Behavioral Demand Response of Consumers

by

Tata Power Delhi Distribution Limited
(**Tata Power-DDL**)

Contents

About Tata Power-DDL

Journey started 1st July'02 onwards

Government of National Capital Territory of Delhi

TATA POWER

DEMING PRIZE WINNER 2024

51:49

JV of The Tata Power Company Limited and Government of Delhi

25 years

License Period

510 Sq.KM

License Area of North and Northwest Delhi

21.5 Lakhs

Customer base

TATA Power-DDL is an ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems), ISO 45001 (Occupational Health and Safety), ISO 22301(Security and Resilience), ISO 27001(Information Security Management), ISO 31000 (Risk Management), ISO 50001 (Energy Management Systems), SA 8000 (Social Accountability), ISO 10002 (Customer Satisfaction - Guidelines for Complaints Handling), ISO 20400 (Sustainable Procurement) certified organization.

Performance Improvement since 2002

Parameter	Unit	July 2002	March 2025
PROFILE:			
Consumer count	Lakh	7	21
Length of Network	Ckt. km	6750	14486
Peak Load served	MW	930	2481 *(Jun 2024)*
PERFORMANCE:			
Consumer Satisfaction Index (Top Box)	%	-	93.9
AT&C Losses	%	53.1	5.54
System Reliability – ASAI -Availability Index	%	70	99.8
Transformer Failure Rate	%	11	0.68
Smart Meters Installed	Lakh	0	5.75
New Connection Energization Time	Days	51.8	5.5
Provisional Billing	%	15	0.28

'Roshni' – our Brand Mascot

Technology Journey

TATA POWER-DDL

AIDA
Collaboration | Innovation | Excellence

THE START 2002-05 — LEGACY

- AT&C Losses- 53.1 %
- Availability Index- 70%
- Old grid substation Panels & Relays
- All Grids (66/33 KV) manned
- No data/ communication

PHASE- 1 2005-10 — FOUNDATION

- SCADA Implementation
- Grid /Sub-Station Automation
- IT/ Fiber infrastructure
- Geog. Information System (GIS)
- SAP ERP, CRM
- AMR Implementation

PHASE- 2 2010-15 — GROWING

- OMS Implementation
- IT –OT Integration
- Real Time Power Management
- Distribution Automation
- SAP-ISU Integration

PHASE- 3 2015-22 — ADAPTING

- ADMS (Adv. Distribution Management System)
- Field Force Automation
- Battery Energy Storage
- AMI/Smart Meter
- Big Data Analytics Implementation
- EV Charging infrastructure

CURRENT 2022-26 — CURRENT

- LV Automation (IoT)
- Behind the Meter services
- **DER Management System**
- Data Analytics, AI/ML usage
- Vehicle to Grid (V2G)
- Power Voltage Transformer

Increased focus on Cyber security for IT & OT Applications

Demand Response

Demand Response

Demand Response is an **electric load management program** which seeks to manage electricity demand at consumer end by encouraging them to increase or decrease their consumption **using incentives or penalties**.

Helps to bring in -

- Demand side flexibility
- Optimization of power procurement

Types of Demand Response (DR)

Automated DR: Load controlled by Utility through connectivity with customers systems

Benefits :
Utility is in control of switching off loads during its requirement
More suitable & cost-effective for C&I loads

Downsides :
Requires segregation of essential & non-essential loads at consumer's end
Requires high level of technological intervention in terms of switching equipment, smart meters & IT communication platforms
Not preferred by customers due to external switching off & control

Behavioural DR: Load curtailment is done by customer based on requirement by Utility

Benefits :
Most preferred mode of DR by customers as they feel "in control"
Requires limited technological support - Only pre & post event meter data is used
No load segregation at customer's end mandated
Suitable & cost-effective for all types of customers

Downsides :
Extremely high dependency on customer for participation & quantum of load shed

Peak Pricing Methodologies in DR

Critical Peak Pricing (CPP)

- **Higher tariff during peak hours**. Peak tariff may vary according to season
- **On critical days (6 – 10 days a year) - Very high tariff during peak hours. Informed a day in advance**
- Consumer stands to benefit, lower bills, if he/she conserves energy during peak.

Critical Peak Rebate (CPR)

- Consumer stays on normal tariff
- **On critical days consumer asked to curtail load during peak. Informed a day in advance.**
- **Consumer rewarded handsomely with incentives for curtailing load. (Used cases from US show 20X incentives)**

Suitable Tariff Support helps in increasing customer participation in Demand Response Programs

Benefits & Use Cases

- **Customers are empowered** to control their consumption in response to time-varying electricity rates or incentive-based programs & reduce bill amount to earn incentive payments.
- Averts the need to use the most costly-to-run power plants during periods of high demand, **driving down Power Purchase Cost**.
- Over the longer term, sustained demand response **lowers aggregate system capacity requirement**s, allowing load-serving entities (utilities and other retail suppliers) to purchase or build less new capacity.
- **Lowers** likelihood and consequences of **forced outages**.
- Helps in grid stabilization & **better integration with renewable sources of generation** & Distributed Energy Resources.

Source : Enel

Indian Context : Imperatives, Scenarios & Potential

Imperatives, Scenarios & Benefits in India

Imperatives

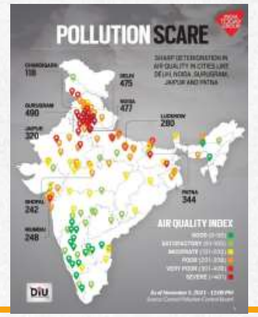
- CEA Guidelines for Resource Adequacy
- Escalating Renewable generation
- Market Price Cap - Pressure on Supply Side
- Rising Pollution

