“Transition from traditional Discom to Smart Utility.”

Praveer Sinha,
CEO & MD
Tata Power Delhi Distribution Ltd.
Perceptible Change

Then
Perceptible Change

Then
Installation of Latest Substations, Circuit Breaker etc. along with Network Revamping
initiatives @ Tata Power-DDL

Metering, Billing & Collection System

Mobile App

Instant Connection

Video Conference

SMS based pull services

Automatic Payment Machines ~6700 pyt avenues

Spot Billing

Integrated Web Services

Smart Revenue Recovery Device
Details of the customer & Customer Count

OMS

Details like repair history, Crew comments, ETR also visible at SAP-CRM

SCADA

Integrated GIS-OMS-SCADA-CRM

Outage status updated on TPDDL website with estimated time of restoration

SAP - CRM

Interactive Voice Response (IVR) system
Information Technology (IT)
Operation Technology (OT)
Supervisory Control and Data Acquisition (SCADA)
Outage Management System (OMS)
Demand Side Management (DSM)
Geographic Information System (GIS) — Winner of Edison Award 2008
Automatic Meter Reading (AMR)
SAP’s Industry Specific Solution for Utilities Industry (SAP-ISU)
24*7*365 Centralized Call Center
Automated Demand Response (ADR)
Mobility Services
Solar Rooftop PV Projects
Project Management Consultancy
Capacity Building
we believe in .........

**MAKING A DIFFERENCE**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>July '02</th>
<th>March'17</th>
<th>% change</th>
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<tr>
<td><strong>OPERATIONAL PERFORMANCE</strong></td>
<td></td>
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<tr>
<td>AT&amp;C Losses</td>
<td>%</td>
<td>53.1</td>
<td>8.59</td>
<td>85%</td>
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<tr>
<td>System Reliability – ASAI -Availability Index</td>
<td>%</td>
<td>70</td>
<td>99.51</td>
<td>41%</td>
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<td>Transformer Failure Rate</td>
<td>%</td>
<td>11</td>
<td>0.84</td>
<td>90%</td>
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<td>Peak Load</td>
<td>MW</td>
<td>930</td>
<td>1791</td>
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<tr>
<td>Length of Network</td>
<td>Ckt. Km</td>
<td>6750</td>
<td>15378</td>
<td>128%</td>
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<tr>
<td>Street Light Functionality</td>
<td>%</td>
<td>40</td>
<td>99.41</td>
<td>150%</td>
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<tr>
<td><strong>CONSUMER RELATED PERFORMANCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>New Connection Energization Time</td>
<td>Days</td>
<td>51.8</td>
<td>5</td>
<td>90%</td>
</tr>
<tr>
<td>Meter Replacement Time</td>
<td>Days</td>
<td>25</td>
<td>5</td>
<td>80%</td>
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<tr>
<td>Provisional Billing</td>
<td>%</td>
<td>15</td>
<td>0.86</td>
<td>94%</td>
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<tr>
<td>Defective Bills</td>
<td>%</td>
<td>6</td>
<td>0.13</td>
<td>98%</td>
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<tr>
<td>Bill Complaint Resolution</td>
<td>Days</td>
<td>45</td>
<td>4</td>
<td>91%</td>
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<tr>
<td>Mean Time to Repair Faults</td>
<td>Hours</td>
<td>11</td>
<td>1.50</td>
<td>87%</td>
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<tr>
<td>Call Center Performance - Service Level</td>
<td>%</td>
<td>-</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Payment Collection Avenues</td>
<td>Nos.</td>
<td>20</td>
<td>6725</td>
<td>33525%</td>
</tr>
<tr>
<td>Consumer Satisfaction Index</td>
<td>%</td>
<td>-</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td><strong>OTHERS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capex (Cumm)</td>
<td>Mn USD</td>
<td>187</td>
<td>984</td>
<td>428%</td>
</tr>
<tr>
<td>Consumers</td>
<td>Count Mn</td>
<td>0.7</td>
<td>1.58</td>
<td>126%</td>
</tr>
<tr>
<td>Employees</td>
<td>Count</td>
<td>5600</td>
<td>3537</td>
<td>37%</td>
</tr>
</tbody>
</table>

*One of the Most Successful Private Power Distribution Utility*

License Area: North and North West Delhi (510 sq. km)
License Period: 25 years

Transformation at Glance
The cumulative savings to Delhi Government has been nearly Mn USD 8923 due to Delhi Discoms and Mn USD 3385 on account of Tata Power-DDL. This has allowed the Government to utilize funds in other infrastructural development activities such as Metro rails, building elevated roads, flyovers, education support and social support.

