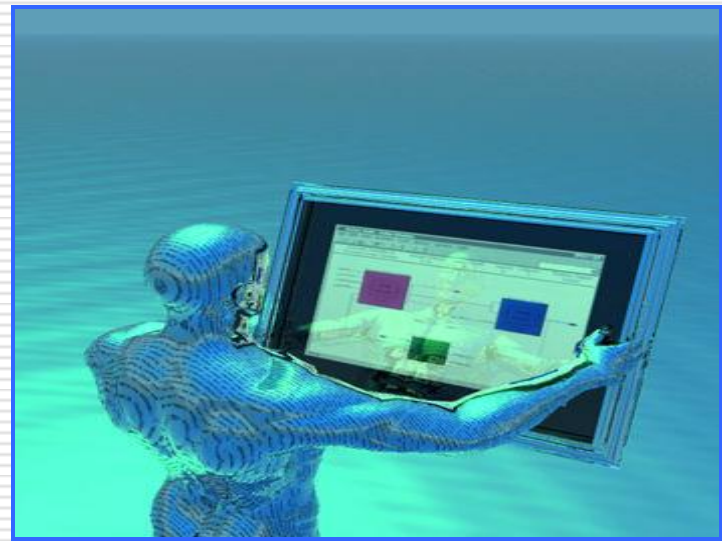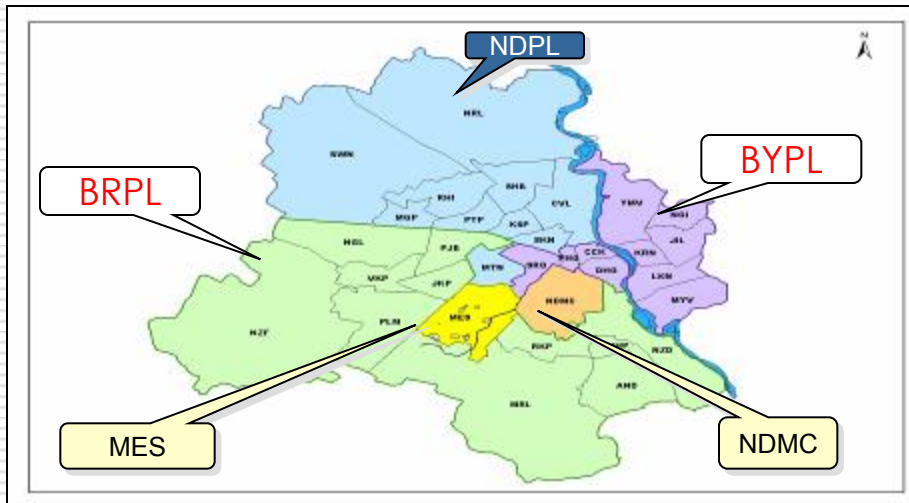# India Smart City Mission

Inputs from a Electricity DISCOM.

Rajesh Bansal, Sr Vice President , BSES Delhi

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BSES Delhi Discoms – A Synopsis

Reliance Infrastructure Ltd. acquired 51% stake in July 2002 in two Discoms

| Sl No	Particulars	Unit	BRPL
1	Area	sq. km	750
2	Total Registered Customer	Million	2.2
3	Peak Demand **	MW	2,685
4	Consumption per Year	MU	12036
5	Employees	MU	10,398
6	Customer Density	Nos / Km	2,653

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*** As on Date*

Understanding Electricity Distribution

To meet "Demand Curve" with Efficiency and Reliability

Efficiency Means : Low power cost, low loss, low operational

Cost, best customer services.

Reliability Means : Power quality and Availability

Power Distribution is not management of Peak 100 Hrs
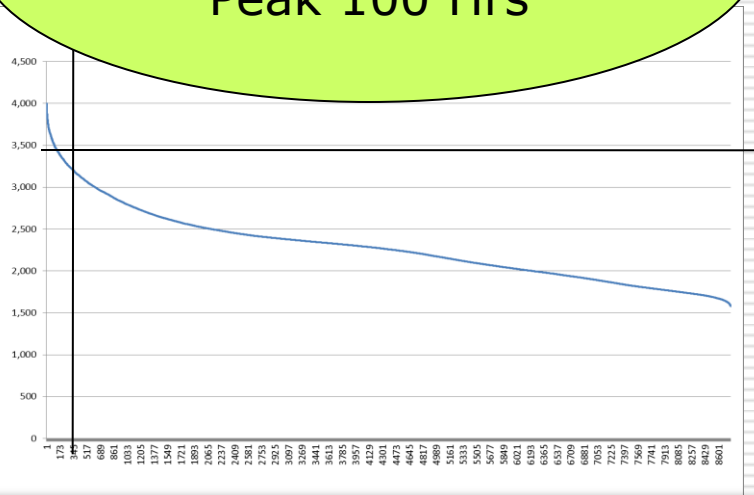
➢Demand is due to user and variable.. It varies every moment.

➢ Major type of generation is fixed in nature. Renewable are unpredictable.

➢**Electricity distribution is a challenge to meet "variable demand" with "Fixed + unpredictable" generation.**

Top 8 to 13% of Peak power demand is for approx 100 Hrs.

Smart Technology………….

☐ ## Why New Technology:

  ➢ **To address new expectations**
  ➢ **To address the issues**
  ➢ **Better efficiency**
  ➢ **Better services**

☐ ## Why smartness:

  ➢ **Ability to monitor**
  ➢ **Ability to detect**
  ➢ **Ability to predict**
  ➢ **Ability to Guide**
  ➢ **Ability to correct**

Electricity plays the most important role in every body life…………….
Thus a key parameter of Smart City Mission

The key is not to implement technology………….
Key is Vision and its achievement

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India Smart City – Energy management

Smart Solutions

ILLUSTRATIVE LIST

E-Governance and Citizen Services

1 Public Information, Grievance Redressal
2 Electronic Service Delivery
3 Citizen Engagement
4 Citizens - City's Eyes and Ears
5 Video Crime Monitoring

Energy Management

13 Smart Meters & Management
14 Renewable Sources of Energy
15 Energy Efficient & Green Buildings

Urban Mobility

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Eight critical pillars of India's Smart City Program

☐ **Smart Energy:** Three crucial dimensions of smart energy systems are:

➢ **Smart Grid**:

  ❖ Electrification of all households with power available for at least 8 hours per day by 2017

  ❖ Establish smart grid test bed by 2014 and smart grid knowledge centre by 2015

  ❖ Implementation of 8 smart grid pilot projects in India with an investment of US$10 million

➢ **Energy Storage**:

  ❖ Addition of 88,000 MW of power generation capacity in the twelfth five year plan (2012-17)

  ❖ India needs to add at least 250-400 GW of new power generation capacity by 2030

  ❖ The Power Grid Corporation of India has planned to invest US$26 billion in the next five years

