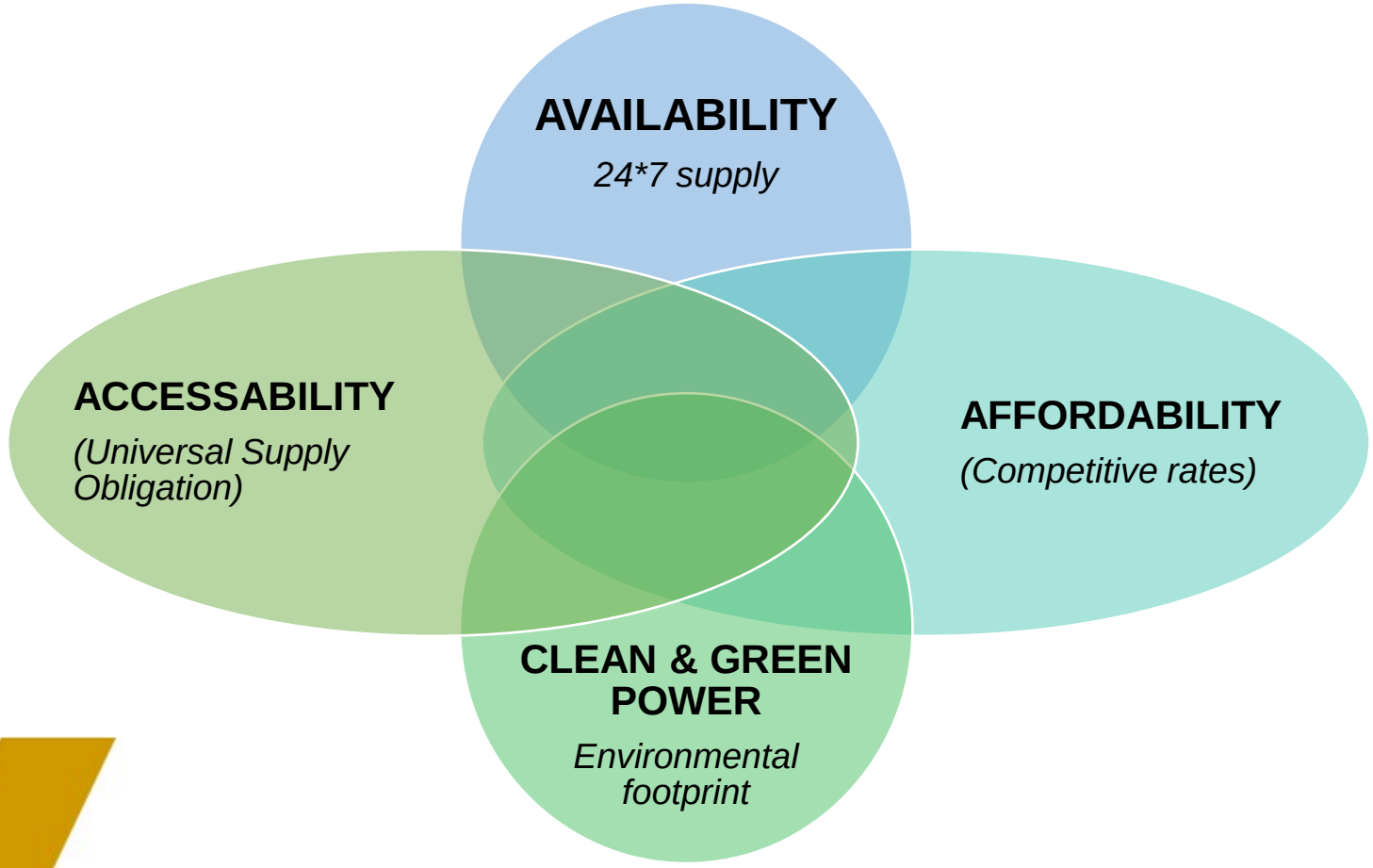



*Illustration source: Research Gate*

# Discom Context




Typically, **CONSUMER** uses varied Appliances to create power demand & **UTILITY** Predicts this and buy Power to meet this **DEMAND**.

With changing paradigm, **PROSUMERS** aided by Capital subsidies, Net metering & Feed in Tariffs is helping boost RE adoption.

# Relevance

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## Duck Neck issue

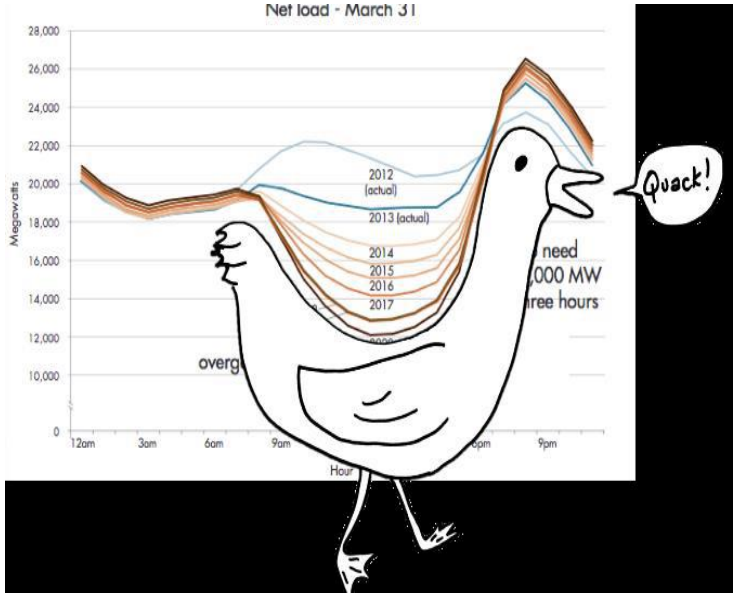
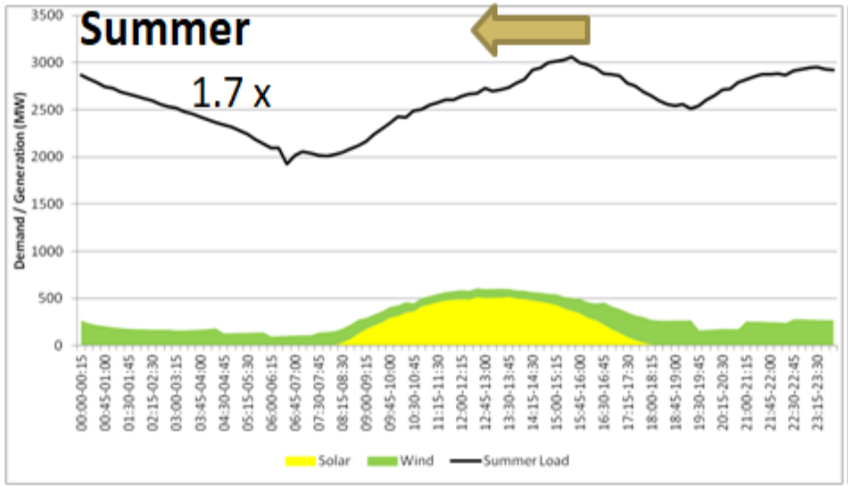
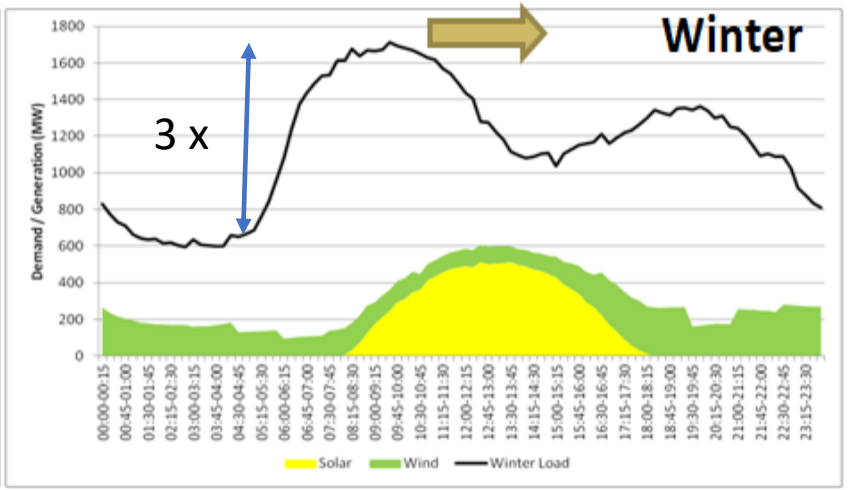