Benefits to Government: Savings
Managing Transition – Public Perception & Political Implications

A holistic approach from all five quarters is essential for delivering sustainable stakeholder value

- Managing Transition
- Government Support and Conducive Regulatory Environment
- Change Management and Mitigating Employee and Union Issues
- Implementation of world class technology and network upgradation
- Financial Prudence
A Revamped Distribution Business Model Post Pvt. Sector Participation

Financial Prudence
- Pragmatic Valuation – Business Valuation or Asset Valuation Concept
- Transfer of Clean Balance Sheet
- Accurate Base Line Data determination
- Equitable Risk Allocation

Government Support & Conducive Regulatory Environment
- Financial Endowment
- Progressive & Clear-cut Policy Directions
- Robust Governance Structure
- Stern Legislations for improving revenue realization
- Establishment of Regulatory Framework
- Concurrence on Performance Targets
- Progressive Policy Directions
- Rational & Opportune Tariff Determination

Change Management & Mitigating Employee & Union Issues
- Skill development
- Progressive Policy Directions
- Tripartite Agreement for employee security
- Creation of Govt. run Trust for Retiral benefits
- Better growth avenues and facilities for the continuing employees
- Fair treatment to all by deployment of transparent HR policies & practices
- Stern & prompt action on violation of ethics

Implementation of world class technology and network upgradation
- Deployment of Technology Road Map
- Replacement of old network
- Auto monitoring
- Implement innovative solutions to improve power quality and reliability
Tata Power-DDL: Future Proof

Tata Power-DDL has collaborated with 78 partners

Technology Partners
- IBM
- 3M
- Enel
- Silver Spring
- Honeywell
- Siemens
- Omron
- IMONITOR
- INNOVARI
- GE
- Pyeong University
- Stanford University
- Berkeley Lab
- Massachusetts Institute of Technology
- Harvard Business School
- The University of Chicago

Research Partners/ Institutes
- Ryerson University
- University of Technology
- PEC University of Technology

Catalysts/ Funding Partners
- ISOF
- SmartGrid Canada
- Info Tech Software
- UKAID
- FIN PRO
- USAID
- Ministry of Power
- IFC
- World Bank

Value Added Services and Products
- Home Automation
- Smart Meters
- Roof Top Generation
- ESCO
- E Vehicle Charging
- Demand Side Management

Key Projects
- Single Digit AT&C Loss (5%)
- Great Places To Work For India
- 0 Complaints, Accidents
- Enabling Vision 2025

R&D at TPDDL
- Smart Grid Lab
- Energy Storage
- Automated Demand Response
- Network Planning with DER
- Data Analytics
- Asset Utilization
- Loss Reduction
- Power Quality & Reliability

Societal Empowerment
- Micro Grid
- LVDC
- Energy Efficient Appliances (Utility-in-a-box)
# Ease of Doing Business – A National Level Agenda

<table>
<thead>
<tr>
<th>Country</th>
<th>DB 2015 Rank</th>
<th>Country</th>
<th>DB 2016 Rank</th>
<th>Country</th>
<th>DB 2017 Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Namibia</td>
<td>66</td>
<td>Luxembourg</td>
<td>28</td>
<td>Germany</td>
<td>5</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>100</td>
<td>New Zealand</td>
<td>31</td>
<td>Singapore</td>
<td>10</td>
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<tr>
<td>Argentina</td>
<td>104</td>
<td>Australia</td>
<td>39</td>
<td>Japan</td>
<td>15</td>
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<tr>
<td>Iran</td>
<td>107</td>
<td>United States</td>
<td>44</td>
<td>United Kingdom</td>
<td>17</td>
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<tr>
<td>Israel</td>
<td>109</td>
<td>Greece</td>
<td>47</td>
<td>France</td>
<td>25</td>
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<tr>
<td>India</td>
<td>137</td>
<td>India</td>
<td>70</td>
<td>India</td>
<td>26</td>
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<tr>
<td>Cambodia</td>
<td>139</td>
<td>Namibia</td>
<td>76</td>
<td>Luxembourg</td>
<td>32</td>
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<td>Afghanistan</td>
<td>141</td>
<td>Sri Lanka</td>
<td>81</td>
<td>New Zealand</td>
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<td>Kenya</td>
<td>151</td>
<td>Argentina</td>
<td>85</td>
<td>United States</td>
<td>36</td>
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<td>Angola</td>
<td>157</td>
<td>Iran</td>
<td>88</td>
<td>Australia</td>
<td>41</td>
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<tr>
<td>Bangladesh</td>
<td>188</td>
<td>Israel</td>
<td>91</td>
<td>Greece</td>
<td>52</td>
</tr>
</tbody>
</table>

**Appearing among Underdeveloped Countries**

**Appearing among developing Countries**

**Appearing among developed Countries**
Social Innovation@ Tata Power-DDL

Joy of Giving...