➢ **Smart Meters:**

  ❖ India to install 130 million smart meters by 2021

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USA Vision for Smart Grid

Self-healing from power disturbance events

Demand response – enabling active participation by consumers

Operating resilience against physical and cyber attacks

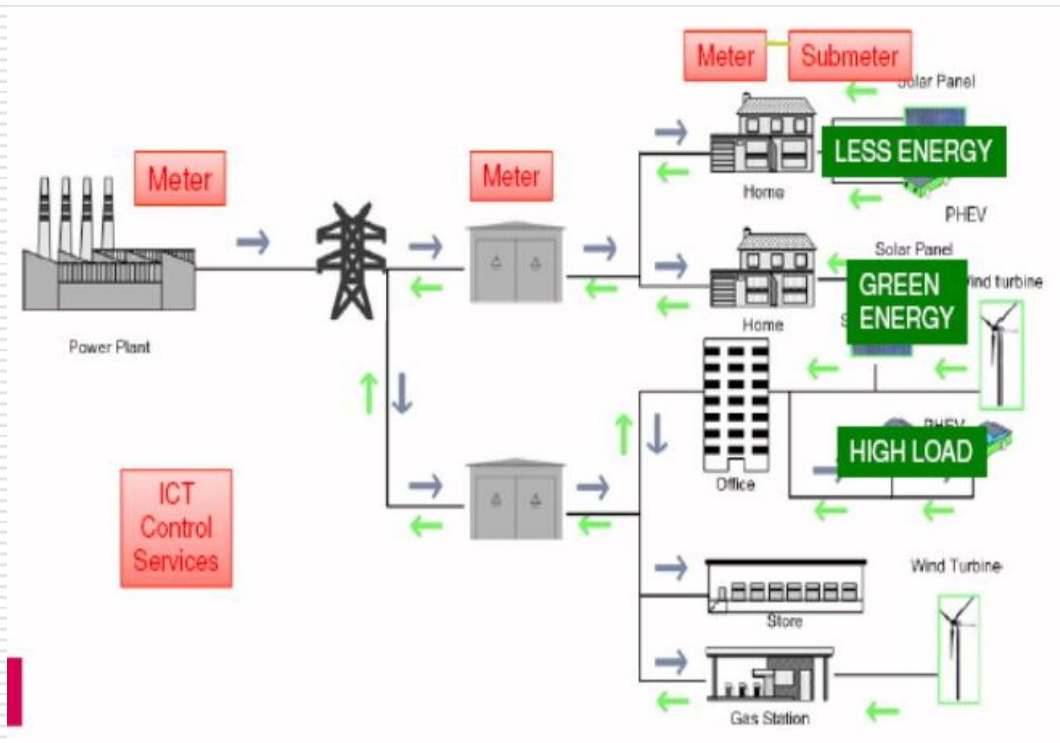Providing power quality for 21st century needs

Accommodating all generation and storage options

Enabling new products, services and markets

Optimizing assets and operating efficiency

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Smart Grid – A definition

Smart Grid = Technical Grid + Smart ICT Control Services

ICT = Information Communication & Technology

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Smart Grid - Data flow

USA Vision for Smart Grid

- Self-healing from power disturbance events
- Demand response – enabling active participation by consumers
- Operating resilience against physical and cyber attacks
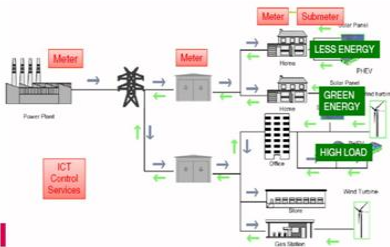- Providing power quality for 21st century needs
- Accommodating all generation and storage options
- Enabling new products, services and markets
- Optimizing assets and operating efficiency

Smart Grid – A definition

Smart Grid = Technical Grid + Smart ICT Control Services

ICT = Information Communication & Technology

Data generation		Smart Meter
Data collection		Communication network
Data processing		Server
Data analytics		Vendor??? User???
Decision & action		Management Interface device

Key is what bring smartness in Distribution ??

Energy Meter has multiple Roles and Affects All Stakeholders

- Tariff compliance
- SLA compliance
- Information to customer
- Supply quality
- Billing dispute
- Street lights

- Network health
- Network Planning
- Outage management
- Fault prediction
- Supply quality
- Field team efficiency

Customer And Regulator

Utility Operations

Utility Balance Sheet

Govt. Future Policy

- Cash box
- Theft control
- Prepayment system
- Non payment – disconnect
- Revenue cycle
- Other business

- Service level norms
- Renewable integration
- Electric vehicles
- Load growth forecasting
- DSM & EE
- Other services

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Smart Grid - Planning

|			
Important →	Data generation		Smart Meter
Very costly →	Data collection		Communication network
Must →	Data processing		Server
Must →	Data analytics		Vendor??? User???
Desirable →	Decision & action		Management Interface device

**It is "Data Analytics" which bring smartness.
Its enhance Value of Investment**

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SMART Metering Philosophy

- **Smart Metering is not just – Data Generation & collection**

- **Analytics is not just – graph/ chart for data presentation**

- **Analytics is finding "Objective" from Reality**

- **Smart Metering should be Objective oriented.**

- **Analytics can also be initiated without Smart Grid.**

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Understanding Analytics

A BSES Concept
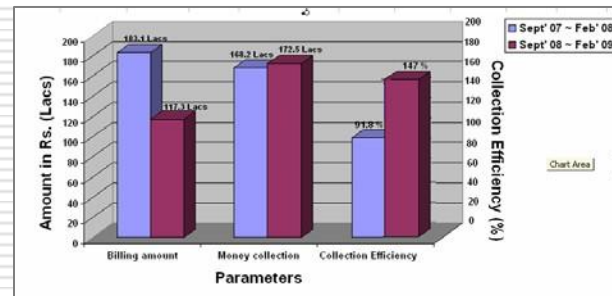
Analytics – Must for Smartness

What is Analytics……

To find Objective from Reality is the Analytics

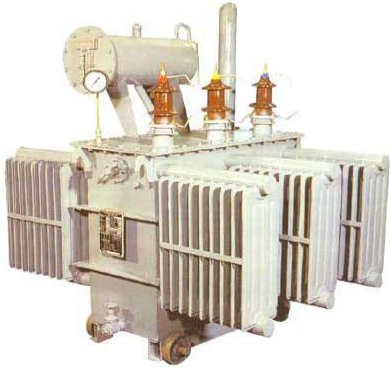- •Sensor do measurement
- •Sensor log events
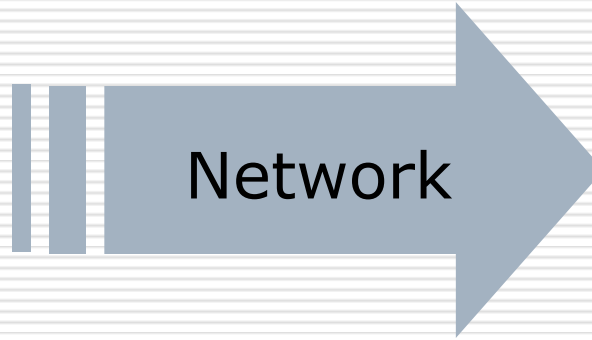
↓

Data is reality

Discom can Have Many objectives
- •Theft
- •Outage

↓

Reliable and efficient power is objective

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Network Health

Supply side

Network

Consumer end

Abnormal Power quality – depends upon network health

Analysis of Supply end Meter data and consumer end meter – helps to know Network Health

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Relation between consumer supply & Network

Grid supply quality

Network Health & installation quality

Consumer end meter parameters

Meter health and installation quality

Consumer load – Characteristics

By analyzing abnormalities in consumer meter data Cause including theft can be identified.