*Image Reference: Jordon Wirfs-Brock*



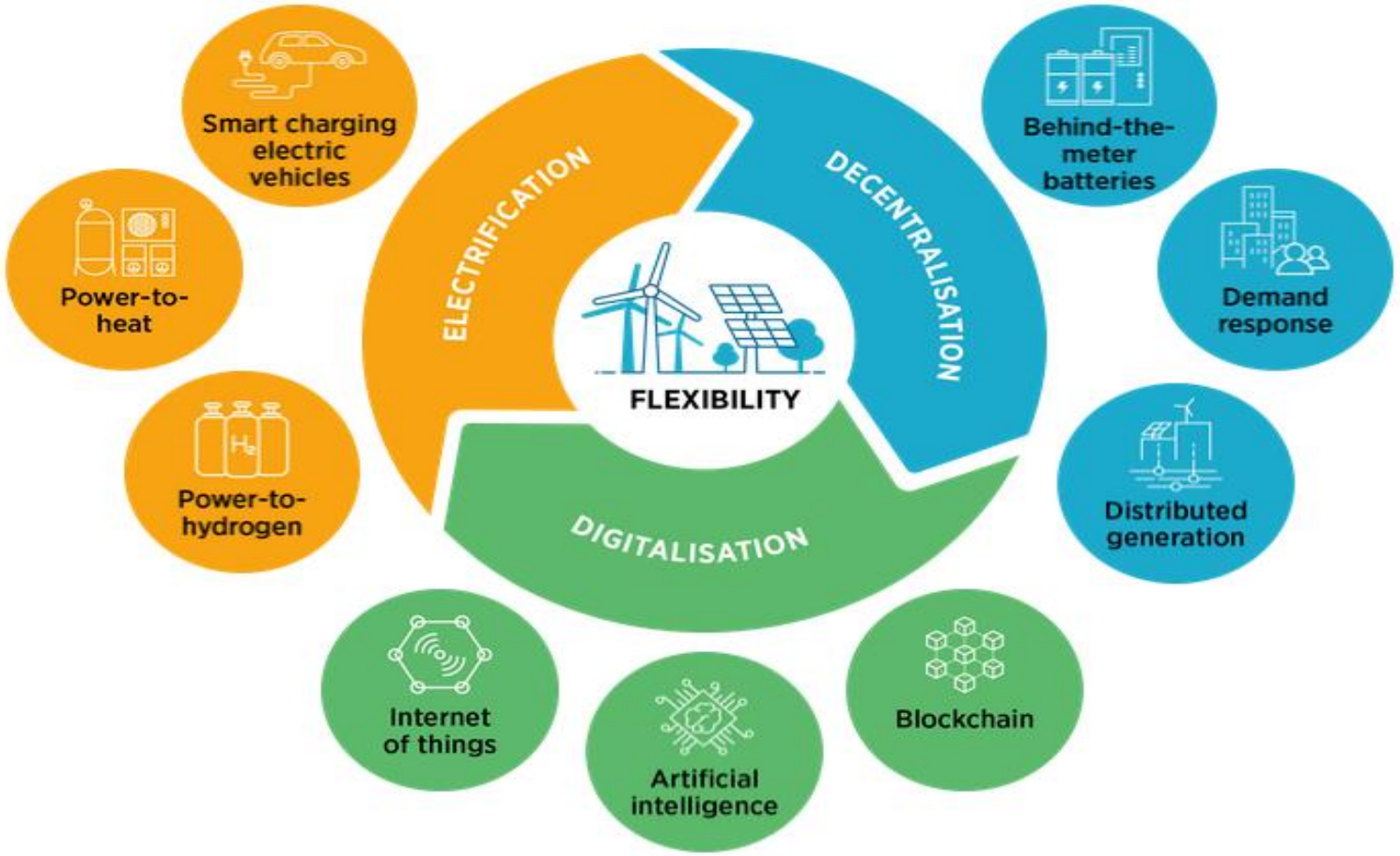




- Opportunity to shift load to high RE generation slots
- Balancing RE with BESS & DR will be needed
- Storage Technology to play a key role – RE firming & Network Optimization

**Key Constraints**

- Costly power in market during ramping requirements
- Availability of flexible resources

# Various sources of System Flexibility




Source: IRENA

# Available Discom Strategies

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**De-centralization**

- Promotion of DERs
- Stand-alone distributed energy storage
- Behind-the-meter solar coupled with Storage
- Innovative Business models
- Battery Swapping Stations
- Vehicle-to-home/grid

