MINUTES OF THE

THIRTEENTH MEETING OF THE FORUM OF REGULATORS (FOR)

Venue : India Habitat Centre, Lodhi Road, New Delhi

Date : 17th July, 2009

The list of participants is at **Annexure-I**.

1. Inaugural Session

Dr. Pramod Deo, Chairperson, CERC/FOR welcomed Shri B.K. Chaturvedi, Member (Energy), Planning Commission. A brief presentation was made by the secretariat (**Annexure-II)** highlighting the main activities of the Forum which included the important recommendations in several crucial areas. In his address to the Members of the Forum, Shri Chaturvedi appreciated that various recommendations of the FOR were very timely and appropriate and efforts were now required for expeditious implementation of the same. He requested that the ERCs should give special attention to the following aspects:

- Appropriate regulatory regime is required for enhancing the efficiency of government owned utilities.
- SERCs might consider advising the States to privatize the business of distribution in the areas which continued to incur high distribution losses.
- Regulations should provide suitable incentives and disincentives to expedite commissioning of generation projects. This could be in the form of additional tariff for a limited period for those projects which are commissioned in time and some reduction in tariff for those projects which are delayed.

- SERCs have special role in ensuring that private sector utilities in monopoly situation are monitored and regulated to ensure maximum public welfare.
- Information technology has been given special emphasis in restructured APDRP, particularly for developing the baseline data on distribution losses.
- ToD metering alongwith ToD tariffs required special emphasis from the viewpoint of demand side management.
- Regulatory systems should be conducive to promoting new investments in transmission and distribution segments.

During the interaction between the members of the Forum and Member (Energy), Planning Commission, the following main points emerged:

a) Delays in reorganization of SEBs is emerging as one of the major hindrances in carrying forward power sector reforms.
b) Development of power markets should take into account the ground realities including the ability of the distribution utility to pass on the power purchase costs to the consumers.
c) There was an urgent need to put in place suitable mechanisms for incentivizing the States for making available new generation sites.
d) Large scale injection of unschedulable power like wind under open access is impacting the dispatch schedule of the State utilities and it required special attention.

2. Presentation and Discussion on “Information Technology in Distribution”

The following four presentations were made:

i) “Re-structured APDRP – IT Enabler in Distribution Sector” by Shri Kapil Mohan, Director (Distribution), Ministry of Power.

ii) “Power Distribution and IT – Perspective for regulators” by Shri Raghu Cavale, Infosys.

iii) “Application/Benefits of IT in Distribution – NDPL Experience” by Shri Praveen Chorghade, Head-Commercial, NDPL.

iv) “Energy & Utilities” by Shri Reji Kumar, Head-Energy & Utilities, IBM India.

These presentations are at **Annexure-III, IV, V & VI** respectively. The presentations were appreciated by the members of the FOR. Shri Kapil Mohan, Director (Dist.), Ministry of Power requested that SERCs may like to interact with the implementation agencies at the States regarding restructured APDRP scheme and the roadmap being prepared for implementation of IT in distribution utilities. He reiterated that the main objective of the restructured APDRP programme was to bring down the distribution losses.

3. Confirmation of the minutes of the last FOR meeting held during 11th – 12th June, 2009 at New Delhi.

The minutes of the 12th meeting were confirmed.

4. Constitution of a Working Group on “Standardization of Regulatory Accounts”.

The Forum decided to constitute a Working Group and authorized the Chairperson to nominate the members of the Group.

5. Training Programmes

The Forum approved the proposal of conducting the following training programmes:

i) Open access, role of LDCs and power markets, at NPTI, Faridabad.
ii) Finance and Economics for Regulatory Commissions at IIM, Bangalore
iii) Legal Aspects of Power Sector Regulation : Experiences and Enforcement Issues at National Law School of India, Bangalore.
iv) Training Programme on Demand Side Management – Load Research at NPTI, Faridabad for two days.

6. Recommendations made by Member (Power), Planning Commission on the Report of the Task Force on Measures for Operationalizing Open Access in the Power Sector.

The Forum considered the recommendation of the Task Force and decided that the wheeling charges applicable to consumer categories to which open access has been allowed should be displayed on the websites of the concerned SERC in a comprehensive manner with the help of illustrative examples.

7. Presentation and Discussion on "Pricing Methodology for Inter-State Transmission".

A presentation was made on behalf of CERC highlighting the main features of the approach paper circulated by CERC on the above mentioned subject for inviting the comments of the stakeholders. A copy of the presentation is at **Annexure-VII**.

During the discussions following the presentation, the members of FOR suggested that the need for determining transmission prices for more number of seasons and different periods of the day (such as peak and off peak) be explored because often there are frequent changes in the demand of distribution utility during a day and during a year.

The meeting ended with a vote of thanks to the Chair.

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/ ANNEXURE – I /

LIST OF PARTICIPANTS ATTENDED THE TWELTH MEETING

OF

FORUM OF REGULATORS (FOR)

HELD ON 17TH JULY, 2009

AT "MAGNOLIA" HALL, CONVENTION CENTRE INDIA HABITAT CENTRE, NEW DELHI

S. No.	NAME	ERC
01.	Dr. Pramod Deo Chairperson	CERC – in Chair.
02.	Shri B.K. Halder Chairperson	BERC
03.	Shri Berjinder Singh Chairperson	DERC
04.	Dr. P.K. Mishra Chairperson	GERC
05.	Shri Bhaskar Chatterjee Chairperson	HERC
06.	Shri Yogesh Khanna Chairperson	HPERC
07.	Shri Mukhtiar Singh Chairperson	JSERC
08.	Shri Rin Sanga Chairperson	Joint ERC for Manipur & Mizoram
09.	Dr. V.K. Garg Chairperson	Joint ERC for Goa & all UTs except Delhi
10.	Dr. J.L. Bose Chairperson	MPERC
11.	Shri V.P. Raja Chairperson	MERC
12.	Shri Jai Singh Gill Chairperson	PSERC
13.	Shri D.C. Samant Chairperson	RERC

14.	Shri S. Kabilan Chairperson	TNERC
15.	Shri V.J. Talwar Chairperson	UERC
16.	Shri Rajesh Awasthi Chairperson	UPERC
17.	Shri Himdari Dutta Member	AERC
18.	Shri K. Srinivasa Rao Member	KERC
19.	Shri C. Abdulla Member	KSERC
20.	Shri Alok Kumar Secretary	CERC
21.	Shri Sushanta K. Chatterjee Deputy Chief (Regulatory Affairs)	CERC

Forum of Regulators: Highlights of activities & Recommendations

FORUM OF REGULATORS

13th Meeting of 'FOR'

17th July,2009

In this presentation…..

- Recommendations in crucial areas
- Critical review of electricity reforms
  - Study through IIM (A)
- Capacity Building of SERCs
- Studies/Tasks in progress

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Recommendations in crucial areas

Protection of Consumers' Interest

- Model Consumer Charter: Incorporating rights and obligations of consumers recommended.
- SERC regulations to prohibit engagement of lawyers in CGRF.
- Regulations to provide non-compliance of CGRF orders as contravention of the regulations of SERC
  - **making licensee liable for action under section 142 of the Act.**

Protection of Consumers' Interest

- Time limit for disposal of grievances by the CGRF.
  - **after which consumer should have the right to approach the ombudsman for settlement of non-redressal of his grievance.**
- Office of Ombudsman should be funded by SERCs
- NGOs should be involved for consumer education and empowerment.

Open Access : Theory and Practice

- Independence of SLDC
  - **SLDC not to report to transmission or trading licensee.**
  - **Reporting requirements could be on lines of State Electoral Officer under Election Commission.**
- Operation of SLDC
  - **with STU as a subsidiary of transmission utility as stop-gap arrangement;**
  - **by a separate entity as soon as possible**
- State Governments be advised to phase out single buyer model.

MoP may take up these issues with State Governments

Open Access : Theory and Practice

- A model scheme for technological upgradation of SLDCs recommended.
- Urgent need of financial autonomy to SLDCs.
  - CERC to make regulations for RLDCs
  - Similar pattern to be adopted by SERCs for LDCs.
- Display of information on OA charges in the websites of SERC/FOR for transparency and to enable informed decision on open access.
- Standby arrangement for open access consumers
  - **by levying retail tariff as applicable for respective consumer categories only for the period during which such standby support is requested.**
- The cross-subsidy surcharge needs to be calculated as per the formula given in the Tariff Policy unless there are valid reasons for deviation.

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Intra-State Open Access - Illustrative Cases

State	Open Access Charges (Rs./kWh)*
Assam	2.94
Chhattisgarh	0.98
Haryana	0.81
Himachal Pradesh	1.39
Karnataka (BESCOM)	1.9
Maharashtra (MSEDCL)	0.84
Orissa	1.6
Punjab	0.57
Rajasthan	0.97
Uttar Pradesh	0.76
Madhya Pradesh	1
Uttarakhand	0.69
Gujarat	1.34
West Bengal	3.77
Tamil Nadu	2.47

*OA charges for a consumer of 5MW at 11 KV (33 KV in some cases) seeking OA for a month. This includes transmission & wheeling losses (Rs/kWh) calculated assuming power purchase cost as Rs 4/kWh.

LOSS REDUCTION STRATEGIES

- Focus on reduction of distribution losses
  - **Transmission losses not to be clubbed with distribution losses**
- Sharing of gains
  - **Under-achievement of loss reduction target should be borne by the licensee,**
  - **In case of achievement over and above the targets the gain should be shared between the licensee and the consumers in the ratio to be determined by SERCs.**

Policies on Renewables

- Mininum level of Renewable Purchase Obligation (RPO) at 5% till 2010 on lines of National Action Plan on Climate Change;
- Suitable mechanism like Renewable Energy Certificate (REC) to promote RE sources.
- Preferential tariff based on the cost-plus approach for non firm RE- based projects during loan period
  - **after which they should be allowed to compete.**

Policies on Renewables

- Bidding Guidelines under section 63 of the Act *needs to be framed by the Ministry of Power*, in consultation with MNRE for bidding amongst:
  - **(a) RE sources which can be scheduled, such as bagasse-based generation; and**
  - **(b) generation projects which cannot be scheduled and which have availed of preferential tariff during the debt repayment period.**
- GBIs are preferable to capital subsidies for promotion of RE technologies.
- *GBIs should be announced upfront, which could be factored in the tariff to be set by ERCs.*

Demand Side Management

- SERCs to also direct all the distribution utilities to submit DSM Plans along with ARR rates for the next tariff period.
- Recovery of cost of approved DSM programmes should be allowed as pass-through in ARR.
- *BEE has been requested*
  - **to undertake development of Monitoring and Verification protocols for various DSM programmes which may be undertaken by utilities.**
  - **to prepare draft of a suggested Regulation for appraisal of programmes of DSM and Energy Efficiency in distribution sector.**

Demand Side Management

- *The State Governments to be requested to consider the following:*
  - **Financially supporting the DSM programmes aimed at such category of consumers which are receiving tariff subsidy from the State Governments.**
  - **Enhancing effectiveness of the State Designated Agency (SDAs).**
  - **Reduction in taxes on energy efficient appliances.**

MYT Framework and Distribution Margin

- Recovery of fixed cost should be linked to achievement for Composite Index of Supply Availability (timely contracting adequate power to meet forecast load) and Network Availability to be specified by SERC
- For every 1% underachievement in composite availability for urban and/or rural areas, Return on Equity shall be reduced by 0.1% of Equity.
- SERCs should disallow adjustment of due subsidy against the outstanding loans.
  - **However, adjustment of subsidy against Electricity Duty actually collected by the Discom be allowed.**
- SERC regulations should provide for issue of bills on the basis of tariff determined by SERC
  - **if State Government does not pay due amount of subsidy in time and in cash.**

Staffing of ERCs

- ERCs should have autonomy on staffing.
  - **IIPA recommendation to MoP :** ***"the Commissions should have full autonomy in matters relating to staffing pattern, organizational structure and adequate power to recruit staff, as required. An overall ceiling on expenditure could, however, be fixed.***
- To attract competent people, compensation package (including pay and other perquisites) as applicable in Central PSUs Schedule 'A' should be adopted.

Ministry of Power may consider these recommendations for implementation for CERC and for SERCs through State Governments.

Metering Issues

- Meters of all high-end consumers say, HT Industrial or others with connected load of 25 KW and above should be read through remote reading devices and the consumption pattern should be monitored on daily basis.
- Distribution Transformer Metering should be made compulsory especially with a view to realizing the objective of energy accounting. Reading of such meters should be through remote control devices.
- Central Electricity Authority may take up a R&D project for developing a cost effective AMR technology suitable for application in rural areas.

Metering Issues

- TOD metering and automatic meter reading system shall necessarily be introduced wherever not already done.
  - To begin with, at least for high-end consumers with the connected load of 25KW and above should be covered under TOD metering.
- SERCs may provide in their Regulations on Standard of Performance that not more than two successive bills would be raised provisionally.
- The State Governments may also be advised to limit the subsidy provisions for metered consumption and upto specified limits.
- To promote development of facilities for third party testing of meters, SERCs may consider financially supporting the initial few independent accredited laboratories in the area of licensee through an appropriate provision in ARR to give assurance of servicing of investments made by such independent parties in the initial 4 to 5 years.

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Electricity Reforms and Regulations- A Critical Review of Last 10 Years Experience – Key Findings of study by IIM (A)

IIM (A) Report - Key Findings

- SERCs to insist on adequate contracting of capacities by the utilities rather than relying on UI
- ABT based management of imbalances does not provide incentives over medium to long term for balancing the demand and supply.
- An alternative to ABT based management of imbalances would be creating real time market (gross pool).
- Meaningful competition is possible only if the capacity allocations, subsidies are fixed for multiple years in advance and administratively the utilities are made independent.

IIM (A) Report - Key Findings

- The terms of offtake from captive generators should be at least as favorable as short-term traded power/ UI charges.
- To incentivise states for making available generation sites:
  - Collective (regional) framework such as UMPPs and central interventions.
  - Alternatively, an incentive mechanism like free power .
  - Another alternative- to allow tax on production rather than on sale of electricity.
- Periodic review of regulatory independence and dissemination of such reviews would identify and highlight problem areas.
- Use of “price cap” regulations or competitive bids for regulating private sector wherever possible

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Capacity building of SERCs

Capacity building programmes conducted

- **Orientation for Chairperson and Members** of SERCs at IIM (A) and UK
- Capacity Building / Training Programme for officers of ERC's by IIT, Kanpur
- Six-days Residential Training Course on "**Open Access & Role of Load Despatch Centre (OA&LDC)"** for officers of ERC at NPTI, Faridabad
- Four-days Residential Training Course on "**Consumer Protection"** for officers of ERCs at New Delhi
- Six-days Residential Training Course on "**Demand Side Management & Energy Efficiency**" for officers of ERC at NPTI, Faridabad
- Four-days Residential Training Course on "**Regulation, Competition and Consumer Issues in the Electricity Sector**" for officers of ERCs at Dharamshala (H.P.)

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Studies/Tasks in progress

Studies/Tasks in progress

- Renewable Energy Certificate (REC) implementation framework
- Model Regulation on Standards of performance (SOP)
- Capital Cost Benchmarks for Distribution Business
- Analysis of Tariff Orders & Other Orders of State Electricity Regulatory Commissions (SERCs)
- Net metering for grid integration of renewables
- Task Force on framing model regulations on 'FOR' recommendations

THANK YOU

Re-structured APDRP

IT Enabler in Distribution Sector

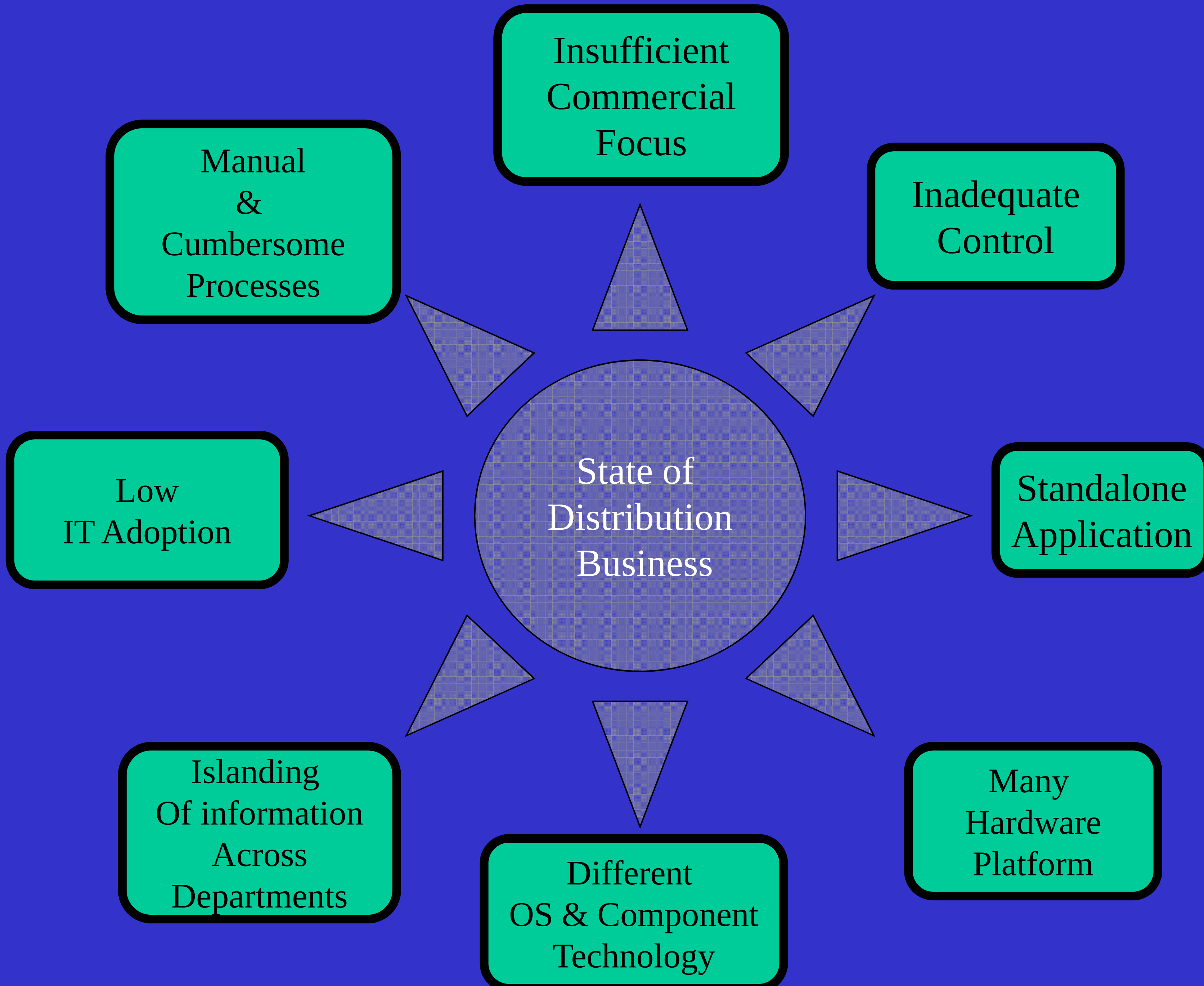
Meeting of Forum of Regulators

17th July 2009

New Delhi

Kapil Mohan, Director (Distribution)

Ministry of Power


Insufficient Commercial Focus
Inadequate Control
Standalone Application
Many Hardware Platform
Different OS & Component Technology
Islanding Of information Across Departments
Low IT Adoption
Manual & Cumbersome Processes
State of Distribution Business

Re – structured Accelerated Power Development & Reforms Programme (R-APDRP)

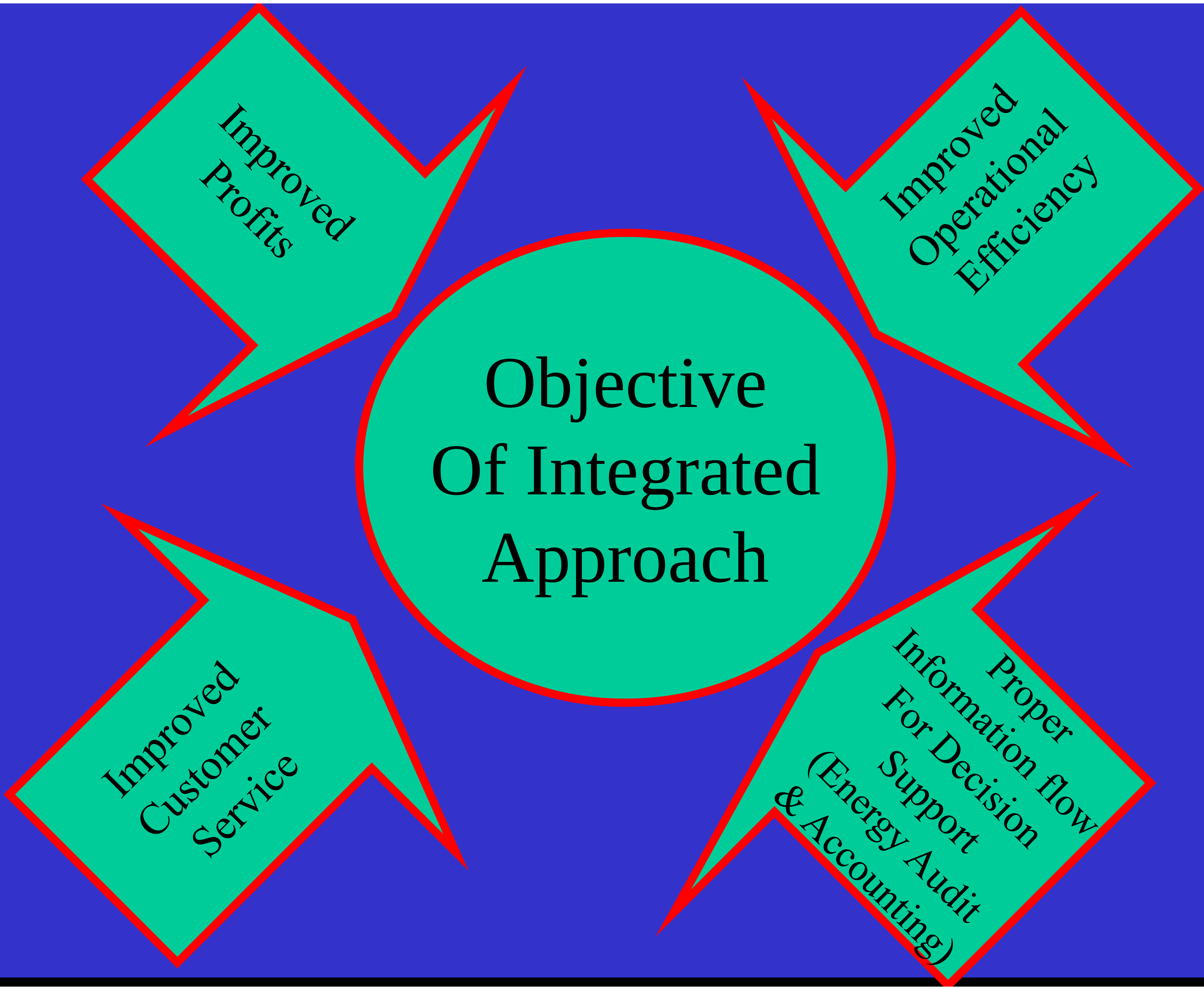
- APDRP launched in 2003 to oprerationalise Reforms in distribution.
- IT components showed least progress. Very few states adopted standalone IT solutions in piecemeal manner.
- Re-structured APDRP approved on 31^{st} July 2008.
- Focus of the programme on **AT&C loss reduction to 15%** on sustainable basis through systematic measures :
  - establishment of base line data
  - adoption of Information and Communication Technologies
  - fixing of accountability
  - strengthening and up-gradation of sub transmission and distribution network

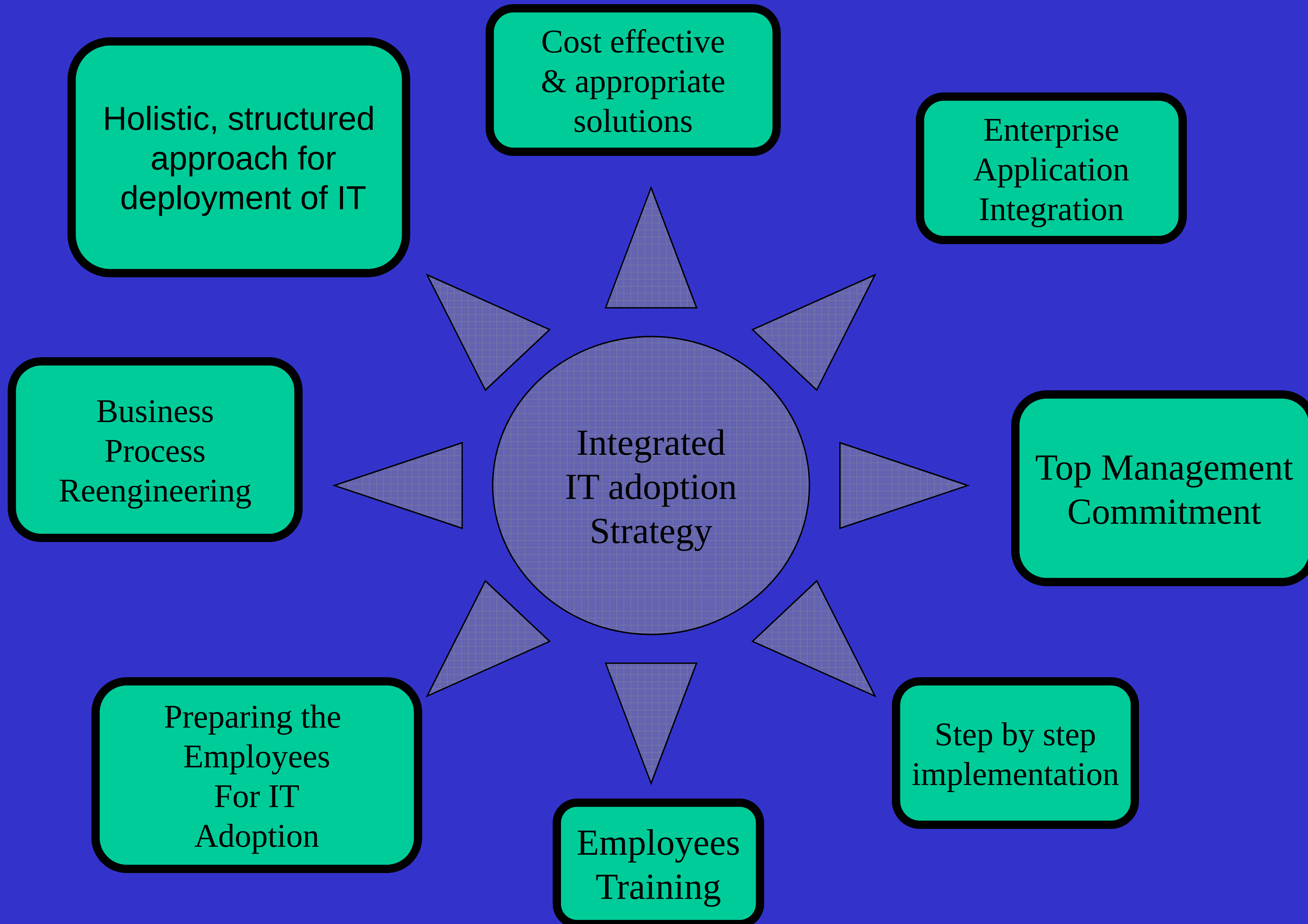
(.... Contd.)

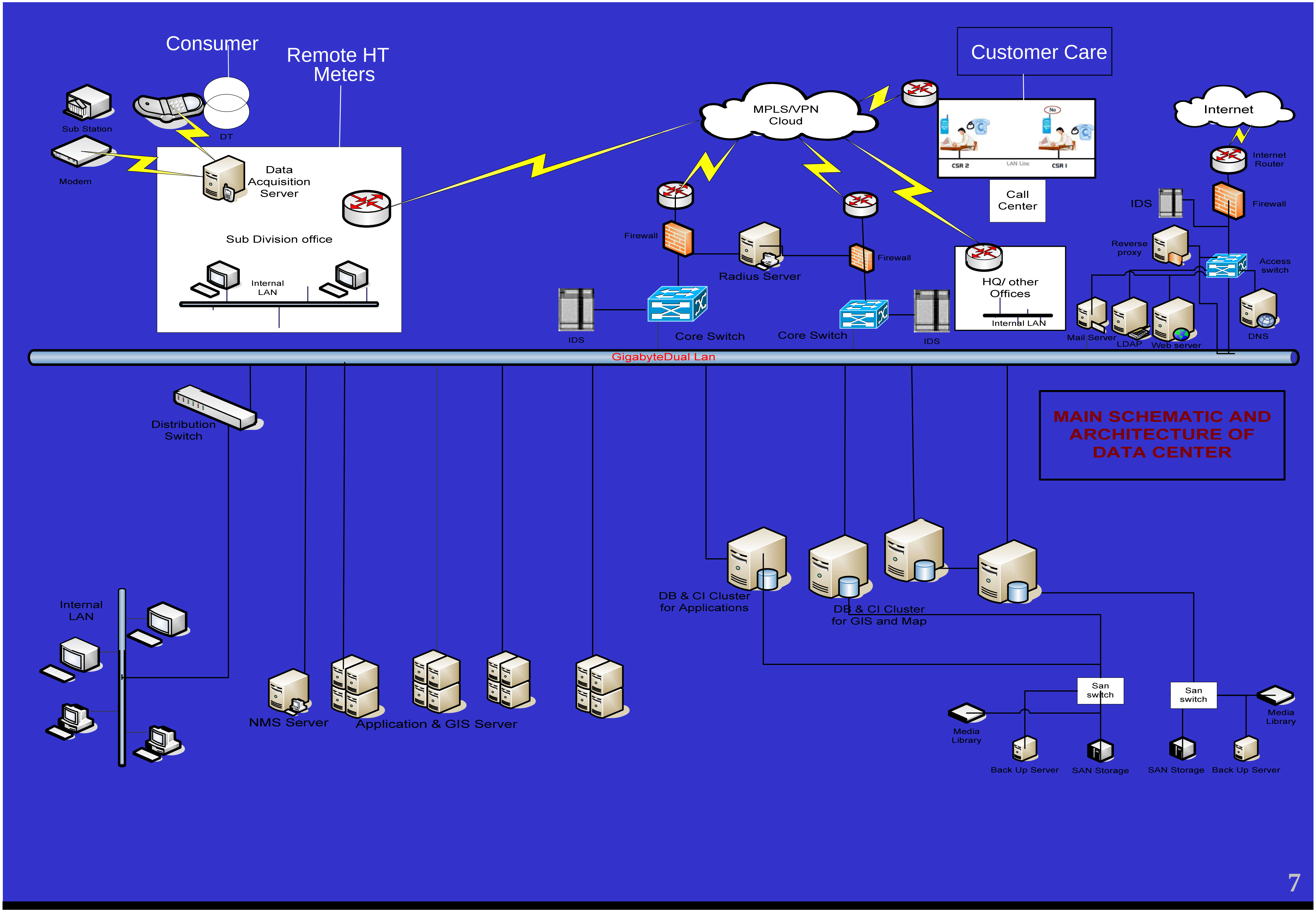
(.... Contd.)

- Project implementation to be taken up in two parts :
  - Part-A: Projects for establishment of baseline data and IT applications for energy accounting/auditing & IT based consumer service centers.
  - Part-B: Regular distribution strengthening projects.
- Initially 100% loan for Part A and up-to 25% (90% for special category States) loan for Part B from the Govt. of India.
- The entire loan for Part-A to be converted into grant after establishment of Base-line data system.
- Up-to 50% (90% for special category States) loan of Part-B to be converted into grant on **achieving the 15% AT&C loss** in the project area.

(Contd. ......)


Improved Profits
Improved Operational Efficiency
Objective Of Integrated Approach
Improved Customer Service
Proper Information flow For Decision Support (Energy Audit & Accounting)


Integrated IT adoption Strategy
Cost effective & appropriate solutions
Enterprise Application Integration
Top Management Commitment
Step by step implementation
Employees Training
Preparing the Employees For IT Adoption
Business Process Reengineering
Holistic, structured approach for deployment of IT


Consumer
Remote HT Meters
Customer Care
Sub Station
DT
Modem
Data Acquisition Server
Sub Division office
Internal LAN
MPLS/VPN Cloud
CSR 2
LAN Line
CSR I
Call Center
Internet
Internet Router
IDS
Firewall
Firewall
Radius Server
Firewall
HQ/ other Offices
Internal LAN
Reverse proxy
Access switch
IDS
Core Switch
Core Switch
IDS
Mail Server
LDAP
Web server
DNS
GigabyteDual Lan
Distribution Switch
MAIN SCHEMATIC AND ARCHITECTURE OF DATA CENTER
Internal LAN
DB & CI Cluster for Applications
DB & CI Cluster for GIS and Map
NMS Server
Application & GIS Server
San switch
San switch
Media Library
Media Library
Back Up Server
SAN Storage
SAN Storage
Back Up Server

Notable features of IT System under R-APDRP

- The Main objective is to create integrated IT platform for utilities.
- The hardware and software architecture is modular in design.
- They are scaleable and expandable to cater future needs of utility.
- The proposed specification is vendor neutral and technology neutral.
- Proper security and data back up to protect business information has been provided.

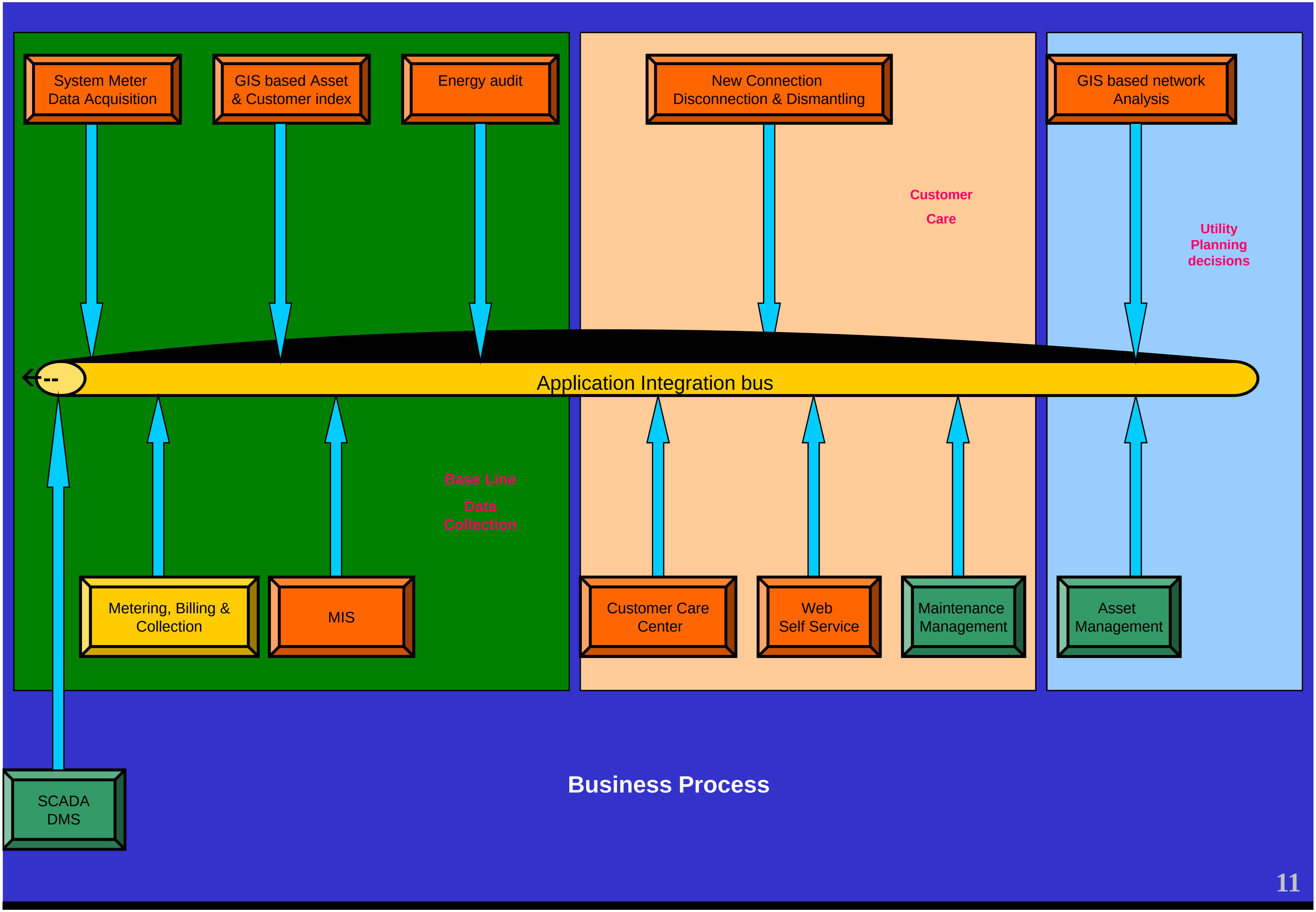
Notable features of IT System under R-APDRP

- GIS based customer indexing and asset mapping to be used as foundation of IT backbone.
- Facilities to integrate with network management applications such as SCADA/DMS in future.
- AMR for system and selected HT consumer and Energy audit and accounting without human intervention.
- Single window customer care center with IVRS facility for customer grievance redressal
- For simplicity of use all the applications shall be web based and shall be accessible through web browser.