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Network Stress

Network Health – 11 KV feeders, Power/distribution Transformers

Importance of network health

❑   **Network technical loss**
❑ **Break down**
❑ **Load growth plan**
❑ **Capital investment optimization**
❑ **Effect on electricity quality**

Key parameters	Analysis- Asset wise
• **Phase-wise Current & voltage** • **Peak KVA** • **Power On/Off** • **Power factor** • **KVAr generation**	• **Overloading/underloading** • **Load Unbalancing** • **Unbalance voltage** • **Power availability** • **Low power factor**

Monitoring can be extended to ACB level for LT feeders

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Network Stress

Power Factor Planning

❑**Key parameters**

- ■ **Power factor at Grid/DT/consumer end with lag & lead**
- ■ **Location of DT/consumer on feeder**
- ■ **KVAr drawl- maximum & minimum values**
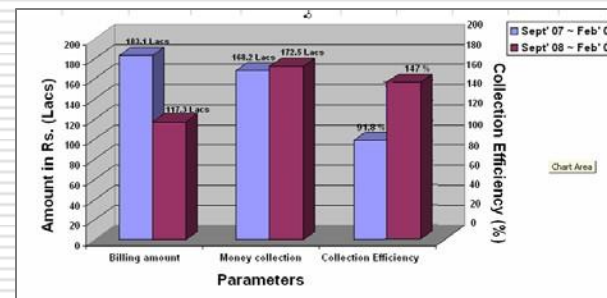- ■ **Distance between assets**

❑**Analysis**

- ■ **KVAr requirement**
- ■ **Location of capacitors**
- ■ **Working status- already installed APFC**

APFC installation requires comprehensive analysis

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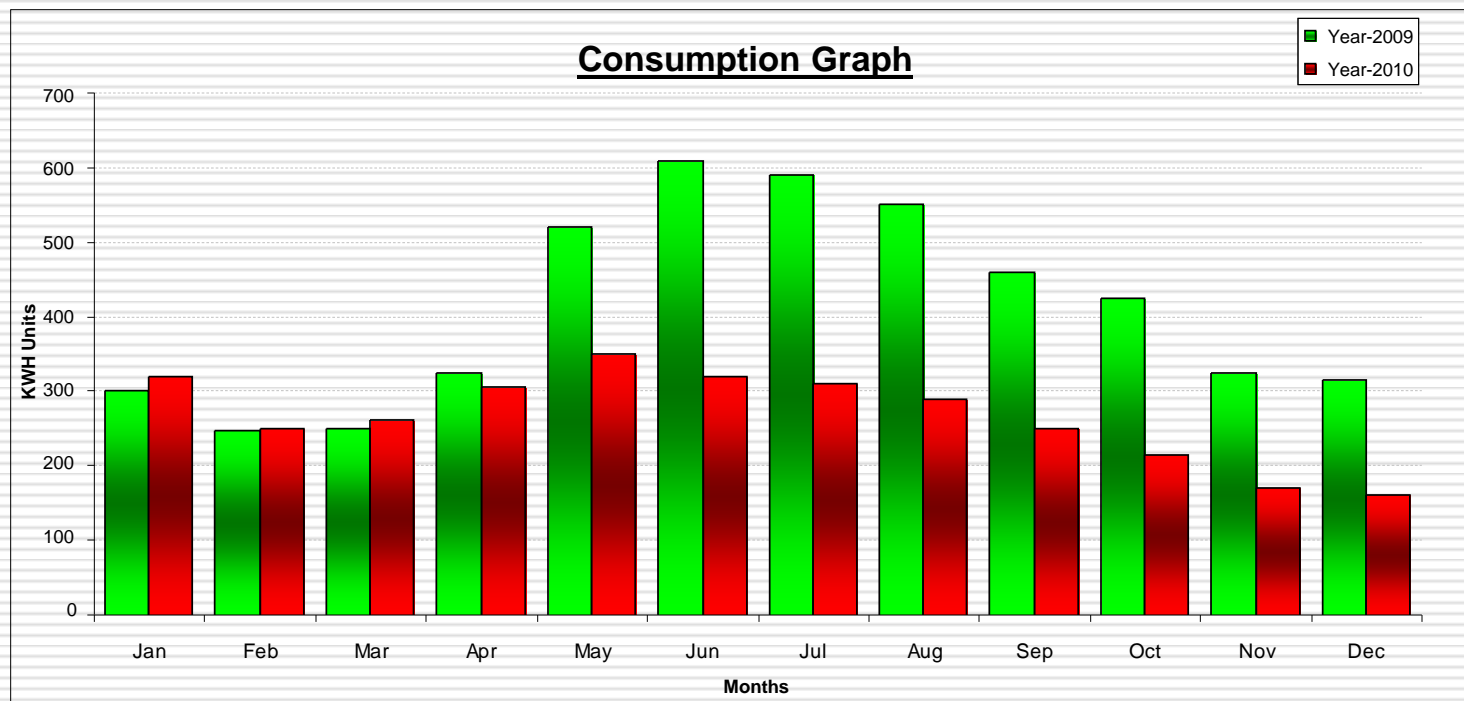# Five Maturity level of Energy Theft Analytics

A BSES Concept

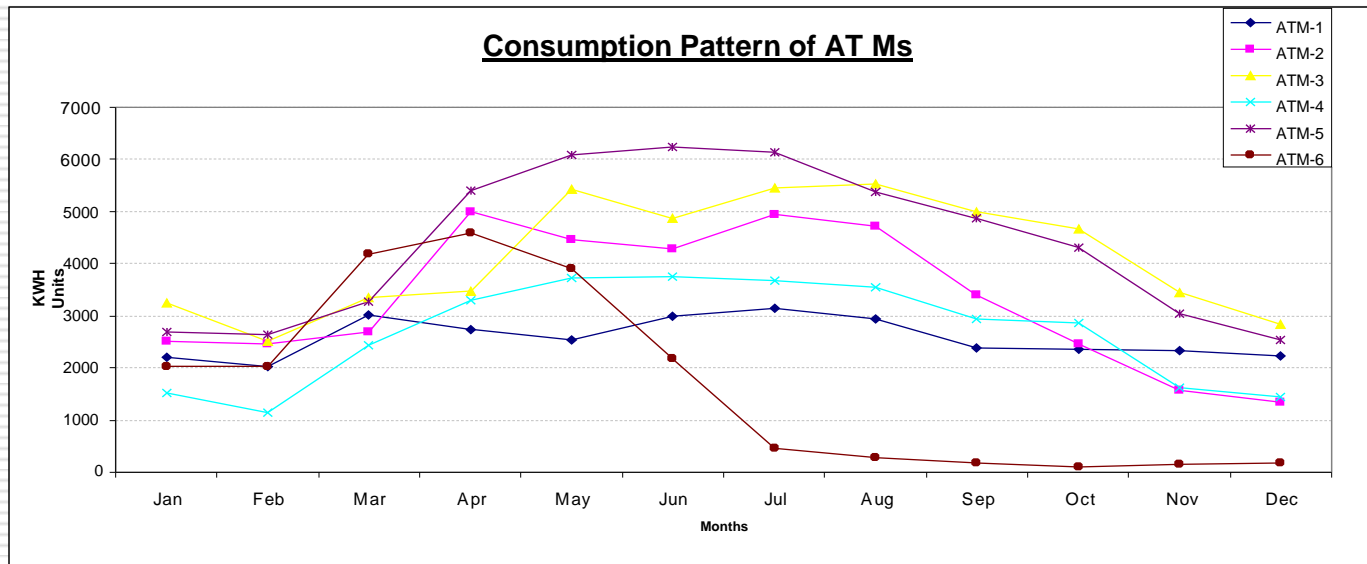# Theft Analytics – Maturity level 01

Consumption Based Analysis

- Simplest Method
- Low strike rate
- Cannot be treated as evidence for theft.