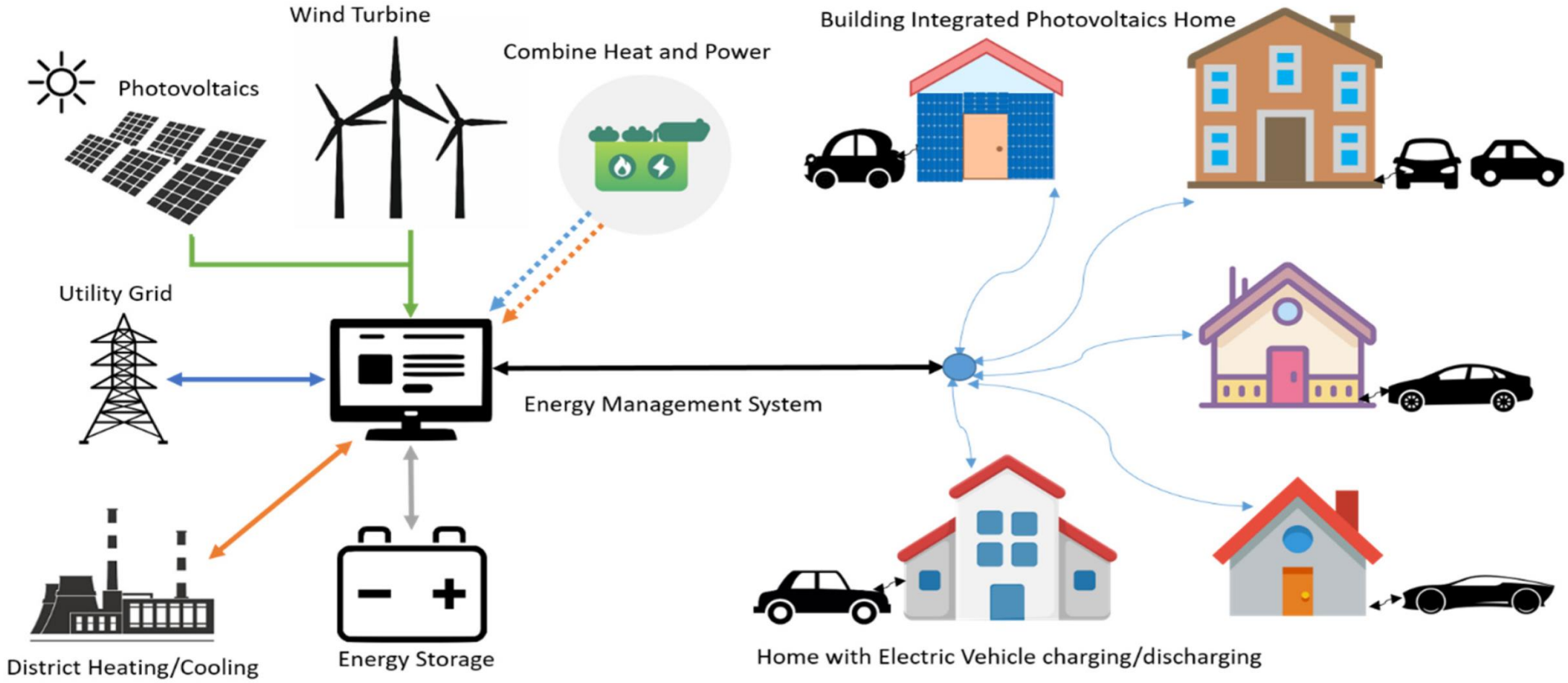
**De-carbonization**

- Large scale RE procurement
- EV100 member
- Facilitation in conversion of Public Transport into EV
- Green Tariff for Hard to Abate sectors
- Demand Side Management
- ESG Compliance

**Digitalization**

- Smart metering / AMI
- Dedicated portal for Rooftop Solar and E-mobility
- Digital Twin
- P2P trading using Block-chain platform
- Automated Demand Response
- Data Lake
- AI-ML Forecasting techniques

# Typical illustration of PEB




*Source: MDPI*

# Discom advocacy in ECBC

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1. **Inclusion of residential buildings:** Domestic load contributes ~70 % of total energy consumption in Delhi. Hence there is a huge power saving potential, For example:

- ❑No. of ceiling fans : ~15 Mn.
- ❑Power consumption of normal ceiling fan: ~80 W.
- ❑Power consumption of super efficient fan: ~28 W.
- ❑Energy saving/ fan: ~52W
- ❑Energy saving potential entire population: ~780 MW.

Other potential power guzzling appliances used in domestic sector: ACs, CFL/ FTL, Refrigerators, Washing machines etc. under Demand side management program (DSM Program).

## 2. Use of RE should be mandatory.

Launched “Solarise Dwarka” & “Solarise Safdarjung” and found that there is potential to install RTS system up to 5 -7% of contract demand.

## 3. Integration of EV charging station with RE:

For efficient use of grid power & optimum utilization of RE.

## 4. Inclusion of DISCOMs in Steering Committee and Executive committee:

As DISCOMs are direct interface hence there should be representation of DISCOMs official in Steering committee and Executive committee.

## 5. DISCOMs as Empanelled Agency:

DISCOMs inclusion would help verify building compliance.

# Solutions used at BRPL

- **Demand Side Management** (Demand Response, TOD Tariff, BTM BESS, Solar PV + BESS)
- **Up-gradation** of Network Assets including BESS at Grid S/s and DT stations
- **Power Markets** for Balancing
- **Automation** and Advanced Tools (AI/ ML for Load Forecasting)
- **DERMS** (Distributed Energy Resource Management System)
- **Utility Scale BESS –** Hybridization with Utility scale Solar PV + Wind to offer a stable profile to Discoms and increase utilization of Power Evacuation lines

# Demand Side Management

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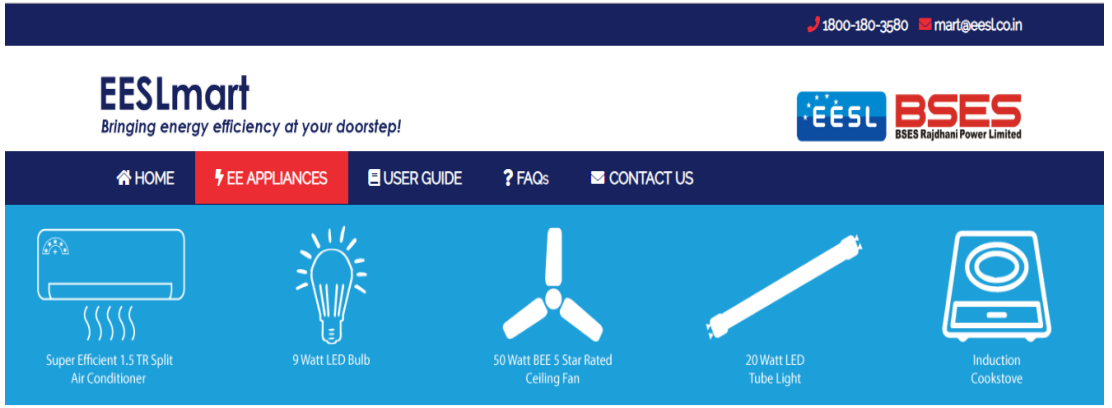