Application packages

- Step - I
  - Metered Data Acquisition, Energy Auditing
  - Customer Care (New connection, disconnection, MIS etc.
  - GIS based consumer indexing, Asset mapping and Network analysis
- Step - II
  - Metering
  - Billing
  - Collection
- Step - III (Optional)
  - Asset Management & Maintenance Management
  - Network automation application viz: SCADA / DMS

    (has to be compulsorily followed by automation of grid in future)


System Meter Data Acquisition
GIS based Asset & Customer index
Energy audit
New Connection Disconnection & Dismantling
GIS based network Analysis
Customer Care
Utility Planning decisions
Application Integration bus
Base Line Data Collection
Metering, Billing & Collection
MIS
Customer Care Center
Web Self Service
Maintenance Management
Asset Management
SCADA DMS
Business Process

Advantages to Utilities

- Metering billing & collection
- Energy accounting and auditing
- Breakdown & preventive maintenance
- Asset & inventory management
- System planning
- MIS
- Customer management
- Performance efficiency
- Network Management

THANK YOU

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Power Distribution and IT

Perspective for regulators

July 2009

CONFIDENTIAL

Contents

Context: Four Planks for Distribution Reforms

Distribution Reforms, Commercial Viability and Consumers' Interests

Policy

- Electricity Act 2003
- National Electricity Policy
- Electricity (Amendment Act) 2007
- Open Access
- Power Exchange
- Reorganization and unbundling of SEBs
- Privatization
- Formation of SERC
- Formalization of APDRP

Funds

- APDRP and R-APDRP
- State Government Funds
- World bank Funds
- ADB Funds
- FII (PFC, REC and others)
- National Transmission and Distribution fund
- Other funds like USAID

Actions

Measurable & Sustainable Results

- Strategic Insights and Vision for each discom
- Operational Restructuring
- Performance Management and Monitoring
- Business Process Reengineering and Change Management
- New Assets Addition and System Refurbishment
- **IT Backbone for all Actions and Results**

Major Steps Taken in Policy and Funds

Major Effort Required in IT

Role of IT :
Landscape for a Modern Power Distribution Co.

Consumers

Executive Information Systems

BI, DW & MIS

Project Management
- Project Planning
- Project Execution
- Project Control
- Project Closure

Customer Management
- Connection Management
- Meter management
- Metering, Billing & Collections
- Revenue Recovery
- Inspections, Assessment & Legal
- Complaints Handling

Operational Management
- Facilities Planning and Maintenance
- Energy Accounting
- AMR/AMI & Meter Data Management
- Work and Asset Management
- Customer Care Centre/ Call Centre
- Document Management, KM & Quality Check

Network Management
- Network operation, planning and designing
- SCADA/DMS/OMS
- Network Modeling and Economics
- GIS
- Customer Premises Planning

Materials Management
- Supplier Management
- Procurement
- Purchase Order Management
- Inventory Planning
- Consignment Handling
- Warehousing
- Fulfillment
- Logistics
- Scrap Customer Management
- Scrap Management

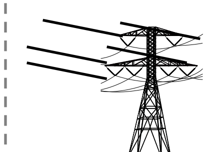
Demand Management
- Load Forecasting
- Energy Sourcing and Allocation
- Power Systems Monitoring
- Grid Recovery

Finance & Accounting
- General Ledger
- Billing and Accounts Receivable
- Accounts Payable
- Bank Reconciliation
- Asset Accounting
- Treasury and Cash Mgmt.
- Costing Budgeting, Planning
- MIS Reporting, Auditing

Human Resource Management
- Manpower Planning
- Recruitment
- Training
- Time and Labor
- Performance Appraisal
- Compensation
- Employee Relocation
- Administrative Management
- Exit Planning

Regulator

Vendors and Suppliers



Transmission Company

Gradual evolution with end-vision in sight: Smart Grid adoption in Indian power distribution context

A system for :
- **Curtailing AT&C losses**
- Driving transparency
- Driving accountability

Step 1
- Part of R-APDRP

A system for:
- Operational efficiency
- Customer service excellence
- Automated control

Step 2
- R-APDRP and beyond

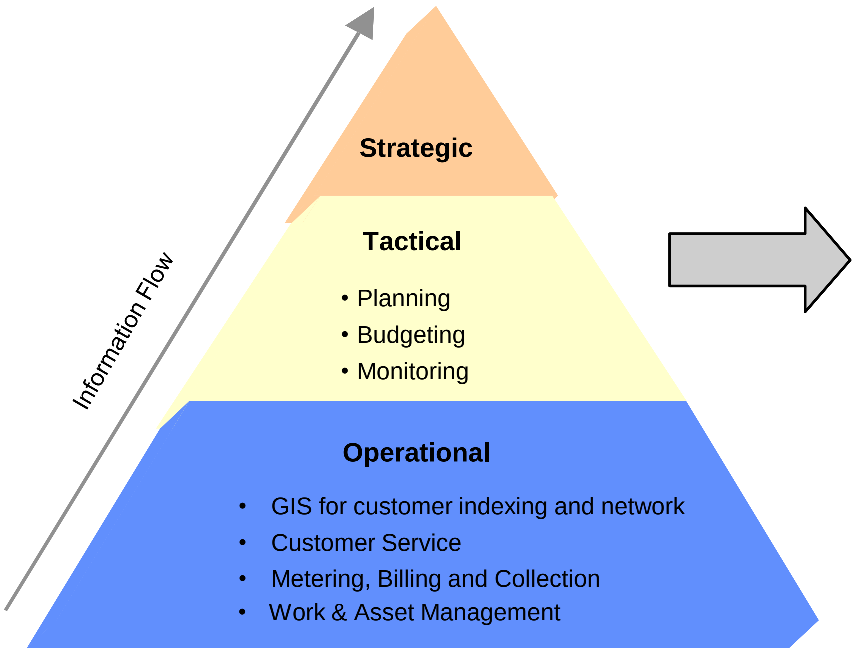
Step 3
- Smart Grid

A system that is:
- Self-healing
- Adaptive
- Interactive
- Secure from attacks
- Accommodates all generation and storage options
- Supports bi-directional energy flow
- Distributed across geographies and organizational boundaries

1 to 3 years | **3 to 5 years** | **5 to 15 years**

R-ADPRP, Part-A would bring IT in Distribution unlocking tremendous value

- Through R-APDRP Part-A investments, IT would become a key enabler to the reforms process by using it to institutionalize changes
- R-APDRP would enable the core business operations at the transaction level using information systems to lay the foundation for sustainable reforms
  - Ensure world-class practices and controls at the operations level
  - Improvement in overall quality of data
  - An overall improvement in the flow of information for decision support



Improved Profits
- More revenue and improved collections

Improved Performance and Operational Efficiency
- Reduction in losses
- Reduction in outages
- Transparency and Accountability
- Collaboration of energy and revenue
- Performance measurement & monitoring

Improved Customer Service
- Better quality and reliability of supply
- Quick complaint resolution

Regulatory perspective in current Indian context

- Addressing industry needs and driving change
  - DSM
  - Renewable energy
  - Energy Efficiency
  - Climate change issues
- Bringing increasing level of discipline
  - Rewards and penalties for performance (specific to distribution)
- Shifting subsidies to targeted benefits
- Development of human resources and communities of practice
- Changing the approach to technology (making it more mature)
  - Defining standards and ensuring adoption
  - Technology choice and cost-benefit analysis
  - Prototyping, testing and scaling up
  - Top-down and comprehensive, not ad-hoc or piecemeal

Thank you

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Appendix

Smart Grid and Power Distribution

What is Smart Grid? Key Attributes

The Smart grid is a confluence of Information, Communications & Electrical/Digital technologies, facilitating a seamless integration of business processes and systems to yield real measurable value across the entire power delivery chain

INTELLIGENT ON THE EDGES
- DISTRIBUTED ARCHITECTURE, EMBEDDED SENSORS & MONITORS, INTERACTIVE

ADAPTIVE, FLEXIBLE , RELIABLE, SECURE, RESILIENT
- SELF HEALING, SELF CONFIGURING, ISLANDING, PLUG & PLAY

INTERCONNECTED, INTEROPERABLE
- INTEGRATES SEAMLESSLY, OPEN STANDARDS, DISTRIBUTED GENERATION

PARTICIPATIVE
- DEMAND/CUSTOMER PARTICIPATION

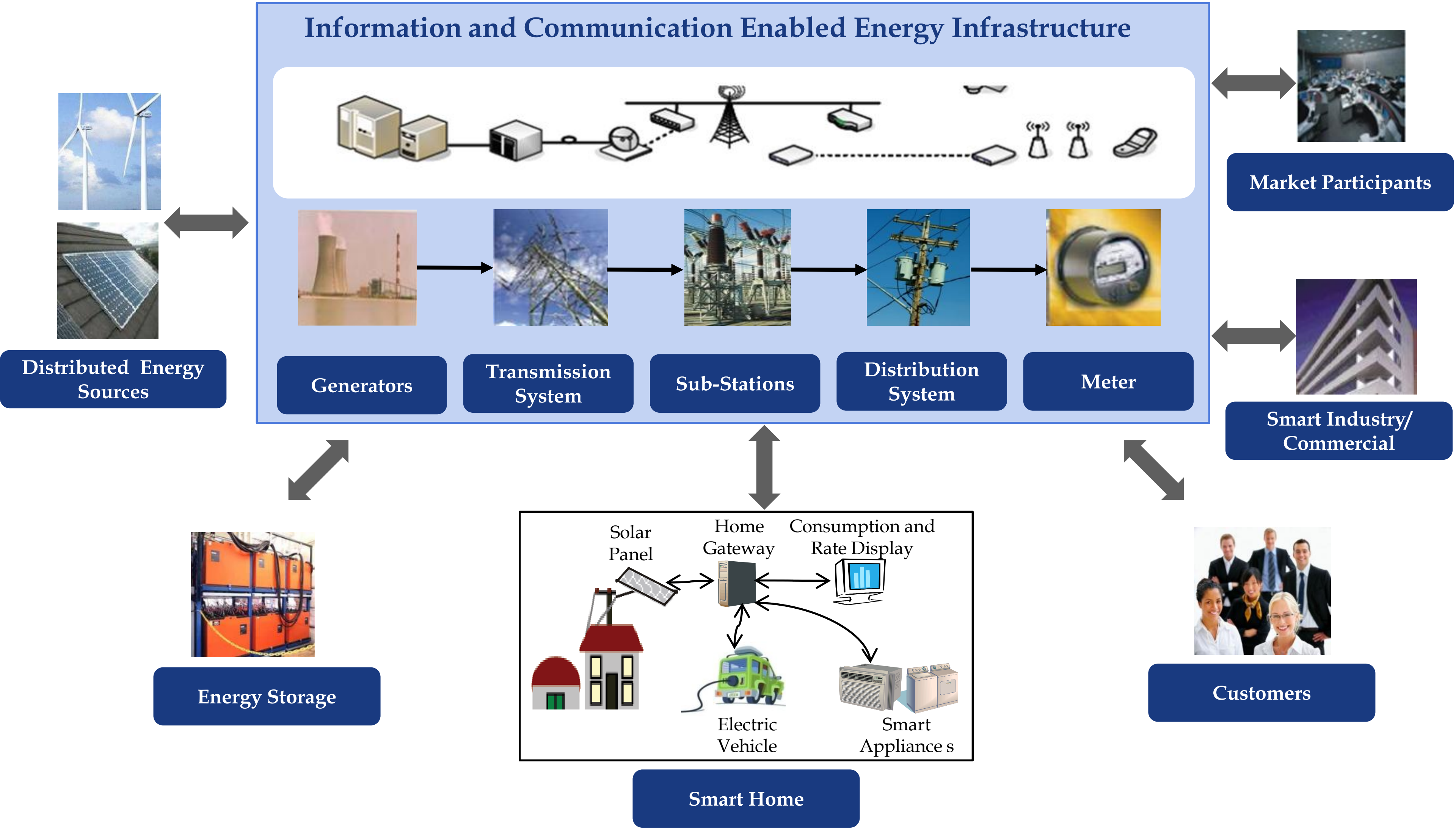
DYNAMIC
- REAL TIME INFORMATION FLOW, DISTRIBUTION AUTOMATION, MOBILE COMPUTING

HIGH SPEED REAL TIME COMMUNICATION IN MULTIPLE DIRECTION
- NET METERING, REMOTE CONNECT/DISCONNECT, REAL-TIME PRICING OPTIONS

LOW COST
- OPTIMIZES NETWORK ASSET UTILIZATION

CLEAN & GREEN
- RENEWABLES INTEGRATION, ENERGY EFFICIENCY

Smart Grid : Functional/Ecosystem view



Smart Grid : Architectural View

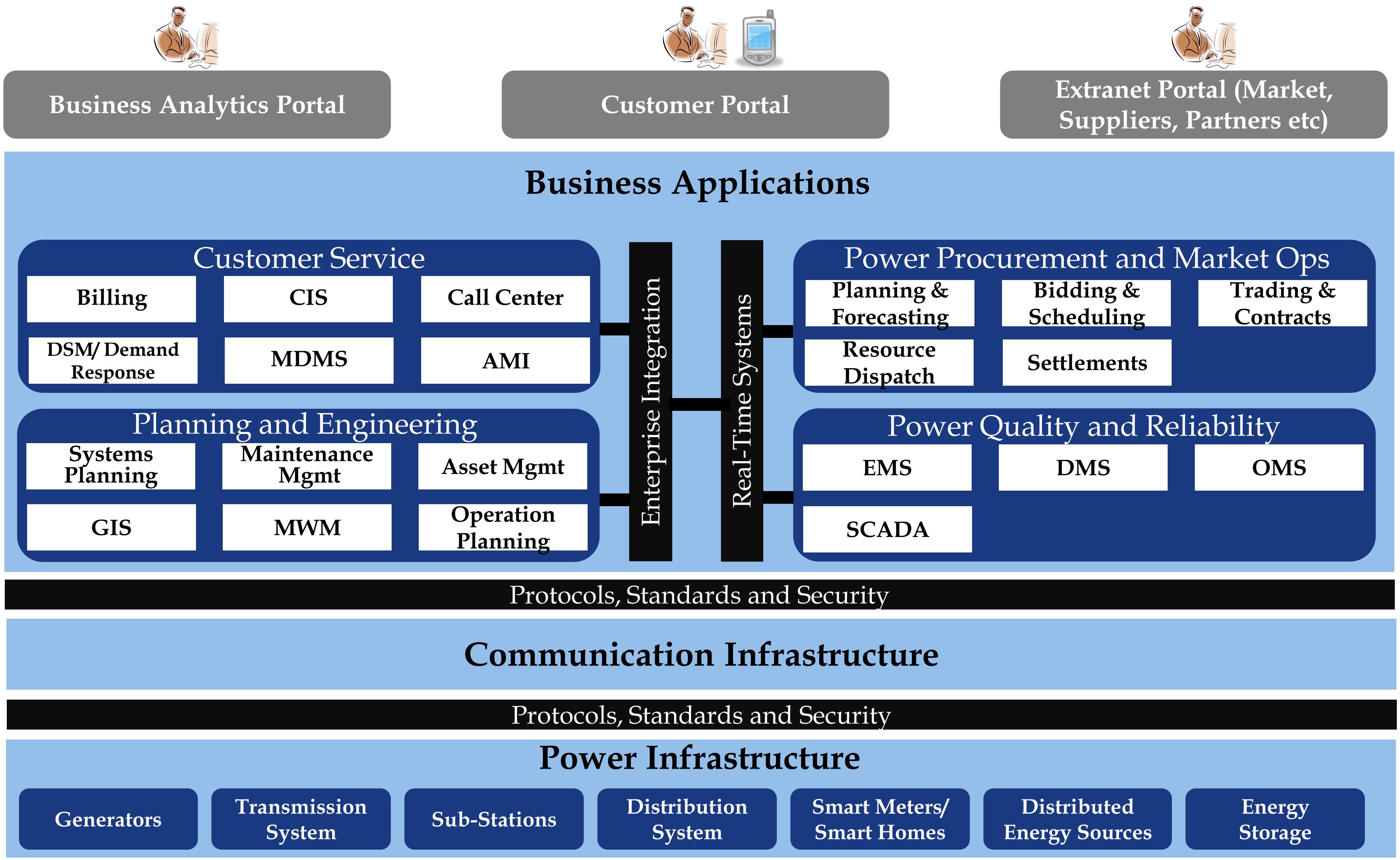
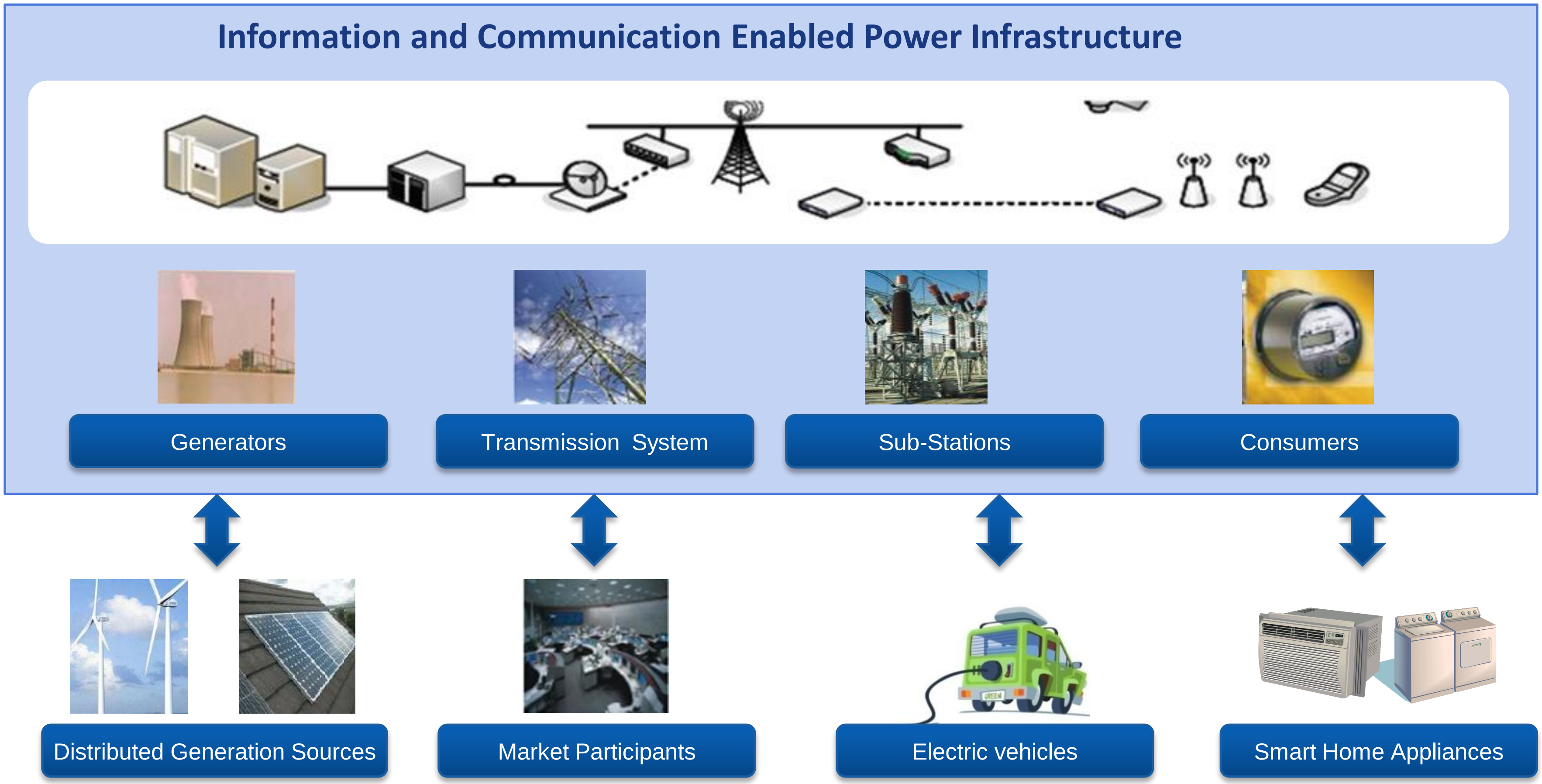


Illustration of A Smart Grid Based On Open Architecture

Self-healing, **Adaptive, Interactive**, **Secure** from attacks, **Distributed** across organisational boundaries, accommodates all generation and storage options and supports **bi-directional** energy flow



Exploit the role of IT

Illustrative

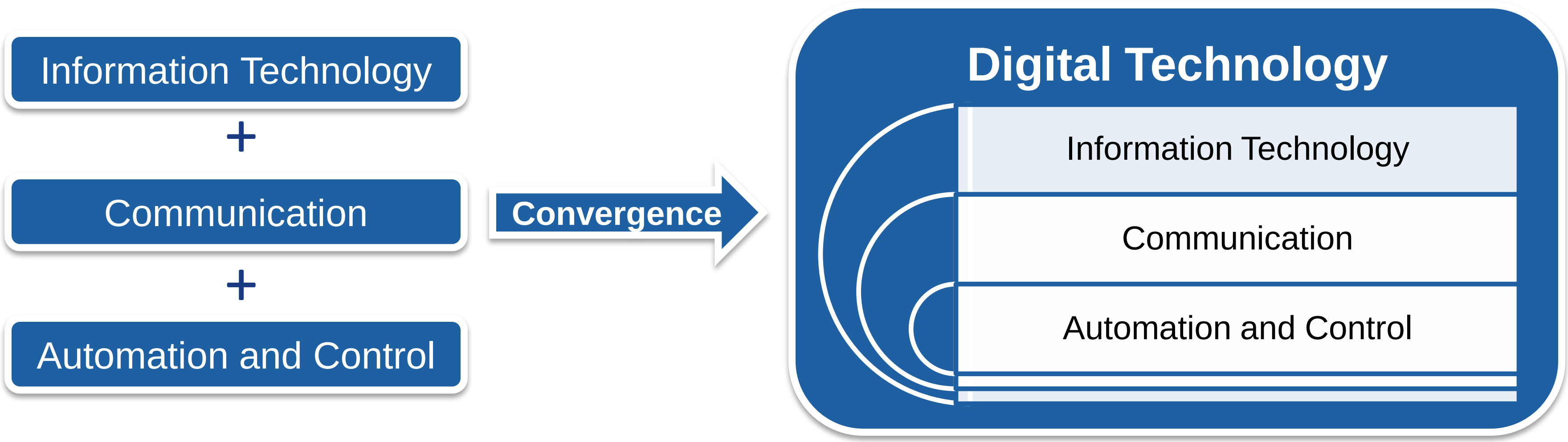
Current State

- OLTP and batch systems
- Well defined skill-sets
- Safe, firewalled systems
- Reporting systems
- Traditional Data storage and computing

Future /Smart Grid State

- Simultaneous Real-time , OLTP and batch systems
- Increased variety of skills
- On Internet - increased focus on security
- Increased role of analytics
- Data historian? Other storage and computing innovations?

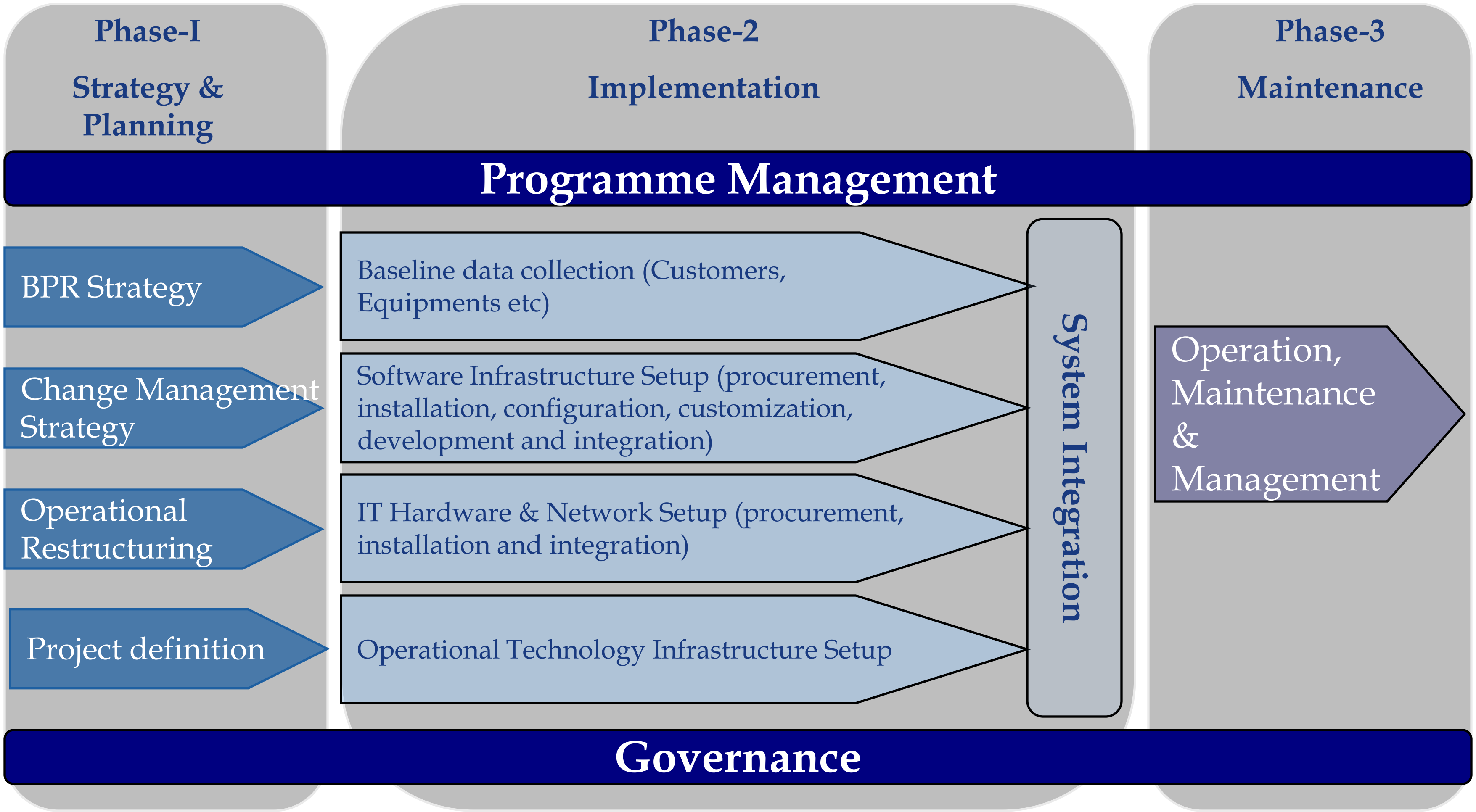
Deep-dive:
Technology should be looked at in totality



- IT, Communication, Automation/Control must be planned and implemented in synergy to achieve optimal results

Deep-Dive:
Overall Programme Management at discom

The Program implementation at any discom needs to consist of three phases:



Game-Changer:
Accelerating Change Through A National Institution

- Phenomenal addition of infrastructure
  - Spending 2000 billion dollars (Generation and T&D)
  - Lasting for next several decades
  - Needs thorough examination of all issues

- A national level coordinator can ensure synergy and increase rate of change
  - National Body, perhaps created by an Act of Parliament
  - Stakeholders from across the industry

- Authority to coordinate, create and assign responsibility
  - For economic/financial analysis, governance and policy, standards, technology transition, research and adoption, human resource development

NDPL

Application / Benefits of IT in Distribution
NDPL Experience

Ministry of Power, GOI

17th July'2009

Praveen Chorghade
Head – Commercial

Akhil Pandey
Director- IT projects

Structure of Presentation

- **NDPL Profile**
- Strategic IT Plan
- Applications of IT Systems
- Results & Benefits

NDPL: Inherited Status - 2002

• AT & C Loss	-	Between 53% to 60%
• Financial Loss	-	Approx Rs 10 Cr / Day
• Govt. Subsidies	-	Approx. 1,200 Cr / Annum
• Billing Receivables	-	Close to 1 year outstanding
• Equipments / Network	-	Pathetic
• Consumer Records	-	Manual & incomplete
• Consumer Care	-	None, No focus
• Power Interruptions	-	Availability 16 hrs/Day

NDPL: Inherited Status - 2002

- Billing Efficiency = 53.72
- Collection Efficiency = 97.18
- AT & C Loss Level = approx 53 %
- No of Computers = 2
- Centralized Billing System = DEBS (Inherited)

NDPL Profile - Today

NDPL

Turnover (FY 08-09)	:	~ Rs. 2,478 Cr
Peak Load	:	1,140 MW
Energy Requirement (FY 07-08)	:	6,298 MU
Total Registered Consumers	:	10.2 Lakh
Number of Employees	:	3,800
Area of Distribution	:	510 Sq Kms
Population Serviced (approx)	:	48 Lakh
Per Capita Consumption (Units)	:	1,395 (National Average of 500, Mumbai – close to 850)
Number of Consumers / Sqkm	:	2,000 (Only Registered)
Employees / MU input	:	0.6
Load / Energy Growth	:	07% / 05%

Structure of Presentation

- NDPL Profile
- **Strategic IT Plan**
- Applications of IT Systems
- Results & Benefits

Strategic Roadmap – 1st Control Period

NDPL

Strategy for 2002-07			
AT&C Losses <25%	**Consumer service & IT Interface** to be comparable with world standards	**System Reliability to** be comparable with best utilities in India.	**Performance Orientation** through Change Management

>50%

1,00,000 backlog complaints

No planned Capex & Opex in past 3yrs

5400 staff in unfavorable working conditions

What NDPL had inherited			
AT&C Losses >50%	No concept of **consumer service & IT Interface**	**Electricity Supply system** on the verge of collapse	Lack of Performance Orientation

Strategic Gaps Identified

NDPL

Energy Loses – Technical & Non Technical

- Technical Losses at Sub-transmission (66kV/33kV) & Distribution (11kV & below)

- Non Technical – Lack of Energy Metering

Theft / Unauthorized Use
- Direct Hooking
- Meter Tampering and Meter By-passing
- Misuse of Category
- Use of multiple connections for misuse of slab
- Sanctioned load lower than actual usage

Metering Process Deficiencies
- Meter (address) not traceable
- Import / Export metering errors
- Stop meter / Slow meter
- Defective meter
- Meters not read
- CT Ratio errors
- Meter number mismatch

Billing Process Deficiencies
- Consumer not billed / under-billed
- Provisional billing
- Bills pending for Quality Check (BQC)
- Bills pending for assessment
- Meters installed but not appearing in data base
- Un-metered:
    - Unauthorized Colonies, JJ Clusters
    - Street Lights Poles

Collection Process Deficiencies
- Part Payment
- Bills not delivered
- Consumer not paid (defaulters)
- Disconnected with Dues

Implementation Roadmap:

- 5 Year Comprehensive CAPEX Plan
  - AT&C Loss reduction, System Improvement, Load Growth, Administration / Infrastructure and Depository Works
- Automation & reliability Improvement
  - Communication network, GIS, GSAS, SCADA, DMS, OMS
- Metering & Energy Audit
  - 4 Level Energy Accounting, Electronic Meter, CMRI, AMR, AMI
- BPR of Commercial Processes
- IT Applications – To bring in Transparency / Efficiency in Consumer's Services
  - SUGAM, SAKSHAT, BBS, DARPAN, SAMBANDH, SAP and finally Integration of Automation systems with all applications

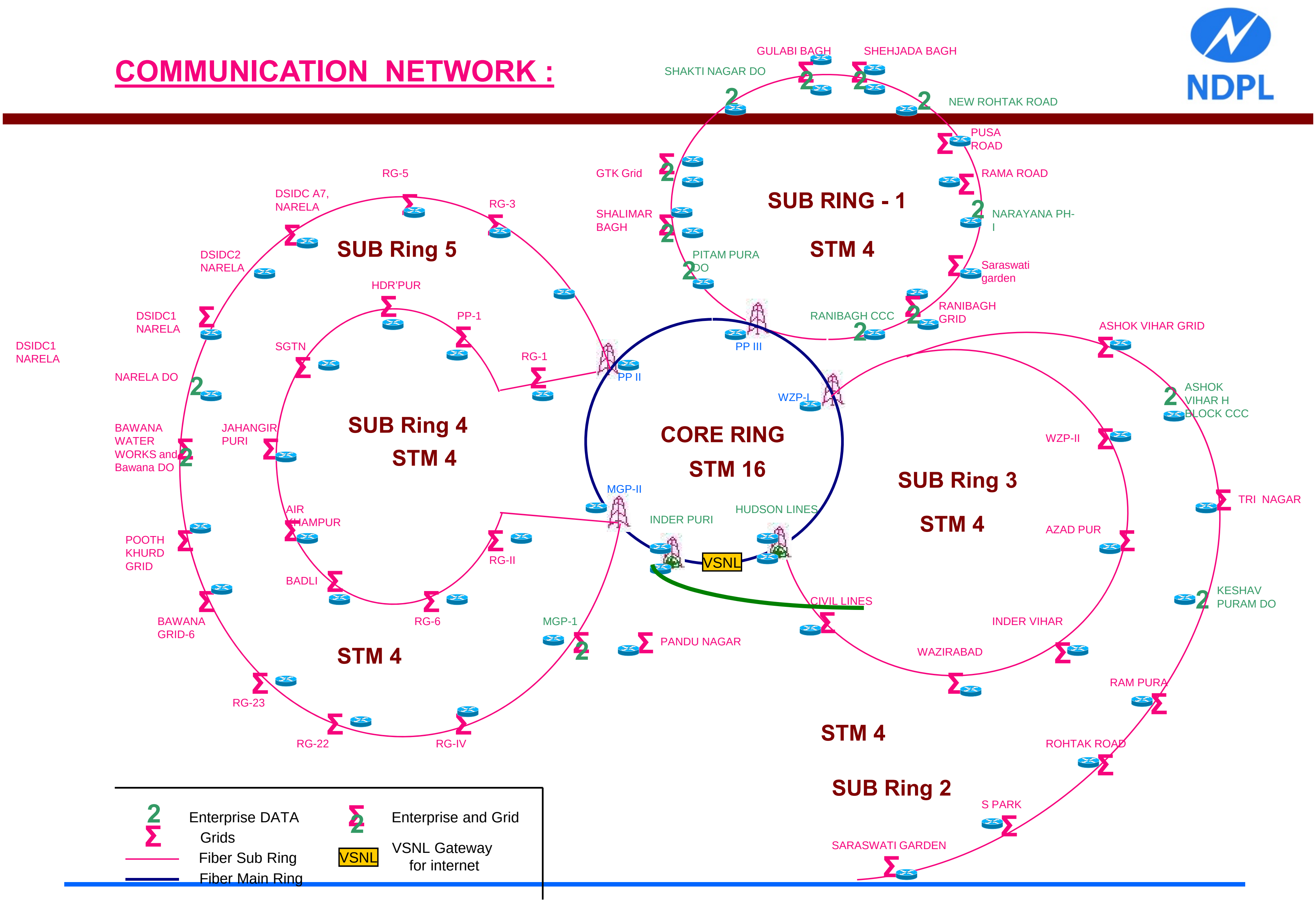
Structure of Presentation

NDPL

- NDPL Profile
- Strategic IT Plan
- **Applications of IT Systems**
- Results & Benefits

Automation & Reliability Improvement

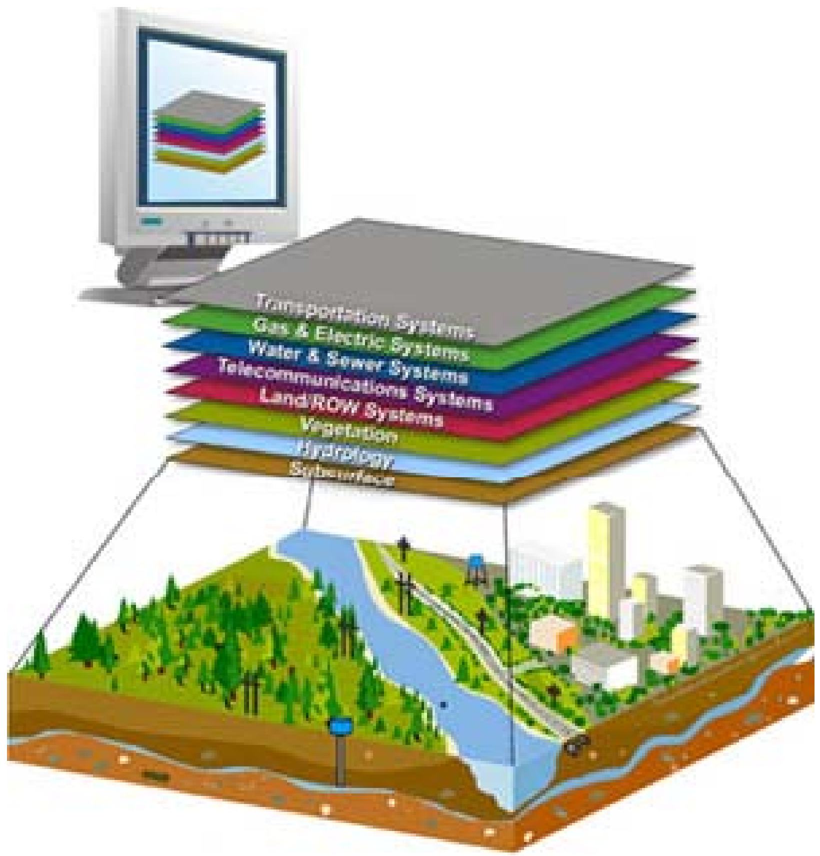
COMMUNICATION NETWORK :



Automation - Journey So Far .....