Consumption Graph

Legend: ■ Year-2009 ■ Year-2010

X-axis: Months (Jan–Dec)
Y-axis: KWH Units (0–700)

Theft Analytics – Maturity level 02

Consumption With Survey Data

- Other information need to be obtained from secondary source (e.g. activity, operating hours, premise size etc)
- Similar consumers need to analyzed by comparing these data.
- High level of experience is need to carry out bench marking.

Consumption Pattern of AT Ms

Theft Analytics – Maturity level 03

Tamper Events

- Program meter so as to Identify abnormalities and log events.
- Analyze Logged events and consumption pattern and Identify theft.
- Leads to high strike rate.
- Can only identify theft according to predefined criteria.

Target – 90% and above success rate
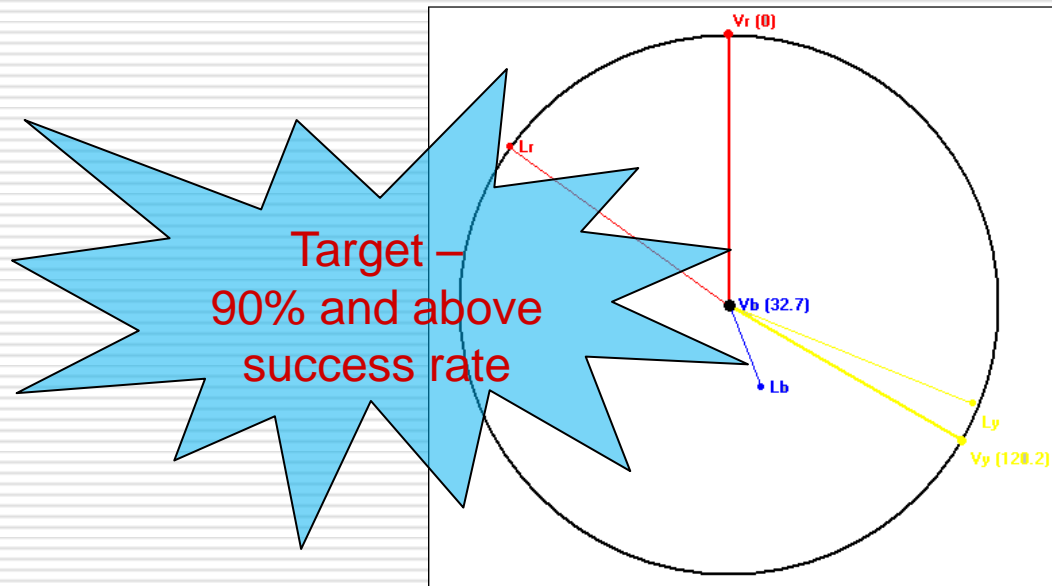
Theft Analytics – Maturity level 04

Instantaneous Parameter

- Meters also log instantaneous parameters such as voltage, current, PF, power on/off etc.

- Analyze the instantaneous parameters pattern and variations to identify theft.

- **Key is Logics** - Relation between theft method and its impact on meter parameters.

- Once relations are established then it is easier to filter the cases.

- Extensive knowledge of metering and electrical engineering is required.

- **Very high strike rate -- Wider acceptance by judiciary.**

Today BSES has 125 Logics

E.g.:-

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Theft Analytics – Maturity level 04

Voltage curve for 2 consumers in same locality

Curve due to abnormal power fail
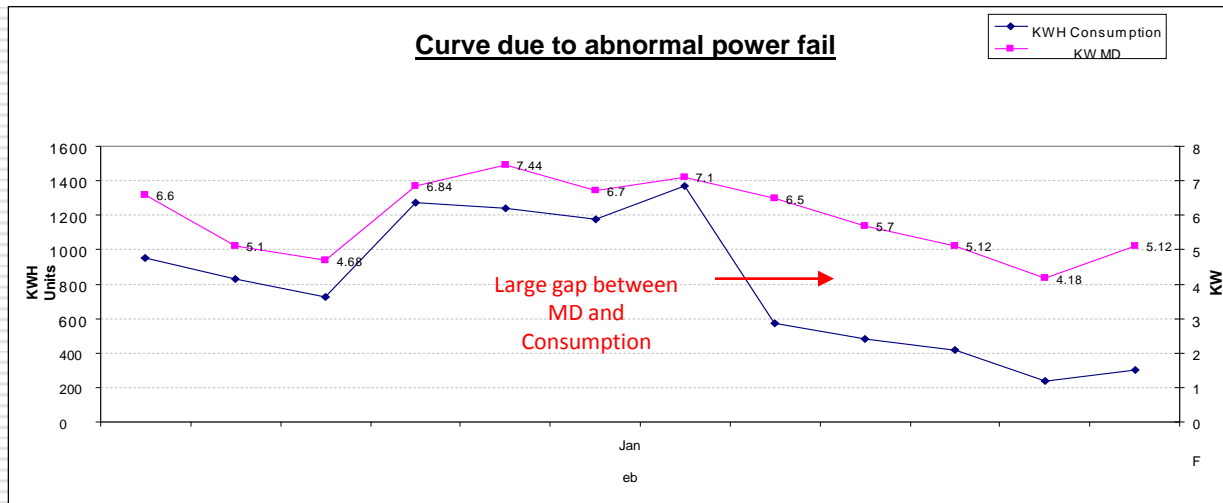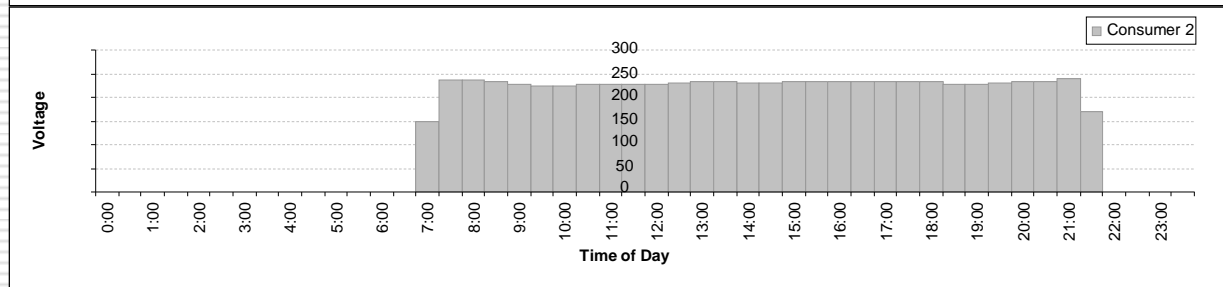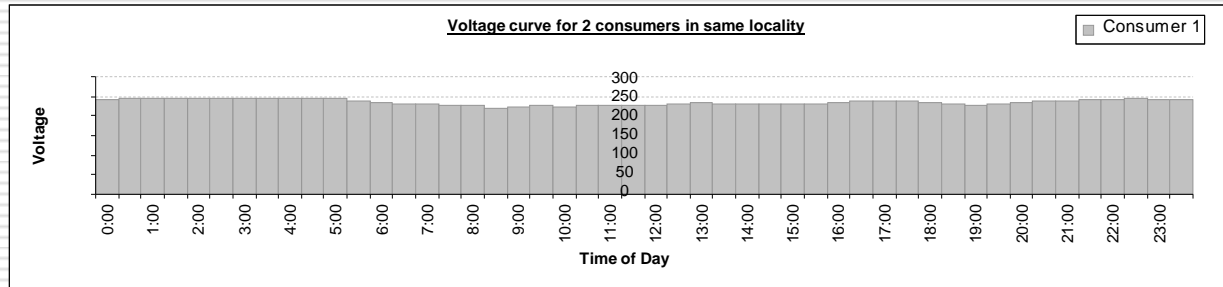
Five Maturity Level of Analytics

Level 05

- A system born from experience and continued analysis.
- A flexible system which learns from past issues, predicts the likely trends for future/unforeseen issues and keeps learning from its experience.