223 JJ Clusters across North and North-West Delhi
“Scenario @ Indian Power Sector”
Indian Power Sector– A Glance

<table>
<thead>
<tr>
<th>Total Consumers</th>
<th>Millions</th>
<th>250</th>
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<tbody>
<tr>
<td>Peak Load</td>
<td>MW</td>
<td>1,65,253</td>
</tr>
<tr>
<td>Input Energy</td>
<td>MUs</td>
<td>12,14,642</td>
</tr>
<tr>
<td>Annual Revenue</td>
<td>In Rs.</td>
<td>5,83,028</td>
</tr>
</tbody>
</table>

61% of total revenue is from 7.96% consumers
Balance 50% capacity is stranded or not being put to use even during the peak load regime

From FY07 to FY17 National peak demand grown by 59%, whereas Generation Capacity addition took place by 146%

Nearly 19000 MW of new thermal capacity is not being scheduled as there is no demand of power by State Commission

Source: cea.nic.in
Renewable Energy emerged as second largest contributor in 2016-17

Source: cea.nic.in
The Government of India is now looking to transform India’s electricity sector

• A tenfold increase in solar installation rates to 100GW by 2022 (40 GW of rooftop solar)

• 60GW of new wind farms, 10GW of biomass

• 5GW of small scale, run-of-river hydro.

• US$200bn investments planned

• Target of 175 GW of Renewable Energy by 2022

• COP 21 Paris Commitment of 40% Renewable Capacity by 2030

Source: powermin.nic.in
**Indian Power Sector – A Glance (Distribution)**

- Distribution is a licensed activity under the EA 2003.
- SERCs award distribution license.
- 85% of Distribution sector largely dominated by State Owned Electricity Boards.
- ACS-ARR Gap (Without Subsidy) 2017 – **47 P/unit***
- High AT&C Losses: National at 26%, with most of the utilities are still hovering at around 35-40%.
- Bonds of USD 34650 Mn issued under UDAY Scheme and Budgetary support of USD 6750 Mn under IPDS.
- Direct costs of downtime in India are in the tune of Rs. 20,000 Million per annum.
- Only 8% of the total villages in Rural India has 100% Household Connectivity.
- Tata Power-DDL (Distribution) is Regulated by **Delhi Electricity Regulatory Commission (DERC)** who is responsible for determination of tariffs chargeable to consumers.

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**Govt. DISCOMs**

- Maharashtra (Bhiwandi, Nagpur, Jalgaon, Aurangabad), UP (Agra), MP (Gwalior, Ujjain, Sagar), Bihar (Muzaffarpur, Bhagalpur, Gaya), Rajasthan (Ajmer, Bikaner)

**Pvt**

- Mumbai, Kolkata, Ahmedabad, Surat, Greater NOIDA

**PPP**

- Orissa, Delhi

**DF**

- DF- Distribution Franchisee; PPP- Public Pvt Partnership
A village is declared to be electrified, if:

- Basic infrastructure such as Distribution Transformer and Distribution lines are provided in the inhabited locality as well as the Dalit Basti hamlet where it exists.

- Electricity is provided to public places like Schools, Panchayat Office, Health Centers, Dispensaries, Community centers etc.

- The number of households electrified should be at least 10% of the total number of household in the village.

- Intensive electrification of villages involves providing access to electricity to left out un-electrified household in an electrified village.

Only 8% of the total villages in Rural India has 100% Household connectivity

Only 10% of off – grid Rural villages have been connected to the Grid

As per GARV app 12,036 villages electrified, 754 uninhabited, 5662 yet to be electrified

Electrification through Micro Grid
Electrification through Micro Grid

1. Minimum efficient scale is too high
   - Size of typical mini-grid
     - 30 kW
     - 10-15 kW
   - Current scale
   - Actual consumption

2. CapEx of mini-grid is too high
   - Cost per Watt
     - Current: $2.85
     - Target: $X?

3. Tariffs are too high
   - Monthly utility bill for package of 3 lights, 2 fans and TV
     - Current: 1,000 Rs
     - Affordable: 400 Rs

Challenges in Grid Extension for Rural Areas

- High cost of grid extension and low recovery due to highly subsidized tariff, low level of tariff collection resulting in negative return
- Supply rationing due to non-availability of power
- High operation and maintenance costs

Efficiency Improvement Areas
1. Improve Solar Panel CUF to 21%
2. Improve Battery Life Cycle
3. Improve Inverter Efficiency
4. Modular Design

Cost Reduction Areas
1. DG elimination
2. 20% cost reduction through R&D (panels, BoS, Battery)

10.06 cents/unit (Rs. 6.41/unit)

Efficiency Improvement Areas
1. Improve Solar Panel CUF to 24%
2. Improved Battery Life Cycle
3. Improve Inverter Efficiency

Cost Reduction Areas
1. 50-60% cost reduction through R&D (panels, BoS, Battery, Inverter)
Utility

Data collection and reconciliation

Tata Power-DDL - Service

The Utility can then iterate through the various possibilities on inputs and check how it reflects on the output

Tata Power-DDL

The inserted data is converted to REM supported format

The data is fed to REM engine

The output data is converted to a specific format and saved in database

The data is retrieved from database and represented in any format required.