• GIS	-	Completed
• GSAS	-	Completed
• Communication Network	-	Established and Stabilized
• SCADA	-	Implemented and Stabilized
• DMS	-	Implemented
• OMS	-	Under Implementation

GIS - Database Development



Land base

- Land base on large scale for an area of over five hundred square kilometers.

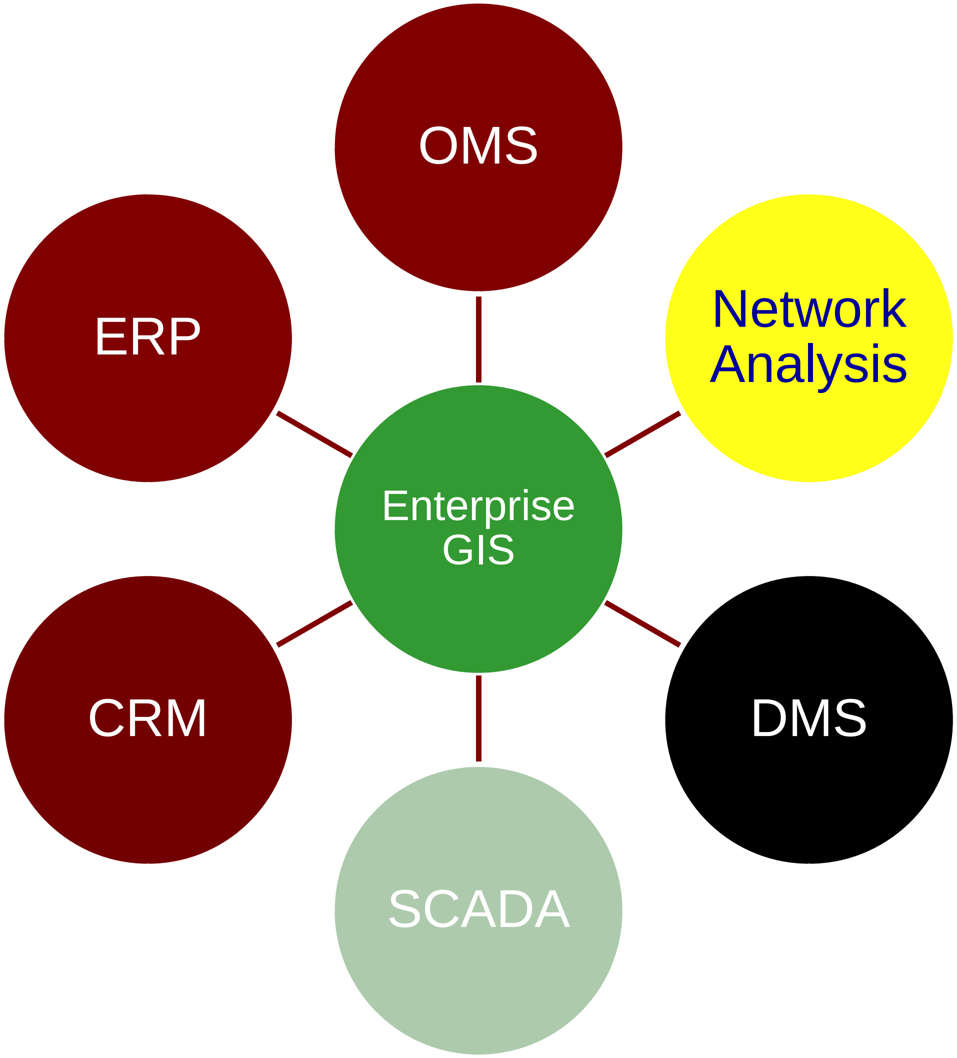
Electrical Network

- Entire EHV, HV and LV Network from grid station to consumer feed points.
- Utility estate assets such as Consumer Care Centers, Cash Collection Centers & other offices.

Consumers

- Meter locations of Consumers

GIS - System Integration



The GIS centric system integration makes use of location specific information through other systems. System Integration majorly requires:

- ❑ Sharing attribute information with other systems like CRM and ERP.
- ❑ Data delivery to other systems like DMS and OMS

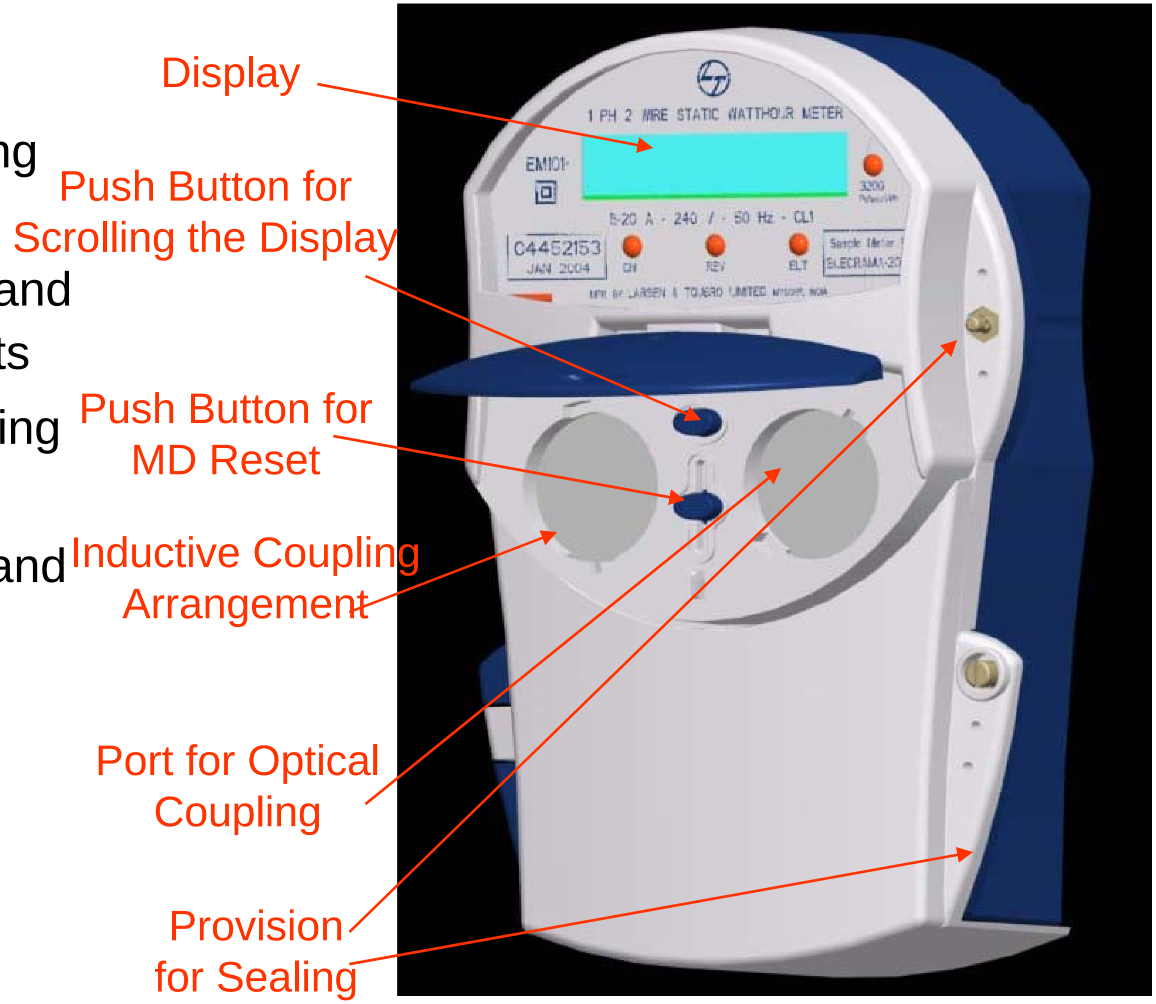
SCADA / DMS / GIS - Usage / Application

- Remote Control and Monitoring of all 66 / 33 KV Grid S/S
- Effective Load Forecasting & Scheduling
- Effective Load Shedding on pre-defined time (and duration)
- Grid / Feeder wise Energy Accounting
- Centralized monitoring of 11 KV Feeders
- Decision making / Network planning based on DMS applications
- Faster Identification and Restoration of faults

Metering &
Energy Audit

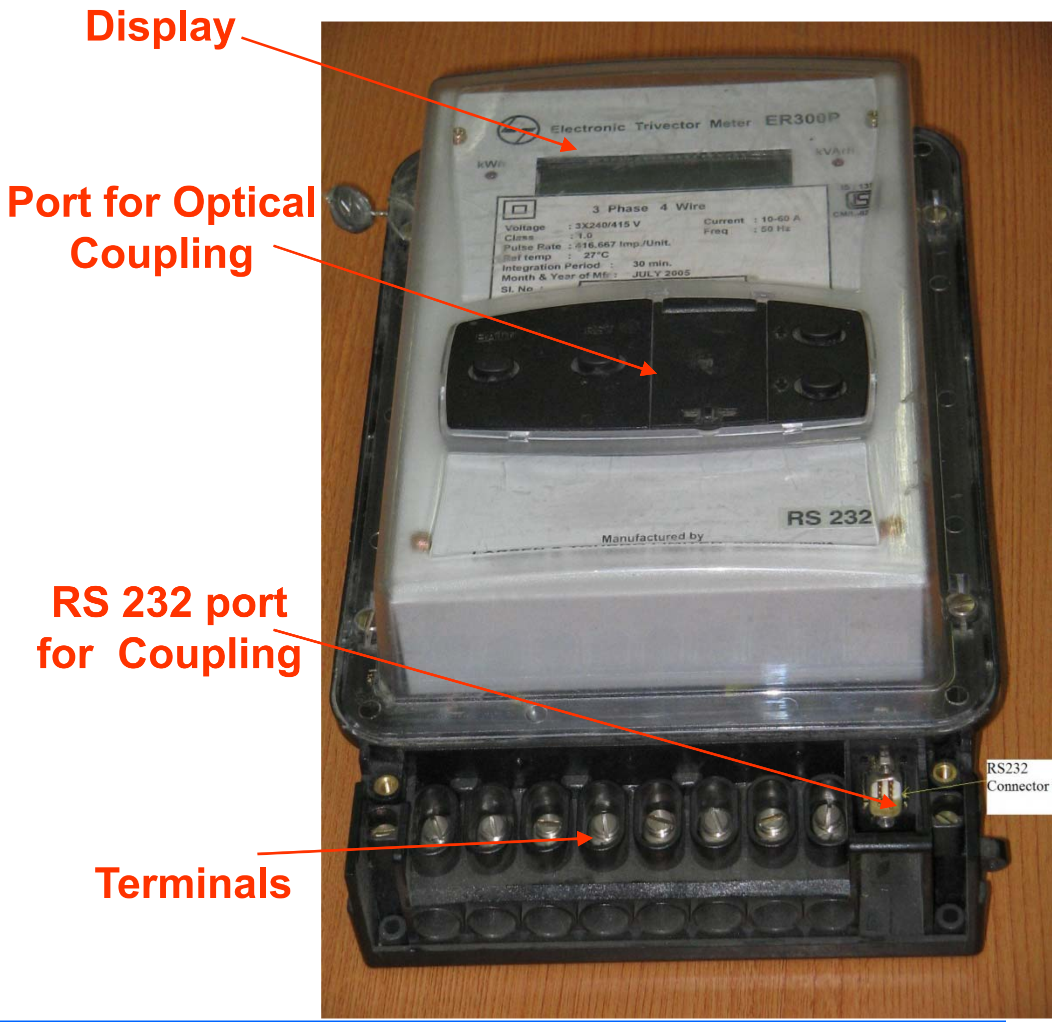
Electronic Metering:

- PCB mounted devices for measurement
- Comprises no moving/rotating parts
- Extremely modular designs and compatible to measurements
- Meter not affected by mounting arrangements
- Accuracy levels do not drift and obtained through choice of components and software-Factory set
- Economies of scale reduce costs
- Tamper proofing requires continuous upgrade



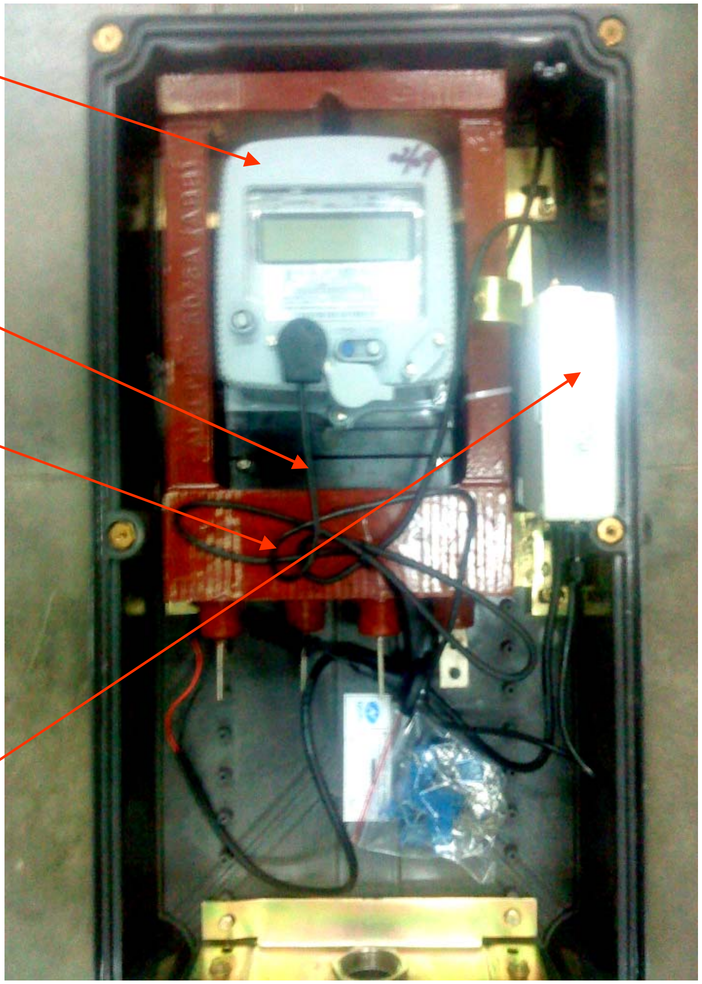
Static / Electronic Meter – The Evolution

- Three-phase electronic meters
- Conform to relevant standards for accuracy
- Multi-parameters displayed including tamper
- Data storage for 60 days for periodical measurements for load survey, tamper analysis and ABT application
- Compatible for communication to enable AMR



The Static / Electronic Meter – Application in NDPL

- Meters enclosed in sealed (polycarbonate) boxes during installation
- 3-phase meters CT meters in sealed boxes along with modems.
- Use of resin-cast CTs with secondary terminals plug-in into meters directly
- Ensure uniform CT .PT ratio,s for an MF=1
- Modem connections also with plug-in power supply
- Only outgoing power terminals accessible once sealed



Automated Meter Reading and Communication Technologies

- Use of GSM communication for meter data
- Use of CDMA in meter data communication
- Radio Frequency communication- LPR
- Power line carrier communication –PLCC
- Combination of these for “Split metering”

Modem

Optical port

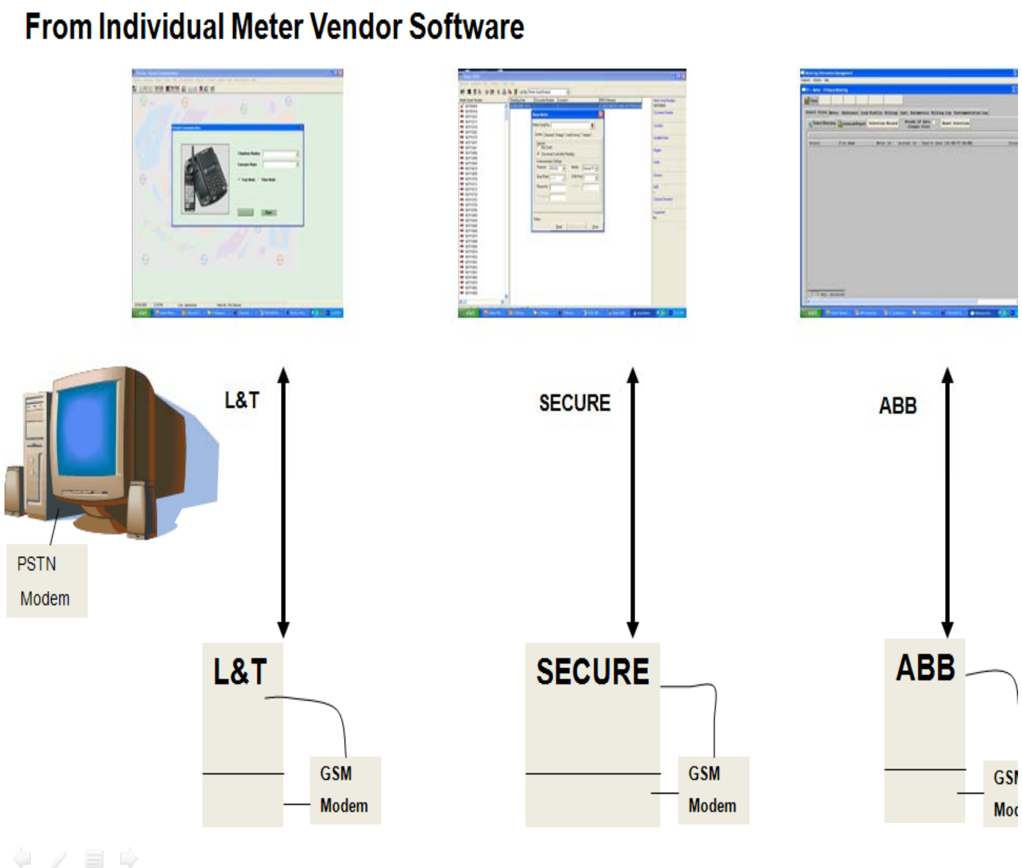
21

Automated Meter Reading and Communication Technologies

NDPL

- Use of GSM for one way communication for meter data
- Use of Vendor propriety API interfaces
- Common Framework Software with embedded APIs at the Central station
- API data converted to XML using common nomenclature to achieve inter-operabilty
- Remote switching can be achieved through GSM

Central Station Structure

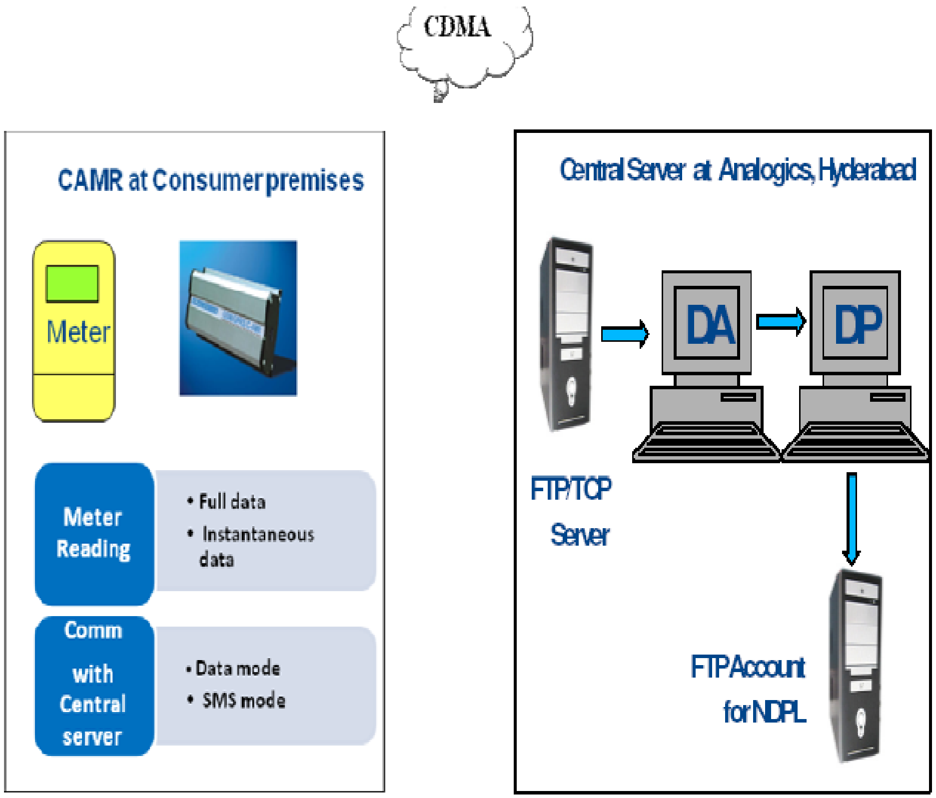


22

Automated Meter Reading and Communication Technologies

- Use of CDMA & IP for two-way communication
- Meter to Modem communication on propriety protocol
- Modem to Central FTP server in TCP/IP protocol. API used at central servers.
- Faster and two-way communication achieved
- Remote switching can be done

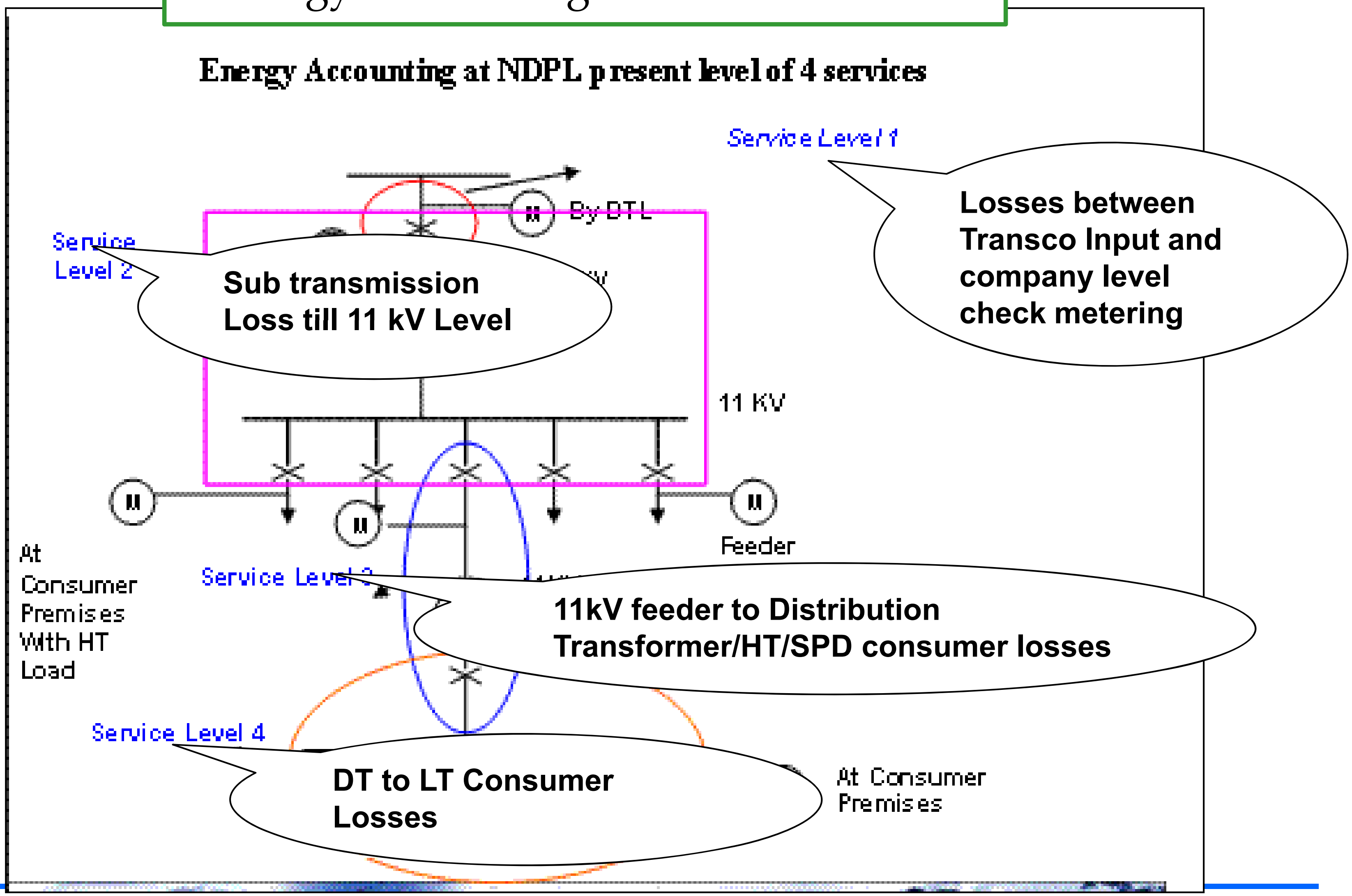
CDMA Communication : Architecture



23

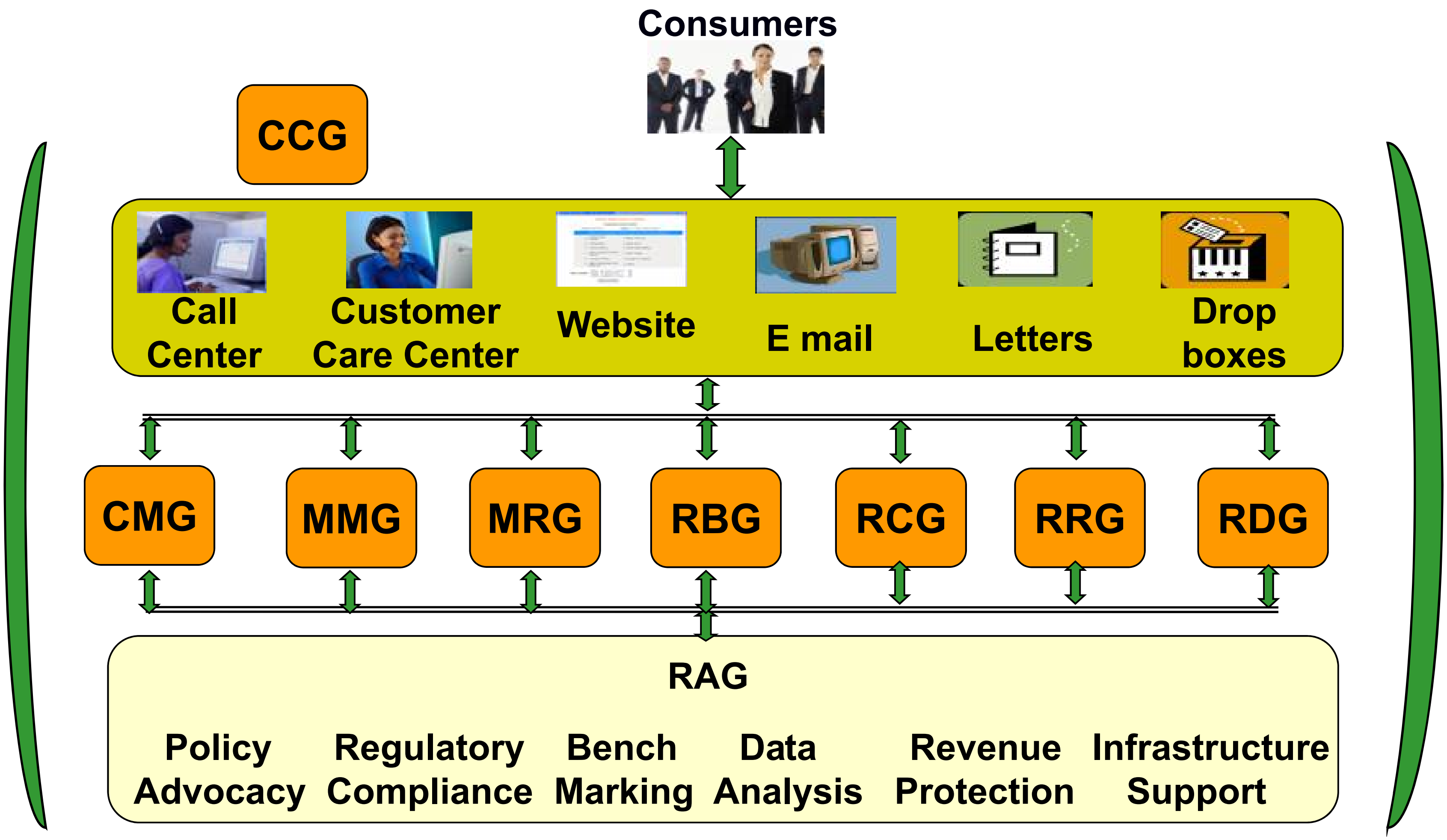
Applications of Metering – Energy Accounting

Energy Accounting at 4 Service Levels



BPR of
Commercial Processes

Business Process Re-engineering (BPR)



SAMBANDH – Integrated Commercial Package software- Industry First!!

IT Applications – Bringing Transparency / Efficiency in Consumer's Services

IT Enablement – Era of Transparency

SUGAM – Billing database of 100% of consumers on website – **First Time In India.** Institutionalized transparency. SUGAM enables consumers to:

- View Electricity Bill
- View Consumption Graph
- Print Duplicate Bill.

Screen shot from SUGAM

Workforce Management System

NDPL

Call Received at Call Centre

SMS Sent to field crew

K. Kalra
32 Rohini
No Current
15mins

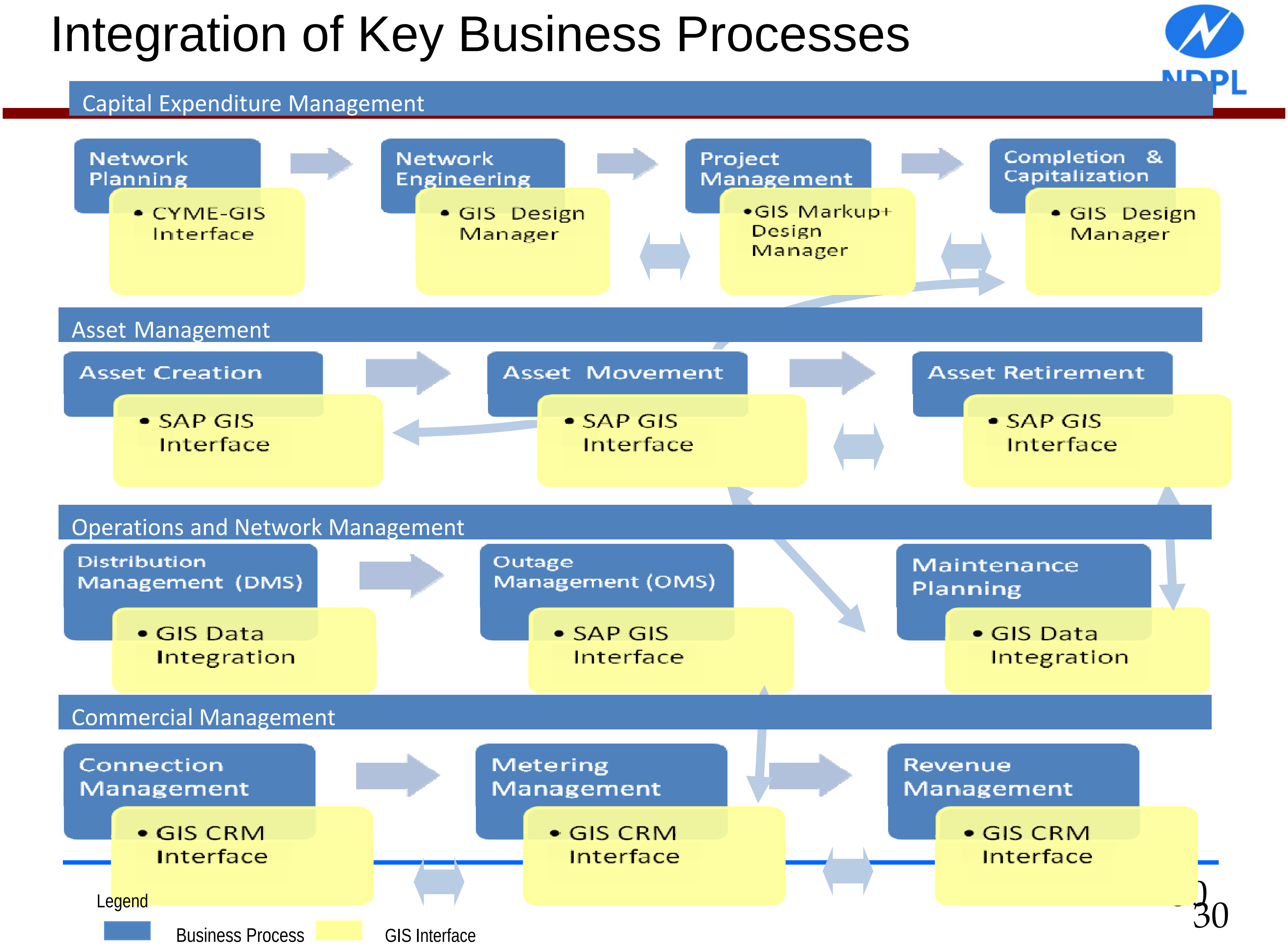
Complaint attended & Call Centre informed

Consumer informed & Call closed

SMS Based Fault Management System

Significantly reduced the fault Restoration time

Integration of Key Business Processes



Integration of Applications:

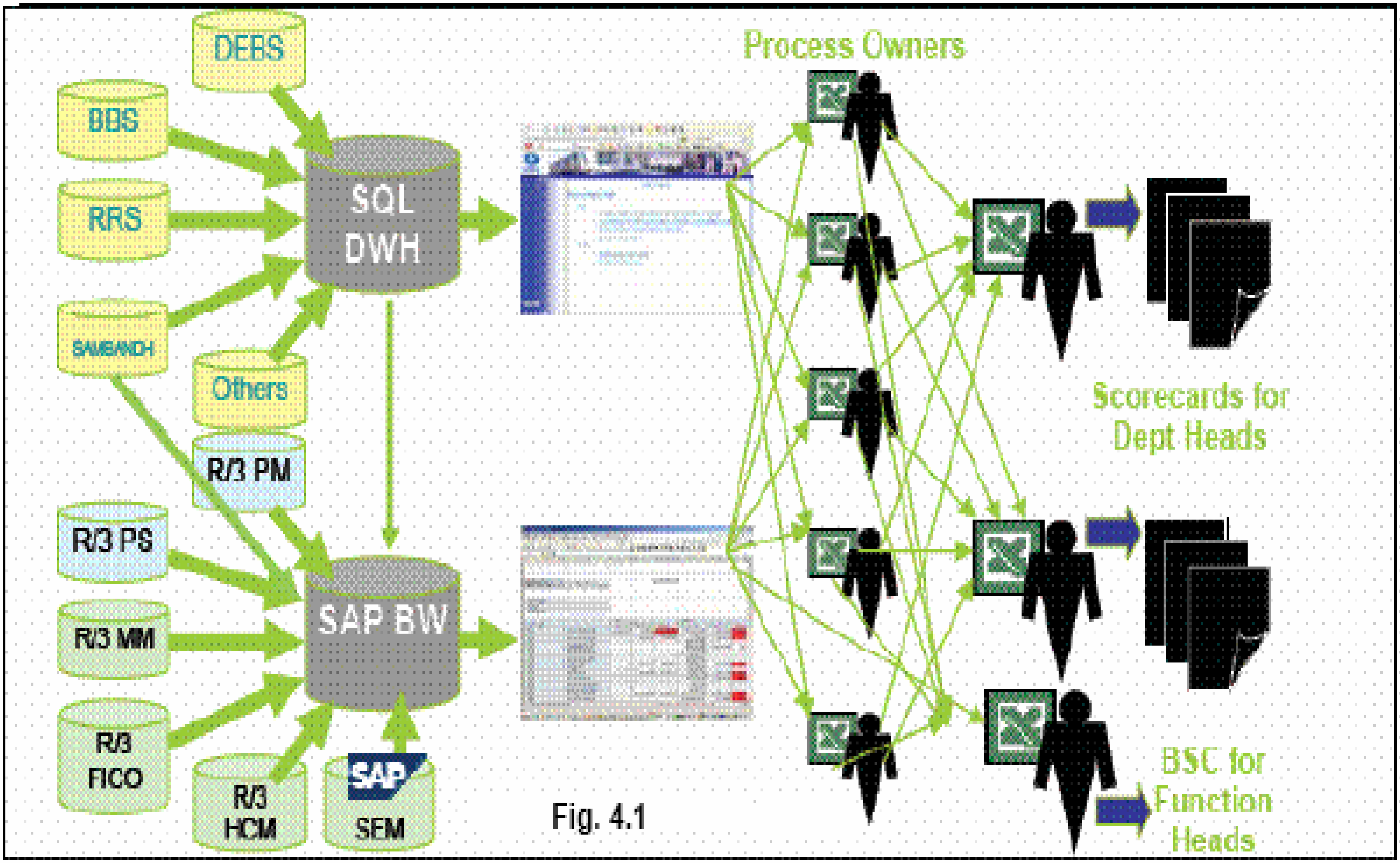


Fig. 4.1

Payment Avenues – Consumer Convenience

- **Payment Avenues** increased from 20 at the time of takeover to 1100+ now.
- **State of the art Collection centers** instituted with all civic amenities.