Scope of Artificial Intelligence - <u>concept can be extended</u>

- To identify faulty meters & quality problem etc.
- To identify consumers who may default
- Consumers who will increase their load requirements etc.

Average curve for domestic consumer for a day

Legend: Domestic Domestic (Theft)

MD Kwh

Average typical curve for a domestic consumer

Curve observed for consumers found involved in theft
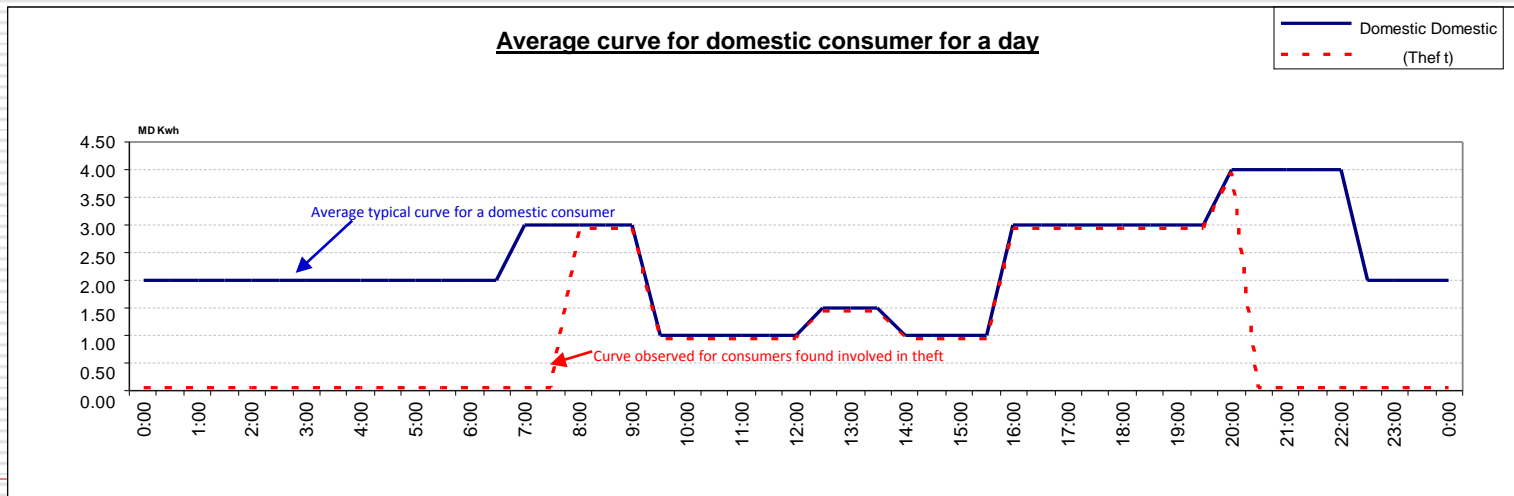
AT&C Loss Reduction Performance

BSES DELHI

Legend: ■ BYPL ■ BRPL

Year	BYPL	BRPL
2002-03	61.88	47.4
2003-04	54.29	45.06
2004-05	50.12	40.64
2005-06	43.88	35.53
2006-07	39.03	29.92
2007-08	29.5	27.1
2008-09	23.2	21.1
2009-10	21.1	19.2
2010-11 target	17	15

Year analytics initiative was started
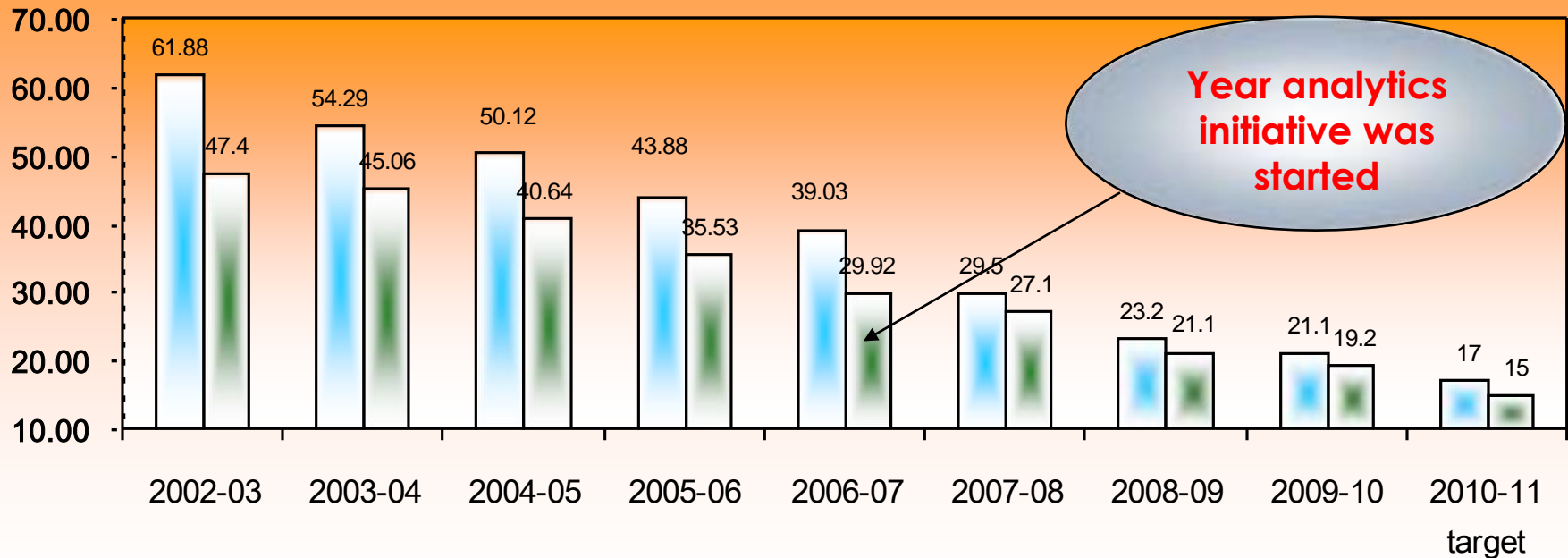
BRPL loss In FY 15-16----- 12.7%.

Feeders Tail End Meters Very crucial
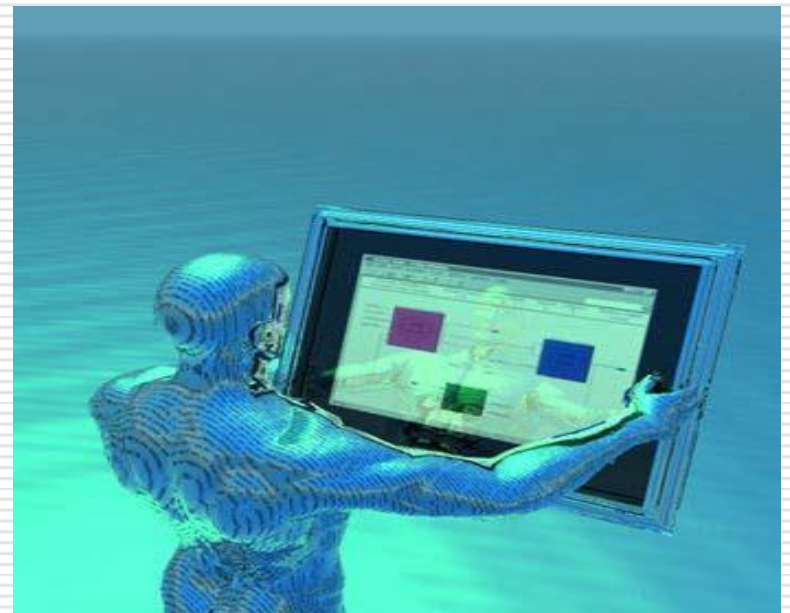
Rajesh Bansal, Head (EMG), BSES Delhi

Outage Management Flow – DT/Tail end

Complaint to call centre

Based on phone / KNO tagging, Consumer plotted on GIS

GIS

No load change at DT

Major load change at DT

Load at DT becomes Zero

DT voltage is zero

DT Automation Software helps in operational decisions.