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# Saving due to Efficient appliances

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| Unit | Value | Assumption |
|---|---|---|
| Numbers | 10 | Operating Hr: 07, Operating Days: 365 |
| KWh | 1278 | |

| Unit | Value | Assumption |
|---|---|---|
| Numbers | 5 | Operating Hr: 06, Operating Days: 365 |
| KWh | 219 | |

| Unit | Value | Assumption |
|---|---|---|
| Numbers | 5 | Operating Hr: 12, Operating Days: 250 |
| KWh | 780 | |

| Unit | Value | Assumption |
|---|---|---|
| Numbers | 3 | Operating Hr: 6, Operating Days: 150 |
| KWh | 2360 | |

**Energy Saving per annum 4636 kWh.**

**Total Saving in Electricity bill per annum Rs. 27864/- (@ Rs. 6.01 / kWh)**

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# BSES Initiatives in EV domain

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- ✓ **Facilitating EV Charging within the licensed area.**
- ✓ **EV ready BSES Offices.**
- ✓ **Facilitating Home Charging for Consumers.**
- ✓ **Creating EV awareness through outreach & Social Media.**

# Stand-alone Energy Storage at Six DT sites

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**Battery Chemistry : Li-Ion (LFP)**
**Main Application: Peak Shaving**
**Secondary Applications: Energy Arbitrage, Reactive Power Support**

| Site No. | KVA_ RATING | Outdoor/ Indoor | BESS Rating Dispatchable (kW / kWh) | BESS Rating Designed/Installed (kW / kWh) |
|---|---|---|---|---|
| 1 | 400 | Indoor | 160/160 | 160/245.76 |
| 2 | 990 | Outdoor (Kiosk) | 78/110 | 100/172.8 |
| 3 | 630 | Indoor | 38/74 | 38/115.2 |
| 4 | 990 | Outdoor | 85/150 | 100/230.4 |
| 5 | 990 | Outdoor | 69/103 | 100/172.8 |
| 6 | 630 | Outdoor | 47/77 | 47/115.2 |
| | | **Total** | **477/674** | **545/1052** |

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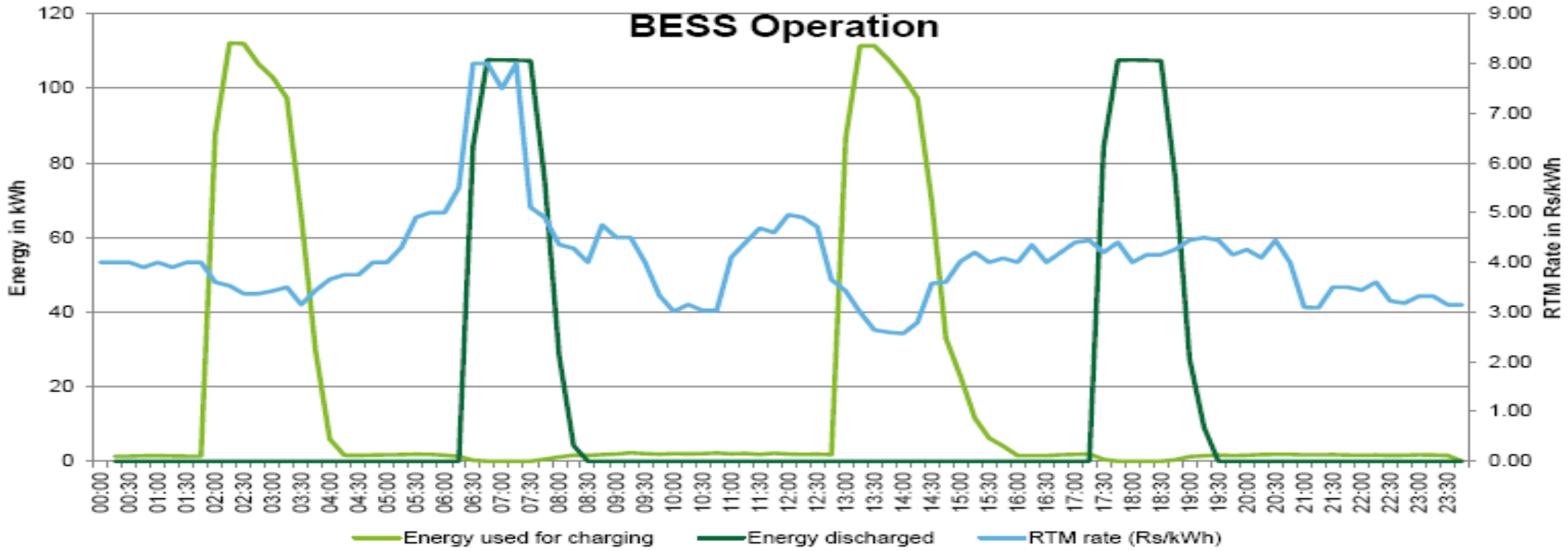
# Energy Time Shifting

# Charging / Discharging based on RTM prices




- Charging is done when the RTM rates are lower and Discharging is done when RTM rates are higher.
- Algorithm for Battery Use optimization in process

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# Peak Shaving / Valley Filling

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# Urban Micro-grid

## BRPL 33 kV Shivalik Grid station

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***Status: Commissioned***

- 100KWp Solar PV + 466.56 KWh of Battery Storage
- Two nos. of EV chargers installed for in-fleet charging
- The Solar PV + Batteries are divided into two components connected to load through SMA 300 KW Multi-cluster box

**1. Connected to one LT feeder of C-Blk Shivalik 630 KVA DT**

| | | |
|---|---|---|
| **Solar PV**<br>**Total Battery Energy Storage** | **100 KWp**<br>**259.2 kWh** | **APPLICATION** |
| No. of SMA SI8.0 Inverters | 15 | **Energy Arbitrage & Peak Shaving** |
| Total continuous output power | 90 kW (continuous output) | |
| Total max output power | 120 kW (for 30 minutes) | |