- Consumer Comfort redefined with **Automatic Cash / Cheque Collection** machines
- **Payment of Energy Bills through Website also (by Credit Cards)** - Website Certified as secure by *'Verisign'.*

Upgraded Consumer Care Infrastructure

State-of-the -Art Collection Center

Consumer Care Centre

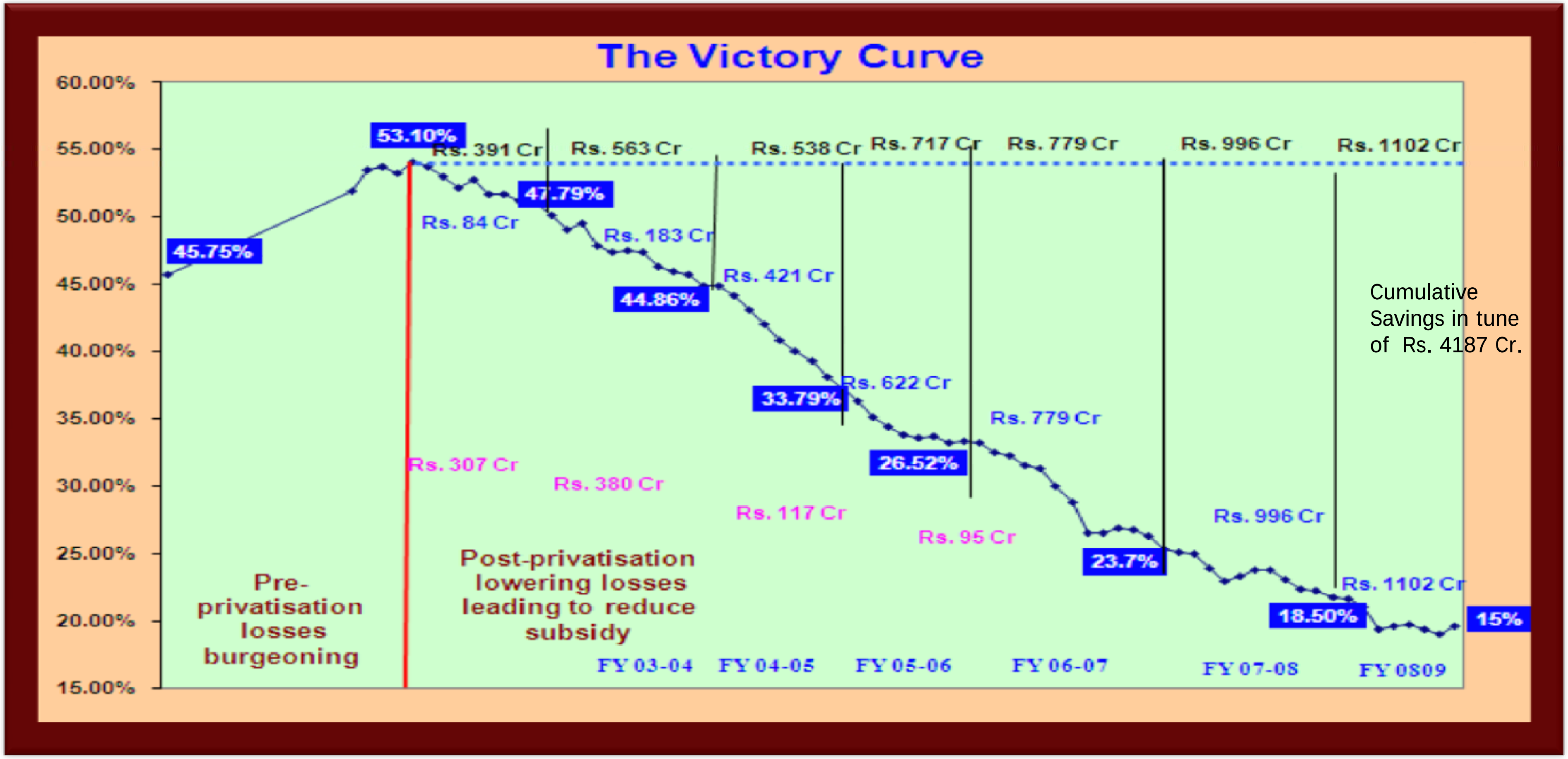
Structure of Presentation

- NDPL Profile
- Strategic IT Plan
- Applications of IT Systems
- **Results & Benefits**

Trend of AT & C Loss Reduction – In NDPL

Parameters	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09
Energy Input (MU)	5237	5552	5549	5695	5986	6281	6298
Units Billed (MU)	2813	3196	3667	4154	4351	4975	5050
Amount Billed (Rs Cr)	1126	1272	1565	1883	2032	2323	-
Amount Collected (Rs Cr)	1095	1219	1568	1897	2132	2394	-
% AT&C Loss	47.79	44.86	33.79	26.52	26.52	18.50	< 16
% Billing Efficiency	53.72	57.56	66.08	72.95	72.68	79.21	> 80
% Collection Efficiency	97.18	95.78	100.20	100.73	104.94	103.04	> 103

AT&C Loss Reduction – Savings to the Government



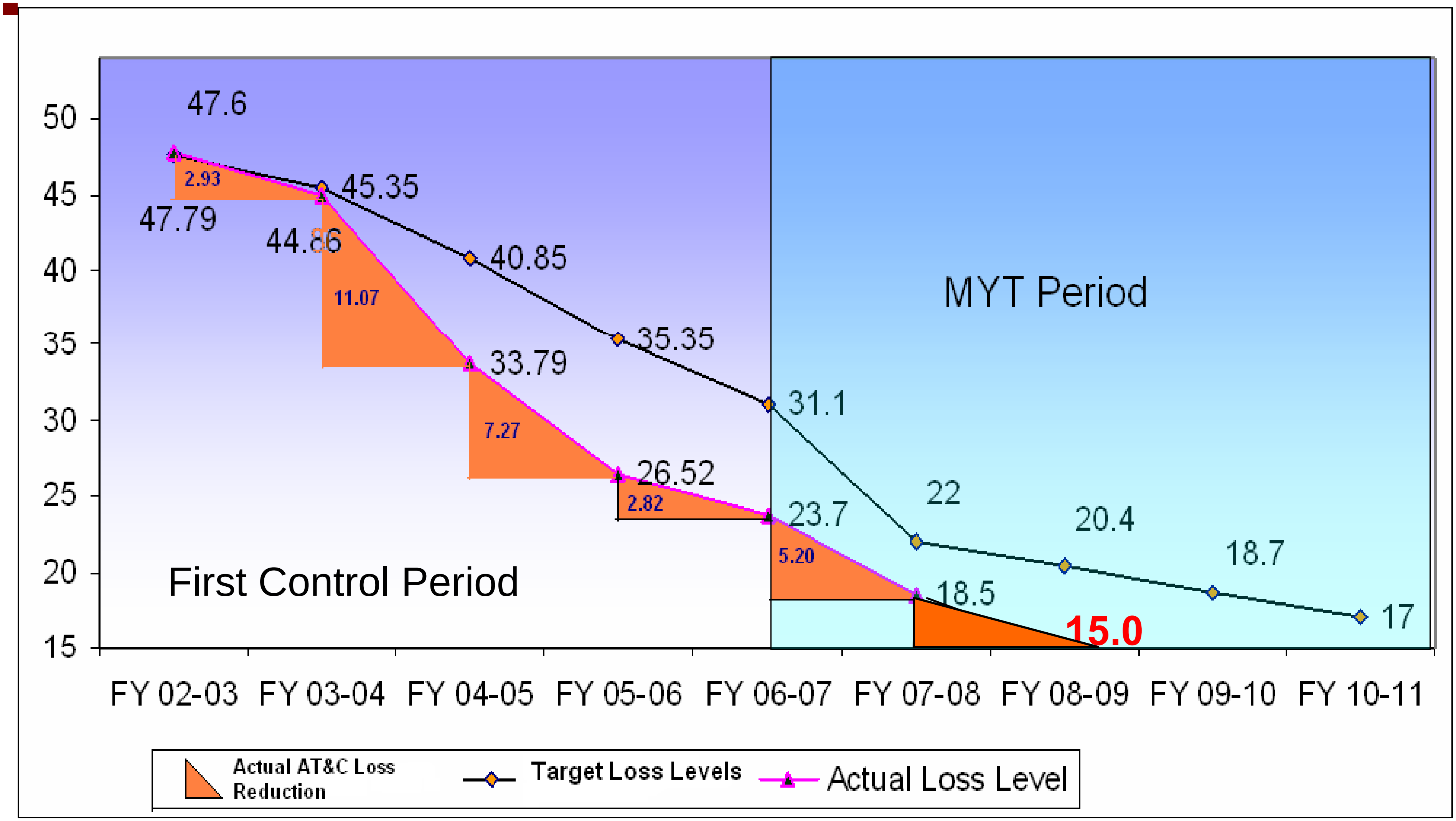
Govt loan of Rs 552 crores prepaid 9 years ahead of schedule

In 2002, Power Theft was about Rs 4 crores per day in NDPL area- Now it is less than 90 lacs/day

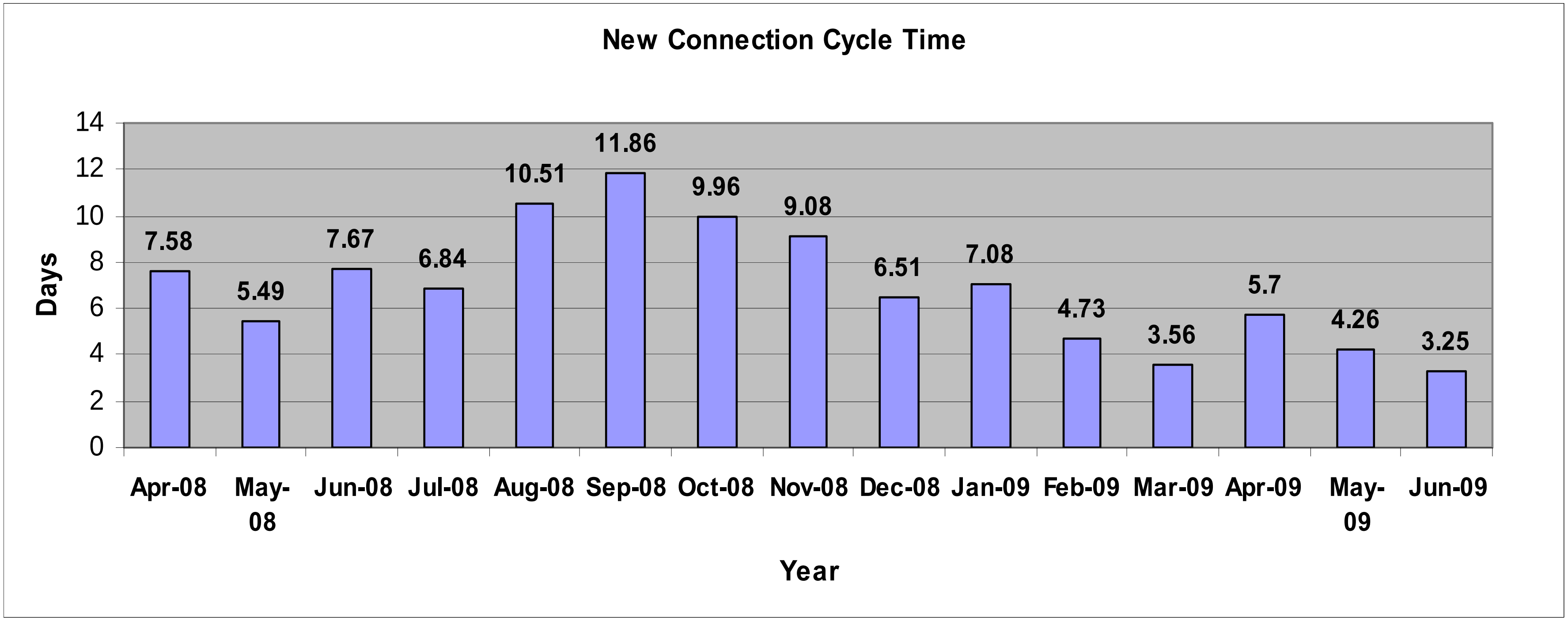
Increase in NDPL paying capacity reduced Transcos dependence on Govt. to NIL

Domestic Tariff continues to be same since July 2004

Achievement : AT&C Loss Reduction

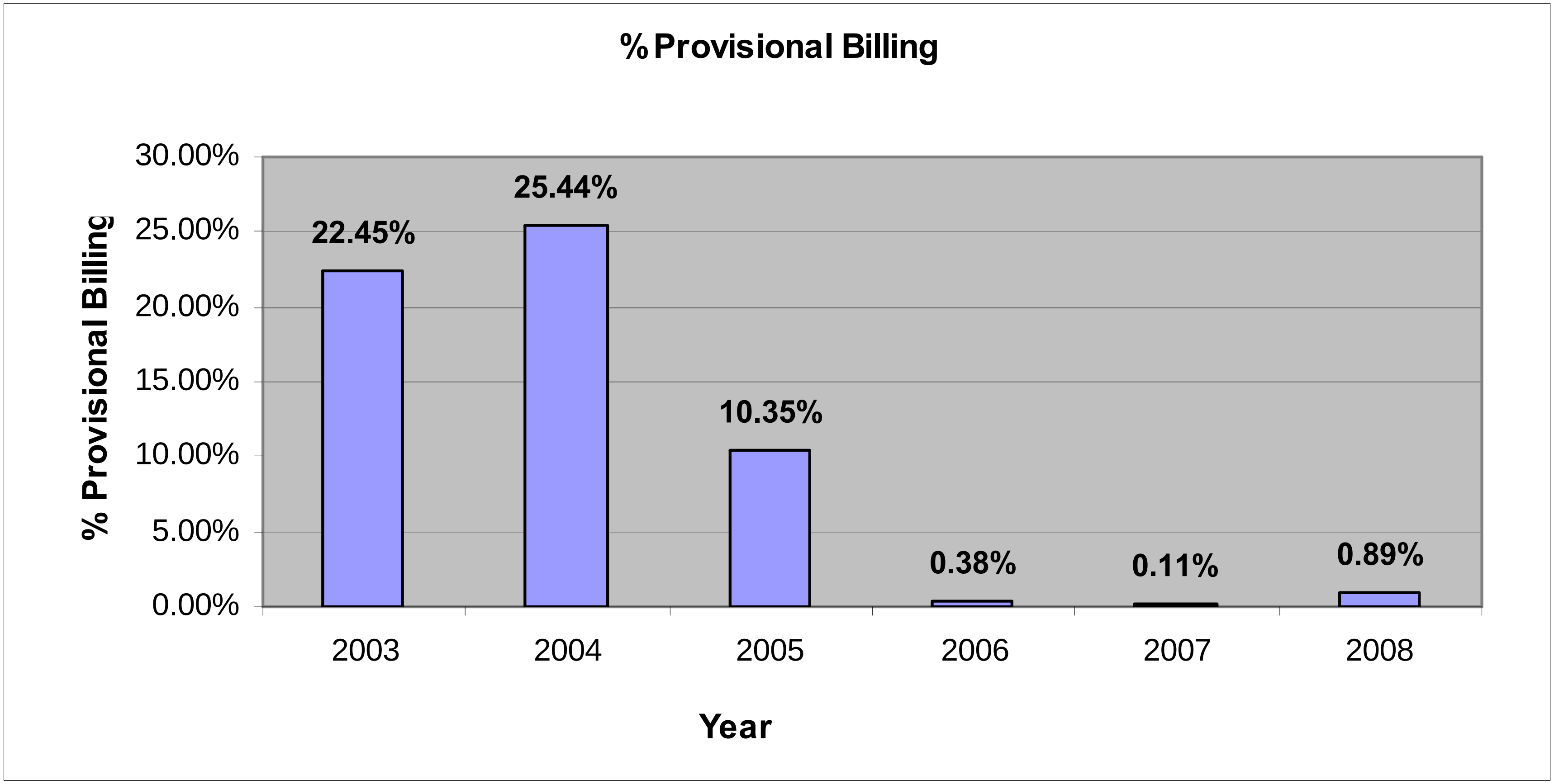


Results – Metering Installations & Cycle time



Instant "Tatkal" New Connection Started in Feb-09 : Meter installed on the same day of Request and Demand note paid.

Billing- Provisional Billing



Results – Few other parameters

Parameters	Before Takeover	At present
<u>Operational Parameters</u>		
Capital Investment (Rs Crores)	1,210	Add. 1,850
Transformer Failures w.r.t Installed Capacity (%)	11	< 1
Percentage Share in Load Shedding (In Delhi)	40	< 2
<u>Commercial Parameters</u>		
Average Days for New Connection Energization (Days)	51.8	8.0
Number of Electronic Meters	-	> 1.0 Million
% Provisional Billing	22.5	< 1
DT – Wise Energy Auditing (%)	-	100
Special Courts (Nos)	-	2
AT&C Losses (%)	53	< 16.0
Capacity to pay BST (Rs/kWh)	1.52	2.90

Structure of Presentation

NDPL

- NDPL Profile
- Strategic IT Plan
- Applications of IT Systems
- **Results & Benefits**

Awards & Recognitions - To name a few

NDPL

National Award for Meritorious Performance
For Years 2004-2005, 2005-2006 & 2007-08

Young NDPL - Mature Achievements

"When we studied the DLSA website, it is indeed re-assuring to know the successful settlement of more than 10,000 cases pertaining to **North Delhi Power Ltd**, in the period Oct 2003 to July 2006, at the aegis of DLSA, pre-litigation stage"

- Dr. A. P. J. Abdul Kalam

10th Nov'2006

Achievers Awards For Record Settlements (10,000 Cases) in Two & Half Years

- Award Instituted by DLSA

Awards & Recognitions - To name a few

Edison Electric Institute (EEI) 2008 - Edison Award for

Implementation of Geographic Information Systems (GIS)

Award Bestowed For " *Distinguished Leadership, Innovation and Contribution to the Advancement of the Electric Industry for the Benefit of All*"

Awards & Recognitions - To name a few

NDPL

POWER UTILITY OF THE YEAR - ASIAN POWER AWARDS

FOR THE YEAR 2007 & 2008

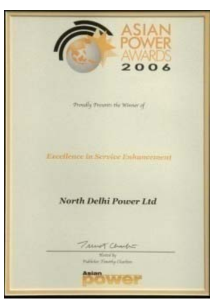
Awards & Recognitions - To name a few

Public Lok Adalat Award for the 10,000 Settlements in 2 ½ years

Expert Choice Award for Most Admired Organization in Private/ Joint Sector by Powerline

SUGAM Award for Transparency in Billing System

Intelligent Enterprise Award For IT initiatives by Indian Express



Asian Power Award for Excellence in Service Enhancement

Award for Corporate Social Responsibility by Amity

Thank You

Energy & Utilities

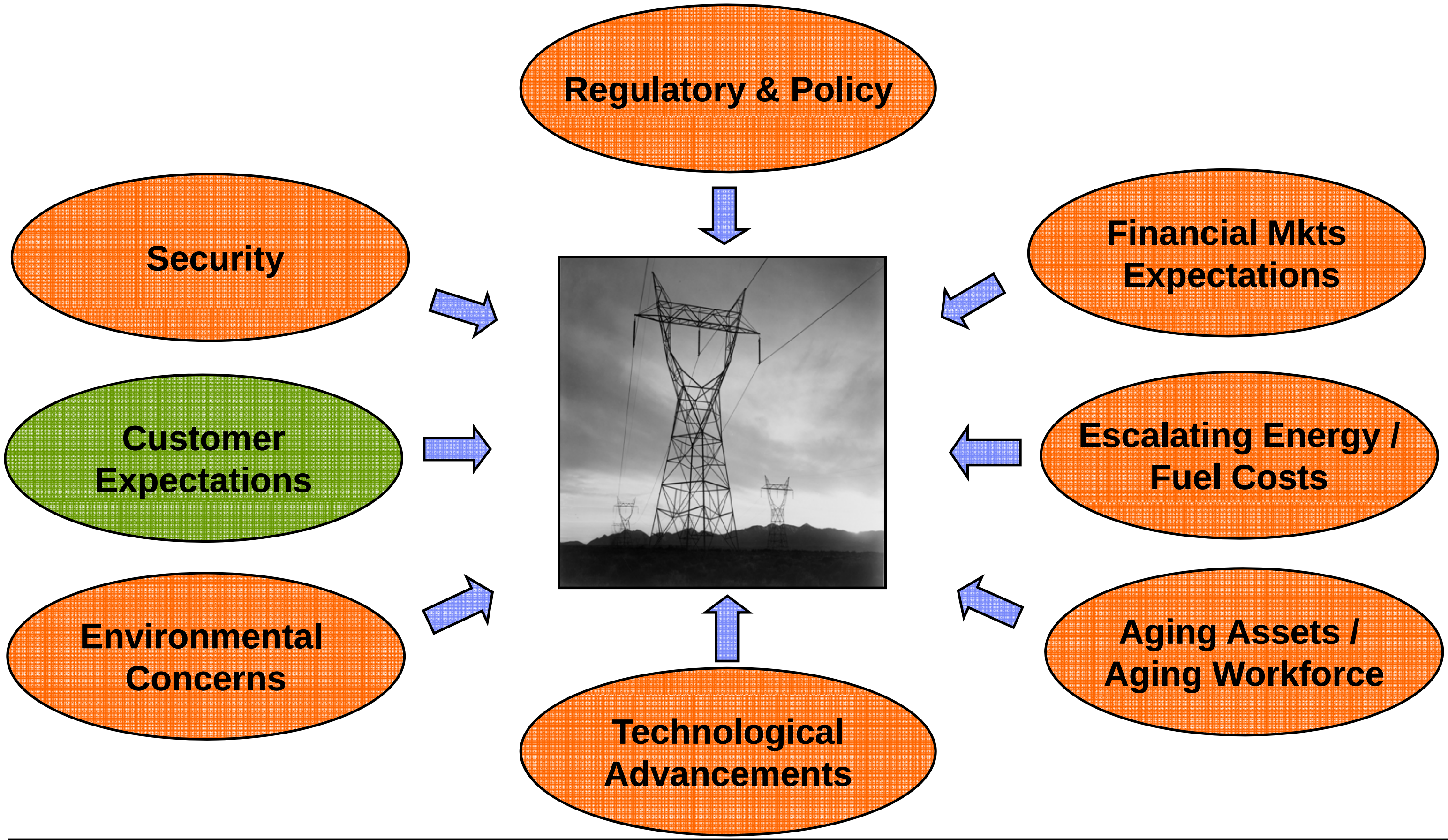
IBM
presentation to
Forum of Regulators

Reji Kumar
Head – Energy & Utilities, IBM India

Date: 17 July 2009

- **The electric utilities will change more in the next 20 years than it has in the last 100!**
- ***The decisions made in the next 5 years will determine whether the transition is considered a success***

Converging Market forces are driving utilities to seek new approaches and business models to operate with…. Driving Investment and Innovation



These forces are increasing the need for greater network reliability, efficiency flexibility and observability…….. creating the need for better enterprise integration and information transparency

As economic, supply and technology dynamics shift business models change and transform

Table 1.8: World Electricity Demand in the Reference Scenario (TWh)

	1980	2000	2005	2015	2030	2005-2030*
OECD	4 738	8 226	8 948	10 667	12 828	1.5%
North America	2 385	4 140	4 406	5 227	6 390	1.5%
Europe	1 709	2 700	2 957	3 467	4 182	1.4%
Pacific	645	1 386	1 585	1 973	2 257	1.4%
Transition economies	1 098	1 015	1 099	1 381	1 729	1.8%
Russia	n.a.	607	647	792	963	1.6%
Developing countries	958	3 368	4 969	9 230	15 180	4.6%
China	259	1 081	2 033	4 409	7 100	5.1%
India	90	369	478	990	2 104	6.1%
Other Asia	129	575	766	1 306	1 927	3.8%
Middle East	75	371	501	779	1 228	3.6%
Africa	158	346	457	669	1 122	3.7%
Latin America	248	626	734	1 116	1 700	3.4%
World	6 794	12 609	15 016	21 278	29 737	2.8%
European Union	*n.a.*	*2 524*	*2 755*	*3 179*	*3 786*	*1.3%*

* Average annual rate of growth.

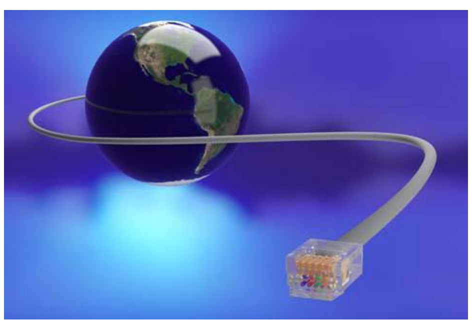
Supply

Demand

Aging Infrastructure

$40 Trillion ?

Globalization



Digital Society

Empowered, environmentally conscious consumers and maturation of new technologies will drive change as well as new growth opportunities

Past/Present	Evolving Future
Passive ratepayers	Empowered consumers
Limited interaction between grid and home	Connected home
Consumer tolerance for outages	Need for uninterrupted power delivery
Decision-making driven solely by price	Many factors: price, climate change, etc.
Consumers indifferent to GHG emissions	Utilities expected to lower GHG emissions
Climate of political opposition to nuclear	More positive policies toward nuclear
Most utilities <5% of sales from renewables	Most utilities >5% of sales from renewables
Centralized generation	Decentralized generation
Highly regulated market	Largely competitive market

Source: IBM Institute for Business Value (IBV) analysis

A discernible shift in the balance of power is evolving, as consumer-driven experiences supplant parts of the past utility-controlled relationship

Utility-Controlled Relationship

In the past…

- **Ratepayers** had limited influence over electricity price and power availability
- **Ratepayers** had limited to no choice of supplier or fuel type
- **Ratepayers** had limited information about their usage patterns, and only in cumulative (e.g., monthly) form
- **Ratepayers'** direct interaction with the utility was primarily through monthly statements or customer-initiated telephone calls and service scheduling, with timing and conditions set primarily at the convenience of the utility
- **Ratepayers'** wants and needs were presented by elected or appointed representatives (regulatory agencies), who maintained exclusive communications channels and "negotiating power" with utilities

Consumer-Driven Experience

In the future…

- **Consumers** will manage electricity consumption to meet specific personal/ household goals such as cost, availability, and environmental impact
- **Consumers** will seek providers, information, and technologies that help them meet their goals
- **Consumers** will want to do business with companies who communicate a set of values consistent with their own
- **Consumers** will seek convenient and more personalized ways to interact with their utility to negotiate customized solutions to allow them to meet their needs
- **Consumers** will act on their own wants and needs where regulatory representation does not provide results satisfying these specific needs, primarily through execution of alternative solutions (e.g., self-generation)

Source: IBM Institute for Business Value (IBV) analysis

Much of the evolving future is driven by customer involvement, influenced by climate change concerns, and enabled by technological evolution

- **Climate Change:** Climate change has become a public policy item near the top of most agendas

- **Customer Involvement:** A discernible shift in the balance of power is evolving, as consumer-driven experiences supplant parts of the past utility-controlled relationship

- **Technology Evolution:** Advances in operational technologies such as metering, network, and distributed generation technologies are accelerating this shift

Source: IBM Institute for Business Value (IBV) analysis

Changes in customer behavior and the explosion in information flow drives the need for the intelligent or smart grid

Increased Climate Change Concerns

Increased Customer Involvement

Technology Evolution

1

Stratification of Traditional Customer Base

Frugal Goal-Seeker (FG)	Energy Stalwart (ES)
Passive Ratepayer (PR)	Energy Epicure (EE)

2

Shifts in Business Models

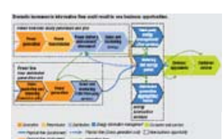
Operations Transformation (OT)	Participatory Network (PN)
Passive Persistence (PP)	Constrained Choice (CC)

3

Transformation of Industry Value Chain

Energy Flow

Information Flow



IUN

Source: IBM Institute for Business Value (IBV) analysis

What is Smart Grid?

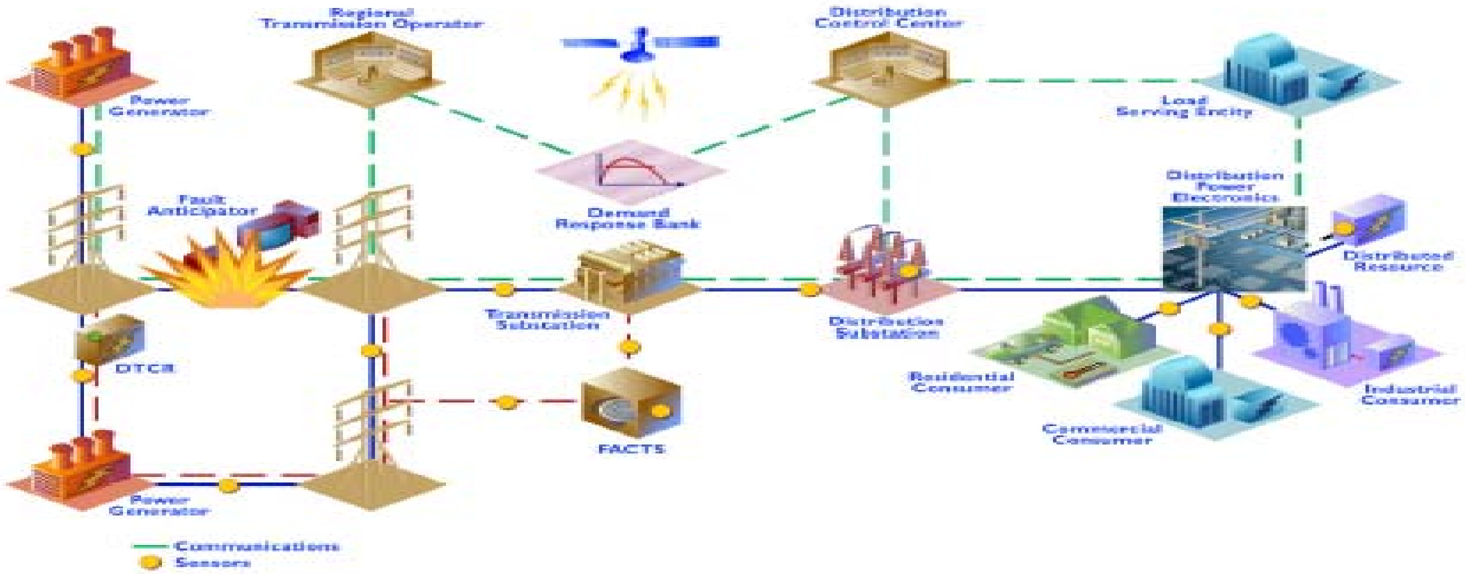
- **Definition of a *Smart Grid* vary according to who defines it:**
  - *to a Network Operator it is all about extension of grid observability, improved reliability, wide area measurement and self-healing properties*
  - *to an Automation Engineer it is all about SCADA/DMS and Substation Automation etc*
  - *to a Meter Engineer it is all about Advanced Metering Infrastructure (AMI)*
  - *to a System Integrator it is all about integration of IT and Automation applications*
- **In reality *Smart Grid* is all of these and much more!**

EPRI’s Vision for Intelligrid…

Made up of numerous automated transmission and distribution systems, all operating in a coordinated, efficient and reliable manner

Handles emergency conditions with ‘self-healing’ actions and is responsive to energy market and utility business enterprise needs

Has an intelligent communications infrastructure enabling the timely, secure and adaptable information flow needed to provide reliable and economic power



Fault Detection, Isolation and Restoration (FDIR) is a Smart Grid’s ‘Self Healing’ feature…The FDIR based self healing network reconfigures and restores service within seconds of un-faulted sections that are supporting customer loads

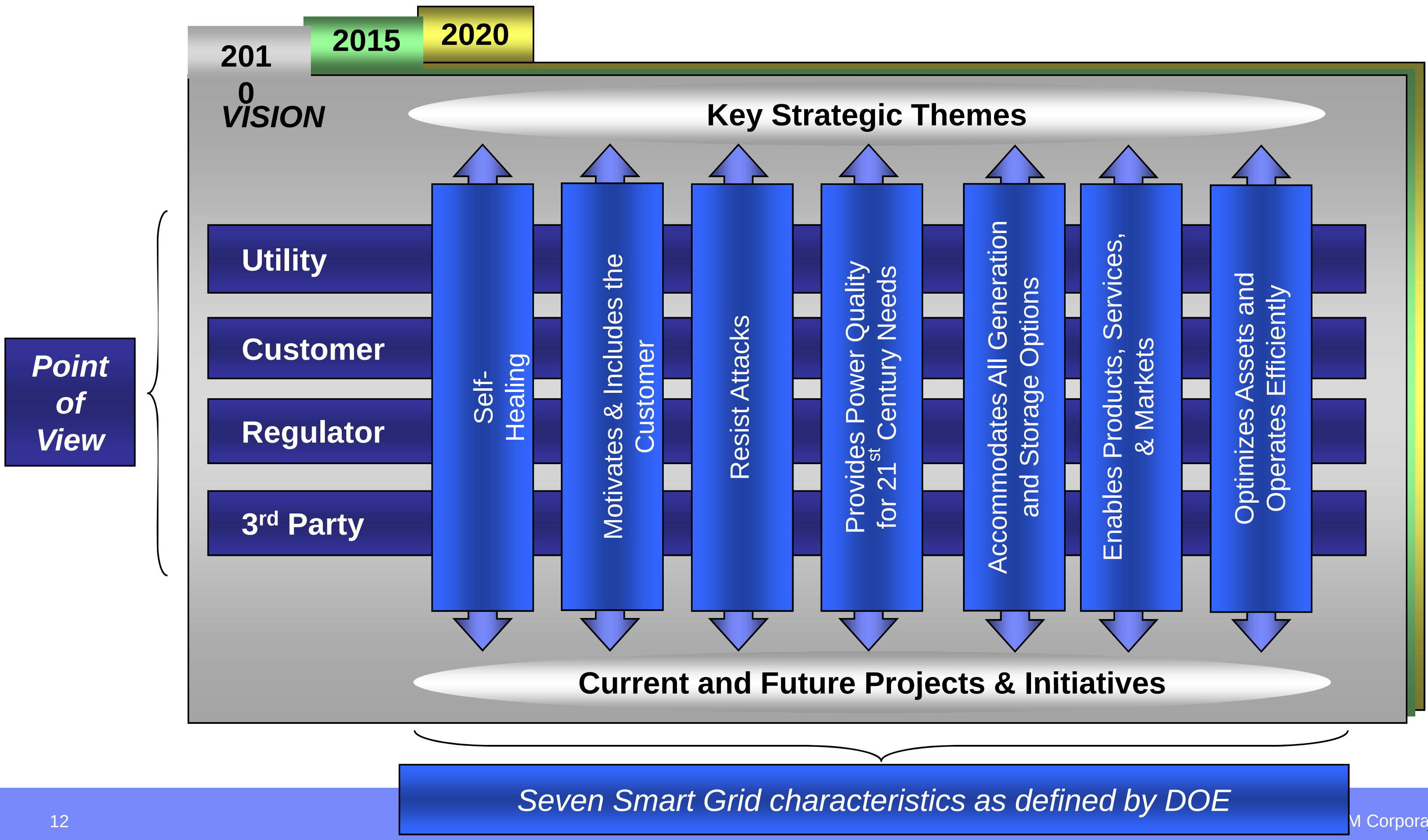
DoE Vision Statement

“ . reen”

Smart Green Grid[SM]

Roadmap Approach

The Smart Green Grid is a **business transformation** that has **distinct key themes at different phase of development**.