Scenarios

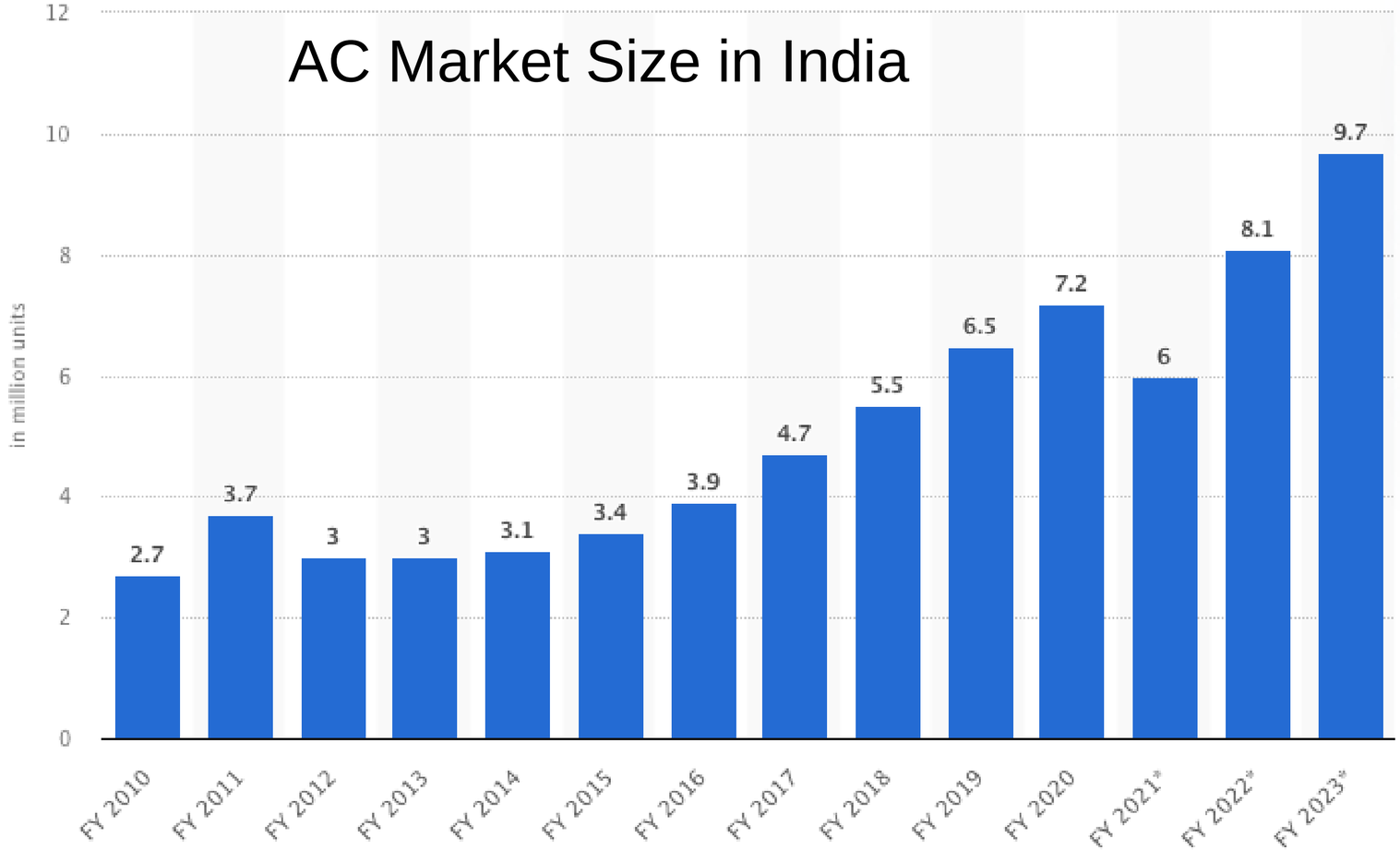
- Highest Peak Demand experienced less than 10% of time
- DR as a flexible resource
- Shift network load to high PV hours

Benefits

- More Demand Shift & Less Shed
- Portfolio Optimization
- Potential Savings in DSM penalties
- Emission Optimization



Potential for Demand Response on the rise



Expected:
Avg annual AC sales 8 million

Potential for DR Added every year> 3GW

Aggregated:
30GW Flexible capacity in next 10 years

Our Demand Response Experiences

Need for Demand Response at Tata Power-DDL : 2020

TATA POWER-DDL

AIDA Collaboration | Innovation | Excellence

Exploding Demand requiring DER integration

- **Delhi's EV Policy -** Additional EV Load projection in Network - 100 MW
- **Solar policy expansion** – Net metering addition
- Retail consumer **load growth** @5% per annum
- **Grid stabilisation** requirement in face of DER integration