Input Interface

Proposed Product

Output Interface

REM Engine

Input

Output

Optimized Cost Electrification Model
Future From Rural Perspective

2030 – A better rural economy

Solar Home Systems is a suitable option for smaller homes up to 200 watt and running DC appliances.

Hybrid Micro Grid Systems can be used for centralized village power supply by serving a mini-grid to satisfy modern domestic needs as well as public services and the development of a local economy.

Off-Grid Systems with Energy Storage is for those who need a reliable power supply, off-grid connect power systems can be individually designed. The off-grid connect power system contains batteries and smart electronics. Also provision of Grid charging of batteries at night will help in improved power supply situation.

Virtual grid extension - Supply from battery/energy storage to small villages where RE is poor and Grid extension is difficult.

Community based operation with supervision from utility experts can be trained to operate such systems.
Future From Urban Perspective

**Advanced DMS:** Integrated electrical system designed to manage and real-time power distribution management system and grid optimization.

**Distributed Energy Storage:** Shall boost the transport sector, RE and advanced grid projects and can store energy locally.

**Distributed Generation:** Rooftop solar photovoltaic technologies shall prove to be extremely effective for consumers.

**Digitization:** With power and speed of computers shall accompany reduction in cost.

**Data analytics:** Will lead to improved infrastructure management and operational efficiency.

**Energy Efficiency:** Combination of Product innovation and energy efficiency programmes shall make energy consumption dramatically more efficient.

**Optimization:** Sophisticated modelling and simulation tools to increase performance.

**Power Management & Weather Forecasting:** High Tech & accurate weather forecasting system with refined logarithm for calculation of discom power need.

**Smart Meter Communication Technologies:** Allow devices across the grid to communicate and provide data useful.

**Intelligent Substation:** Shares all information on control, protection measurement and monitoring equipment through one bus by applying both “digital technology” and “IT-related technology.”

**Energy Efficiency**
Combination of Product innovation and energy efficiency programmes shall make energy consumption dramatically more efficient.

**Future From Urban Perspective**

- **Power system balancing with 100 GW of solar and 60 GW of wind is achievable at 15-minute operational timescales with minimal renewable energy (RE) curtailment.**

- **The peak system-wide 1-hour up-ramp increases by 27% compared to a system with no new RE, to almost 32 GW, up from 25 GW.**

- **160 GW of solar and wind may generate 370 TWh of energy annually shall meet 22% of India’s electricity demand in 2022 and reduce 21% of power sector carbon dioxide emissions compared to those in case no new RE capacity is built until 2022.**

- **National and regional coordination of scheduling and dispatch eases RE grid integration and results in cost savings by smoothing the variability in RE generation and broadening the supply of system flexibility.**

- **Digitization with power and speed of computers shall accompany reduction in cost.**

- **Energy Efficiency:** Combination of Product innovation and energy efficiency programmes shall make energy consumption dramatically more efficient.

- **Future from Urban Perspective:**

  - **160 GW of solar and wind may generate 370 TWh of energy annually shall meet 22% of India’s electricity demand in 2022 and reduce 21% of power sector carbon dioxide emissions compared to those in case no new RE capacity is built until 2022.**

  - **National and regional coordination of scheduling and dispatch eases RE grid integration and results in cost savings by smoothing the variability in RE generation and broadening the supply of system flexibility.**

  - **Digitization with power and speed of computers shall accompany reduction in cost.**

  - **Energy Efficiency:** Combination of Product innovation and energy efficiency programmes shall make energy consumption dramatically more efficient.
An illustrative dispatch curve for May 2030 is shown in the figure after incorporating judicious mix of Renewable, Storage and Demand Response to meet the demand requirements of the country by 2030.
Future From Urban Perspective : Key Insights

- Conventional Generation to Distributed Generation
- Conventional Transport to E-Transport
- Monopoly to Competition
- Service Providers to Solution Providers
- Limited Access to Universal Access
- Supply Management to Demand Management
- Isolated to Interconnected Systems/Consumers
- One Way Communication to Intelligent Real Time Systems

All Utilities have to adapt to this Changing Utility of the Future
Thank You