**2. Connected to Critical load of Station Trafo (DERC)**

| | | |
|---|---|---|
| **Total Battery Energy Storage** | **207.36 kWh** | **APPLICATION** |
| No. of SMA SI8.0 Inverters | 12 | **Energy Arbitrage** |
| Total continuous output power | 72 kW (continuous output) | |
| Total max output power | 96kW (for 30 minutes) | |

100 kWp Solar PV Carport

Sunny Island Inverters & Battery Clusters

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# Energy Time Shifting

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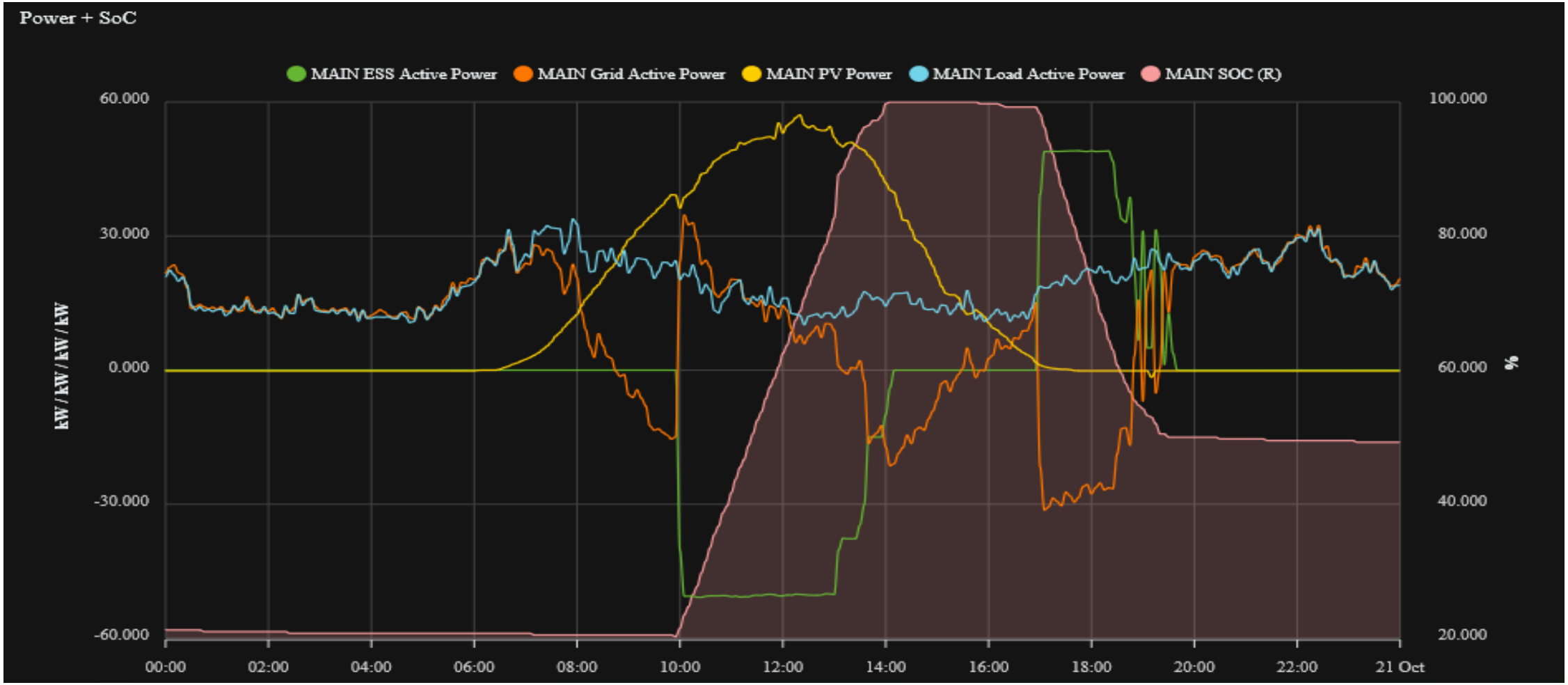


# Automated Demand Response (ADR) program



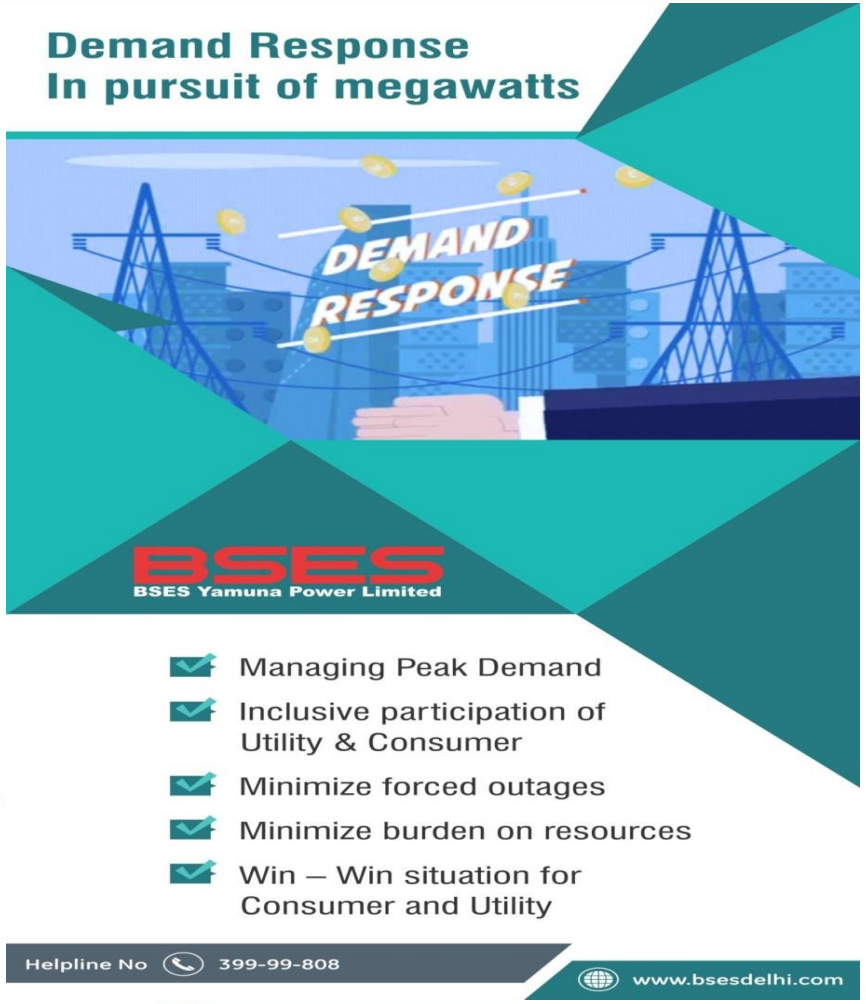
- **Automated Demand Response (ADR) means** customers changing their electricity usage (typically reducing use or shifting use to other times in the day) in response to economic incentives, price signals, or other conditions.
- Effective Auto demand response programs provide various economic and environmental benefits **on a self-sustainable basis**.
  - ✓ Avoiding the purchase of high-priced energy and network augmentation cost
  - ✓ Providing greater reliability to the grid, which helps prevent blackouts
  - ✓ Avoiding the consumption of fossil fuels which can damage the environment
  - ✓ Help in RE integration and help deal with high load ramp rate due to Duck Curve phenomenon
- Participating Consumer gets incentive for the load reduction during the DR event