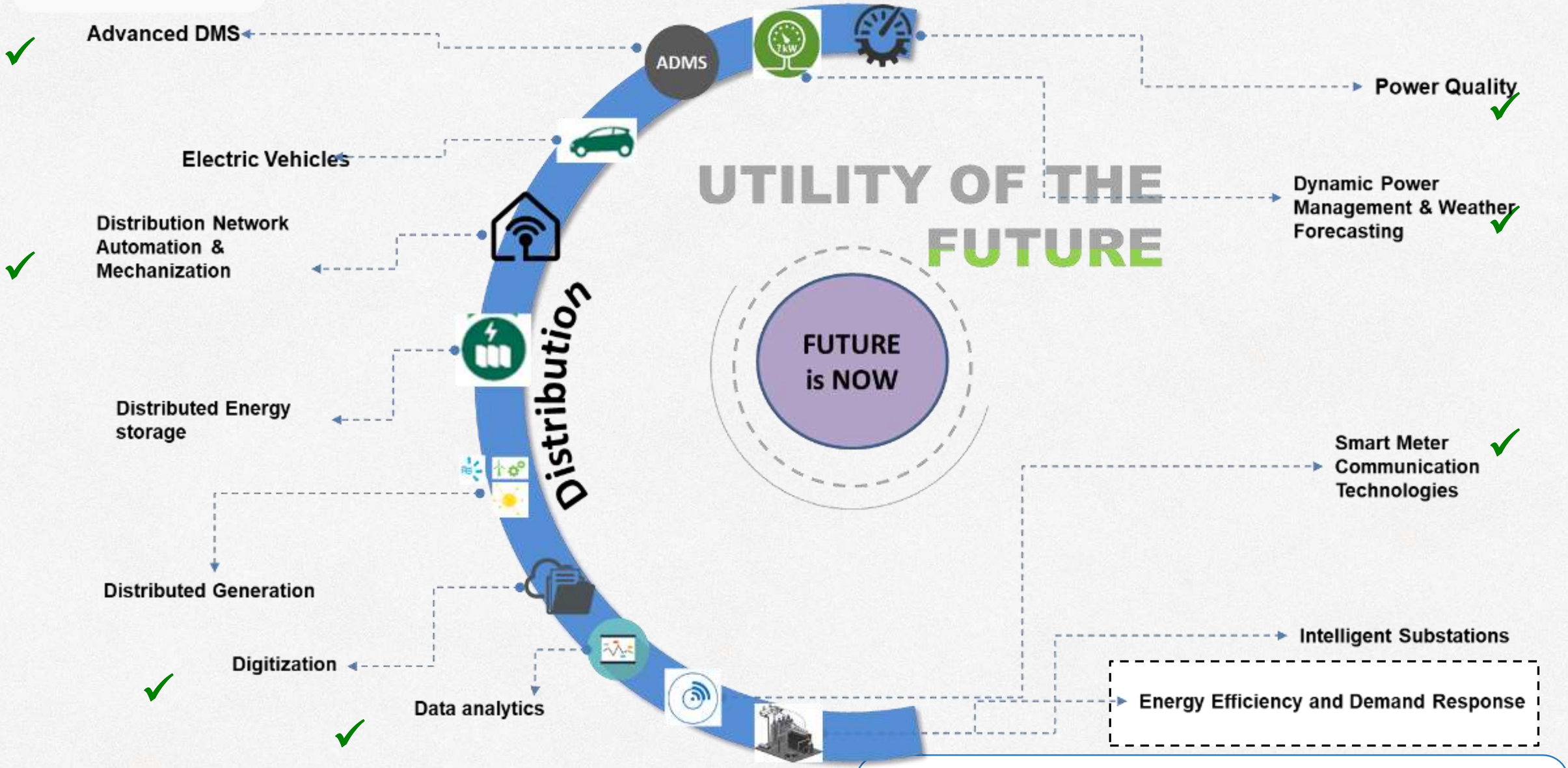
Technological Advancements

- **Matured AMI & Smart Meter** technologies for real time monitoring
- Better IT-OT landscape helping in **stronger back-end integration**
- Availability of internationally proven **M&V** (Measurement & Verification) **technologies**

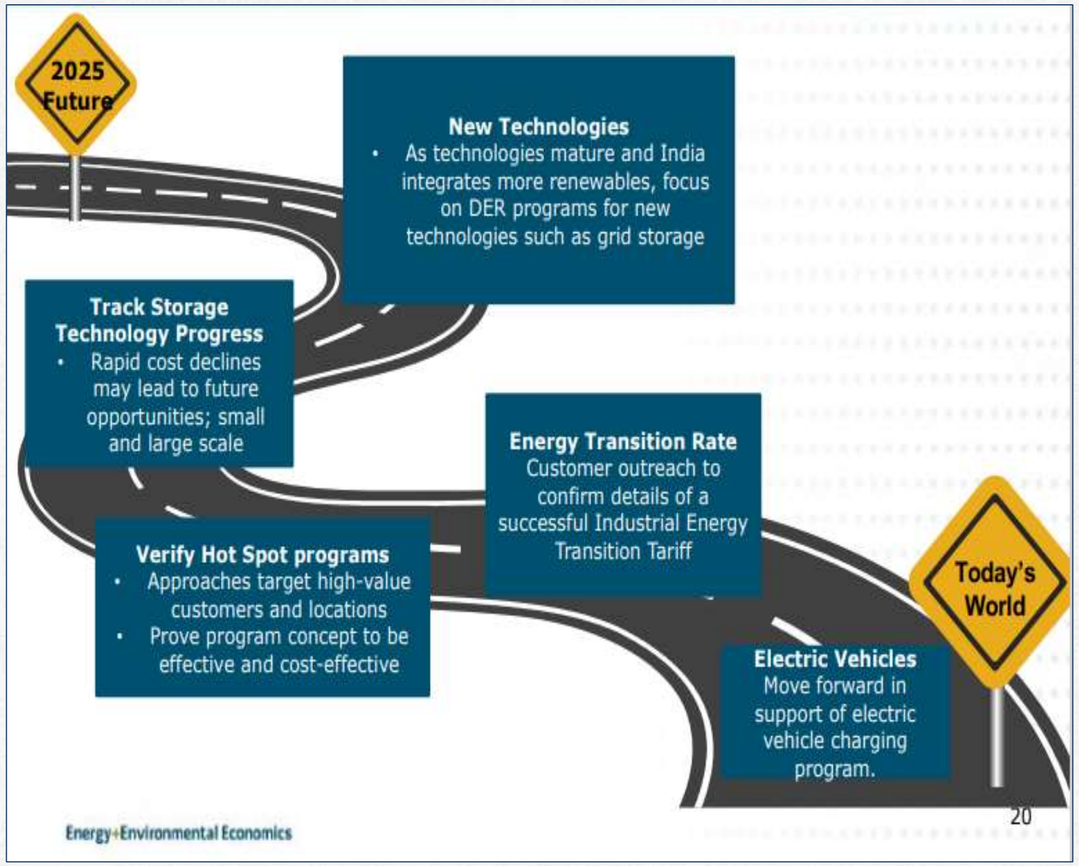
Customer Voices

- Large establishments are facing cash flow issues & are looking for **avenues to save cost**
- **Interested in Behavioural DR programs** - Voluntarily participate in programs where internal systems do not require modifications