12

Smart Green Grid Roadmap

2010 **Energy Policy Goals** **2020**

20% Renewable Energy penetration

California Solar Initiative 3000 MW

2016

30% Greenhouse Gas emission reduction from projected levels

33% Renewable Energy penetration

2009 - 2011

Deploy base technologies
- ✓Smart meters installed
- ✓OMS/DMS system
- ✓Microgrid Pilot

New Customer programs offered by Utilities
- ✓ Dynamic Pricing
- ✓ EE, Demand Response
- ✓ HAN, Energy Management

Many Smart Grid components are initially deployed
- ✓Self-healing-grid technologies in full deployment
- ✓Microgrid technology deployed and self sustaining community concept demonstrated
- ✓PHEV infrastructure pilots

2012 - 2015

Automated outage detection, restoration, and customer notification
- ✓Expanded SCADA & line devices
- ✓Self Healing Grid technologies in place

Traditional utility relationship with customer is changing due to more mature new services for customers
- ✓Load control with DR
- ✓Bundled services
- ✓DER Aggregation (including PHEV)

Major regulatory issues are solved
- ✓Data ownership and access
- ✓Cross jurisdictional conflicts
- ✓T&D renewables strategy

2016 - 2020

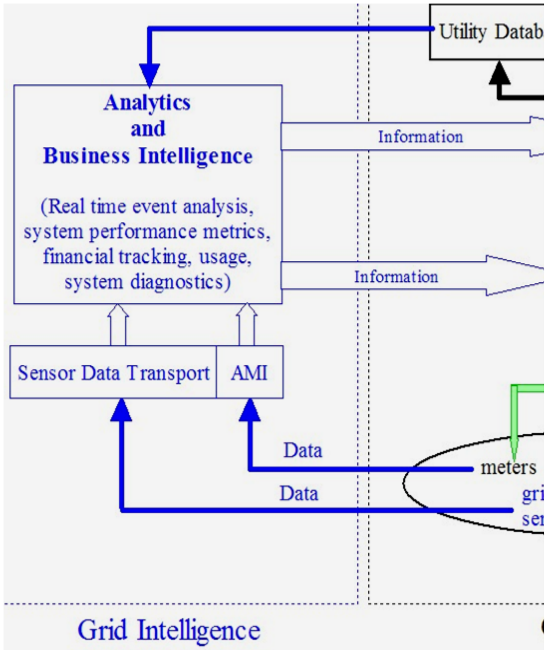
Customer supply side & storage decisions become the norm
- ✓Significant DER Penetration
- ✓Additional Microgrids where cost effective
- ✓"Customers as resources"

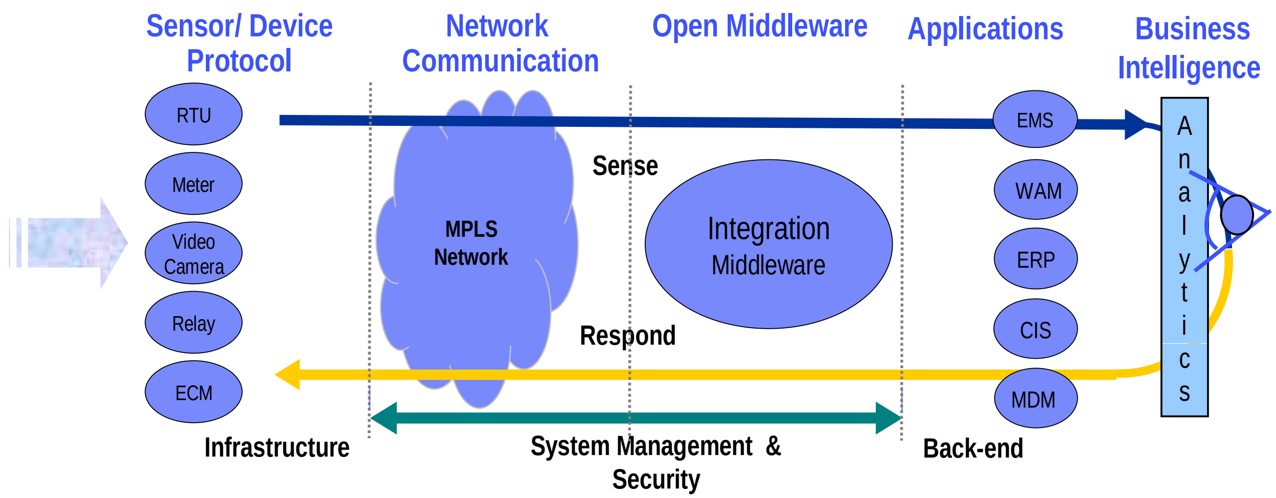
PHEV adoption rises- utility becomes "gas station of the future"
- ✓PHEV adoption emerges as a critical component of DER
- ✓Charging infrastructure in place
- ✓PHEV rates in place (charge & discharge)

Advanced grid technologies in place
- ✓CBM, Cable Diagnostics
- ✓Advance Energy Storage to support RPS goals
- ✓Self-healing grid is a reality

13

Intelligent Utility Network ....IBM view





An Intelligent Utility Network is an information architecture and infrastructure which enables the continuous automated monitoring of a Utility's ***Customers, Assets & Operations*** *and uses this 'On Demand' information to improve* ***Service, Reliability & Efficiency***

Costs

Risks

Revenue

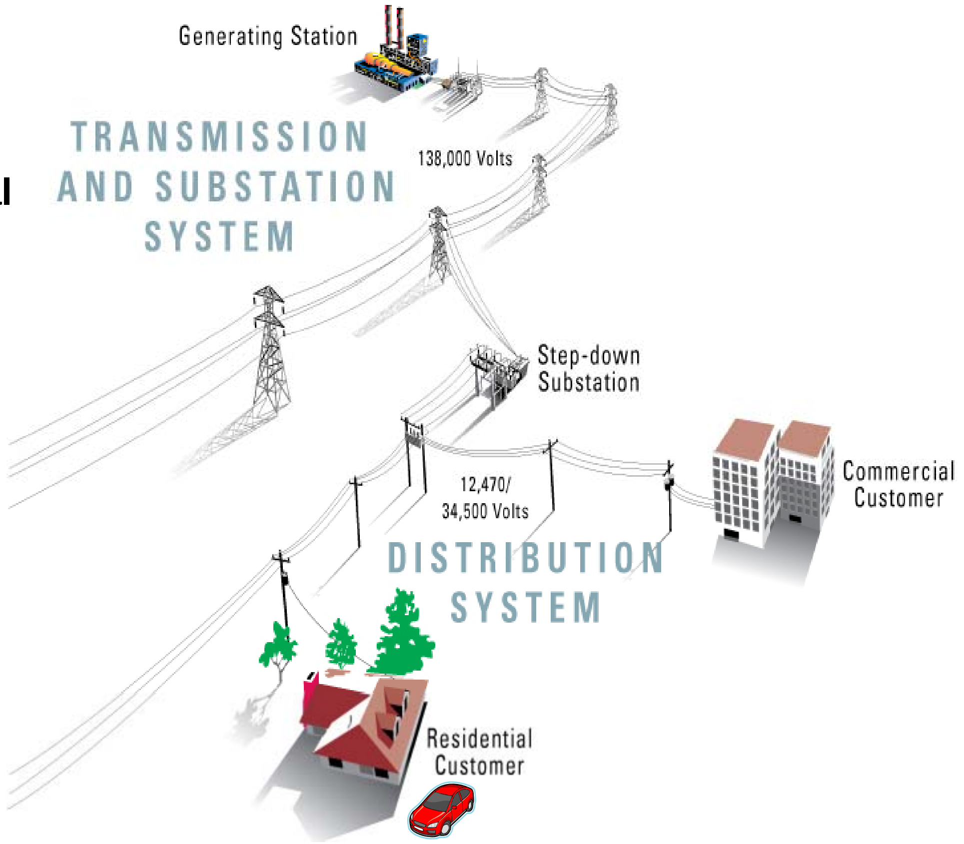
Customer Satisfaction

The Traditional Network - a 20th Century Grid

- **“World’s Largest Machine” – but Analog**
- **Limited information on real-time and historical status of network**
- **Limited sharing of information**
- **Limited tools for analysis**

"A high-tech world can no longer afford a low-tech electricity grid."
(Edison International Chairman John Bryson)

“The US electrical grid, once the envy of the world, is no longer world-class.”
(McKinsey Global Institute)



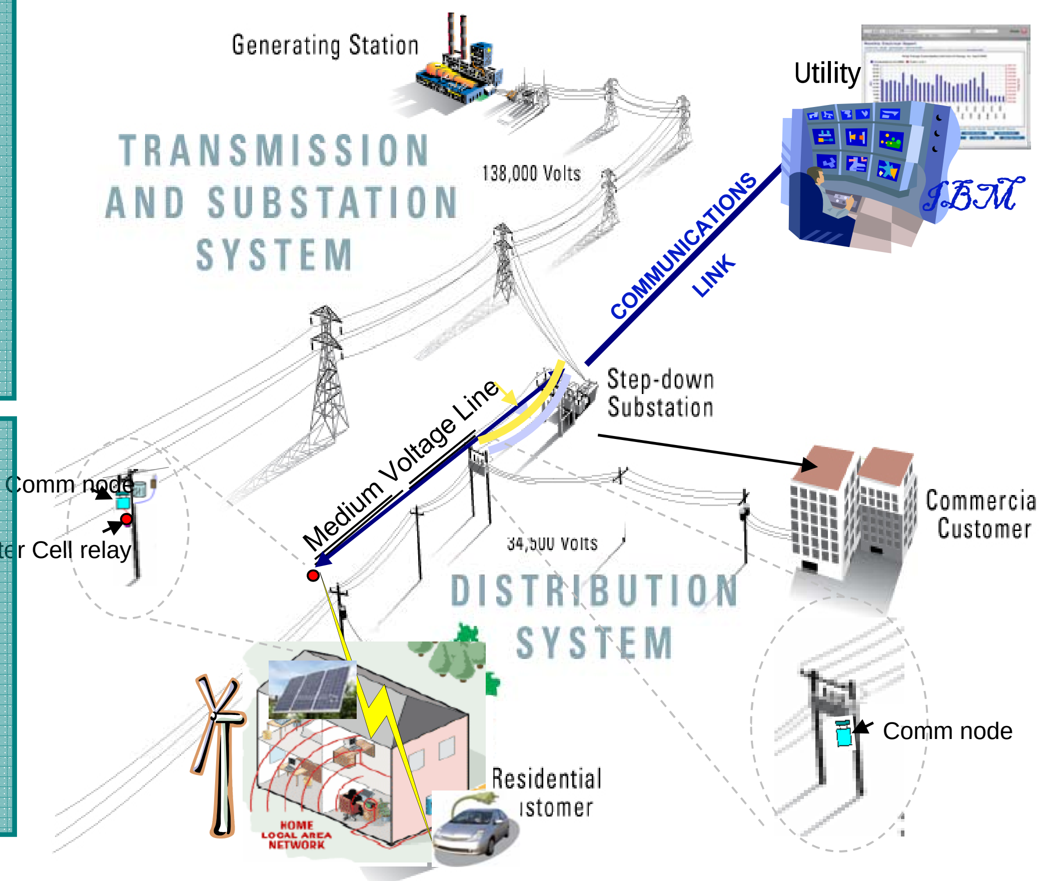
The 'Intelligent Network' - a 21st Century Grid

Digitization of "World's Largest Machine"

- Rich source of information
- Communications, IT infrastructure to manage information across enterprise & with customers
- Advanced tools to create value from information

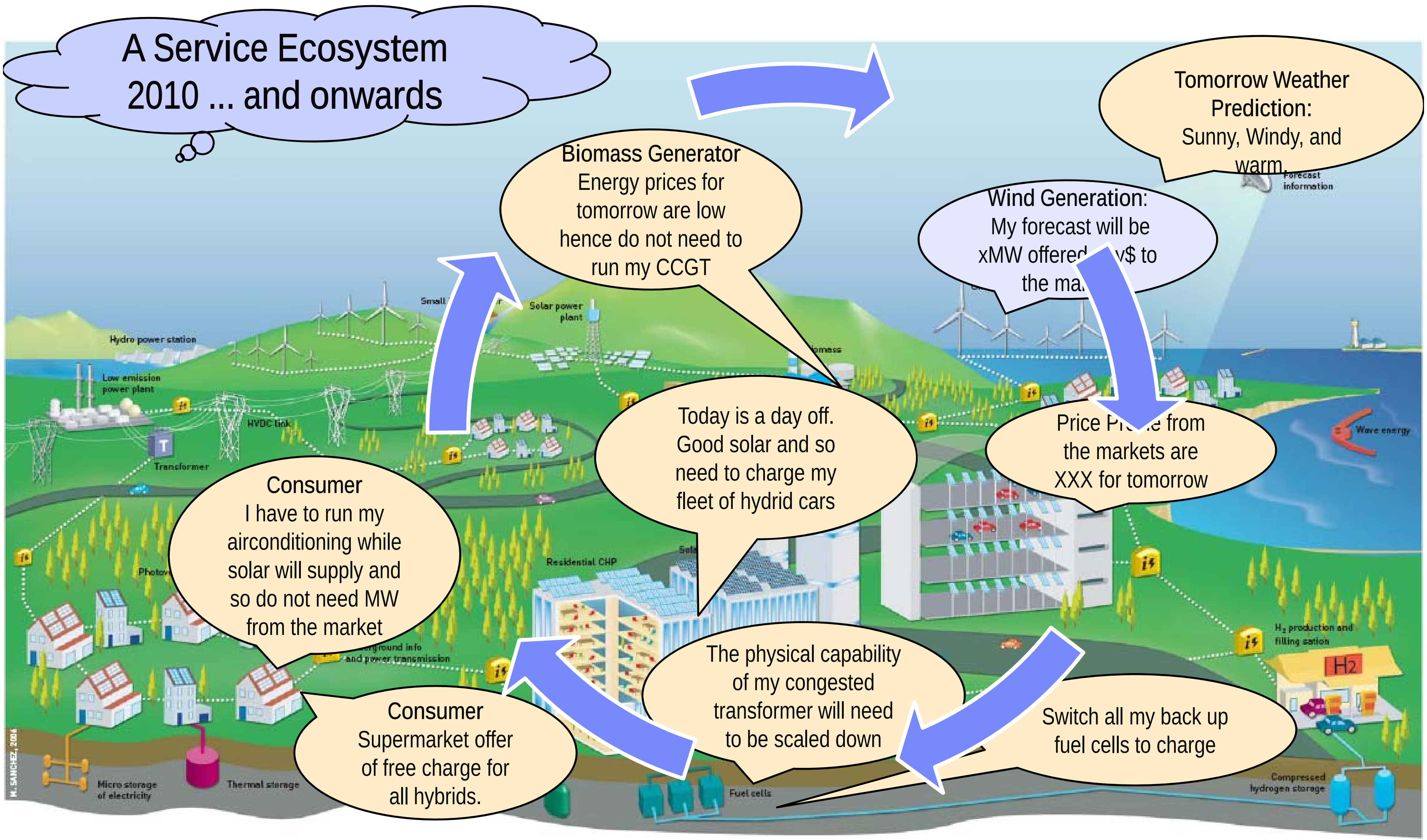
Expanding Virally …

- Billions of linked devices
- Highly complex energy flows
- Highly complex information flows
- Elevated role of consumer as producer
- Supported by smart money, moving even faster than forecasted

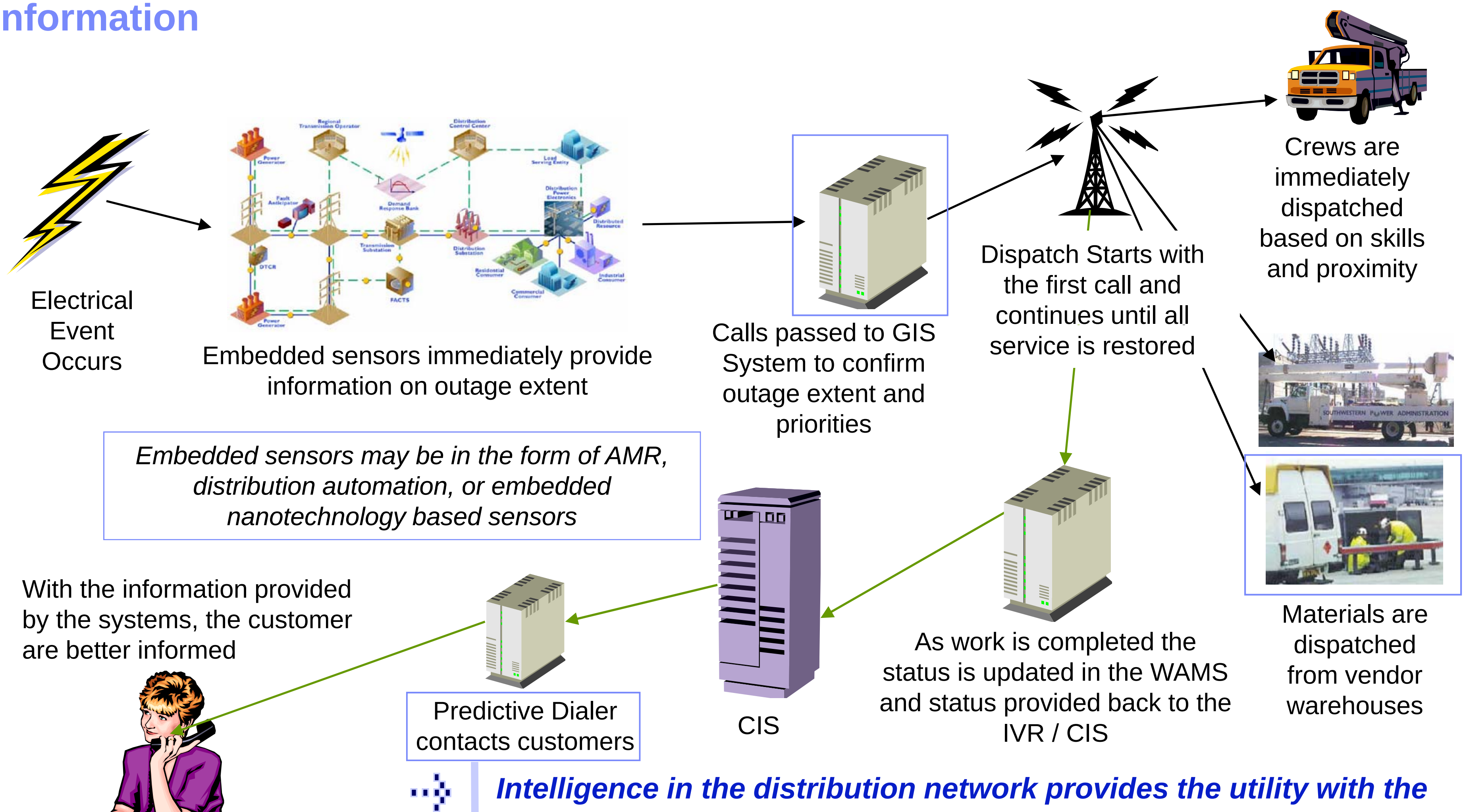


"To get an idea of what the future electricity grid will look like, think of the Internet. Like the Internet today, the electricity network needs to be able to connect billions of devices and still operate reliably." (John Wellinghoff, FERC Commissioner)

A Day in the Life of a Utility in 5-10 years

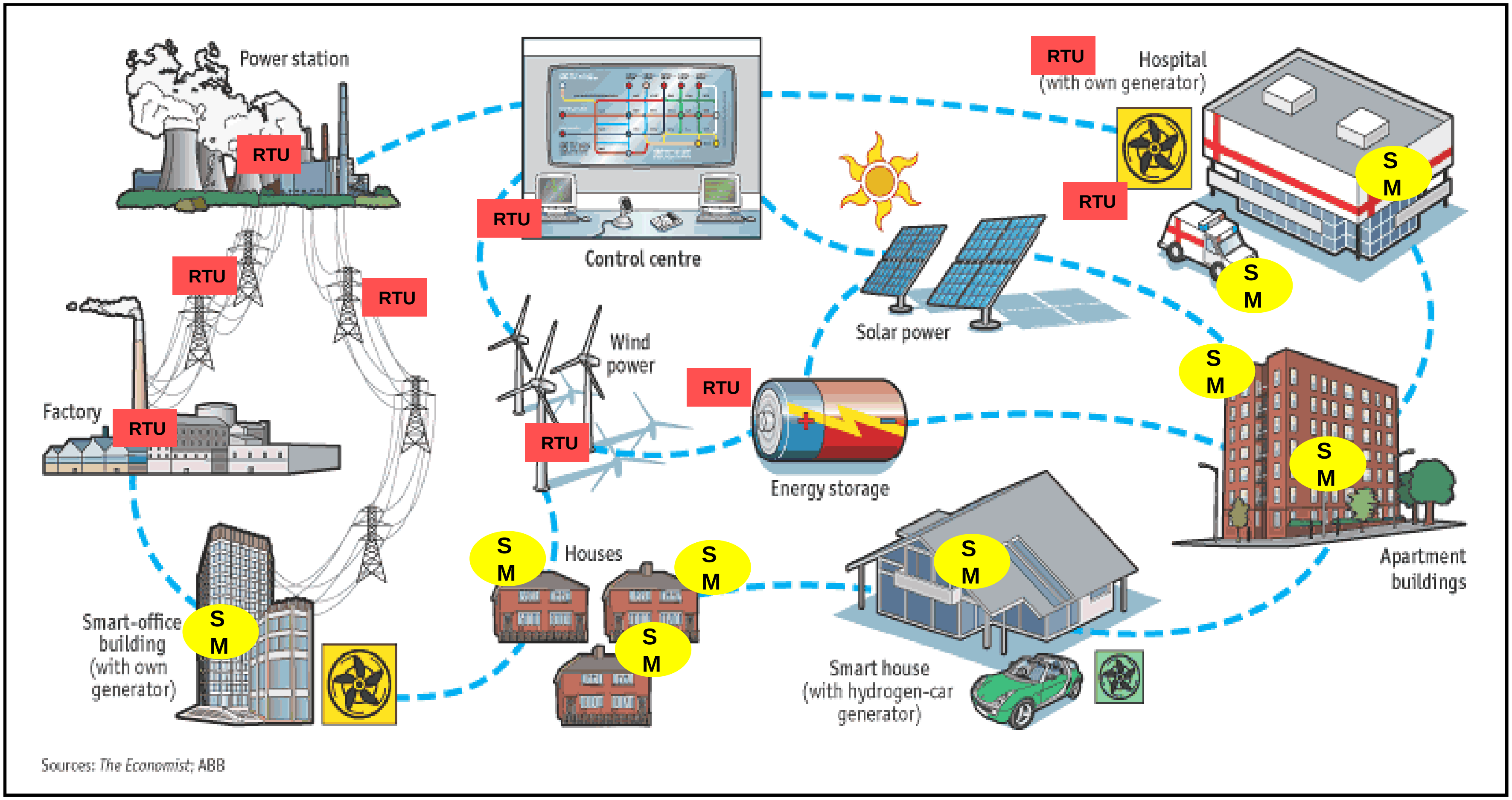


With sensors in the distribution network, utilities can finally operate their systems effectively and dispatch their resources based on real time information



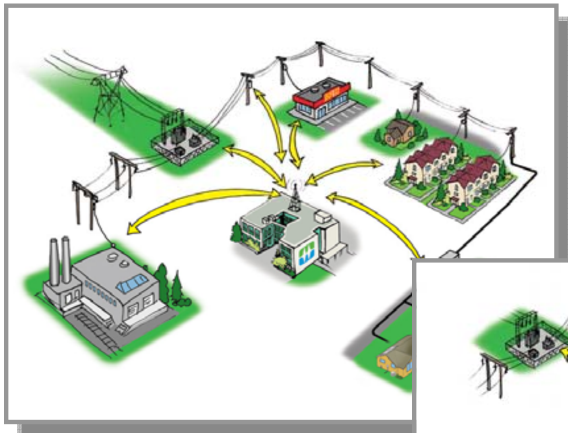
Intelligence in the distribution network provides the utility with the necessary information to improve customer satisfaction. They can now significantly improve communication while rapidly respond to operational needs.

A new type of network will emerge

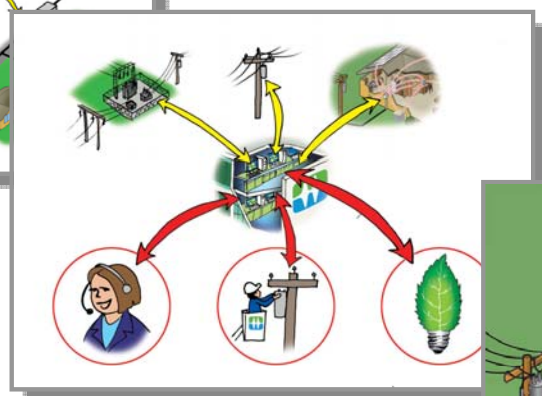


Intelligent Network Becomes the Connective Tissue of the new Energy Value Chain

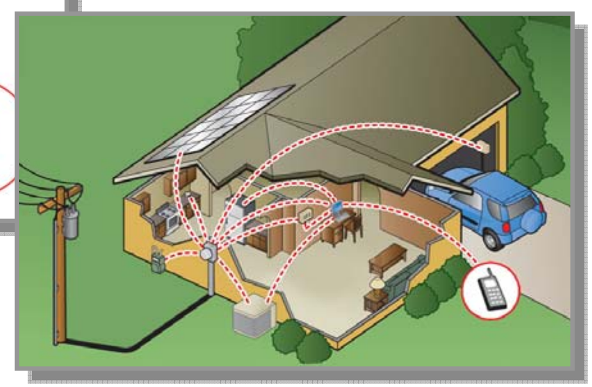
SMART GRID is the connective information fabric of the transformed utility value chain



Smart Grid



Smart Utility



Smart Customer

New Drivers for Smart Grid

- Utilities around the globe as well as in India are struggling to match supply and demand – meeting peak demand is a real challenge!
- Utilities are looking at Demand Response (DR) as a more effective solution for peak-load shaving (than previously tried Time of Use and Critical Peak Pricing). DR is achieved through Advanced Metering Infrastructure (AMI)
- Regulators are mandating Utilities to build “green energy” or “renewable energy” portfolio
- Customers with self generation (particularly “green”) are being encouraged to sell their surplus to the grid (Canadian examples)
- Distributed Energy Resources (DER) integration with the grid is the new challenge for Utilities
- Plug-in Hybrid Electric Vehicles (PHEVs) are becoming a reality (even in India very soon) – V2G Technologies are emerging
- Customer expectations are changing – prepared to pay more for “Green Power”, want to sell self generation and power from PHEVs to Utilities
- *The Grid need to be Smart to address all these changes on the horizon!*
- New standards and models for Smart Grid are emerging

Smart Grid Standards and Maturity Model

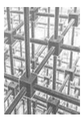
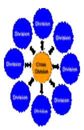
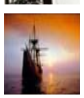
- **With the stimulus package in US provisioning $3.9 billion for Smart Grid, the Department of Energy (DoE) asked National Institution of Standards and Technology (NIST) to develop Smart Grid Interoperability Standards. NIST engaged EPRI to develop an interim roadmap which was released in May 2009 (http://www.nist.gov/smartgrid/InterimSmartGridRoadmapNISTRestructure.pdf)**
- **IEEE organized a symposium in June 2009 to discuss the Standards for Smart Grid**
- **IEC has announced development of V2G standards - goal is to prevent millions of PHEVs charging simultaneously at the peak hour!**
- **IBM and APQC developed a *Smart Grid Maturity Model (SGMM)* during 2006-2008. SGMM has been used as a tool to evaluate 40+ utilities (including NDPL) and found acceptable to Utilities around the world**
- **SGMM has been handed over to the Software Engineering Institute (SEI) of Carnegie Mellon University (which manages the CMMI)**

IBM

The Heart of Smart Grid Maturity Model

8 Domains - logical groupings of functional components of a smart grid transformation implementation

SGMM The Smart Grid Maturity Model

Level	Strategy, Management & Regulatory	Organization & Structure	Technology	Societal & Environmental
5 	- Overall strategy expanded due to SG capabilities - Optimized rate design/regulatory policy (most beneficial regulatory treatment for investments made) - New business model opportunities present themselves and are implemented	- Collaboratively engage all stakeholders in all aspects of transformed business - Organizational changes support new ventures and services that emerge - Entrepreneurial mind set, Culture of innovation	- Autonomic computing, machine learning - Pervasive use and leadership on standards - Leader and influence in conferences and industry groups, etc… - Leading edge grid stability systems	- Actualize the "triple bottom line"- (financial, environmental and societal) - Customers enabled to manage their own usage (e.g. tools and self-adaptive networks) - Tailored analytics and advice to customers - Managing distributed generation
4 	- SG drives strategy and influences corporate direction - SG is a core competency - External stakeholders share in strategy - Willing to invest and divest, or engage in JV and IP sharing to execute strategy - Now enabled for enhanced mkt driven or innovative regulatory funding schemes	- Integrated systems and control drive organizational transformation - End to end grid observability allows organizational leverage by stakeholders - Organization flattens - Significant restructuring likely occurs now (tuning to leverage new SG capabilities and processes)	- Data flows end to end (e.g. customer to generation) - Enterprise business processes optimized with strategic IT architecture - Real world aware systems - complex event processing, monitoring and control - Predictive modeling and near real-time simulation, analytics drives optimization - Enterprise-wide security implemented	- Collaboration with external stakeholders - Environmentally driven investments (aligned with SG strategy) - Environmental scorecard/reporting - Programs to shave peak demand - Ability to scale DG units - Available active mgmt. of end user energy uses and devices
3 	- Completed SG strategy and business case incorporated into corp. strategy - SG governance model deployed - SG Leader(s) (with authority) ensure cross LOB application of SG - Mandate/consensus with regulators to make and fund SG investments - Corp. strategy expanded to leverage new SG enabled services or offerings	- SG is driver for org. change (addressing aging workforce, culture issues, etc.) - SG measures on balanced scorecard - Performance and compensation linked to SG success - Consistent SG leadership cross LOBs - Org. is adopting a matrix or overlay structure - Culture of collaboration and integration	- SG impacted business processes aligned with IT architecture across LOBs - Common architectural framework e.g. standards, common data models, etc. - Use of advanced intelligence/analytics - Advanced sensor plan (e.g. PMUs) - Implementing SG technology to improve cross LOB performance - Data comms. detailed strategy/tactics	- Active programs to address issue - Segmented & tailored information for customers – including environmental and social benefits - Programs to encourage off-peak usage - Integrated reporting of sustainability and impact - Synthesize triple bottom line view across LOBs
2 	- Integrated vision & acknowledgement - Initial strategy / business plan approved - Initial alignment of investments to vision - Distinct SG set-aside funding / budget - Collaboration with regulators and stakeholders - Commitment to proof of concepts - Identify initial SG leader	- New vision influences change - Organizing more around operational end-to-end processes (e.g. breaking silos) - Matrix teams for planning and design of SG initiatives across LOBs - Evaluating performance and compensation for Smart Grid	- Tactical IT investments aligned to strategic IT architecture within a LOB - Common selection process applied - Common architectural vision and commitment to standards across LOBs - Conceptual data comms. strategy - IED connectivity and business pilots - Implementing information security	- Established energy efficiency programs for customers - "Triple bottom line" view – (financial, environmental and societal) - Environmental proof of concepts underway - Consumption information provided to customers
1 	- Developing first SG vision - Support for experimentation - Informal discussion with regulators - Funding likely out of existing budget	- Articulated need to change - Executive commitment to change - Culture of individual initiatives and discoveries - Knowledge growing; possibly compartmentalized (i.e. in silos)	- Exploring strategic IT arch. for SG - Change control process for IT for SG - Identifying uses of technology to improve functional performance - Developing processes to evaluate technologies for SG	- Awareness of issues and utility's role in addressing the issues - Environmental compliance - Initiating conservation, efficiency, "green" - Renewables program

Level	Grid Operations	Work & Asset Management	Customer Management & Experience	Value Chain Integration
5	- Grid employs self-healing capabilities - Automated grid decisions system wide (applying proven analytic based controls) - Optimized rate design/regulatory policy - Ubiquitous system wide dynamic control	- Optimizing the use of assets between and across supply chain participants - Just in time retirement of assets - Enterprise-wide abstract representation of assets for investment decisions	- Customer management of their end to end energy supply and usage level - Outage detection at residence/device - Plug-n-play customer based generation - Near real-time data on customer usage - Consumption level by device available - Mobility and CO2 programs	- Coordinated energy management and generation throughout the supply chain - Coordinated control of entire energy assets - Dispatchable recourses are available for increasingly granular market options (e.g. LMP – Locational Marginal Pricing)
4	- Integration into enterprise processes - Dynamic grid management - Tactical forecasts based on real data - Information available across enterprise through end-to-end observability - Automated decision making within protection schemes (leveraging increased analytics capabilities and context)	- Enterprise view of assets: location, status, interrelationships, connectivity and proximity - Asset models reality based (real data) - Optimization across fleet of assets - CBM and predictive management on key components - Efficient inventory management utilizing real asset status and modeling	- Usage analysis within pricing programs - Circuit level outage detection/notification - Net billing programs in the home - Automated response to pricing signals - Common customer experience integrated across all channels - Recent customer usage data (e.g. daily) - Behavior modeling augments customer segmentation	- Energy resources dispatchable/tradable, utility realizes gain from ancillary services (e.g. power on demand) - Portfolio optimization modeling expanded for new resources and real time markets. - Ability to communicate with HAN (Home Area Network), incl. visibility and control of customer large demand appliances
3	- Sharing data across functions/systems - Implementing control analytics to support decisions & system calculations - Move from estimation to fact-based planning - The customer meter becomes an essential grid management "sensor" - New process being defined due to increased automation and observability	- Component performance and trend analysis - Developing CBM (Condition Based Mgmt.) on key components -Integrating RAM to asset mgmt, mobile work force and work order creation - Tracking inventory, source to utilization - Modeling asset investments for key components based on SG data	**- High degree customer segmentation** - Two-way meter, remote disconnect & connect, and remote load control - Outage detection at substation - Common customer experience - Customer participation in DR enabled - New interactive products/services - Predictive customer experience	- Integrated resource plan includes new targeted resources and technologies (e.g. DR, DG, volt/VAR) - Enabling market and consumption information for use by customer energy mgmt systems - New resources available as substitute for market products to meet reliability objectives
2	- Initial distribution to sub-station automation projects - Implementing advanced outage restoration schemes - Piloting remote monitoring on key assets (RAM) for manual decision making - Expanding and investing in extended communications networks	- Developing mobile workforce strategy - Approach for tracking, inventory and event history of assets under development - Developing an integrated view of GIS and RAM with location, status and nodal interconnectivity	- Piloting AMI/AMR - Modeling of reliability issues to drive investments for improvements - Piloted remote disconnect/connect - More frequent customer usage data - Assessing impact of new services and delivery processes (e.g. HAN)	- Introducing support for home energy management systems - Redefine value chain to include entire eco-system (RTOs, customers, suppliers) - Pilot investments to support utilization of a diverse resource portfolio - Programs to promote customer DG
1	- Exploring new sensors, switches, comms. devices and technologies - Proof of concepts / component testing - Exploring outage & distribution mgmt. linked to sub-station automation - Building business case at functional level - Safety & physical security	- Conducting value analysis for new systems - Exploring RAM (Remote Asset Monitoring), beyond SCADA - Exploring proactive/predictive asset maintenance - Exploring using spatial view of assets	- Research on how to reshape the customer experience through SG - Broad customer segmentation (e.g. geography, income) - Load management in place for C&I - Reactive customer experience	- Identified assets and programs within value chain to facilitate load management programs - Identified distributed generation sources and existing capabilities to support - Develop strategy for diverse resource portfolio

5 Maturity Levels – defined sets of characteristics and outcomes

200 Characteristics – capabilities you would expect to see at each stage of the smart grid journey

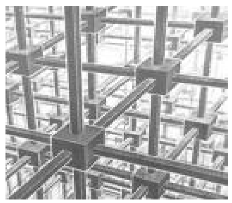
Smart Grid Maturity Model – Levels, Descriptions and Results

Level 5:
Innovating – Next wave of improvements

New business, operational, environmental and societal opportunities present themselves, and the capability exists to take advantage of them.

Perpetual Innovation
Self-healing operations
Autonomic business
Innovators

Level 4:
Optimizing – Enterprise Wide



Smart Grid functionality and benefits realized. Management and operational systems rely on and take full advantage of observability and integrated control across and between enterprise functions.

Transformation
Real time corrections
Broad reuse
Victors

Level 3:
Integrating – Cross Functional

Smart Grid spreads. Operational linkages established between two or more functional areas. Management ensures decisions span functional interests, resulting in cross functional benefits.

Systemization
Repeatable practices
Shared information
Cross LOB Champions

Level 2:
Functional investing

Making decisions, at least at functional level. Business cases in place, investments being made. One or more functional deployments under way with value being realized. Strategy in place.

Strategy
Proof of Concepts
Missionaries

Level 1:
Exploring and Initiating

Contemplating Smart Grid transformation. May have vision, but no strategy yet. Exploring options. Evaluating business cases, technologies. Might have elements already deployed.