**ADR serves as the viable Non-Wired Alternatives (NWAs) due to unique nature of demand curve**

# Requirement of ADR Program

- Automated Demand response requires technological support like hardware and software to implement on sustainable basis.
- GSM based IOT smart switch is one of the best solution for hardware support since it is easily communicable, programmable and remotely controllable.
- The smart switch may prove to be a significant enabler for enhancing demand response program for BRPL as a utility, the real power and process of such IoT capable devices can only be harnessed when such devices are integrated with a Software Platform which will open up the possibility of real time analysis, monitoring on the demand side and controlling, scheduling and monitoring of the load demand during peak period as per agreed term and conditions between utility and consumers.

# Auto Demand Response




ADR is a voluntary program for reduction of sudden surge in peak demand or when the system stability is in danger

Consumers participate for demand curtailment when requested by Discom

Consumers is incentivized for reducing demand during the event of request for carrying out ADR program

Implementation of ADR is subject to regulator approval

# Behavioral Energy Efficiency (BEE) program-
# Home Energy Report (HER)

# BEE program (Pilot)

### Home Energy Report under Behavioral Energy Efficiency (BEE) program

**It employs simple, actionable messages that are relevant to customers and motivate them to save energy.**

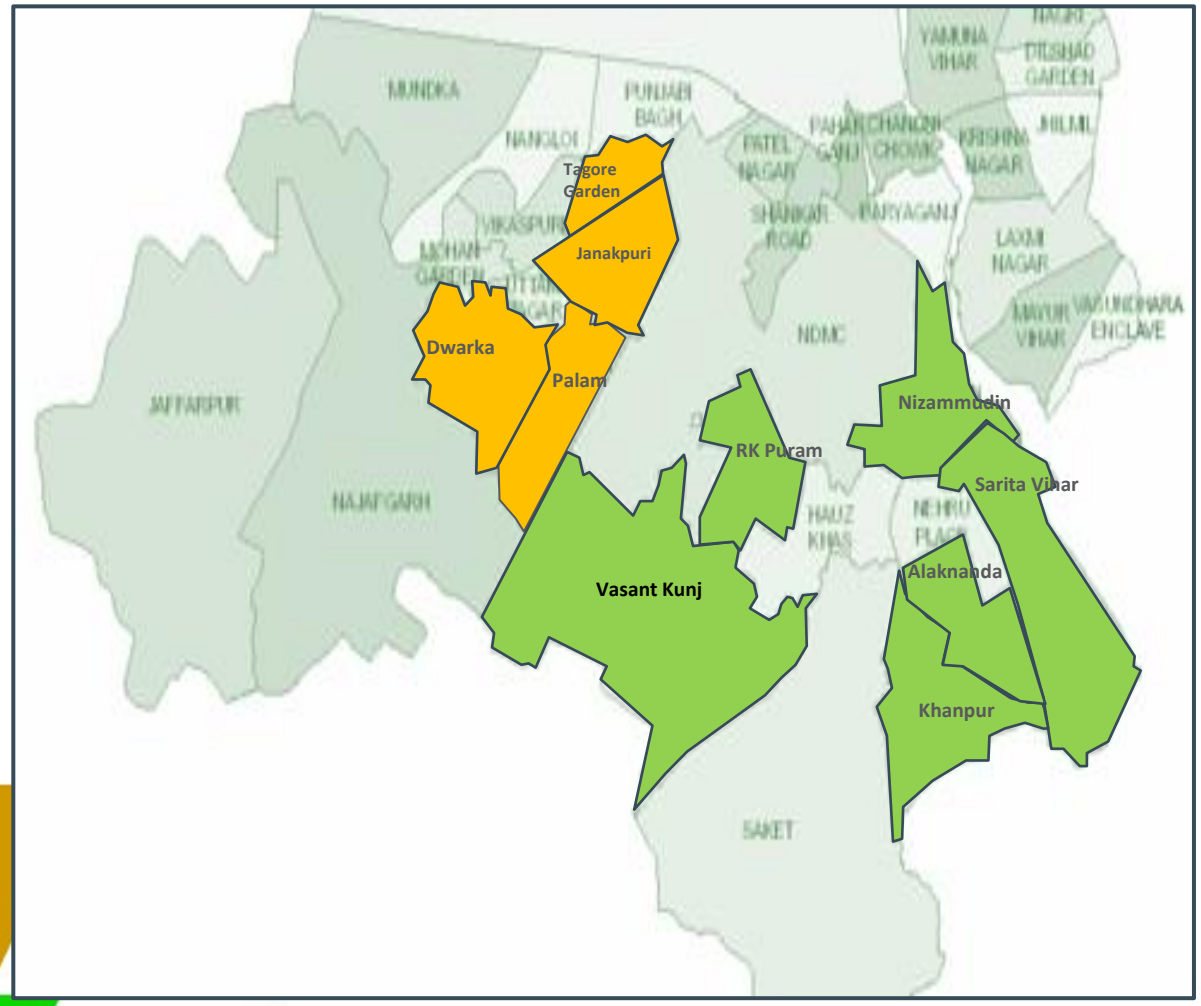
### Communications through multiple channels

**viz.; web page, print report , mail – to help customers get engaged and focused on saving money and reducing waste in energy consumption**

### Benefit demonstration to consumers:

- **Empower consumers to save ~2% money on their energy bills.**
- **Promote domestic consumer energy literacy and energy efficiency by participation in key EE programs**

**Pilot program covers 2 Lakh consumers in 10 divisions**




| Division Name | Number of Recipients | Percentage |
|---|---|---|
| Alaknanda | 16,821 | 8% |
| Dwarka | 21,555 | 10% |
| Janak Puri | 58,300 | 28% |
| Khanpur | 13,430 | 6% |
| Nizamuddin | 25,161 | 12% |
| Palam | 7,621 | 4% |
| R K Puram | 12,535 | 6% |
| Sarita Vihar | 8,744 | 4% |
| Tagore Garden | 35,075 | 17% |
| Vasant Kunj | 10,758 | 5% |
| **Total** | **2,10,000** | |