Tata Power-DDL's Roadmap

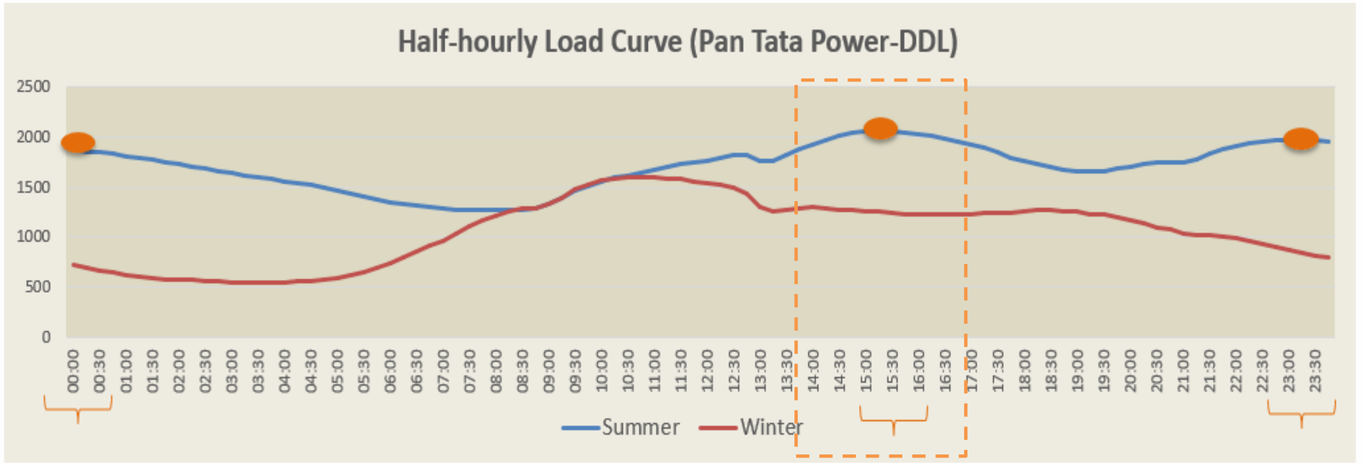


DER Program Roadmap



Distribution peak management through Demand Response

Pilot targeted distribution peak load programs through targeted DR program with Critical Peak Rebate*



Targeted Day Peak

** Critical Peak Pricing method not adopted as ToD was already available for C&I customers*

Launch of pilot in 2021

1 Goals

- Test effectiveness of Manual DR as an alternative to Auto DR
- Assess the acceptability of DR programs among consumers.
- Assess response of consumers to different variants of programs
- Create a Tariff structure which stimulates consumers to change their load pattern.
- Measure response of consumers to incentives/additional pricing

2 Program Highlights

- Offer customers incentives on reduction in consumption from normal levels during critical events as called by utility (CPR)
- Only for Residential customers **(First in India)** using smart meters
- **Availability Period :**

  15th Jul to 30th Sep 21 (**16 number** of Events) - Residential
- **Response Timing** : Day Peaks
- **Technology used** : Smart meters, Big data platform, Measurement & Verification through **DERMS platform** of AutoGrid (Current acquired by Schneider)
- **Funding partner :** From renowned NGO
- Implemented with intimation to DERC

3 Methodology

- **Notification to customers** : 24 hrs in advance thru sms, email & calls
- **Measurement :** Drop in consumption compared to last 10 days during same slot
- **Calculation :** Porting of customer profile data, last 10 day's 30-minute interval data & consumption data of day of event
- **Customer Compensation Structure :** Cash rewards (Rs. 250/- participation/ event) & Lucky Draw Schemes for top participants

Implementation Strategy

- Nos. = Participation ≥ 10% of Baseline
- LS = Load Shed

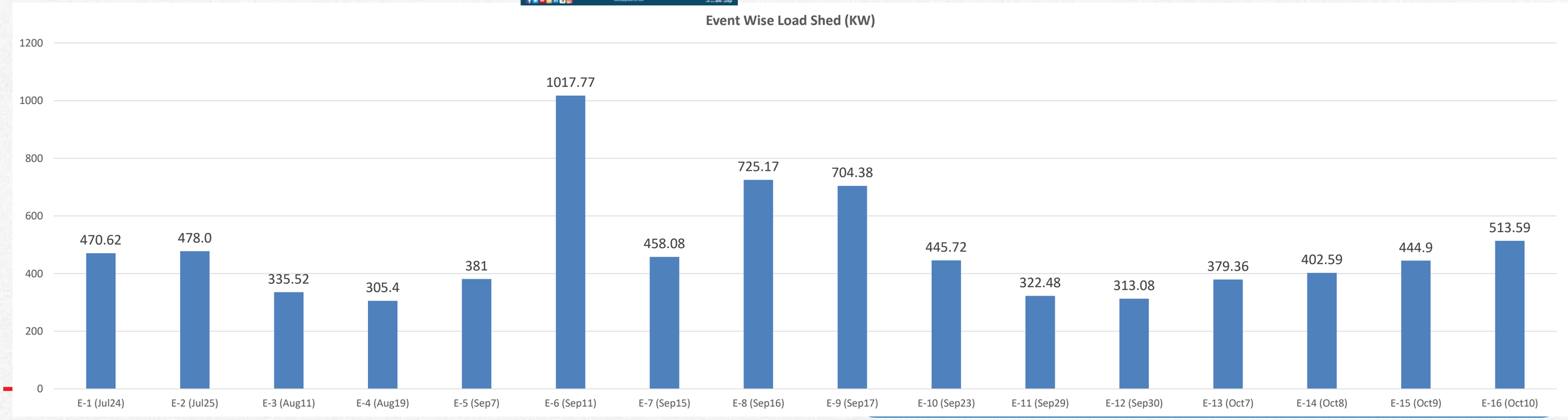
- No. of Customers Targeted: **4,417**
- No. of Customers Enrolled: **2,044**
- No. of Event Executed: **16**
- Total Load Shed: **7.69 MW**
- **11** Day Events & **5** Night Events
- Avg. Per Meter Shed: **0.4 KW**

Program validation through Indian Statistical Institute, Delhi

Customer Engagement

SMS: 88.4K
E-Mailers: 72.4K
1 to 1 Phone Calls: 22.8K
Letters: 2.04K

Customer Incentives of Rs 45 lacs disbursed
(INR 200 for enrollment; INR 250 per event for successful participation)



Process for Implementing DR

- Identify target customers with smart meters.
- Analyze peak load patterns using data analytics.