Vision
Experiments
Prophets, Heroes

Eight Smart Grid domains and important elements

People and Technology Domains

Strategy, Management and Regulatory

Vision, planning, decision making, strategy execution and discipline, regulatory, investment process

Organization

Communications, culture, structure

Technology

Information, engineering, integration of information and operational technology, standards, and business analytics tools

Societal and Environmental

Conservation and green initiatives, sustainability, economics and ability to integrate alternative and distributed energy

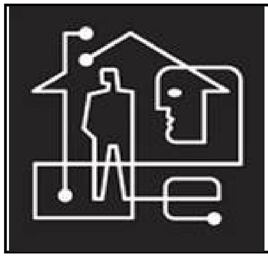
Process Domains

Grid Operations

Advanced grid observability & advanced grid control, quality and reliability

Work and Asset Management

Optimizing the assets and resources (people and equipment)



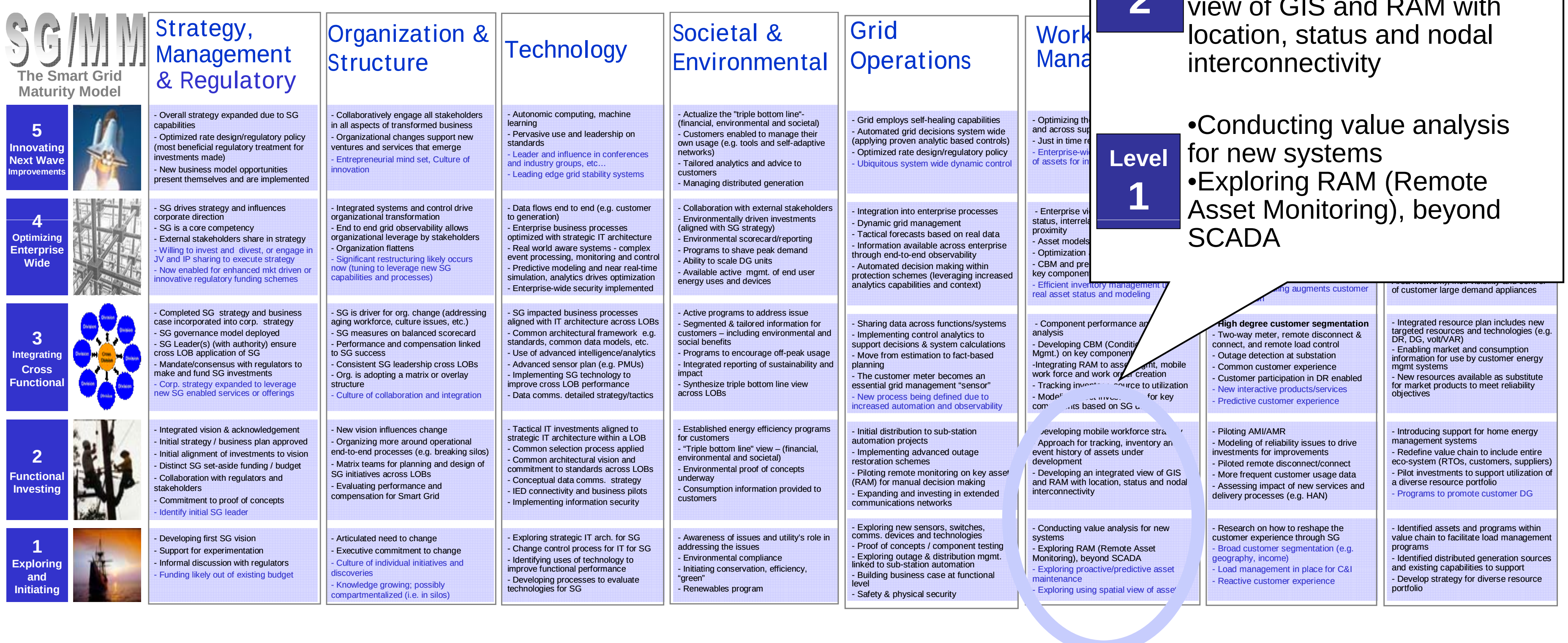
Customer Management and Experience

Retail, customer care, pricing options and control, advanced services and visibility into utilization quality, and performance

Value Chain Integration

Enabling demand and supply management, distributed generation, load management, leveraging market opportunities

The heart of the model - Sample smart grid characteristics



Characteristics Examples:

Work & Asset Management

Level 2

•Approach for tracking, inventory and event history of assets under development

•Developing an integrated view of GIS and RAM with location, status and nodal interconnectivity

Level 1

•Conducting value analysis for new systems

•Exploring RAM (Remote Asset Monitoring), beyond SCADA

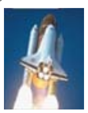
The heart of the model - smart grid characteristics

Characteristics Examples:
Organization & Structure

Level 3

- •Performance and compensation linked to SG success
- •Consistent SG leadership cross LOBs
- •Org. is adopting a matrix or overlay structure
- •Culture of collaboration and integration
- •SG measures on balanced scorecard

SG/MM The Smart Grid Maturity Model

Level		Strategy, Management & Regulatory	Organization Structure				… & Asset …gement	Customer Management & Experience	Value Chain Integration
5 Innovating Next Wave Improvements		- Overall strategy expanded due to SG capabilities - Optimized rate design/regulatory policy (most beneficial regulatory treatment for investments made) - New business model opportunities present themselves and are implemented	- Collaboratively engage all stakehol… in all aspects of transformed busines… - Organizational changes support ne… ventures and services that emerge - Entrepreneurial mind set, Culture o… innovation				…e use of assets between …ply chain participants …tirement of assets …de abstract representation …vestment decisions	- Customer management of their end to end energy supply and usage level - Outage detection at residence/device - Plug-n-play customer based generation - Near real-time data on customer usage - Consumption level by device available - Mobility and CO2 programs	- Coordinated energy management and generation throughout the supply chain - Coordinated control of entire energy assets - Dispatchable recourses are available for increasingly granular market options (e.g. LMP – Locational Marginal Pricing)
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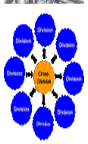
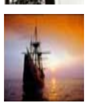
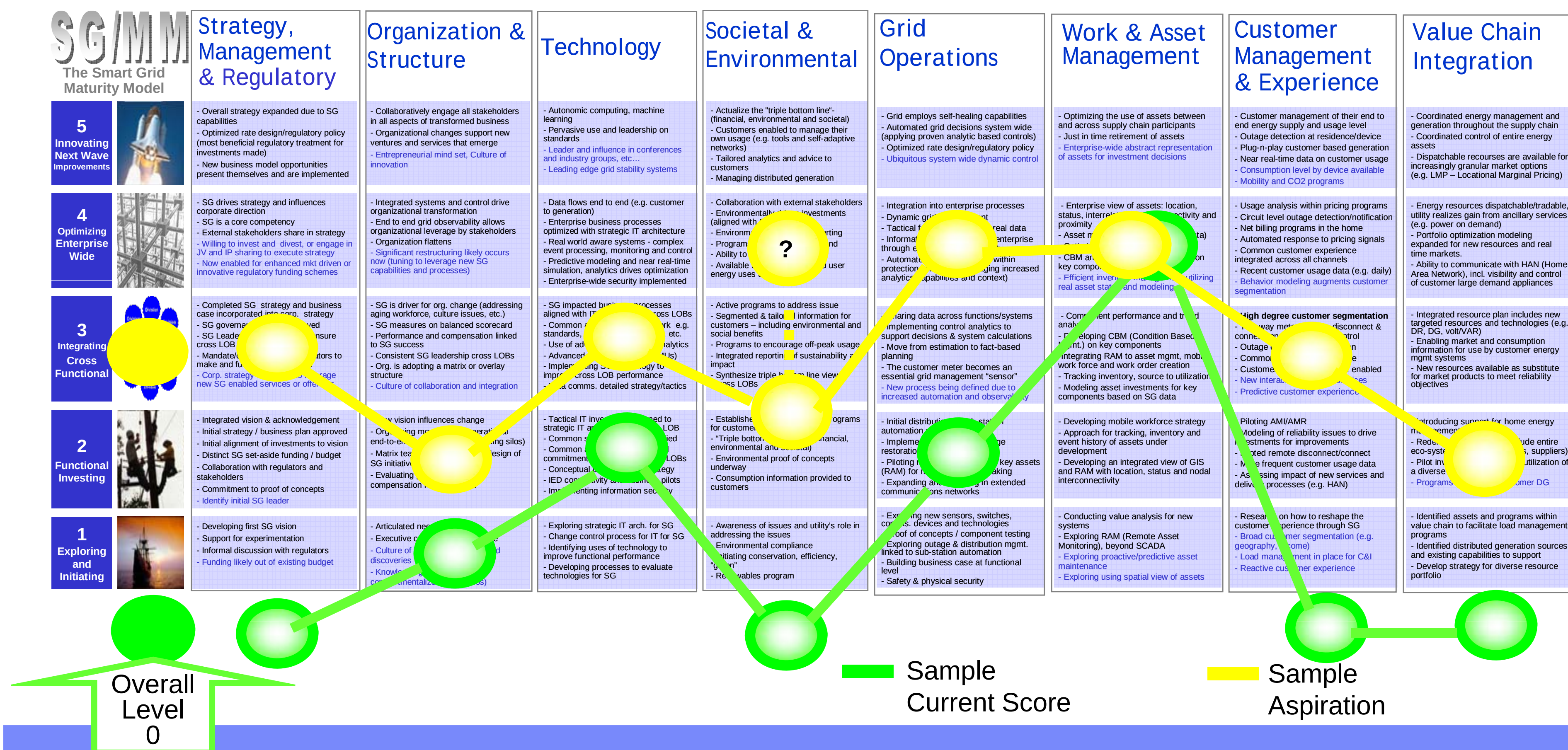
3 Integrating Cross Functional		- Completed SG strategy and business case incorporated into corp. strategy - SG governance model deployed - SG Leader(s) (with authority) ensure cross LOB application of SG - Mandate/consensus with regulators to make and fund SG investments - Corp. strategy expanded to leverage new SG enabled services or offerings	- …is driver for org. change (addre… …ng workforce, culture issues, etc.) - SG measures on balanced scorecard - Performance and compensation linked to SG success - Consistent SG leadership cross LOBs - Org. is adopting a matrix or overlay structure - Culture of collaboration and integration	…G impacted business processes aligned with IT architecture across LOBs - Common architectural framework e.g. standards, common data models, etc. - Use of advanced intelligence/analytics - Advanced sensor plan (e.g. PMUs) - Implementing SG technology to improve cross LOB performance - Data comms. detailed strategy/tactics	- Active programs to address issue - Segmented & tailored information for customers – including environmental and social benefits - Programs to encourage off-peak usage - Integrated reporting of sustainability and impact - Synthesize triple bottom line view across LOBs	- Sharing data across functions/systems - Implementing control analytics to support decisions & system calculations - Move from estimation to fact-based planning - The customer meter becomes an essential grid management “sensor” - New process being defined due to increased automation and observability	- Component performance and trend analysis - Developing CBM (Condition Based Mgmt.) on key components -Integrating RAM to asset mgmt, mobile work force and work order creation - Tracking inventory, source to utilization - Modeling asset investments for key components based on SG data	- **High degree customer segmentation** - Two-way meter, remote disconnect & connect, and remote load control - Outage detection at substation - Common customer experience - Customer participation in DR enabled - New interactive products/services - Predictive customer experience	- Integrated resource plan includes new targeted resources and technologies (e.g. DR, DG, volt/VAR) - Enabling market and consumption information for use by customer energy mgmt systems - New resources available as substitute for market products to meet reliability objectives
2 Functional Investing		- Integrated vision & acknowledgement - Initial strategy / business plan approved - Initial alignment of investments to vision - Distinct SG set-aside funding / budget - Collaboration with regulators and stakeholders - Commitment to proof of concepts - Identify initial SG leader	- …vision influences change - Or… …ng more around oper… end-to-e… …ing silos) - Matrix teams for planning and design of SG initiatives across LOBs - Evaluating performance and compensation for Smart Grid	- Tactical IT investments aligned to strategic IT architecture within a LOB - Common selection process applied - Common architectural vision and commitment to standards across LOBs - Conceptual data comms. strategy - IED connectivity and business pilots - Implementing information security	- Established energy efficiency programs for customers - “Triple bottom line” view – (financial, environmental and societal) - Environmental proof of concepts underway - Consumption information provided to customers	- Initial distribution to sub-station automation projects - Implementing advanced outage restoration schemes - Piloting remote monitoring on key assets (RAM) for manual decision making - Expanding and investing in extended communications networks	- Developing mobile workforce strategy - Approach for tracking, inventory and event history of assets under development - Developing an integrated view of GIS and RAM with location, status and nodal interconnectivity	- Piloting AMI/AMR - Modeling of reliability issues to drive investments for improvements - Piloted remote disconnect/connect - More frequent customer usage data - Assessing impact of new services and delivery processes (e.g. HAN)	- Introducing support for home energy management systems - Redefine value chain to include entire eco-system (RTOs, customers, suppliers) - Pilot investments to support utilization of a diverse resource portfolio - Programs to promote customer DG
1 Exploring and Initiating		- Developing first SG vision - Support for experimentation - Informal discussion with regulators - Funding likely out of existing budget	- Articulated need to change - Executive commitment to change - Culture of individual initiatives and discoveries - Knowledge growing; possibly compartmentalized (i.e. in silos)	- Exploring strategic IT arch. for SG - Change control process for IT for SG - Identifying uses of technology to improve functional performance - Developing processes to evaluate technologies for SG	- Awareness of issues and utility's role in addressing the issues - Environmental compliance - Initiating conservation, efficiency, “green” - Renewables program	- Exploring new sensors, switches, comms. devices and technologies - Proof of concepts / component testing - Exploring outage & distribution mgmt. linked to sub-station automation - Building business case at functional level - Safety & physical security	- Conducting value analysis for new systems - Exploring RAM (Remote Asset Monitoring), beyond SCADA - Exploring proactive/predictive asset maintenance - Exploring using spatial view of assets	- Research on how to reshape the customer experience through SG - Broad customer segmentation (e.g. geography, income) - Load management in place for C&I - Reactive customer experience	- Identified assets and programs within value chain to facilitate load management programs - Identified distributed generation sources and existing capabilities to support - Develop strategy for diverse resource portfolio

Smart Grid Maturity Model
…helping determine strategic intent

Green dots = Current status based on survey
Yellow dots = Aspirations based on planning
Gaps in between = Opportunities for improvement



IT initiatives under APDRP

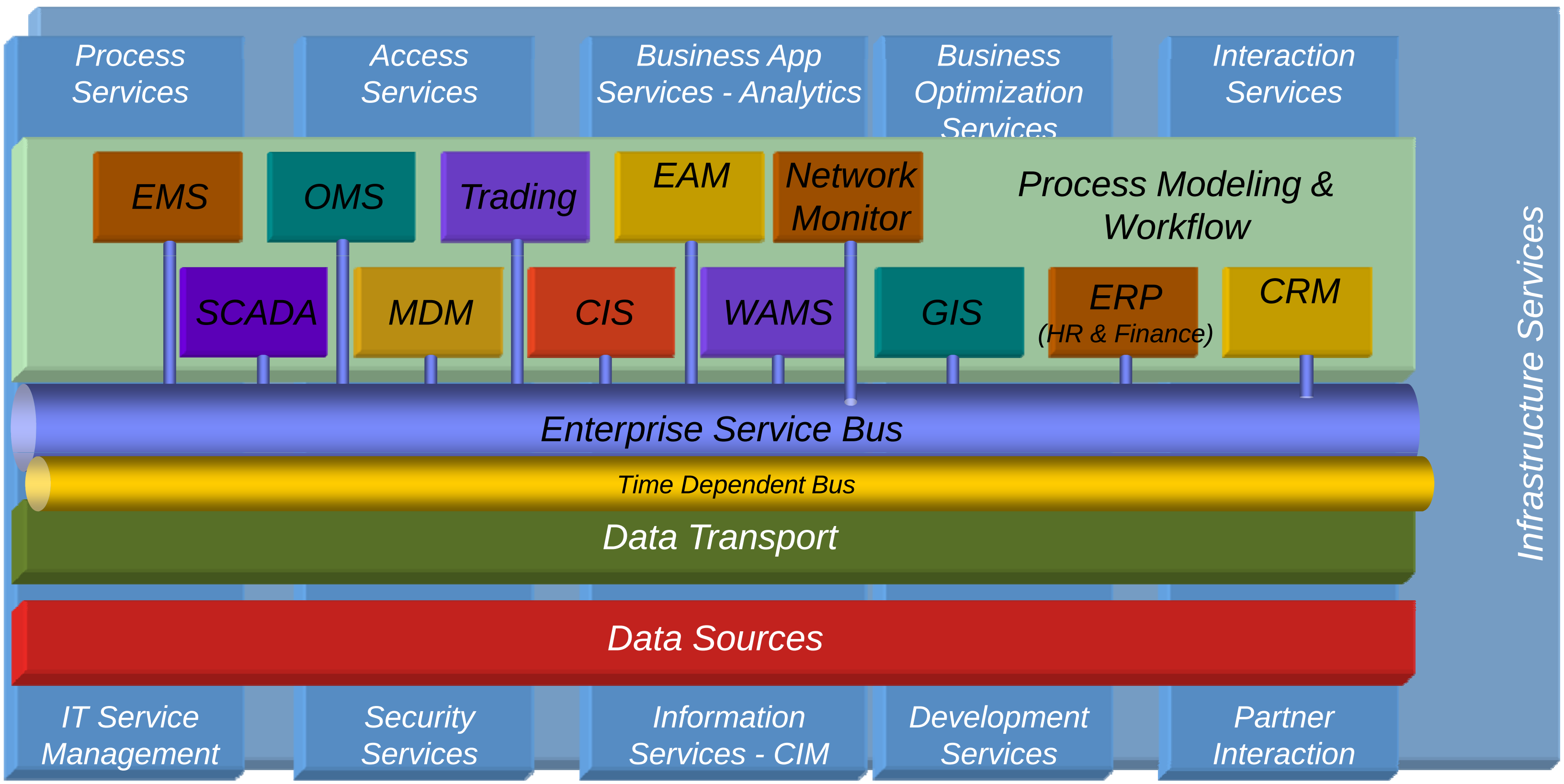
IT Solutions & Services prescribed in the SRS

SRS Document Ref No	Modules	Description
G2 - 3.0, 4.0, 13, 14, 15, 2.0	**Metering, Billing & Collection**	**Billing including Spot Billing, Point of Sale (POS) machines, , CRM, Touch Screen Kiosk, Cash & Cheque Collection Kiosk, Energy Audit, HHD, POS Machines, Kiosks, Cash Collection machines, Slip printers**
G2 - 1.0	**Meter Data Acquisition**	**Head/End, MDMS, Modems**
G2 - 5.0	**GIS**	**GIS Solution for Customer Indexing and Asset Mapping**
G2 - 7.0	**Centralized Customer Care Services: *CTI / IVRS***	**CTI/IVRS, SMS, Voice Logger, CTI Server, Dialer**
G2 - 9.0	**Web - Self Services**	
G2 – 16	**Asset Management**	
G2 – 17	**Maintenance Management**	
G1 - 3.1	**Document Management**	
G1 - 3.1	**Business Intelligence & Data Warehousing**	

IT Solutions & Services prescribed in the SRS

SRS Module		
Establishment of a common Data center	▪ **The scope covers establishment of a common data center along with associated hardware and software for selected towns, Design and provide the hardware at data center with suitable expandability for covering the entire utility area at a later date (Utility will specify the total consumer and asset base) along with a 7.5% per annum growth in consumer and asset base for next five years.**	
FACILITIES MANAGEMENT (5 Years)	▪ **Transition Management** ▪ **HELP DESK** – *Providing Help Desk Solutions Application* – *Hardware and Software Services* – *Management Services* – *Install/MAC Services (Install Move Add Change)* – *User Oriented Services* ▪ **Asset / Inventory Management** ▪ **Vendor Management Services** ▪ **Desk Side Technical Support Services** ▪ **Anti-Virus Management** ▪ **LAN & Local Server Administration** ▪ **Network Monitoring & Management- WAN/VPN/ Internet** ▪ **Data Center Operations** ▪ **Server Administration/ Management** ▪ **Database Administration Services** ▪ **Backup/Restore management** ▪ **Mail/Messaging System Management** ▪ **Management of EMS, NMS** ▪ **Incident Management, Ticketing Management** ▪ **Problem Management** ▪ **Change Management, Release Management**	

Reference Architecture for Smart Grid Solutions …
… SRS prescribes most of the fundamental blocks



***An architectural blueprint** to support the integration of applications and new services for a Utility company.*

IBM experience around the Globe

IBM's Leadership among North American AMI Deployments

North America's Largest Programs	Number of Electric Meters	IBM Leadership Role
1. Pacific Gas & Electric	**4,900,000**	✓
2. Ontario IESO	**4,500,000**	✓
3. SCE	**4,100,000**	✓
4. TXU	**2,900,000**	
5. CenterPoint Energy	**1,900,000**	✓

IBM is the lead program manager / systems integrator for 4 of the 5 largest AMI deployments being undertaken in North America

Largest fixed network AMI deployments completed, underway or announced

SCE: Advanced Metering Infrastructure Program

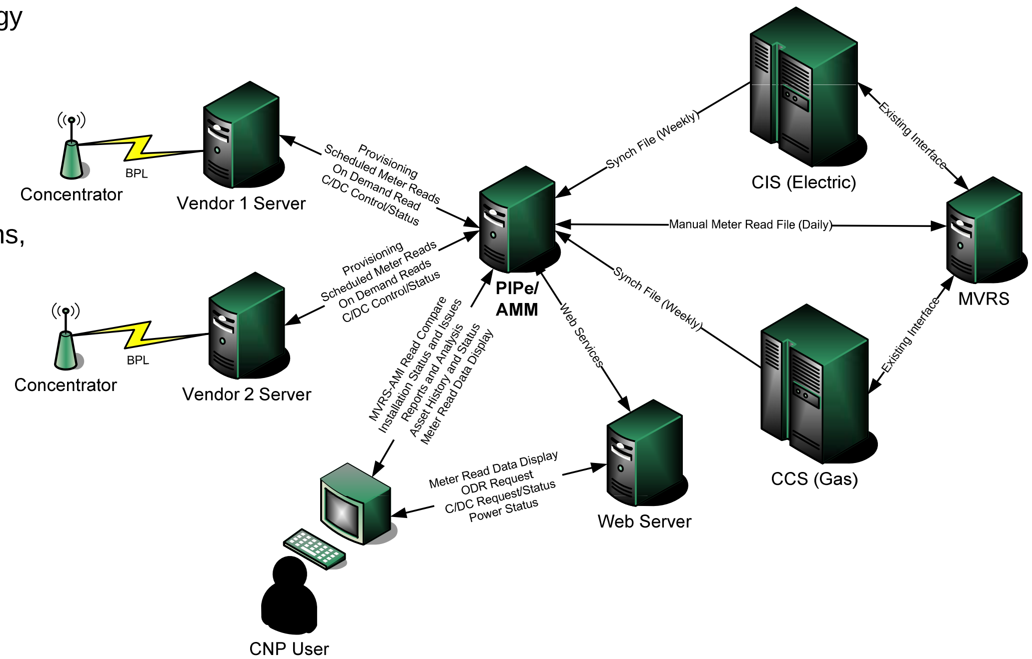
- About SCE
  - Target 5.5 million customers central and southern California, excluding the cities of Los Angeles and San Diego
- The Project
  - Concluded that an AMI deployment would not be cost-effective for SCE, given the limited functionality and operational benefits available at the time.
  - SCE filed a proposal with the CPUC to develop an enhanced solid state electric meter for use in its territory
  - Worked with vendors and utilities to drive demand for “next generation” AMI based on business uses
    - Manage risk by leveraging commercially-available components by using open designs for both the metering and communications devices.
  - The Benefits
    - Meter reading, price response, load control, operations, customer service
- IBM’s Role
  - Project management
  - Business case refinement
  - Vendor selection support for meter, communications, meter data management, and meter installation/deployment
  - Business process design
  - Deployment management
  - Technical architecture and systems integration

“ We want a solution that won’t be obsolete in a matter of a few years.”

Lynda Ziegler, VP Customer Programs and Services, SCE

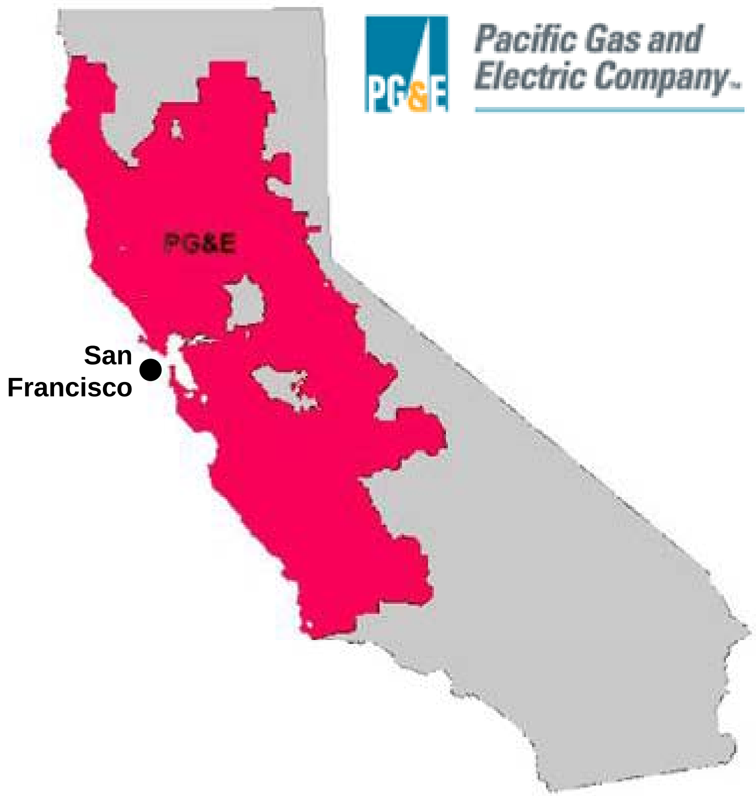
CenterPoint Energy: An Intelligent Utility Network Implementation integrating AMI

- About Centerpoint Energy
  - Houston, TX
  - 5 million metered customers in five states
  - Gas and electricity service
- The Project
  - Employ broadband over power lines (BPL) technology
  - Initial AMI rollout to 50,000 homes
- IBM's Role
  - Project management
  - Regulatory positioning with briefing center
  - Technical architecture and systems integration
  - Vendor evaluation support for meter, communications, and meter data management
  - BPL network design, build-out and monitoring
- Benefits
  - Enabling new retail services
  - Improved service reliability
  - Faster outage restoration
  - Improved service levels (e.g., Remote connect/disconnection)
  - Addressing aging workforce challenges



PG&E: North America's Largest Deployment

- About PG&E
  - 4.9 million electric customer accounts
  - 4.1 million gas customer accounts
- The Project
  - Response to CPUC order related to demand response
  - Deployed between 2006 and 2011
  - Largest fixed network AMM in North America
- IBM's Role
  - After a 1-year procurement process, selected IBM
    - Project Management and systems integration
    - Vendor management and architecture
- Costs & Benefits
  - Implementation: $1.25B US capital and $213M expense
  - $157 per meter costs including all integration
  - 90% of costs offset by operational savings over 20 years
  - 69¢ per month rate increase for a gas and electric customer



Pacific Gas and Electric Company

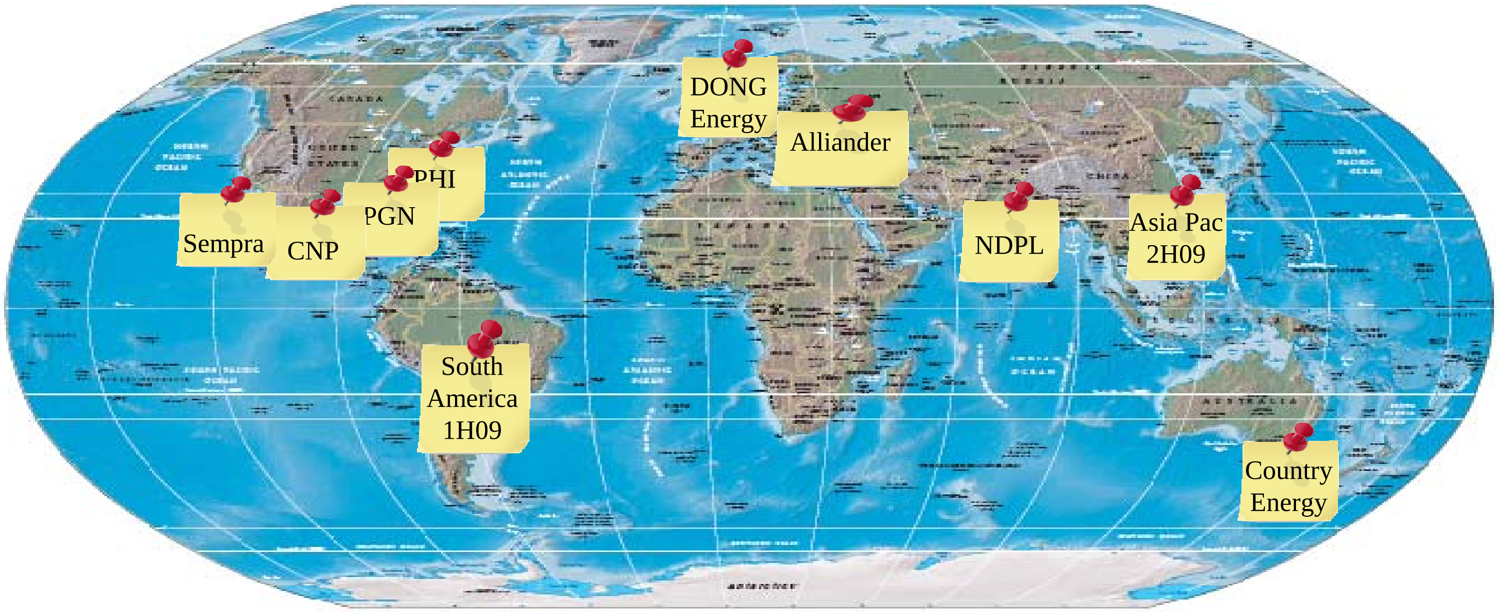
PHI (Pepco Holdings Inc.): Update

- PHI (Pepco, Delmarva, Atlantic City Electric) in April ’07 became the second IUN Coalition partner
- IBM is assisting PHI in the following areas:
  - MDMS Requirements, Planning and Selection
  - “Blueprint of the Future” Roadmap Strategy
  - Customer Value Study
  - Program Office Management (PMO) Approach (incl. Rational)
- IBM has future opportunities in these areas:
  - Advanced Meter Management Program
  - Distribution Automation
  - Customer Service projects (CIS replacement, others)

IBM's Global IUN Coalition

IBM formed the Global Intelligent Utility Network Coalition to support smart grid transformations by sharing best practices and lessons learned among utilities

Together, the current Global IUN Coalition member base serves 45.5M electric and natural gas consumers



- The Global IUN Coalition is a strategic relationship that IBM is forming with a small group of select utilities globally to shape, accelerate, and share in the development of the smart grid
- The Coalition's purpose is to collaborate in the market to enable the rapid creation of solutions, adoption of open industry-based standards, and informed policy/regulation which drive the adoption of the IUN/Smart Grid

A key benefit of the coalition is it ***reduces regulatory, financial, market and implementation risk*** for both IBM and the coalition members

ALLIANDER: history of the company

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009

1998: 1st tranche B2B market liberalised

Energie Noord West, Nuon Old and three other utilities merge into Nuon

2002: 2nd tranche B2B market liberalised

2004: Consumer market liberalised

2005: Separate grid operator set up

Continuon

alliander

2008: 1/10/2008: new name for grid operator

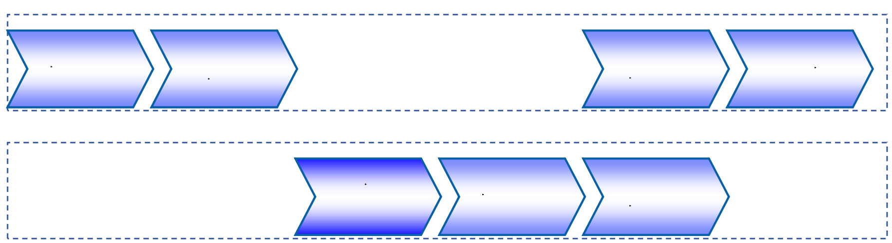
Announcement acquisition Nuon by Vattenfall

2009: 1/7/2009: fully operational unbundling

Unbundling in the Netherlands

Generation & retail

Gridcompany



Liberalised/ Privatised

Public / regulated

Facts and Figures Alliander

Number of Electricity and Gas connections:

Electricity 2,8 million and Gas 2,1 million

Number of employees 2.801

Average number of customer minutes lost:

Electricity 24 minutes and Gas 21 seconds

Transported Volumes:

Electricity 32.950 GWh and Gas 6.232 million m3

Customer switches 448.000

Nett-turnover € 1.336 million   Profit after tax € 284 million

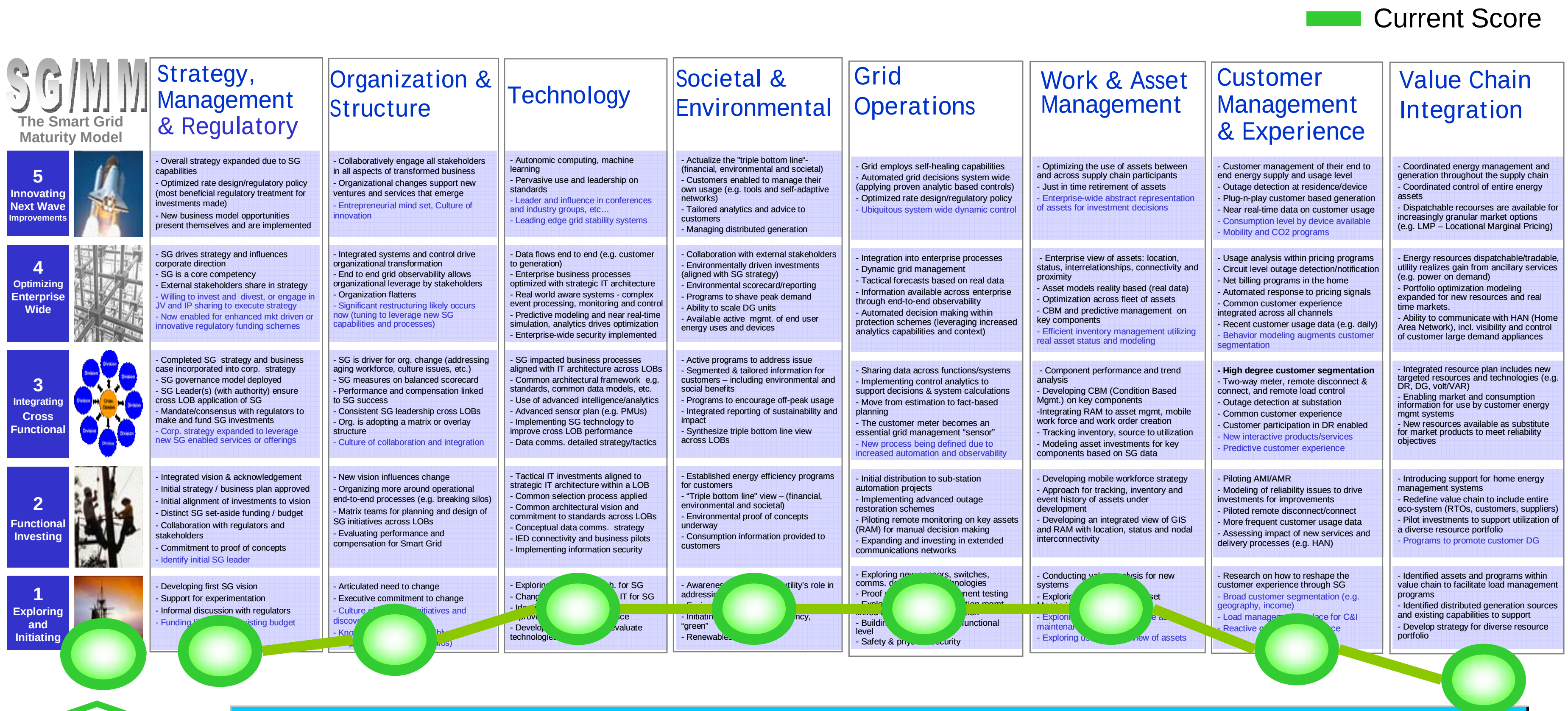
ALLIANDER: The key drivers for a Smart Grid are:
- the increasing decentralized renewable electricity generation,
- the expected increase of electricity demand and
- the increasing need of status information of medium - and low voltage grids

- Facilitating feeding-in renewable energy at multiple voltage levels
- Facilitating market processes (switching, moving houses, disconnect/reconnect, etc.); this will be done by smart meter implementation
- Keeping grid performance up to standard (Customer Minutes Lost 2008 = 24)
- Enlighten the information darkness in medium and low voltage grids
- Shaving the ´CapEx peak´
- Anticipate on new appliances like heat pumps and electric vehicles with high connecting power and high operating hours

ALLIANDER : Major Smart Grid initiatives taking-off

- AMM: 80.000 smart meters are installed. Coming 1½ year another 500.000 will be installed depending on regulatory progress
- Large scale rollout of sensors in the MV-grid: SASensors will be deployed in 150/10 kV substations
- IT-architecture to be completely redesigned and implemented to facilitate smartgrids (including IT/OT convergence)
- Pilot projects:
  - Electric vehicles; 10.000 charging pedestals will be installed, 30 electric company cars will be procured
  - 200 micro-CHP´s on one substation
  - Domestic areas with 100 % heatpump penetration
  - 20 kV i-grids
  - Intelligence in 10 KV substations
  - Mixing Biogas and Natural gas
  - Microgrid on PV

Alliander took part in the smartgrid maturity assessment



Overall level at this time = 0,63

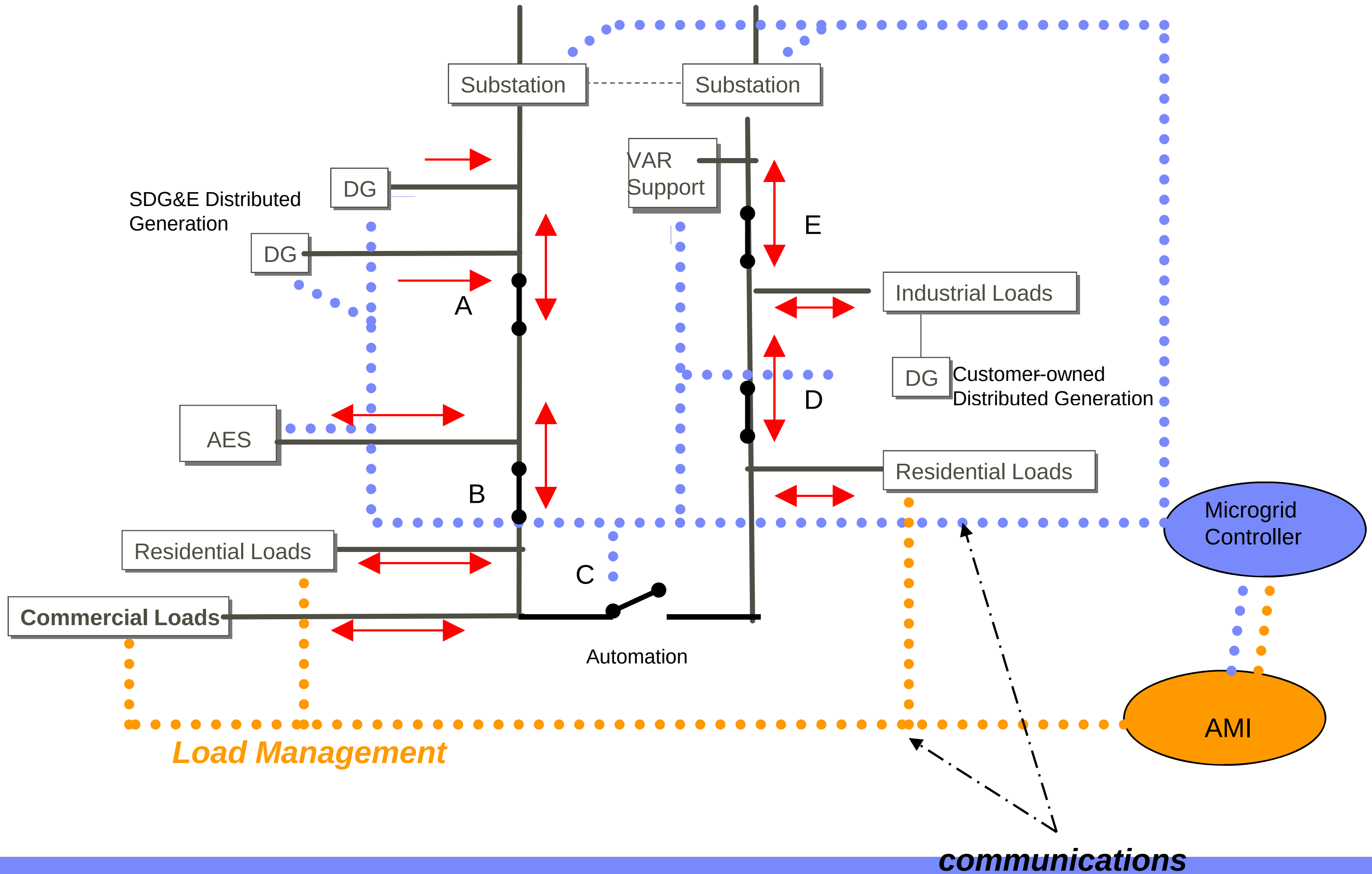
Alliander									
0,63	SGMM Overall Score	Strategy and Management	Organization	Technology	Societal and Environmental	Grid Operations	Work and Asset Management	Customer Management and Experience	Value Chain Integration
Level 5	0,08	0,07	0,50	0,00	0,00	0,07	0,00	0,00	0,00
Level 4	0,15	0,27	0,10	0,20	0,18	0,00	0,40	0,08	0,00
Level 3	0,28	0,45	0,40	0,23	0,25	0,18	0,27	0,44	0,00
Level 2	0,42	0,52	0,13	0,51	0,58	0,63	0,37	0,52	0,13
Level 1	0,63	0,60	0,70	0,85	0,95	0,70	0,57	0,40	0,27

SDG&E: Smart Meter Program

- $572M program approved by the California Public Utilities Commission (CPUC) in 2007. Program Scope
  - 1.4M electric meters and 900,000 gas modules
  - 2-way communications, Interval Storage Reads, Home Area Network (HAN), Integrated Remote Connect / Disconnect, Online Energy Analysis
- Key Milestones
  - 2008 – Technology Selection and development of IT systems
  - 2009 – Start of mass deployment (March), implementation of new software & firmware release (August), Consumer Energy Network & Google Interface (Q3/4), 200,000 meters deployed by year-end.
  - 2010 – New rate program (PTR) and new functionality (HAN, Remote Connect / Disconnect). 1.5M meters deployed by year-end.
  - 2011 – Complete all deployments by year-end.