OMS Software

SMS

Field Operational level

All Tail End voltage OK

Tail End voltage = 0

All Tail End voltage = 0

Local fault

LT feeder level

ACB level

11 KV feeder level

BS

More calls from area

Outage Team

Network Stress – comparing Tail end voltage

Voltage drop in network

❑ **Key parameters**

- ■ **Voltage at Grid/DT end**
- ■ **Voltage at Tail end consumer**
- ■ **DT & consumer location on feeder**

❑ **Analysis**

- ■ **Voltage drop represent the technical loss in network.**
- ■ **Higher voltage drop means network under stress**
- ■ **Variation of Vdrop with load change –input for Vregulation**
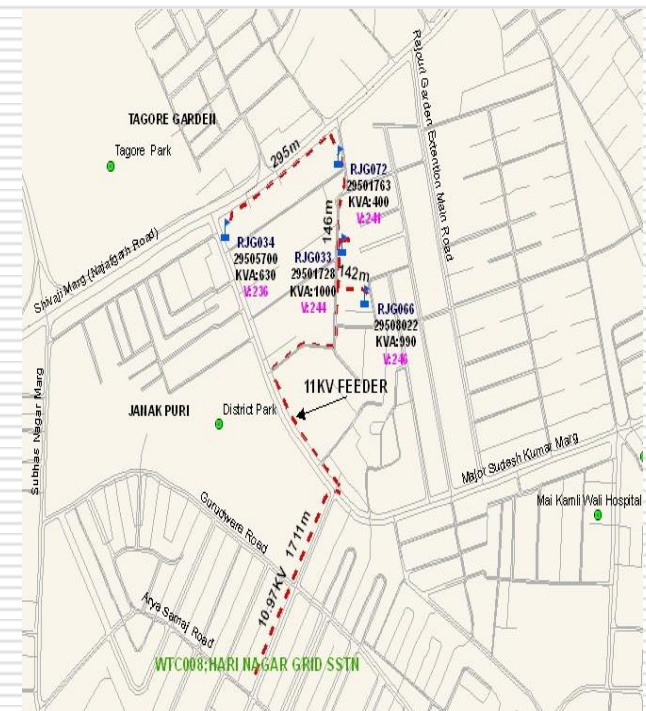
Voltage drop is the easiest way to estimate technical loss & voltage regulations

DSM Emerging trend - Voltage control

Principal

➢ Typical consumer voltage 220 ~ 230V.

➢ The allowable tolerance +/- 6%

➢Wattage consumption depends upon voltage

By controlling instantaneous voltage –

consumption in MW can be controlled

Typical thumb rule – 1% V effects 1.3% power consumption

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Delhi distribution scenario

2002

NOW

2002	NOW
Age Old Network	Reliable Network
High Theft > 50%	Loss level 12.7%
Power outage ~ 25%	Less than 1%
Govt. subsidy Rs 12 billion/yr	"NO UDAY !!"

Chandni Chowk, June 2002

Sharing views based on this journey

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Power 24 X7 Status
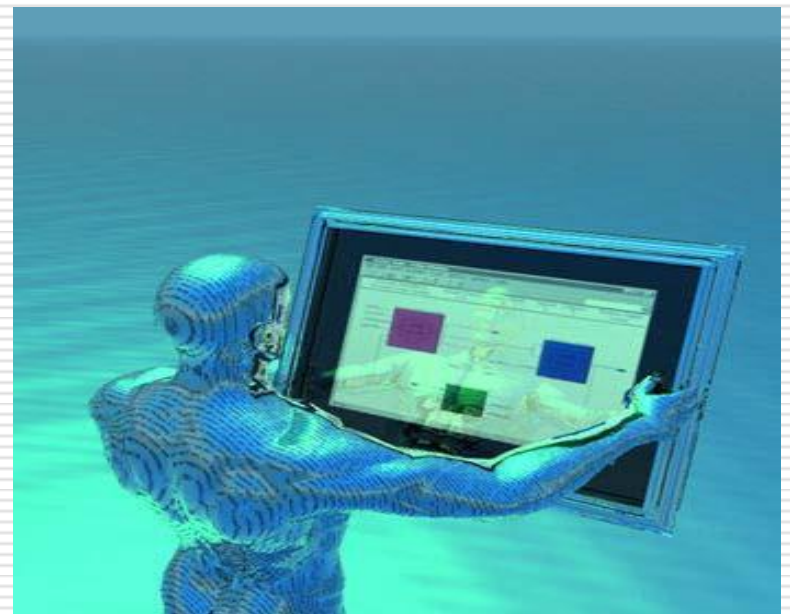
Rajesh Bansal, Head (Network) , BSES Delhi

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Power For all ….. 5 Maturity Levels

DELHI IS IMPROVING , HAS REACHED ALMOST / AROUND LEVEL 4

**Experience summer 2016
Fear we may travel back wards**

Level 5 – Capability to sustain main faults.