•1. Project Design

- Target residential customers.
- Use smart meter data to identify high-consumption periods.

2. Prospecting Customers

- Engage customers through awareness campaigns, incentives, and notifications.

3. Customer Enrollment

- Send 24-hour advance SMS, email and calls.
- Encourage voluntary load reduction

4. Customer Engagement

- Schedule events during day and night peaks in line with PSC

5. Event Scheduling

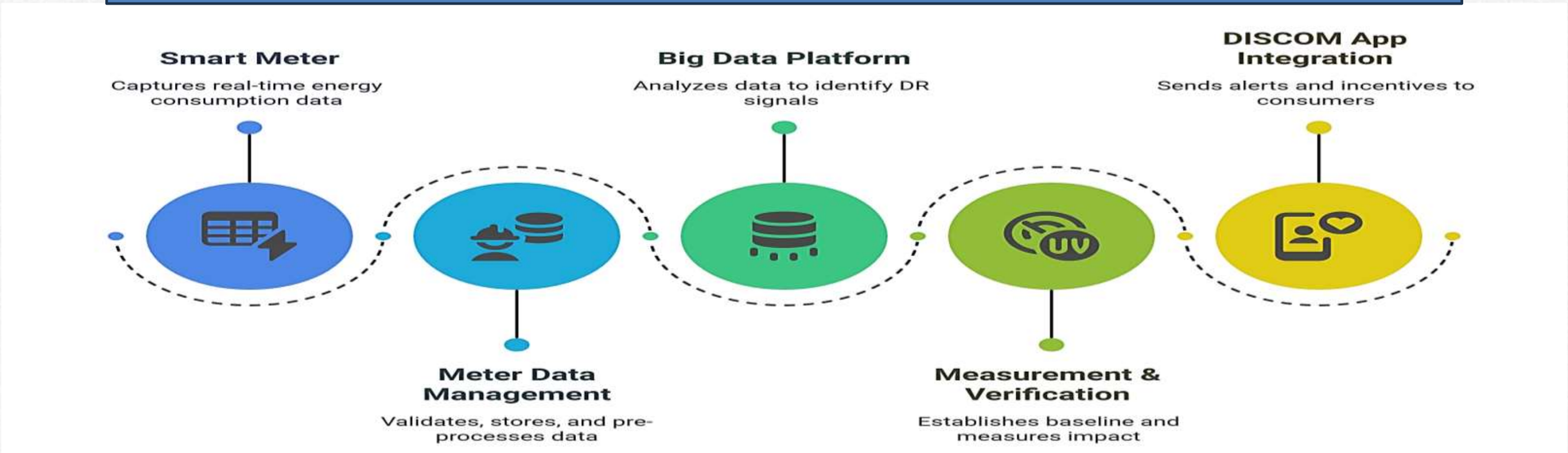
- Use IT platform for data analysis.
- Compare consumption during events with the last 10 days' data.

6. M&V

- Rewards and lucky draw schemes for top participants.

7. Reward

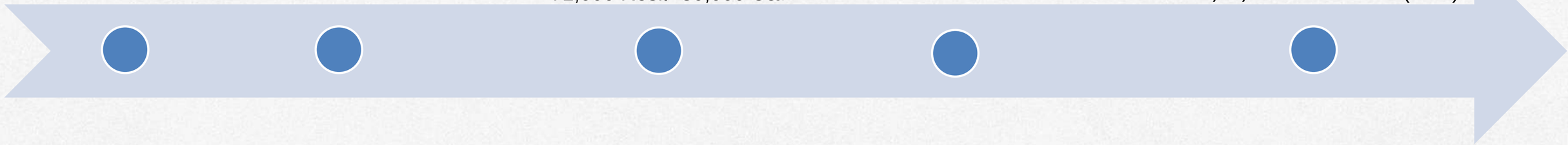
Technological capabilities driving the program



BDR Journey Over the Years

Tata Power-DDL is “first” in India to initiate BDR on a Mass Scale with smart meters

- Extensively engaged with customers to manage peak demand through voluntary contribution
- Developed **in-house Measurement & Verification** (M&V) platform for accurate tracking of BDR Program FY25 onwards



FY22
BDR Pilot
2000 Customers

7.7 MW Cumulative Load Saving
PPC (Power Purchase Cost) Saving : 1.4 L

FY23
BDR Build-up
26,400 Customers
16,000 Resi+10,500 C&I

85 MW Cumulative Load Saving
PPC Saving : 15.3 L

FY24
BDR Maximum Potential Demo
1,01,000 Customers
71,000 Resi.+30,000 C&I

560 MW Cum Load Saving
PPC Saving : 1.08 Cr

FY25*
BDR Scale Up
1,26,500 Customers
(Resi)