SDG&E Microgrid Concept

More than one of switches A through E can be open simultaneously without outages due to distributed generation. Power flow direction is variable.



47

DONG ENERGY - major New challenges before 2020

Large amount of Heat Pumps

Large Wind production – will drive demand response

Large penetration of EV's

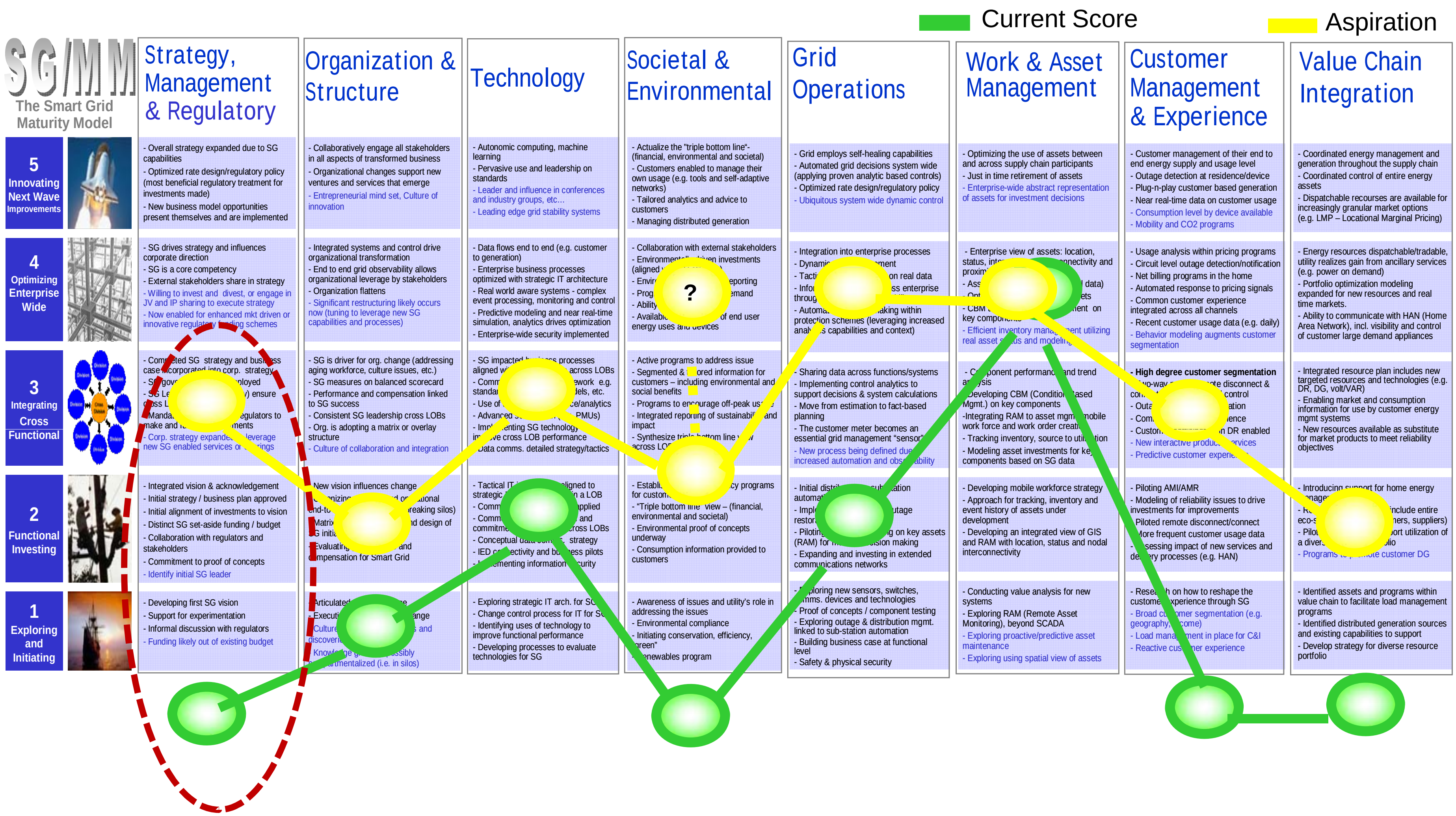
Dynamic and large peaks in the powergrid

local / embedded generation

This is the new incentive for Smartgrid in DONG Energy

48

DONG Smartgrid Maturity – Current & Aspiration



DONG ENERGY - Maturity Model
1. domain : Strategy, Management and Regulatory

Why do we wish to mature from 0 – 3

- In terms of beeing able to prepare for the future – which might be far more volatile than we are used to – we need topmanagement consensus about future scenarios
- To get the right economic incentives preparing for the new challenges – these future scenarios also need to be understood and agreed on, from our Regulator

Activities that will take us there..

Internally

- Convince top management about scenarios
- Make a Smartgrid Strategy that copes with the challenges
- Calculate the consequneces of the different combinations of scenarios and strategies

Regulator – Government - TSO

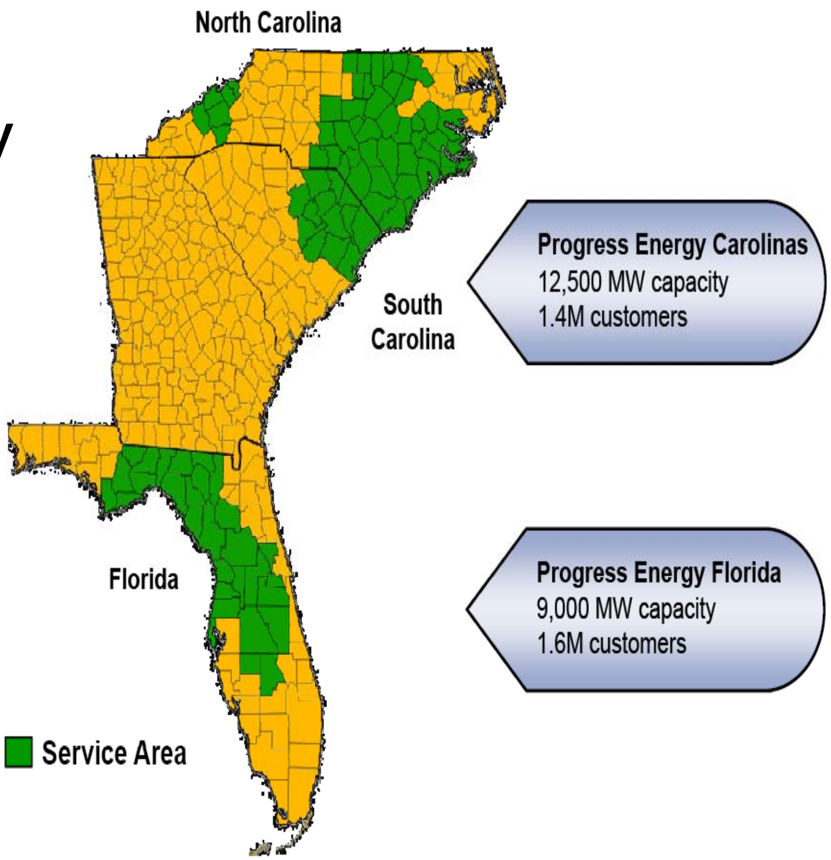
- Danish initiatives to help the Regulator and the TSO to support Smartgrid activities and understand the scenarios

0	1	2	3	4	5
2008	2009	2010	2012		

50

Progress Energy

- Fortune 250 corporation
- Fully integrated electric utility
- $10B in annual revenues
- 54,000 square miles service territory
- 8,700 employees
- 11,000 miles of transmission
- 99,000 miles of distribution



PROGRESS ENERGY : History of Innovation

1997 - Present

The Base – A History of Innovation

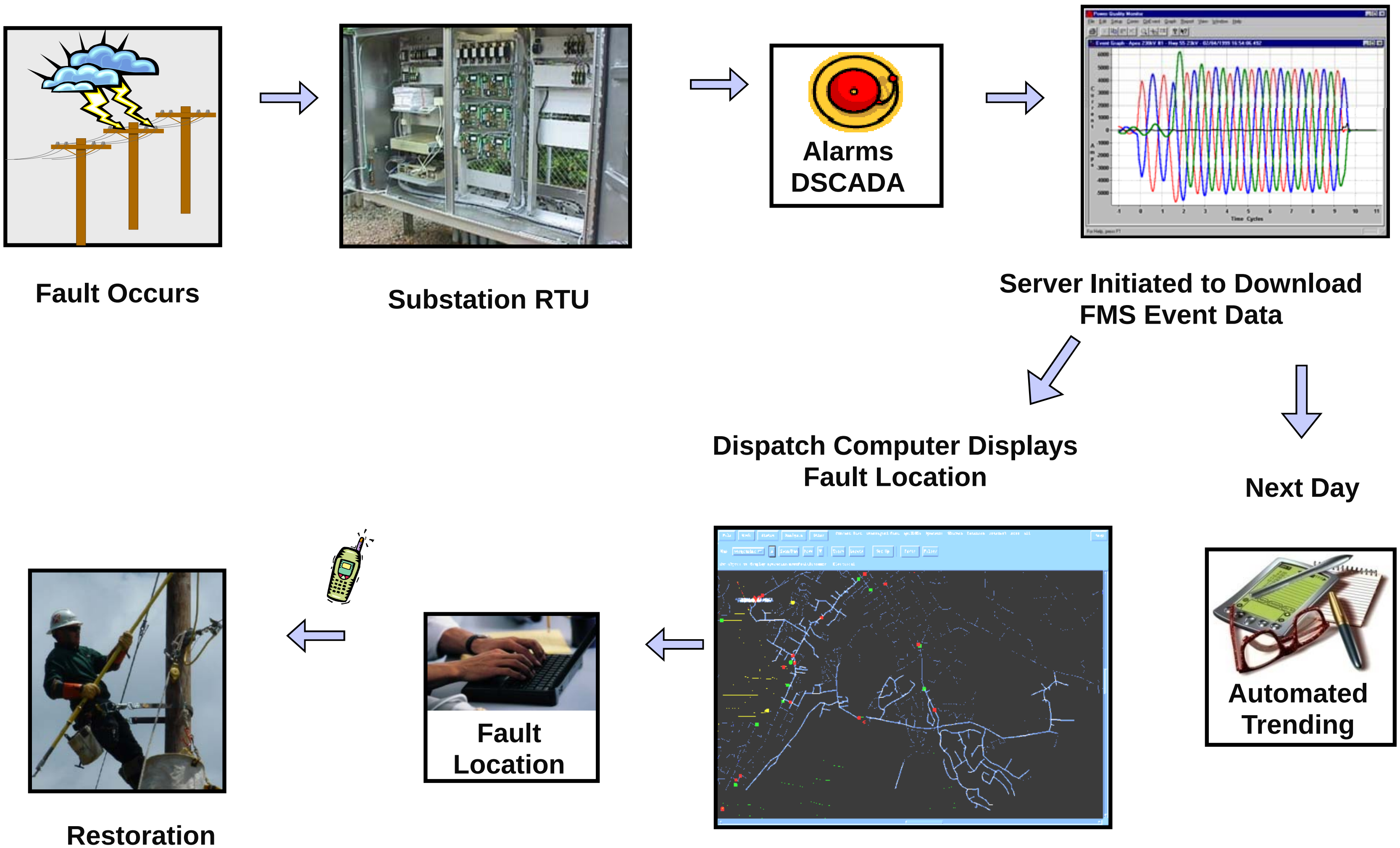
DSM (traditional load control) Skilled Workforce OMS Mobile MOMs

MobileLink FMS ITR/ETR SCADA/DSCADA Var Management System

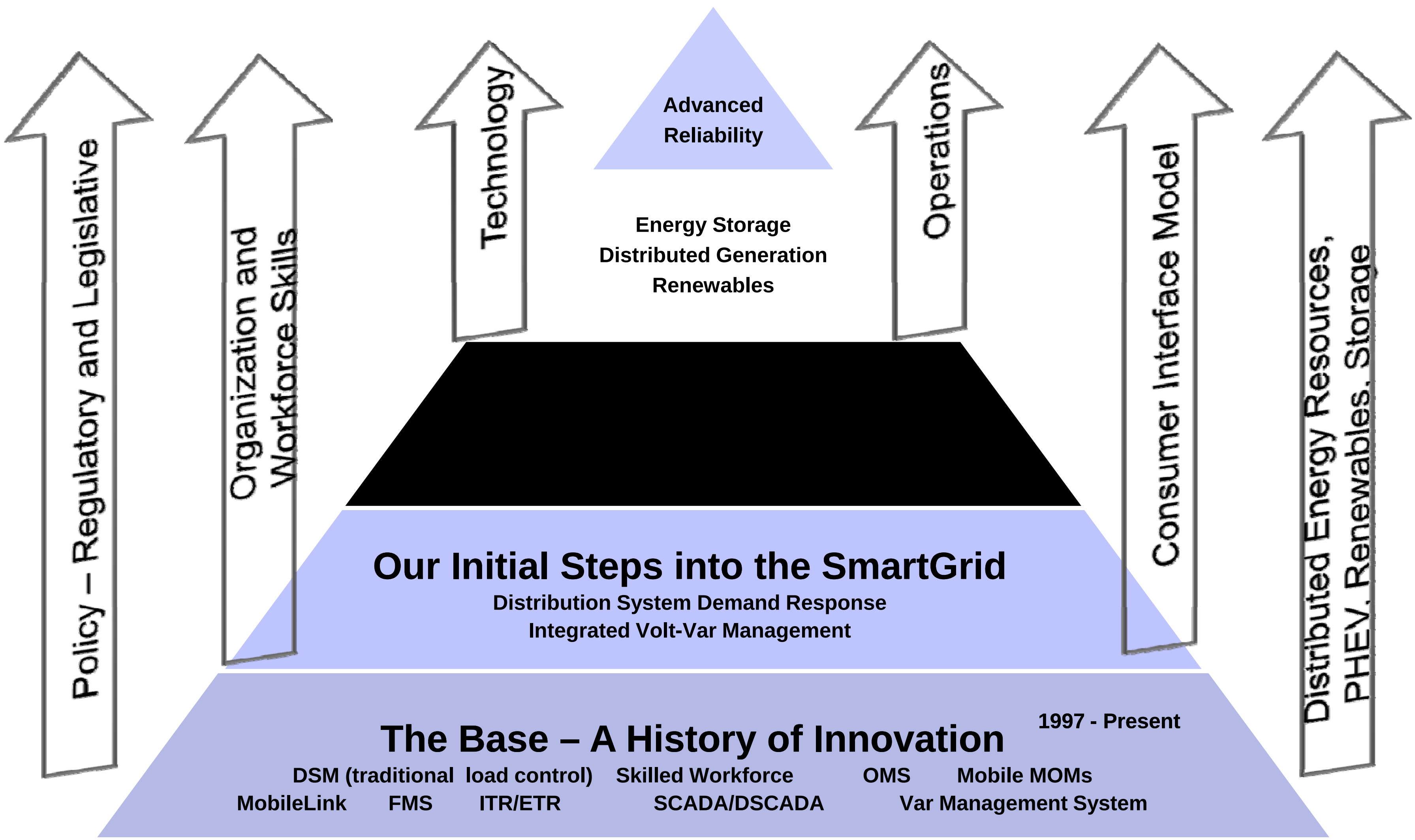
PROGRESS ENERGY
Fault Locating: First It Was a Manual Process

- Dispatcher used FMS through dial up connection to substation RTU
- Review the event data and determine fault current, type of fault, and phases affected
- Manually entered fault current value into analysis tool
- Manually review probable fault locations
- Excluding locations behind protective devices
- Provide locations and source-side sectionalizing switch information to serviceman

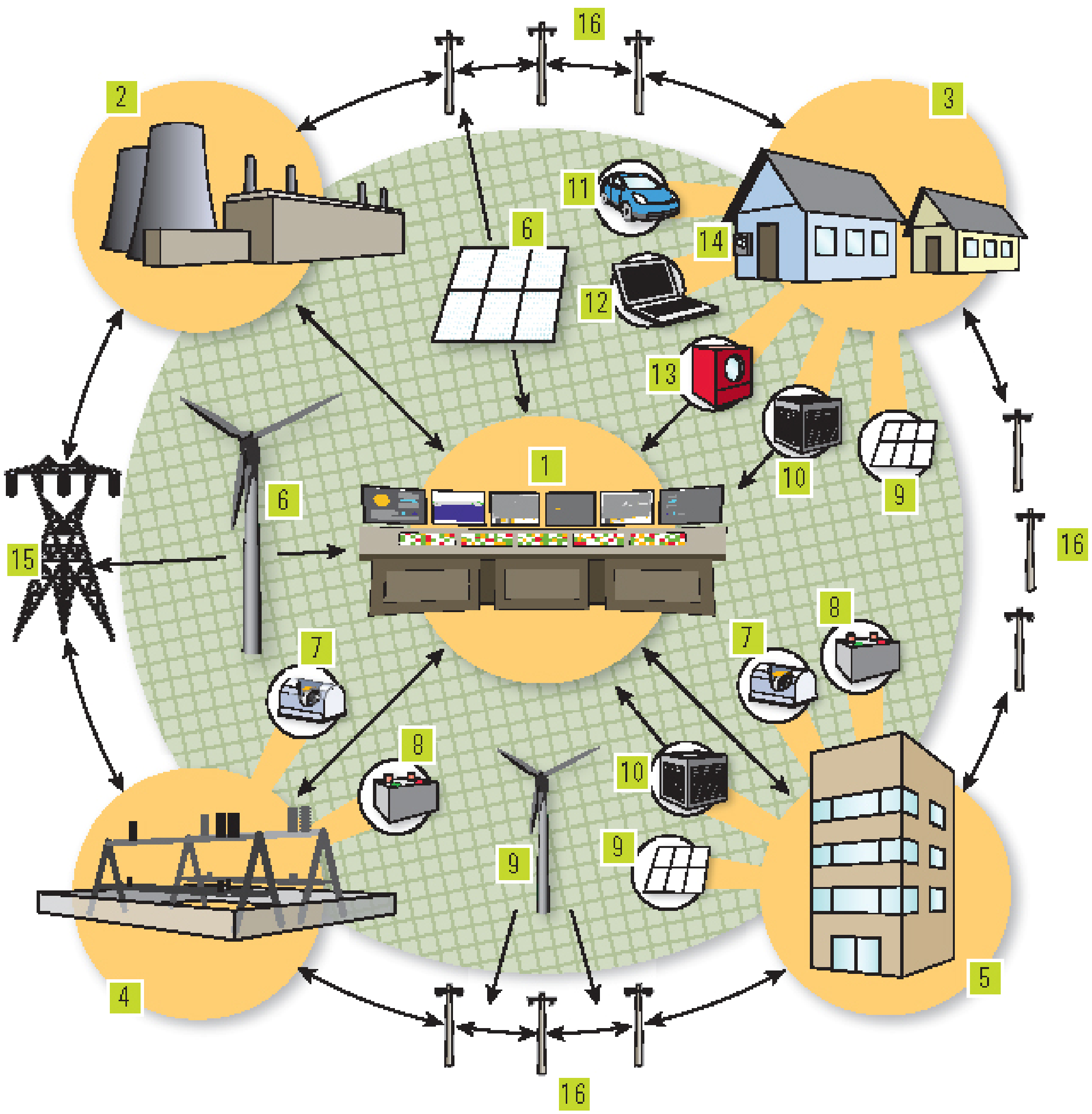
53


Fault Occurs
Substation RTU
Alarms DSCADA
Server Initiated to Download FMS Event Data
Dispatch Computer Displays Fault Location
Next Day
Automated Trending
Fault Location
Restoration

Progress's Smart Grid Approach

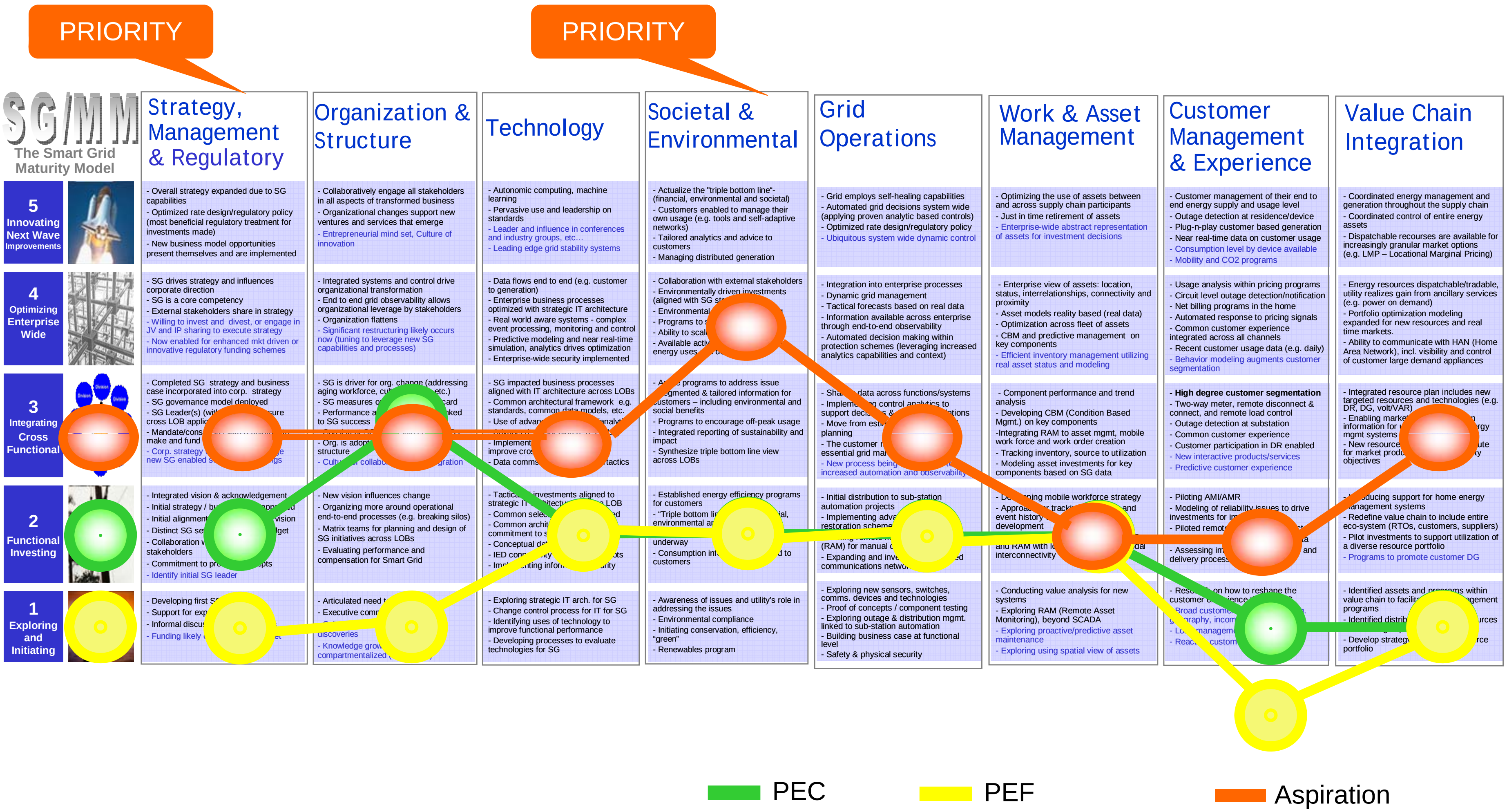


Our Smart Grid Vision



1. Command center at Progress Energy
2. Baseload state-of-the-art power plants
3. Residential homes
4. Substations
5. Commercial, industrial and government (CIG) facilities
6. Utility-scale renewable energy generation
7. Distributed traditional generation
8. Distributed energy storage
9. Distributed renewable energy generation
10. Energy-efficient appliances
11. Electric vehicles
12. Real-time customer info
13. Demand-side management programs
14. Smart meters
15. Transmission lines
16. Distribution lines

Progress Energy SG MM
Current Position and 1- 3 Year Aspiration



DSDR – PROGRESS's First Smart Grid Projec

Summary of Benefits

Generation
Fuel Savings
Deferred CT
Delivery
Peak Load Reduction
Spinning Reserve
Line Loss Optimization

Customers
Quality Voltage
Avoided Fuel
Environmental
Avoided Impact
Carbon-Free
Green MW

Our Initial Steps into the Smart Grid

Distribution System Demand Response
Integrated Volt-Var Management

The Base – A History of Innovation

1997 - Present

DSM (traditional load control)
MobileLink
ITR/ETR
Skilled Workforce
SCADA/DSCADA
OMS
Mobile MOMs
Var Management System

The Beginning of the Smart Grid System

What is DSDR?

New 21st Century Capability

Peak Load Reduction Tool

Combustion Turbine construction deferral

Increased value of the distribution system

DSDR Components	% of Total cost
Feeder Conditioning	40
Grid System Design	20
IT Systems & Integration	10
Telecom	20

Demand Side Resource

Cost Effective Investment

Designed for system dispatch

250 MW Capability

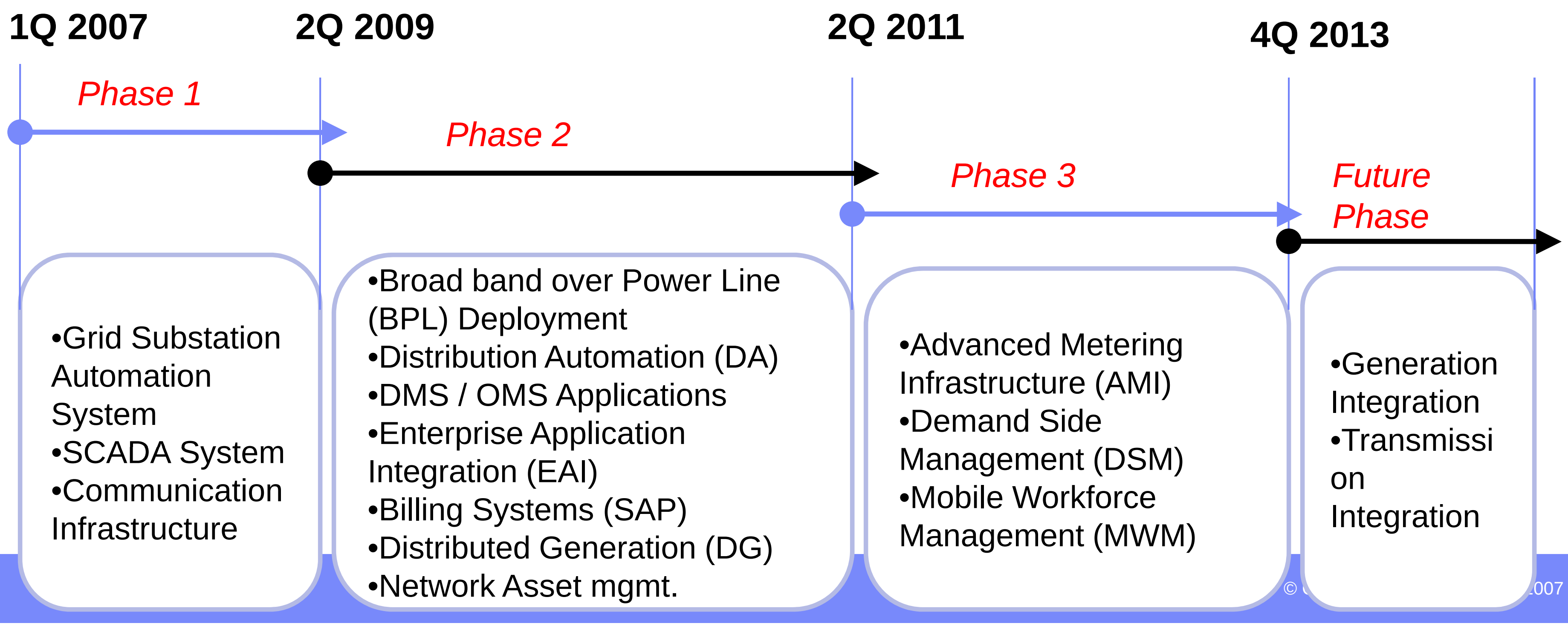
NDPL – an utility of the future – a Smart Grid

❖ Like any advanced utility, in NDPL proactive efforts are on to ensure convergence of digital and physical infrastructures. We are continuously striving for adoption of Smart Systems to transform our energy grids and intelligent infrastructure for leading edge position in the market and customer places.

❖ New technologies will drive fundamental changes in the way electricity is distributed, priced and used. More and more customers will want to manage their energy use more closely and "Smart Meters" will not only provide real time price information but also will help in better tailoring of operations and planning.

❖ In future, at NDPL, all the various components of the energy delivery system will be linked through real time communication. State of the art technology will help us pinpoint outages and make repairs more quickly. The ultimate goal is to provide greater reliability with less environmental impact – at a lower cost to our customers.

Proposed Smart Grid Deployment in NDPL



Smart Grid stimulus packages around the Globe

World wide movement to accelerate renewable energy and Smart grid.