# Measurement Approach

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Targeted customers

2,10,000

Random Allocation

2,00,000

Treatment Group

+

Receives Home Energy Report

Measure

Statistically equivalent groups

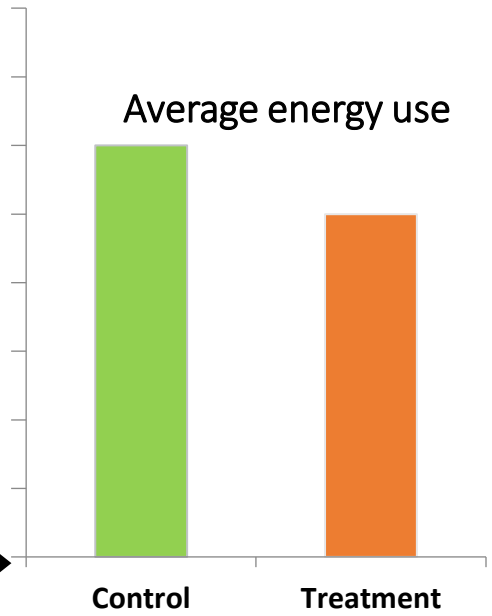
Control Group

10,000

+

n/a

Measure

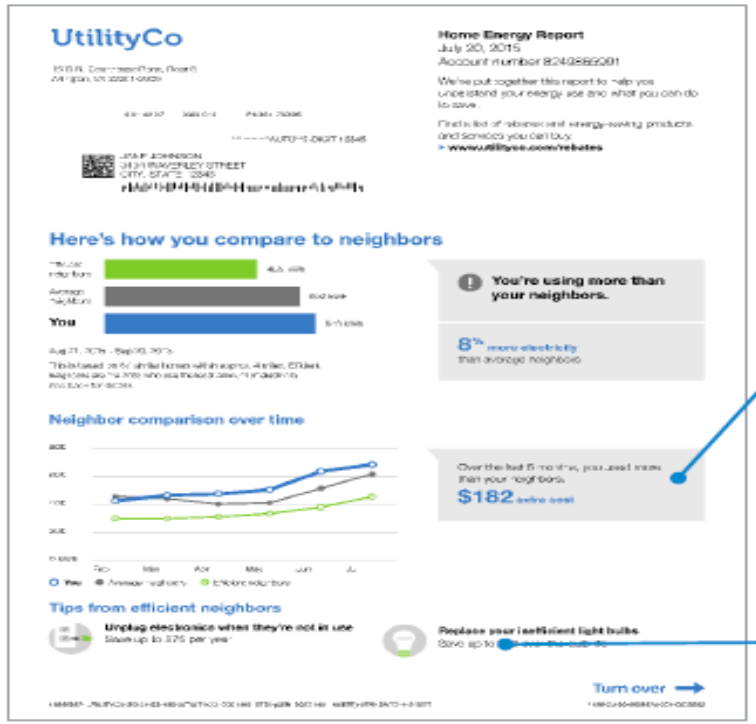



*Track-wise and Overall*

# HER Design: Fast Path to Insight and Action

## Reads like a story

Bold, graphic headers help tell a consistent and approachable narrative about the customer's energy use.




## Instant insights

Highlights the two most important insights using proven behavioral science levers — normative comparison and loss aversion.

## Leads customers to action

Two quick and easy tips from neighbors leverage a third behavioral science driver — social proof.

# Home Energy Report

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NO-15 SECT-5
HIMANCHAL DHAULADHAR CGHS, DWARKA
WALKING SEQUENCE: 906203666ROAD
NEW DELHI 110075

**Home Energy Report**
17 August, 2018
CA No. : 103425617

Welcome to your Home Energy Report. Discover how your home is using energy with these personalised reports and exclusive online tools.

Learn more about your use at
▸ www.bsesdelhi.com

## Here's how you're doing in comparison


19 Jul, 2018 – 17 Aug, 2018

This is based on 95 homes like yours. Energy-efficient homes are the 20% who use the least amount of electricity.
See back for details.

Great
**Good**
Using more than average

**60%** more electricity than energy-efficient homes

## How are you using electricity?

**See what uses the most energy in your home**

Take a quick online Home Energy Analysis to understand more about how you consume electricity.

Log in to take the survey now at **bsesdelhi.com/group/brpl/hea**

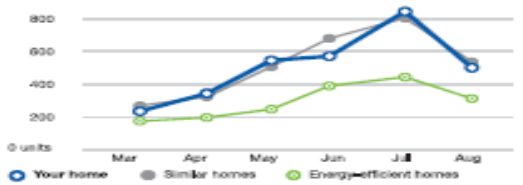
## Tips from efficient homes

**Keep your refrigerator door closed as much as possible**
Save up to ₹ 450 per year

**Use computer power-saving modes**
Save up to ₹ 155 per year

Turn over

## Electricity comparison over time




In the last 6 months, you used more than energy-efficient homes in your locality.
**₹ 5,915** extra cost

## Save on your next bill

**Use focused lighting (table lamps) at your workplaces**

When you are studying or working at your desk, you need light only at your workstation, not the entire room. Using focused lighting will allow you to reduce the amount of energy used for lighting while providing sufficient lighting for your work.

Choose from various available focused lighting products in the market which will enable you to light your workspace sufficiently well. You can get the help of a knowledgeable sales representative for determining the right lighting fixture for the kind of task you need to perform.

Save up to ₹ 700 per year

## Frequently Asked Questions

**What is a unit?**
A unit is a measure of electricity use. A 100-watt lightbulb uses 1 unit in 10 hours.

**How is my comparison calculated?**
We use similar area, dwelling type, and relevant records for identification of similar homes from our database, typically within a few kilometers of your home within the BRPL license area.

**How do I access the online tool to find more information or update my home's data?**
Visit https://bsesdelhi.com/web/brpl/home and log in using your account username and password in the **My Account** menu, or create an account by clicking on the **New User Sign Up** link displayed below the **Login** button.

**Can I opt out of this program?**
Yes. You can contact us by email at brpl.homeenergy@relianceada.com, or call us at 19123 / 011-399 99 707 to opt out of the program.