400 MW Cumulative Load Savings
PPC Saving : 66.6 L

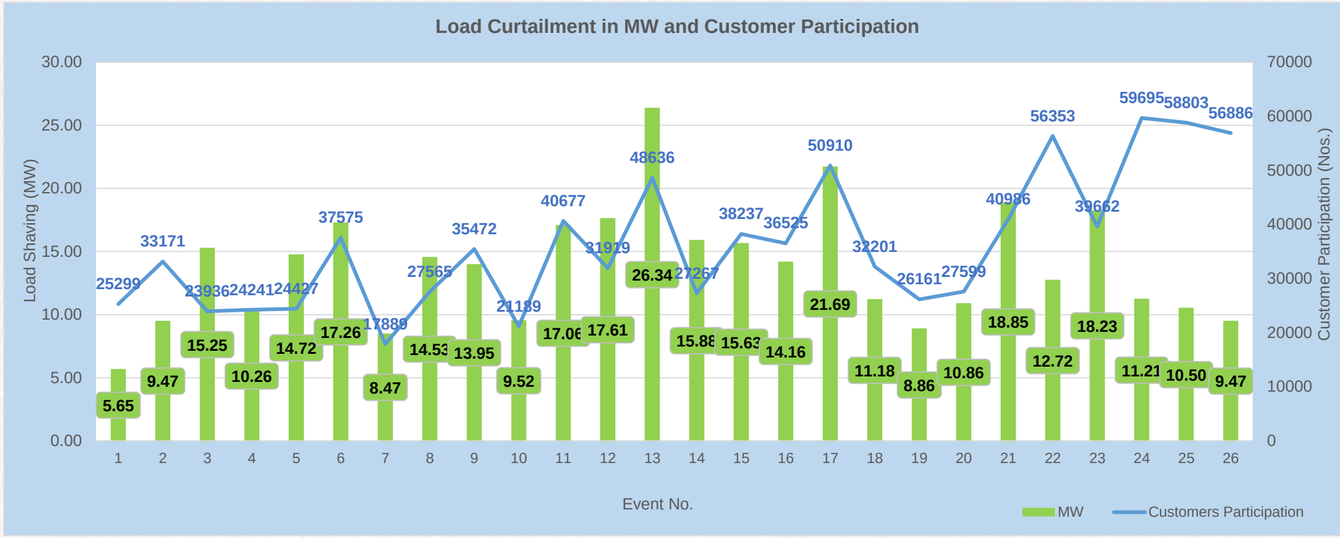
FY26**
BDR Nxt - Diversified
1,54,000 Customers (Resi)

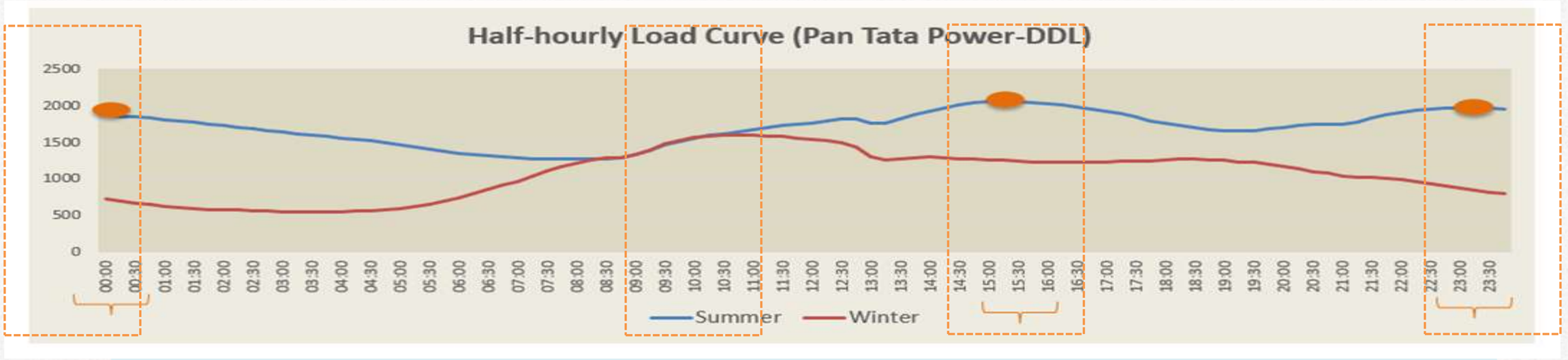
360 MW Cumulative Load Savings
PPC Saving : 52.5+ L

** Emphasis on Residential customers*
*** In progress*

BDR Nxt : FY26 Program

- Introduced events to cater to multiple (day/night/ seasonal) peaks when PPC (Power Purchase Cost) is higher
- Flexible time slots events to align customer behaviour to peak time needs (1/2/4 Hours)
- Events are triggered on **real time peak** & power shortage requirements
- Moving towards community involvement through DT-level events





Targeting Multiple Peaks

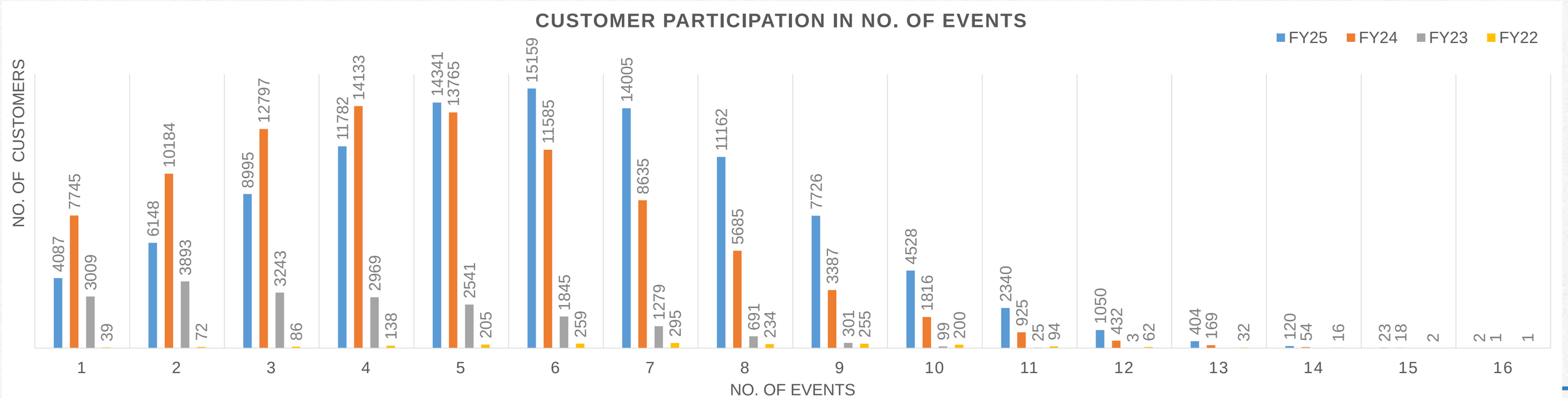
Learnings from the Programs

Constant customer engagement (Calls, SMS, WhatsApp) on sustainability premise gives better participation

Per capita residential customers give lower shed & is steady over the years

C&I customers are interested to participate based on incentives

M&V Platform along with smart meter backbone helps in data analysis & instant feedback to customers