- USA (ARRA) $4.5B ($500M+ for SG projects)
- Australia (NEEI) A$4.5B – CCS, Solar, $100M smart grid
- Japan $158B – “50%” for EVs, PV
- France $2B – 2 year PV accelerator
- China 6% PV total generation by 2020
- Germany
- Korea

Overview – Smart Grid Stimulus - USA

1306 - Matching Grants for Smart Grids ($3.675B)	**Smart Grid - 4 Areas - $500K - $20M for each project** Area, Regional, and National Coordination Regimes Distributed Energy Resource Technology Delivery (T&D) Infrastructure Information Networks
	PMU - PMU Technology Deployment - $100K to $5M
1304 - Smart Grid Demonstration Projects ($615M)	**Smart Grid Regional Demonstration: 8-12 total - $180-$400M** 6-8 with IOU @ $20-$40M each = $160-$320M 2-4 with Publicly Owned Utilities @ $5-20M each = $20-$80M
	Large Scale Storage Demonstrations: $180-$210M Battery Storage for Utility Load Shifting or for Wind Farm Diurnal Operations and Ramping Control - $40M to $50M total Frequency Regulation Ancillary Services -$40M to $50M total Distributed Energy Storage for Grid Support - $25M total Compressed Air Energy Storage (CAES) - $50-60M total Demonstration of Promising Energy Storage Technologies - $25M total
	Synchrophasors Demonstrations: 4-5 @ $15-20M each = $60-80M

Subsection (D) of EISA section 1304(b) states that "no" person or entity participating in any demonstration project conducted under this subsection [Regional Demonstration Initiative] shall be eligible for grants under section 1306 [Federal Matching fund for Smart Grid Investment Costs] for otherwise qualifying investments made as part of that demonstration project." DOE reminds applicants of this prohibition so they may plan accordingly

Purpose of Smart Grid Investment Grant Program - USA

- Stimulate the rapid deployment and integration of advanced digital technology that is needed to modernize the nation's electric delivery network

- Promote the deployment and integration of phasor measurement unit (PMU) technology

- Application of advanced digital technology to greatly improve the reliability, security, and efficiency of the electric grid, while minimizing its environmental impact

- Enhanced connectivity will call for different applications, systems, and devices to be interoperable with one another
  - open system architecture, as an integration platform
  - commonly-shared technical standards and protocols for communications and information systems

Aim of DoE:

Peak demand reduction

Peak Demand Reduction through the application of smart devices and how they might affect consumer behavior and enable renewable and distributed energy resources

Demand side management improvements

How generation, transmission and distribution assets are utilized through improved demand-side management and infrastructure investment deferrals

Reliability improvement

Reliability Improvement through the application of smarter sensing, communication and control devices

Reduction in emissions of environmental pollutants

e.g., carbon dioxide, and reliance on foreign-supplied fuels

Job creation

“There is no likelihood man can ever tap the power of the atom.”
Robert Millikan, Nobel Prize winner in Physics

“There is no reason for any individual to have a computer in their home.”
Ken Olsen, President of Digital Equipment Corp

“640K ought to be enough for anybody.”
Bill Gates, Founder and CEO Microsoft

“Who the hell wants to hear actors talk.”
Harry Warner, 1927

THANK YOU

Formulating Pricing Methodology for Inter-State Transmission in India

Central Electricity Regulatory Commission

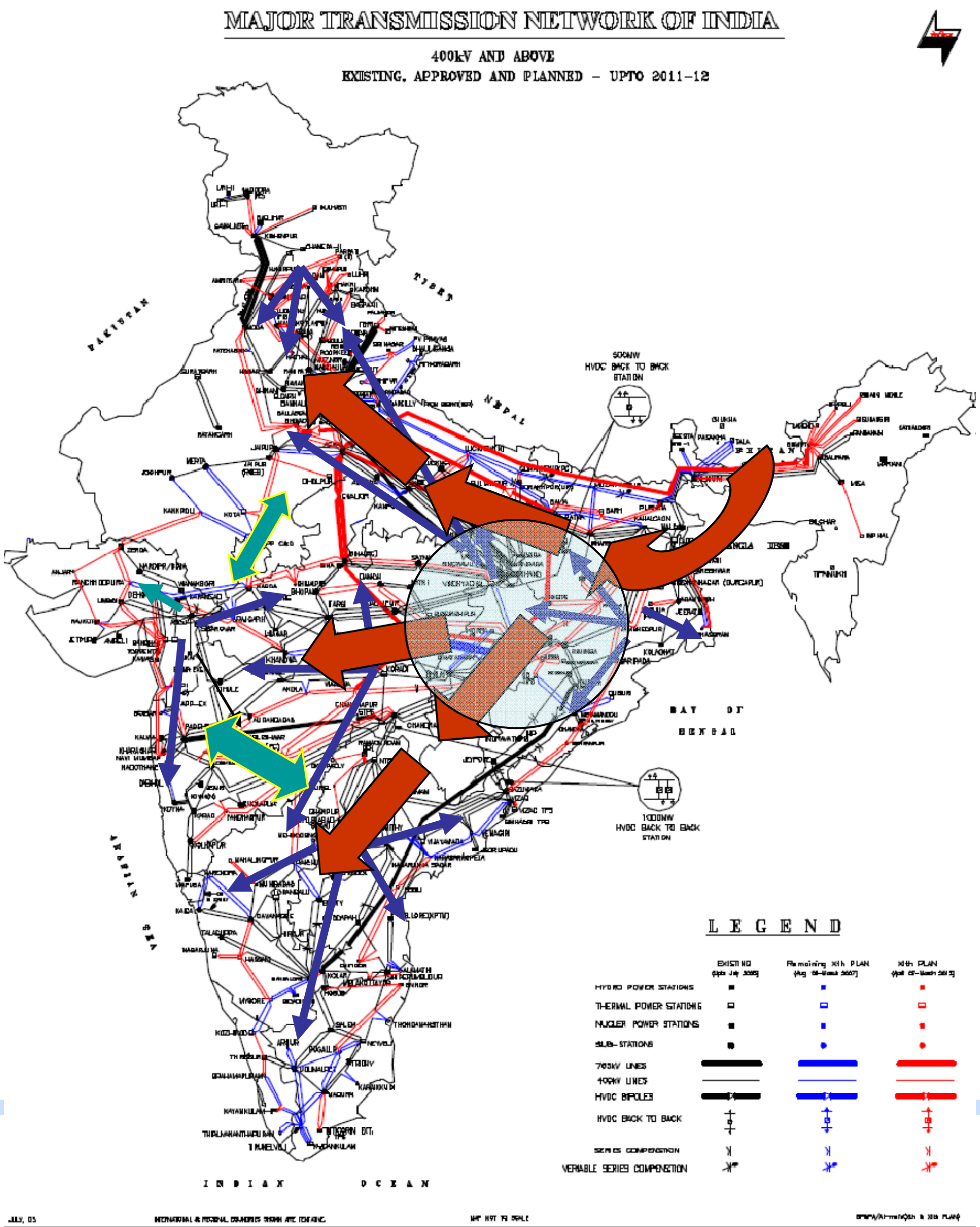
Agenda

- Policy Mandate
- Tariff Design Options
- Selection of the preferred framework
- Discussion of Results
- Implementation of the preferred framework

Tariff Policy Mandate

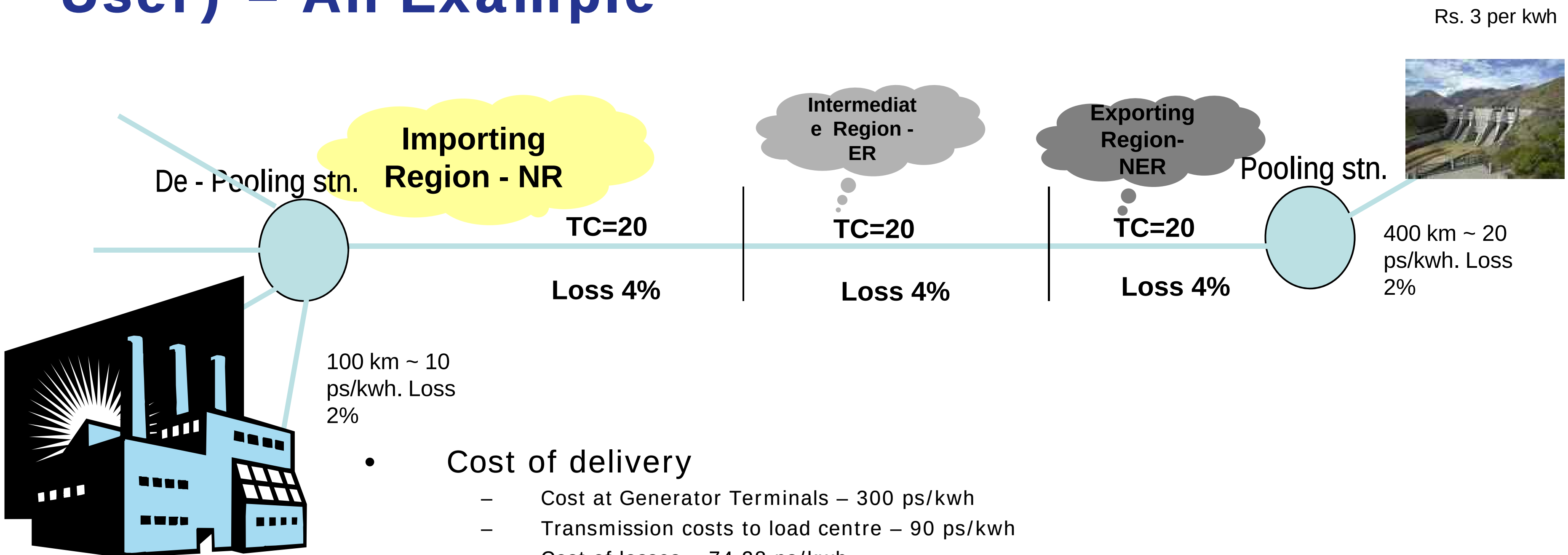
- Para 7.1 (2)
  - Transmission charges should be sensitive to
    - Distance
    - Direction, and
    - Quantum of flow
- Para 7.1 (3)
  - Network users should share transmission costs in proportion of their respective utilization of the transmission network
- Para 7.1 (4)
  - Prior Agreement with the beneficiaries should not to be a pre-condition for transmission capacity expansion
  - Network expansion in consonance with the National Electricity Plan and in consultation with stakeholders, after due regulatory approvals

PGCIL Map (Till 2012)



- Evolution of high density coridors between NE/E to W and N
- Frequency integration of all regions currently, except South
- South to be integrated better after 2012. Single national grid to become operational
- Predominantly unidirectional flows **for long term transactions**

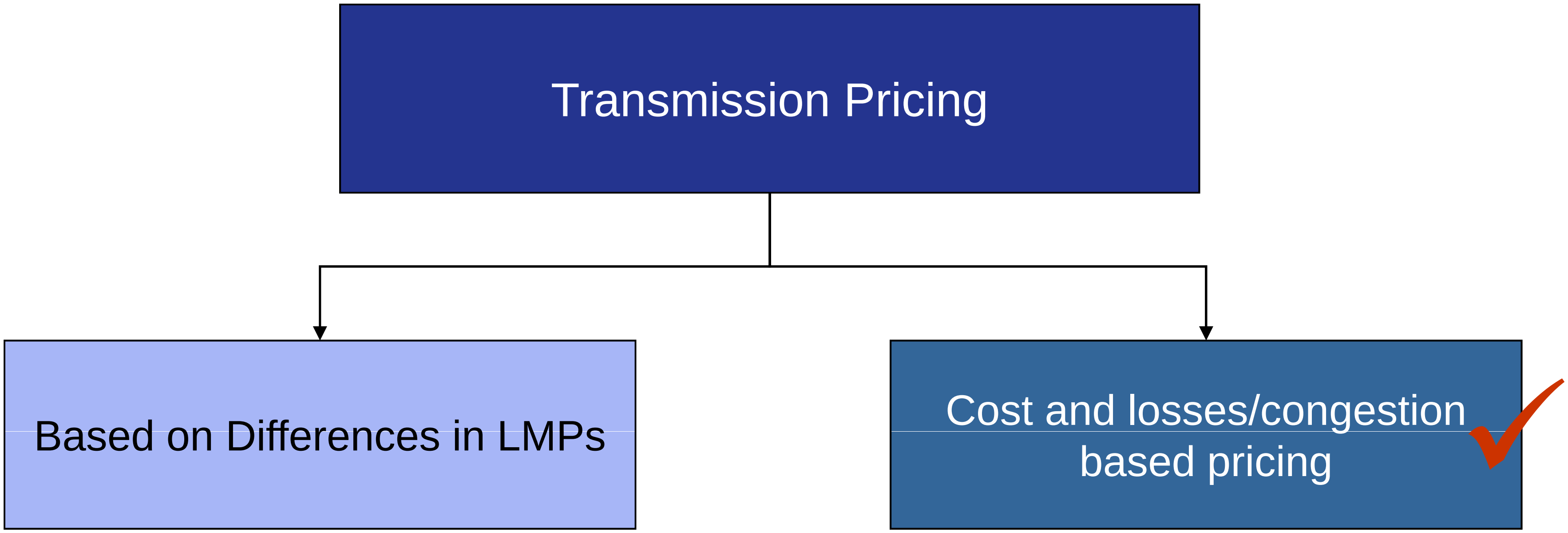
Pricing under Postage Stamp (Long term User) – An Example



- Cost of delivery
  - Cost at Generator Terminals – 300 ps/kwh
  - Transmission costs to load centre – 90 ps/kwh
  - Cost of losses – 74.28 ps/kwh
  - Final costs – 464.28 ps/kwh
- Much of the cost levels are genuine. There could even be element of cross-subsidisation of new transmission costs by existing beneficiaries
- If new line costs are loaded on to first user(s), then the cost of delivery can be prohibitive
- There could be a tendency of over-estimation of losses
- **Hence the need to ensure a *fairer* allocation**

Tariff Design Options

Overall Options



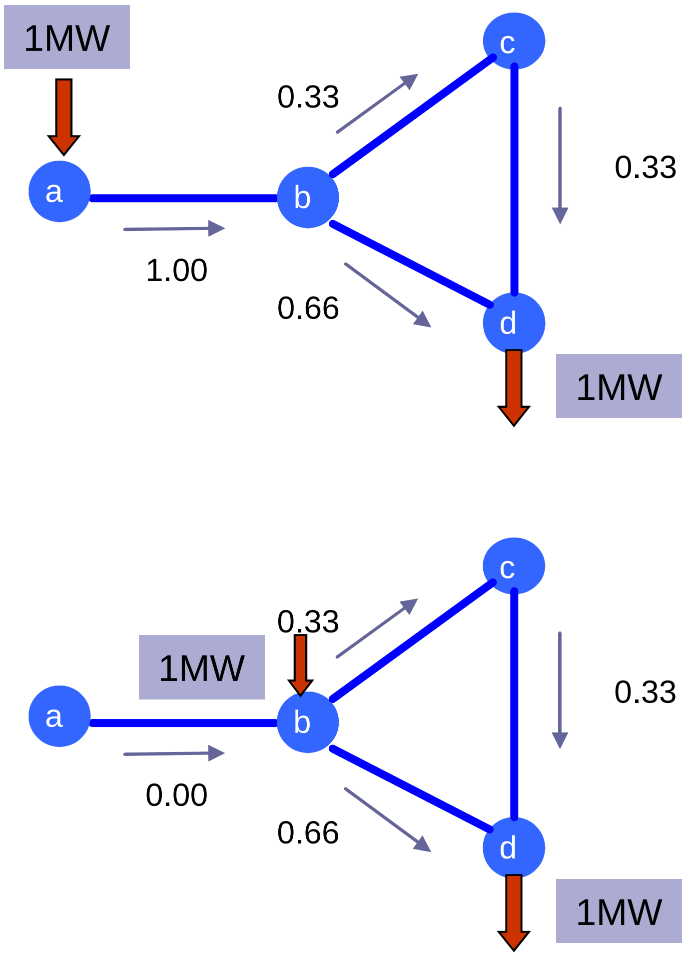
For India cost and congestion based pricing is relevant on account of design and operations of the power markets

Options for allocation of Transmission Network Use of System (TNOUS) Charges

- Marginal Participation (MP) Method
- Average Participation (AP) Method
- Zone-to-zone Method

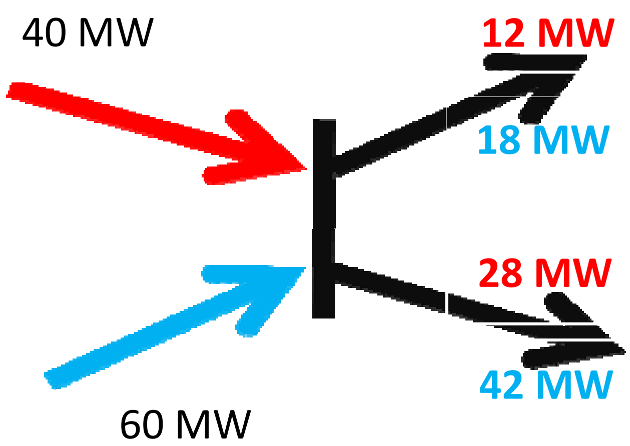
The MP and AP methods are variants of the Point of Connection Tariff Approach

Marginal Participation Method (Point Tariff)



- Based on the extent to which a unit increase in power injected into and withdrawn from the grid at each node affects the various network elements
- This assessment produces the 'marginal participation' of each node in the power flow over each network element
- Total participation at each node is obtained by multiplying its marginal participation by net power injection/withdrawal at each node
- This method requires selection of a slack (reference) bus and allocations are sensitive to the location of the slack bus

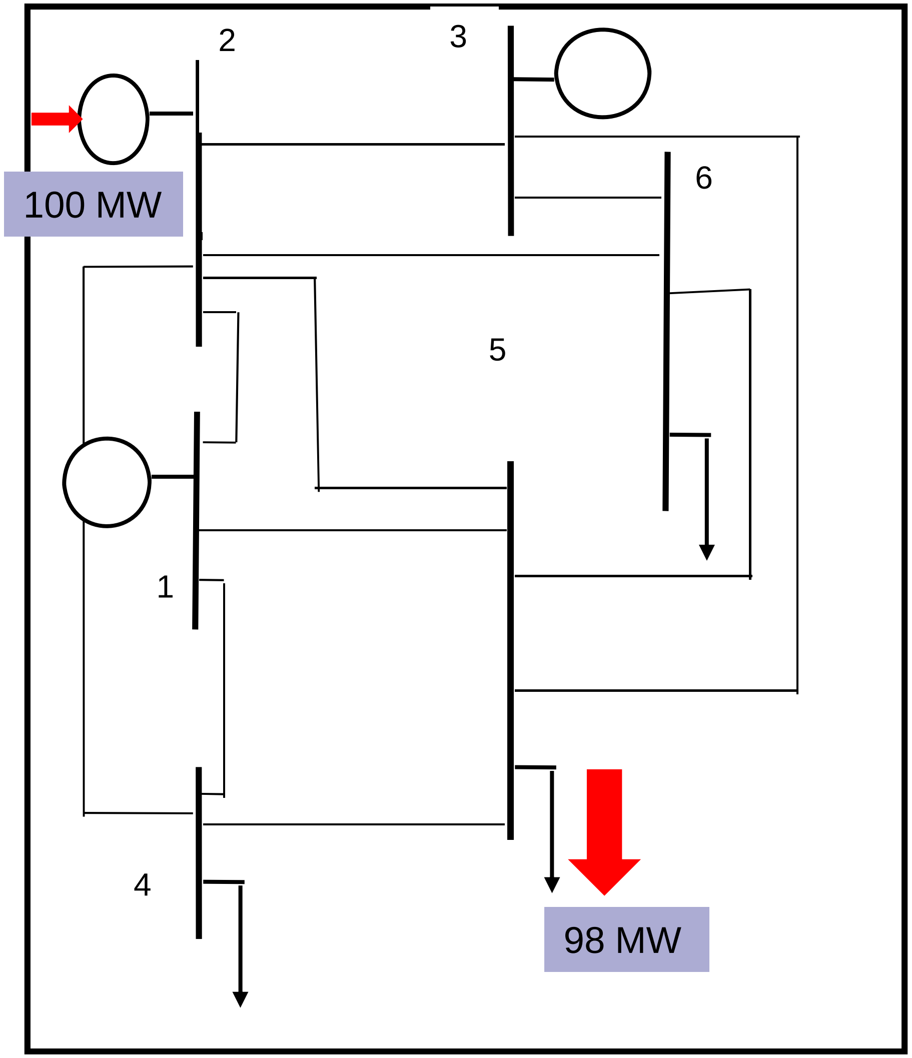
Average Participation Method (Power Flow Tracing)



$$30 \times \frac{40}{(60+40)} = 12$$

- Power flow is traced from the injection nodes to withdrawal nodes using assumptions
- Power flow tracing based on equi-proportionality principle
- It is possible to identify and measure the responsibility of each injection and withdrawal nodes for the power flows on each network element
- Responsibility is measured is terms of MW-mile

CEA Zonal Method



- The zonal matrix stamps are derived from load flow studies for base cases for the six scenarios and corresponding sensitivity cases to determine the incremental load that can be met in Zone X from 100 MW incremental generation in Zone Y.
- The matrix so obtained is normalized to obtain stamps for allocation of transmission charges (normalization collared at 4) and losses (normalization collared at zero)
- Flows are not traced (and hence assets used are not directly identified), injection and withdrawal nodes are considered

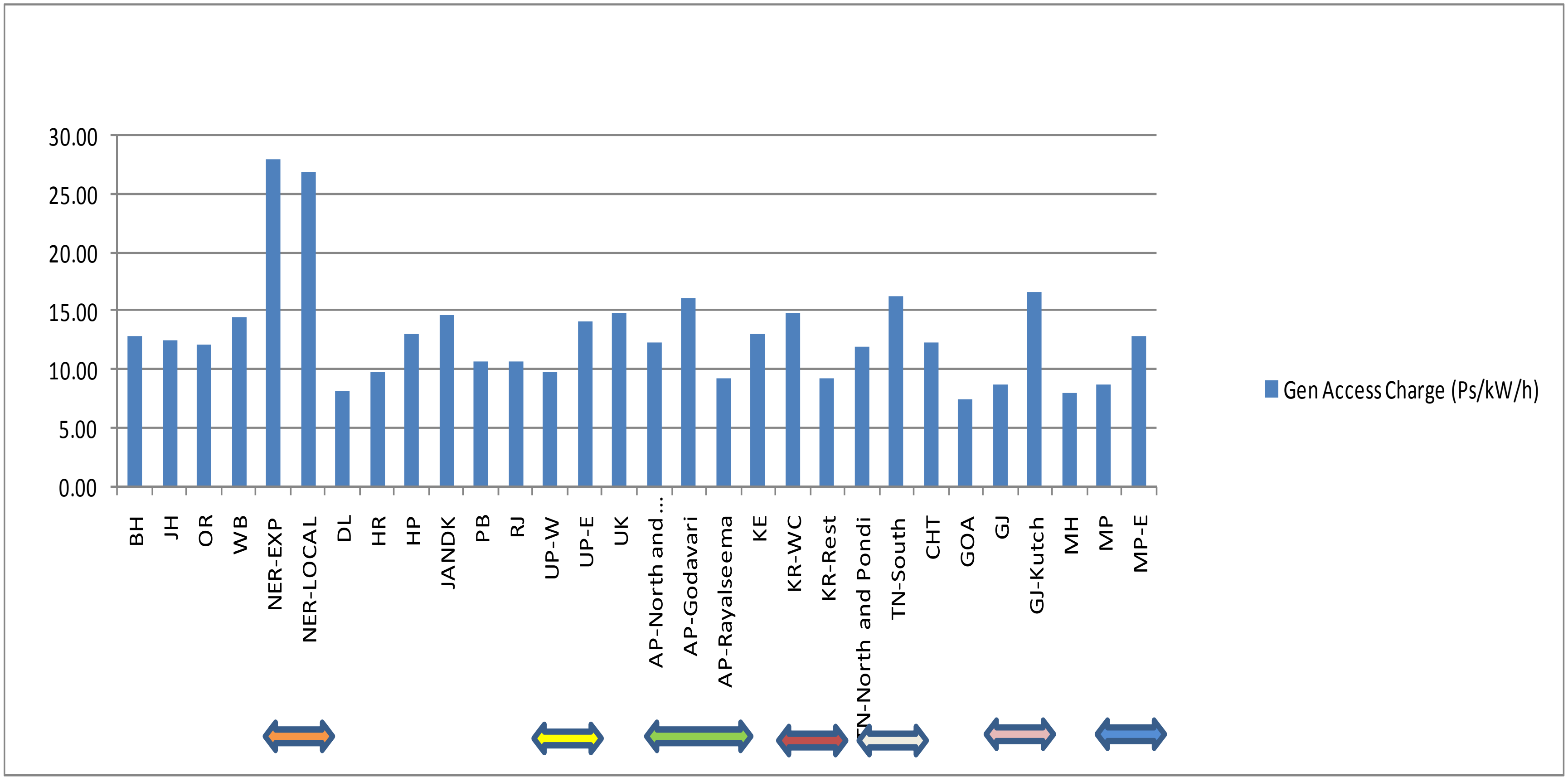
Why Marginal Participation Method?

- Addresses the policy mandate. The charges determined
  - Are sensitive to Distance
  - Are sensitive to Direction
  - Are sensitive to Quantum of Flow
  - Obviate the need for BPTAs for capacity expansion in Transmission
- The charges are based on incremental utilization of network assessed through load flows
- Allocators less arbitrary - Provides better locational signals as compared with AP method
- Is backed by considerable international experience

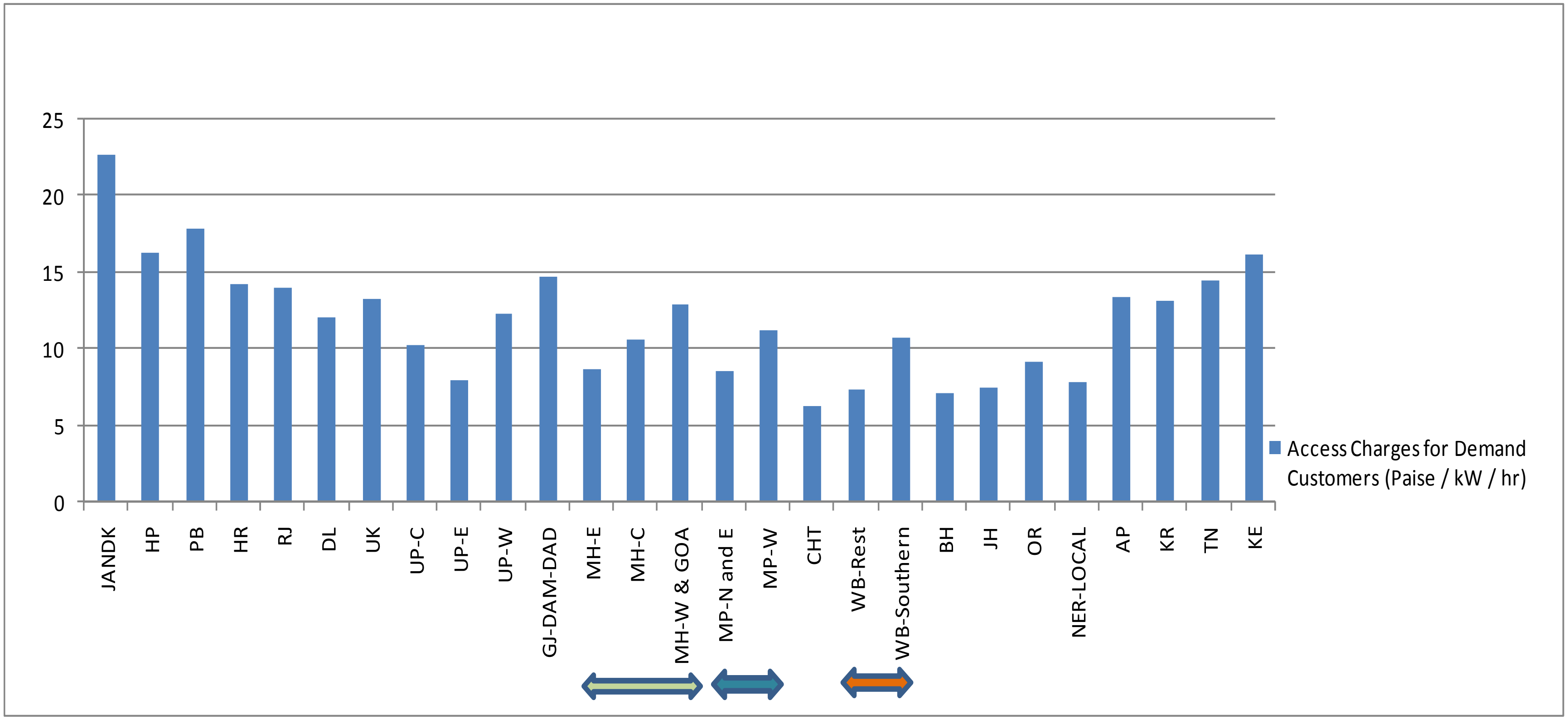
Creation of Zones

- Zones contain relevant nodes whose marginal costs (as determined from the output from the computation model) are within a logical range.
- The nodes within zones are geographically and electrically proximate.
- Generation and demand are separately zoned
- The total number of generation access zones created is 30 and the number of demand access zones is 27.

Transmission Access Charges Payable by Generators



Access charges payable by Demand Customers



Impact on network users - Inter-regional network users

- Inter-regional transfers under the proposed mechanism are relatively cheaper as compared to the present mechanism.
  - Avoids Pancaking
  - Transfers from Jharkhand to Delhi:
    - Under MP Method: 24 paise / kWh
    - Current Postage stamp charge: 32 paise / kWh (Approx)
  - Transaction from Jharkhand to Andhra Pradesh
    - 26 paise/kWh,
    - Jharkhand to Karnataka 25.6 paise/kWh,
    - Jharkhand to Tamil Nadu 27 paise/kWh and
    - Jharkhand to Kerala 28.60 paise/kWh
    - Existing charge: 32-36 paise/kWh.
  - Transaction from NER to Kerala
  - 44 paise/kWh
  - Current Mechanism: 80+ paise/kWh.

Impact on network users - Intra-regional network users

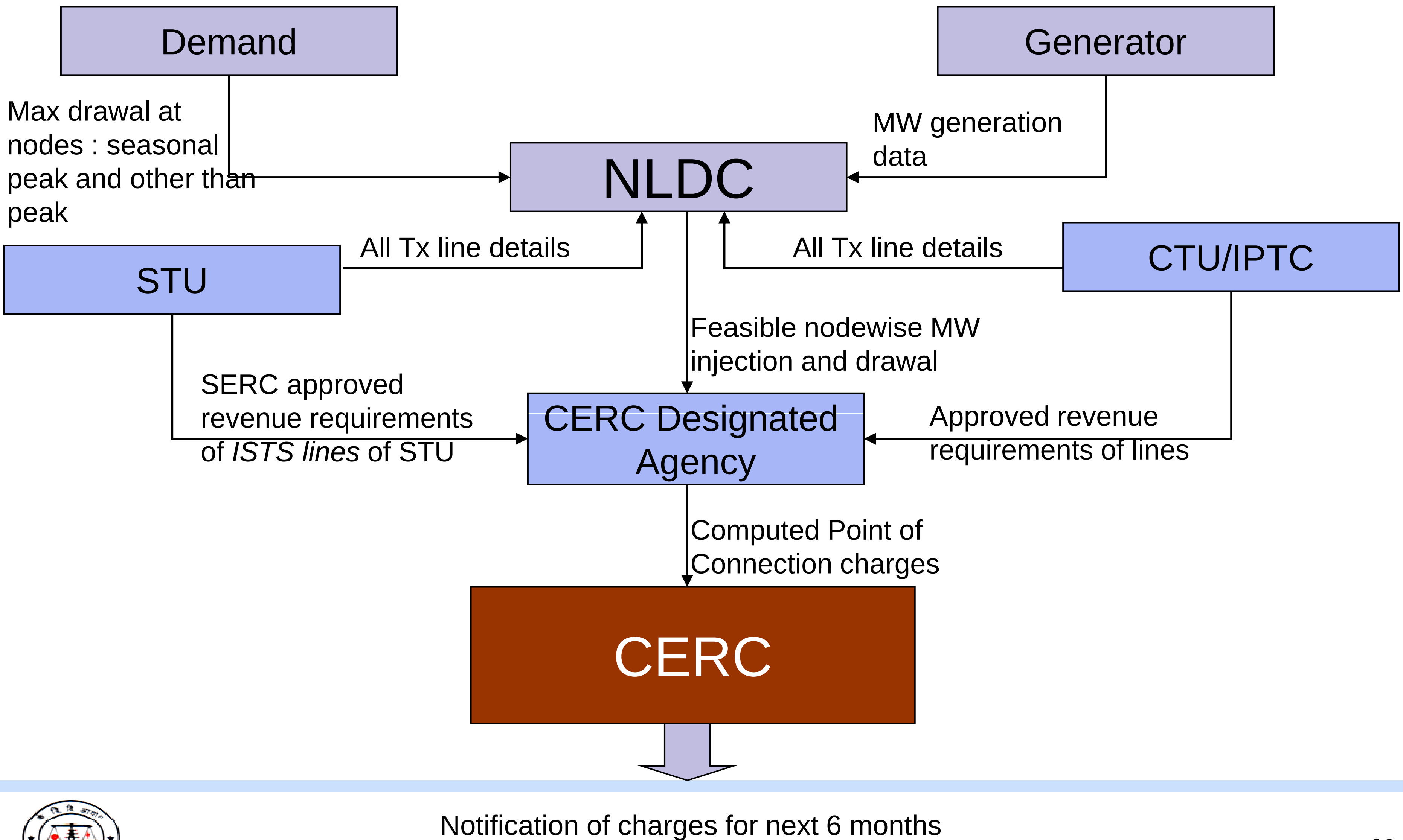
- Chattisgarh to Maharashtra-East
  - 21 ps/kWh
  - Current Charge: 20 paise / kW / hr.
- West Bengal to Bihar
  - 21.56 paise / kWh
  - Current Charge: 20.6 paise / kW / hr
- To demand customers in Andhra Pradesh
  - from Generators in AP-Rayalseema zone: 22.53 paise/kW/hr to be paid as access charges
  - from generators in AP-North and Central, AP-Godavari: 25 paise/kWh and 29 paise/kWh respectively
  - Current Charges: 25.14 paise / kW / hr
- Higher transmission access charges attributable to generators in APGodavari are because of long transmission lines (more than 100 kms)

Transmission charges for hydro and wind generators

- The key low carbon generators in the Indian power system are the hydro and wind resources.
- Access charges for generators in NER under MP method:
  - 28.1 paise / kW / hr
  - If it were reduced to : 25 paise / kW / hr
  - Additional burden on other grid connected entities: 0.05 paise/kW / hr.
- It may be necessary and indeed worthwhile to reduce the access charges for generators in NER by a small but meaningful amount
  - to encourages more generation capacity in the region
  - make market access more attractive (without altering Locational signals significantly)
  - impact on the rest of the system users is negligible.

Implementation Aspects

Information Flow and Processes



How would network service providers (CTU, STUs and IPTCs) be compensated

- CTU / RLDCs would be required to maintain an account of the transmission charges to be collected from each user of the ISTS.
- The bills for the transmission charges for use of the ISTS would be raised by RPCs based on RLDC data.
- The mechanism is similar to that adopted for collection and disbursement of UI pool charges
  - As with UI, the transmission pool collection agency would not be liable for under / delayed payment

What is Connection and Use of System Agreement?

- Users of the ISTS will be governed by the Connection and Use of System Agreement (CUSA) - a multi-party agreement
- Grid connected entities to open an escrow with a depository nominated by CTU/RLDCs
- CTU/RLDCs would compensate on a monthly basis all the transmission service providers based on their approved ARR.
  - This would include the CTU, the IPTCs or any state owned line designated to be a part of the ISTS
  - This kind of arrangement is already in place for the Tala transmission link and for STU lines considered in ISTS

How is delay in injection / withdrawal from the Grid treated?

- The transmission charges depend on the chargeable capacities committed by the generators / demand customers (6 monthly)
- CUSA would identify the force-majeure conditions under which the delay by grid connected entities would not be charged.
- Under all other conditions the charges would be paid by the grid connected entities.
- If synchronization of new generator is delayed, it will be made to bear the burden of the default per CUSA
- Similarly, the demand customer will bear the burden of delay in the materialization of demand

How is advancement of injection / withdrawal treated?

- In case a new generator is synchronised before schedule, it will be required to obtain short term access for such period
- Similar will be the case with demand
- Access would be granted at the same level of charges, subject to network availability
- Amount recovered in excess would be credited to the Transmission Charges pool for adjustments in subsequent periods

How is the delay in creation of transmission capacity treated?

- The Transmission Utilities would be signatories to CUSA
- In case of a delay (non force-majeure), transmission utility would be governed by the terms of the CUSA
- The mechanism proposed is identical to the system being evolved for the IPTCs who are awarded projects through competitive bidding

How is violation of CUSA by Generators treated?

- If the actual generation increases above the forecast for the charging season
  - the party will be liable for the additional charge incurred for the full season
- In case the generation is in excess of the contracted transmission capacity (but within permissible limits), the billing would be as per actual generation
- Generation significantly higher than the access capacity contracted (either short or long term) could attract penal charges
- No recalculation is to be done in the cases where the generation is below the forecast generation level
- Same principles will apply for demand

What are the key actions required from Regulatory Perspective

- Review of some of the core business processes in the utilities
  - Forecasting methods followed
  - Scheduling and despatch processes at the utilities keeping in mind the nodal generation and load
- Transmission network cost information (for state networks included in the ISTS)
  - Information on cost and ARR of the lines
  - Transformers and the associated sub-station equipment
  - Sub-station configuration
- Ensuring timely submission of utility forecasts and network data to the NLDC and other designated agencies

Thank You

What is the information required to determine transmission charges using MP method?

- Nodal generation information
- Nodal demand information
- Transmission circuits between these nodes
- Technical characteristics of each network branch: Resistance, Reactance, line charging and capacity of each network branch
- The associated lengths of each line

Who will provide this information?

- Nodal generation information
  - All generators connected to ISTS
  - SLDCs in case of generators connected to the ISTS network owned by STUs
- Nodal demand information
  - Beneficiary demand customers (distribution utilities/ SEBs / STUs)
- Transmission Data
  - CTU / STUs / SEBs
- This information is currently used by reliability coordinators in RLDCs

What would be the mechanisms for revisions in charges?

- The charges would be revised every six months initially
  - The data for computation of transmission access charges applicable from April 1 to September 30 of a financial year will be submitted by September 30 of the preceding FY (i.e. 6 months in advance)
- Subsequently, once enough experience is gained, the revisions can be made every year
- An appropriate agency designated by CERC will compute the transmission charges as per approved methodology
- The charges will be notified by CERC after review

What data will be provided by the Generators and Demand and how will the same be used?

- Generation levels committed by each generator under specific – seasonal peak and other than peak conditions identified a-priori
- Similarly, nodal demand data will be based on forecasts by beneficiary utilities (SEBs / distribution utilities) will be utilised
- NLDC will validate the information supplied
- Based on the nodal information obtained the load flow based simulation would be undertaken
- Approved transmission capacity for injection/ transaction by each generator/demand customer would form basis for commercial transactions

Which transmission data will be used for computation of transmission charges?

- ISTS transmission circuit data is to be supplied by the CTU based on transmission expansion plan
- Data of the STU lines considered for Inter-state transmission of electricity will be supplied by the STU, (along with the revenue requirement) with approvals of appropriate SERC