Level 4 – Self healing/ Redundancy in network to ensure supply even of small fault
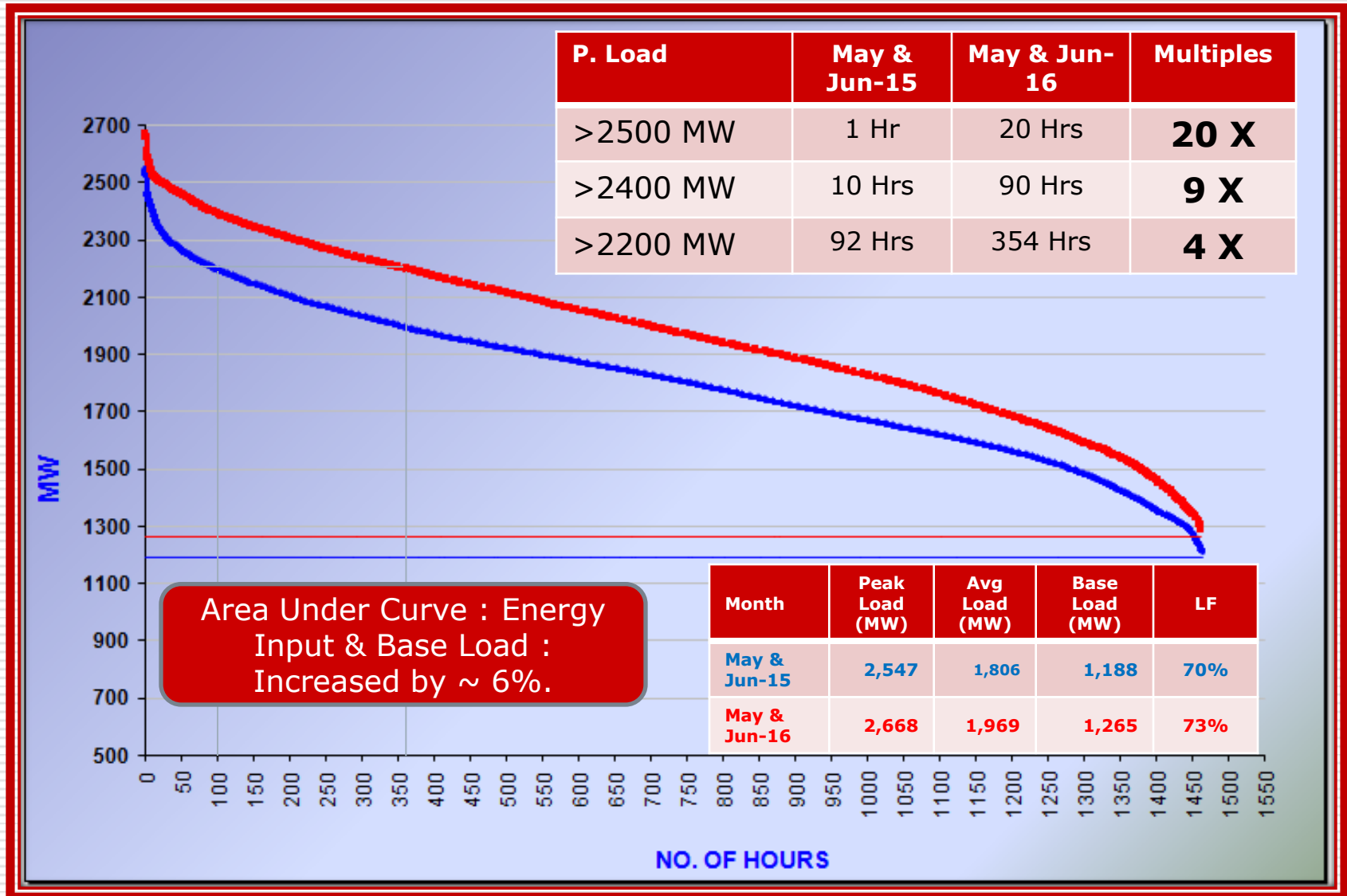
Level 3- Infrastructure capable to supply 24X7

Level 2- Getting minimum 8 hrs supply

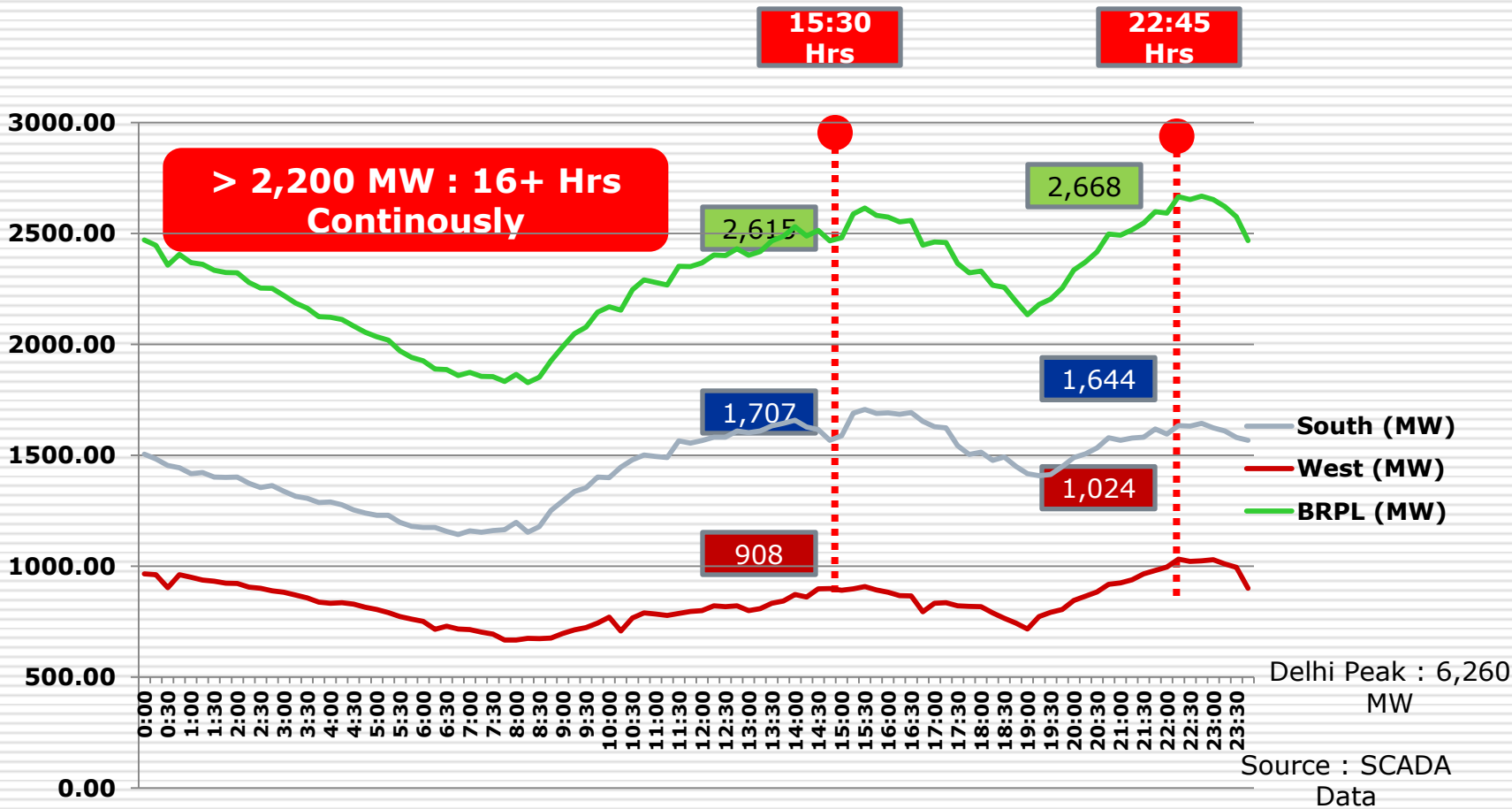**Level 1 - Every Body has electrical connection, connected to network**

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High Energy Growth in June-16

	Division Wise Energy Input Report : June'16			
Sl. No.	DIVISION NAME	Total (Mus) June'16	Total (MU's) June'15	% Change
1	ALAKNANDA	75.68	69.91	8.25%
2	HAUZ KHAS	74.76	66.87	11.81%
3	KHAN PUR	61.96	54.17	14.37%
4	NEHRU PLACE	71.09	69.13	2.84%
5	NIZAMMUDIN	81.99	72.26	13.47%
6	R.K.PURAM	51.41	49.54	3.76%
7	SAKET	125.37	110.78	13.17%
8	SARITA VIHAR	117.56	107.99	8.86%
9	VASANT KUNJ	117.24	103.73	13.02%
10	DWARKA	75.84	65.09	16.51%
11	JAFFARPUR	21.72	18.46	17.63%
12	JANAK PURI	106.58	96.80	10.10%
13	MUNDKA	42.18	36.23	16.42%
14	NAJAF GARH	59.19	47.97	**23.37%**
15	NANGLOI	65.80	58.42	12.62%
16	PALAM	75.86	64.83	17.01%
17	PUNJABI BAGH	57.01	50.68	12.50%
18	TAGORE GARDEN	73.87	63.22	16.84%
19	VIKAS PURI	103.59	87.40	**18.53%**
	Total	**1458.72**	**1293.51**	**12.77%**

34 **BSES**

Unexpected growth defeat planning

BRPL Load Duration Curve – May & June 16

P. Load	May & Jun-15	May & Jun-16	Multiples
>2500 MW	1 Hr	20 Hrs	**20 X**
>2400 MW	10 Hrs	90 Hrs	**9 X**
>2200 MW	92 Hrs	354 Hrs	**4 X**

Area Under Curve : Energy Input & Base Load : Increased by ~ 6%.