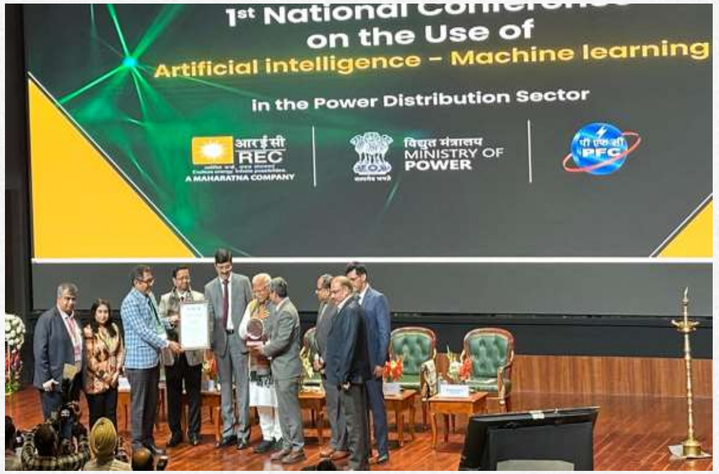


Policy Advocacy & Recognition

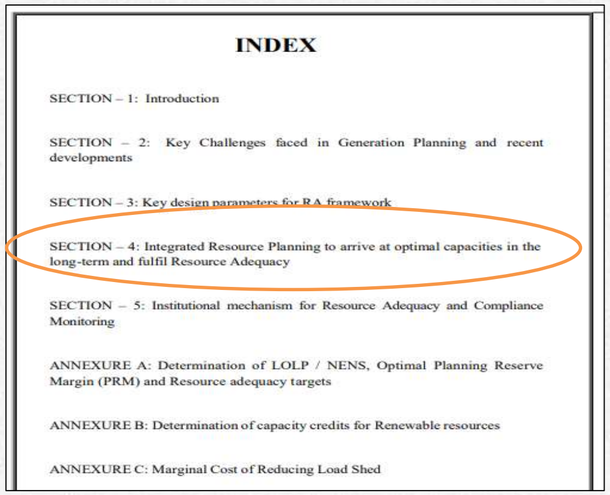
Policy Advocacy for mainstreaming Demand Response

- Interactions & sharing of results with **CEA (Resource Adequacy Program),** FoR, ISGF, CEEW
- State DISCOMS (Goa, Gujarat, Punjab)
- Showcased program to Mr Shashank Misra, JS Power ; DR has been **included in Smart Meter Technical Committee** as a successful use case of smart meter deployment
- **Petition** filed **in DERC** in May 25 for incentivizing customers & Discom for generating savings from BDR ; Matter admitted & appreciated & hearing is under progress due to persistent efforts (rejected earlier by regulator in 2021)
- Research paper in collaboration with IIT-Roorkee has been published in international journal

MoP Recognition - **1st prize** at the **National Conference** on use of AI/ML in Power Distribution Sector



Global Recognition- **International Smart Grid Action Network (ISGAN) Award**



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Full-length article

Leveraging enhanced consumer engagement to achieve demand response and flexibility in an Indian energy community

Robins Anto [a], Rhythm Singh [a,*], Dipanwita Ray [b], Syed Hasan Imam [b], Amit Arora [b]

[a] Department of Hydro and Renewable Energy, Indian Institute of Technology Roorkee, Roorkee, 247667, Uttarakhand, India

Voice of Customer

The Behavioral Demand Response Program is a great initiative by Tata Power Delhi Distribution under which we can save energy through optimum utilization. The energy saved can be used for essential requirements.

Vishal Vadhera
Pitampura

We received SMS from Tata Power-DDL regarding the Behavioral Demand Response Program which involved energy saving during the peak demand periods. My family used to switch off all extra lights, fans, ACs and sit in one room using single AC during the event.

Dr. Veeta
Malkaganj, New Delhi

25

We were excited to be a part of Tata Power-DDL's Behavioral Demand Response Program as this was a first-of-its-kind initiative that was being carried out. I used to switch off the television, and listen to music on my mobile phone during the designated events.

Shreya
Pitampura

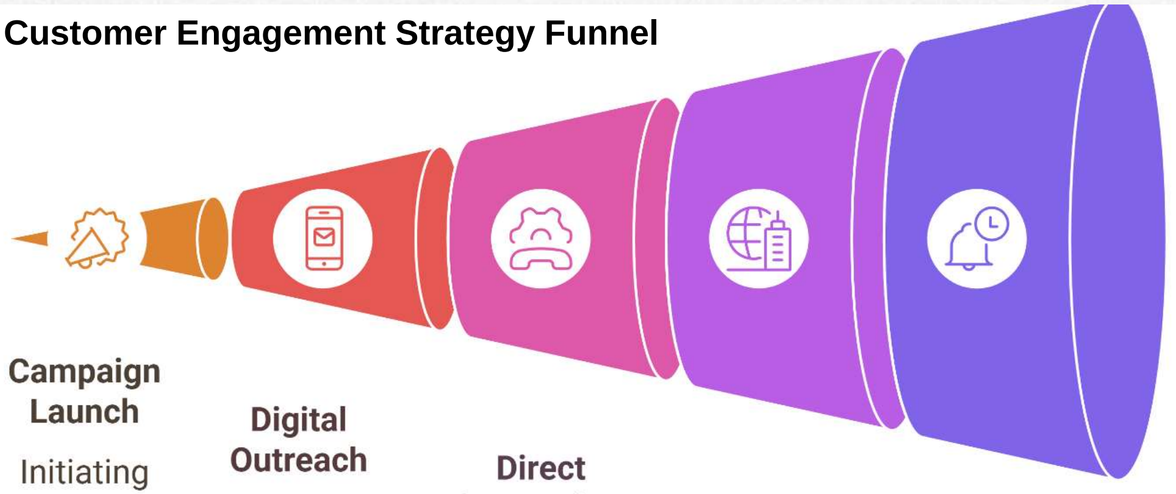
The Demand Response Program helped us save energy through minimum use of power during the designated slots. This is a great way towards building a brighter future for our country. After the completion of each of the events, we got confirmation about our successful participation.