## We are here to help

▸ https://bsesdelhi.com/web/brpl/home
▸ brpl.homeenergy@relianceada.com
▸ 19123 / 011-399 99 707

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The data used in calculation is based on consumption (units). They are an indication and may vary from household to household depending on usage, age of appliances and other factors. BRPL does not guarantee the amount of money or energy saved while implementing the recommended actions.

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# Energy Wise Energy Rise

## Consumer Awareness Program with TERI

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# Key Takeaways

- Probabilistic study on assessing the impact of RE addition on reliability of power portfolio of Discoms as well as quantification of need for balancing power by them.
- Systemic Innovation is key to increase flexibility and integrate higher share of RE at the least cost.
- For **“PROSUMERS”** to provide grid support, the grid needs a wide range of:
  - Enabling Technologies
  - Business Models
  - Market Design
  - System Operations

# Q&A

*For further discussions/suggestions/queries*

# Grid Flexibility

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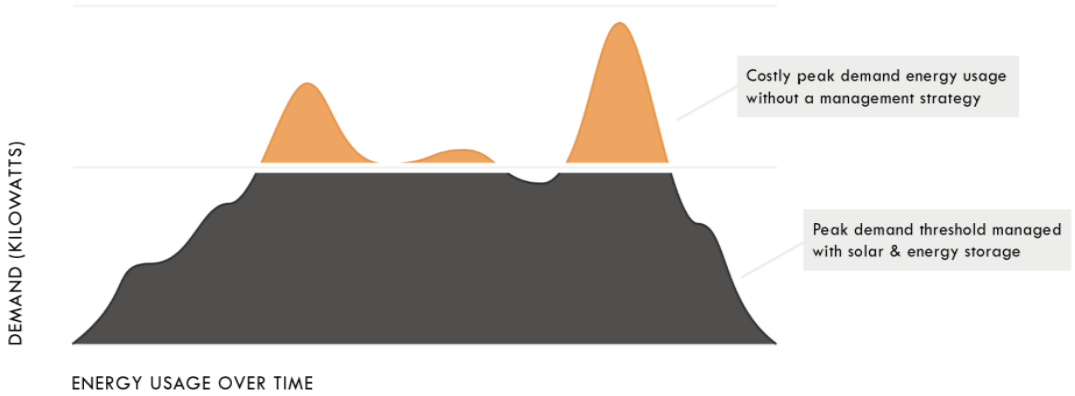
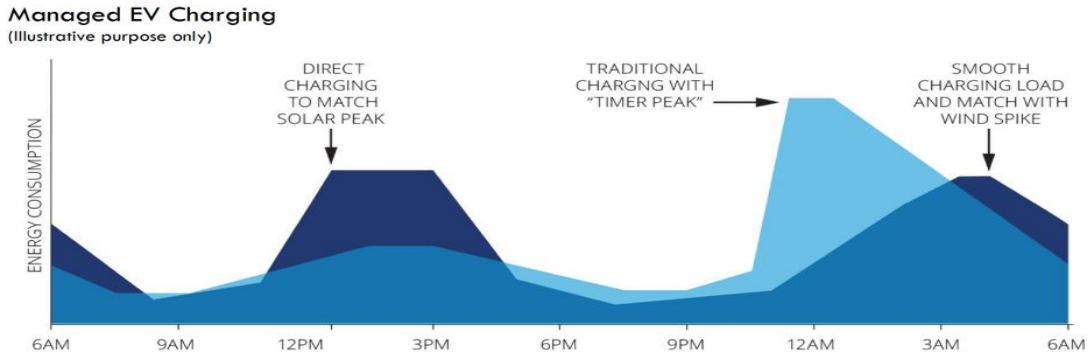
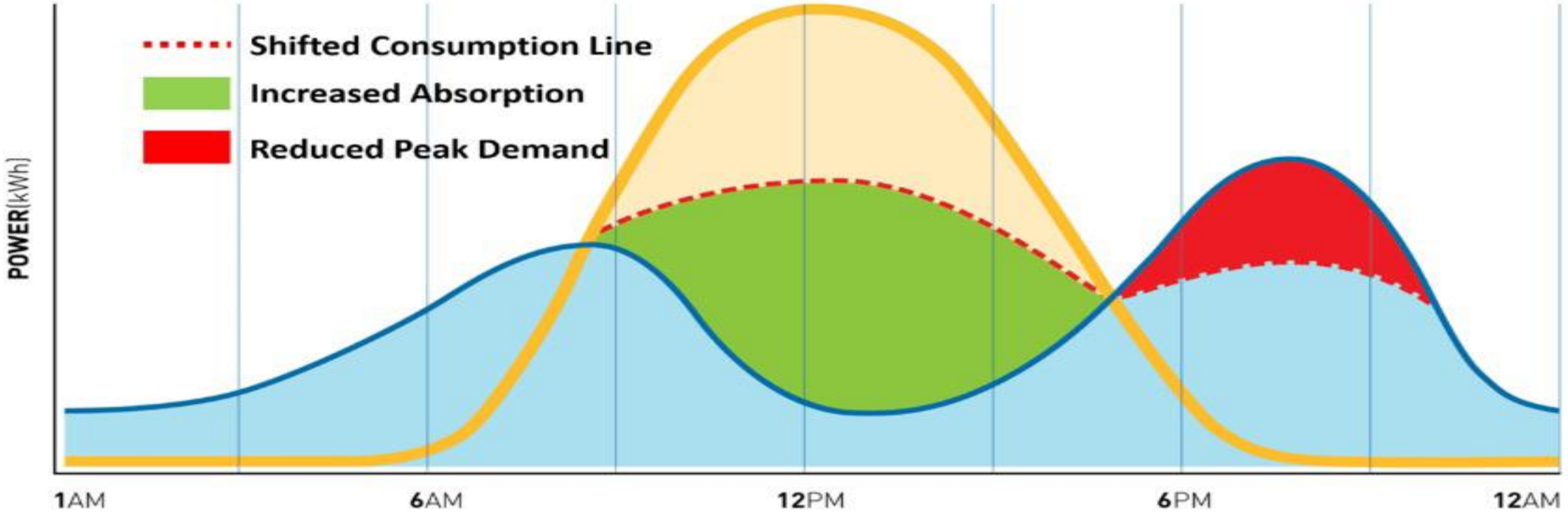
- Distributed energy resources (DERs) like Rooftop solar, Battery energy storage systems, Demand response, Evs and virtual power plants can deliver grid flexibility services.




With appropriate regulatory support and techno-economic levers, DERs can provide the much-needed grid flexibility support.

# Impact of DERs on Grid Flexibility




**DERs can enable grid flexibility in Delhi, maximize utilization of low cost RE and help manage the growing peak loads in the city.**

# Power flexibility - How