Month	Peak Load (MW)	Avg Load (MW)	Base Load (MW)	LF
May & Jun-15	2,547	1,806	1,188	70%
May & Jun-16	2,668	1,969	1,265	73%

MW

NO. OF HOURS

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Peaks are occasional, However BRPL faces it persistently

BRPL Load Curve : 30-June-16 – Typical Behavior of Peak Load

15:30 Hrs

22:45 Hrs

> 2,200 MW : 16+ Hrs Continously

2,615

2,668

1,707

1,644

1,024

908

South (MW)
West (MW)
BRPL (MW)

Delhi Peak : 6,260 MW

Source : SCADA Data

1. Load >2,200 MW : Persistent for more than 16 Hrs
2. BRPL network faces peak 2 times in a day : Increasing stress on network
3. Between 2 peaks : South Reduces by 4% ; West Increases by 13%

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Though BRPL Peak of 2,668 MW,
Network needed for 1,707 (S) + 1,024 (W) = 2,731 MW

Space constraints and encroachment

➢Increasing demand – No space for augmentation/ new infrastructure.

➢Narrow lane – safety clearance from balcony

➢Houses beneath HT/ EHT line.. Prone for accident/ assess ability issue. Frequent tripping.

➢Vehicle and material movement constraints

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Unauthorised construction need a policy.
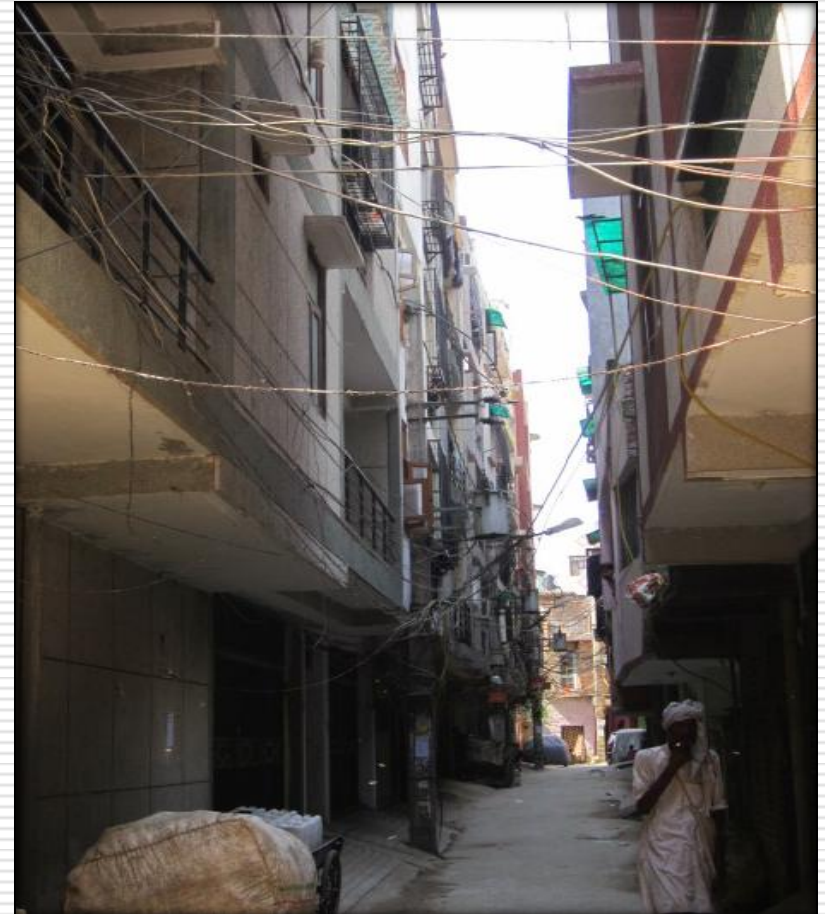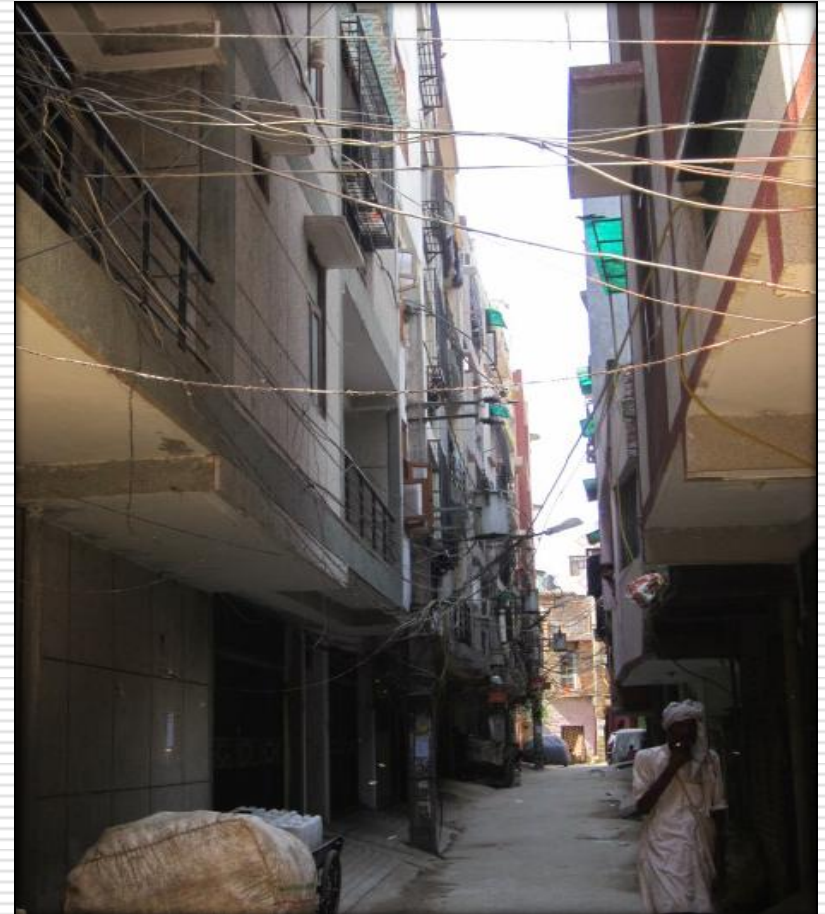
Other issues…..

Un-authorised Colonies

Direct theft damaging assets

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Safety issue....

> Usage of safety devices ... How to ensure even though ELCB/ RCCB is must.

> Horizontal clearance

> Tress and Poles both on pavement. Tree trimming a issue.

> Houses beneath the HT/ EHT wire

Good service ask for disciplane also.

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Suggestions ….

ICT will generate Data. Usage of data is essential.

Smartness come from analytics. For objective oriented Data usage , use domain experts. Analytics of exiting should be started.

Having Safety Regulations is good. But need mechanism for implementation.

Only technology will not solve the issue. Need consumer awareness program. We also need Sociologist.

All stakeholders have to understand their role.

**If "Infrastructure" we treat as "Human Body"
Then "Data Is blood" and " Analytics is Brain"
And "Society is Soul "**

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Thank You

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Email: rajesh.m.bansal@relianceada.com

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