Sumesh
Pitampura

Critical Success Factor - Customer Engagement

- **Engagement Strategies:**
  - **Awareness Campaigns:** Educate customers on the importance of DR.
  - **Webpage: Dedicated Webpage & Information on Mobile App**
  - **SMS: 70+ Lacs number of SMS**
  - **WhatsApp: 15+ lacs number of messages**
  - **One to One Calling: 2.3+ Lacs number of calls**
  - **Connect with RWAs: Engagement with 10+ Residential Welfare Associations (RWAs)**
  - **Notifications:** 24-hour advance alerts via SMS/WhatsApp, e-mails.
- **Behavioral Change:**
  - Increased participation in FY24 without incentives, indicating a shift in consumer behavior.
  - **Incentives:** Initially offered rewards but transitioned to voluntary participation.

Customer Engagement Strategy Funnel



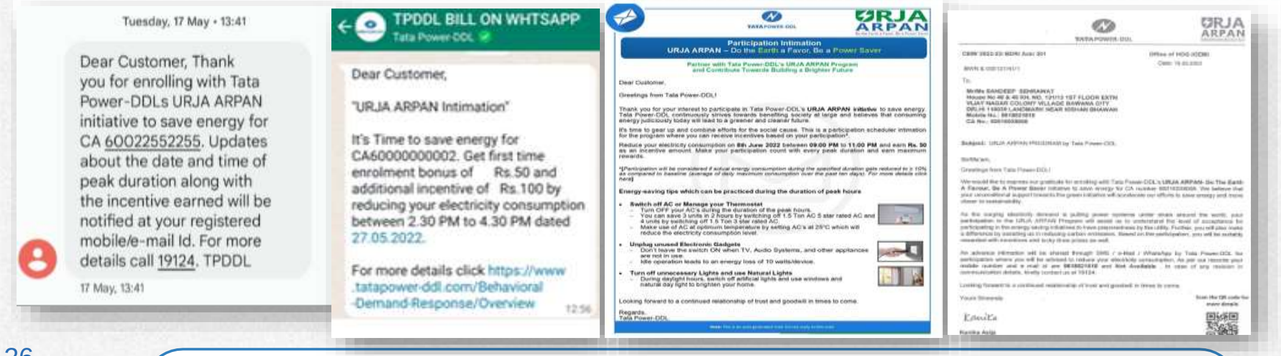
Campaign Launch
Initiating awareness through various channels

Digital Outreach
Engaging via SMS and WhatsApp messages

Direct Interaction
One-on-one calls for personalized engagement

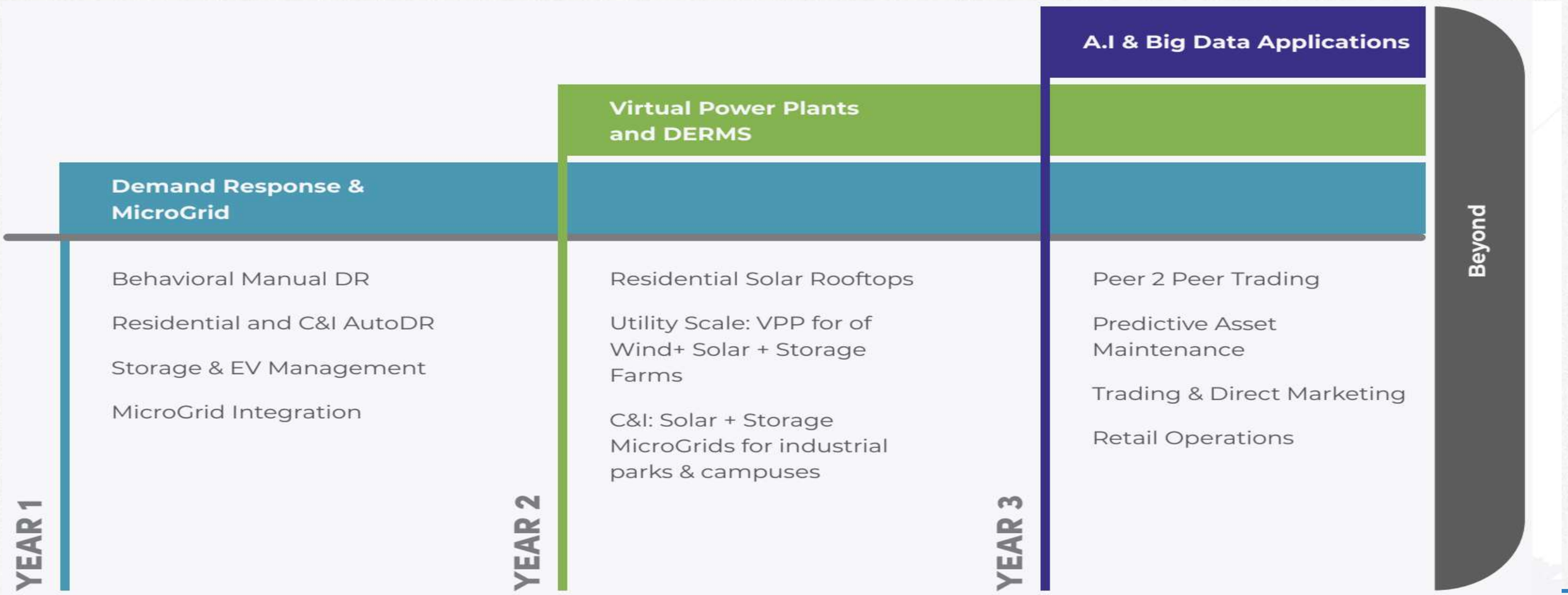
Community Engagement
Collaborating with residential associations

Timely Notifications
Providing 24-hour alerts and updates



India : Regulatory Requirements for Flexible Resourcing Model

- **Tariff support for Critical Peak Rebate across all segments of customers**
- **Framework for Time Of Use metering**
- **Open Standard for DERs connectivity**



Thank You