



Smart Grid Transforming the Electric Grid into a Digital Grid



Agenda

- ▶ Smart Grid Solutions “Building Blocks”
- ▶ Advanced Smart Grid Applications
- ▶ Customer Examples

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Smart Grid

Enabling a Revolution



Utility concerns:

- consumer satisfaction
- rate management
- controlling costs/ efficiency
- CO2 emissions/ regulatory compliance

When customers are aware of Smart Grid technology and the utilities' attempts to implement it, overall satisfaction goes up.

J.D. Power

Five ways Smart Grid technologies improve the grid

Making the grid work smarter not harder



Capacity



Reliability



Efficiency

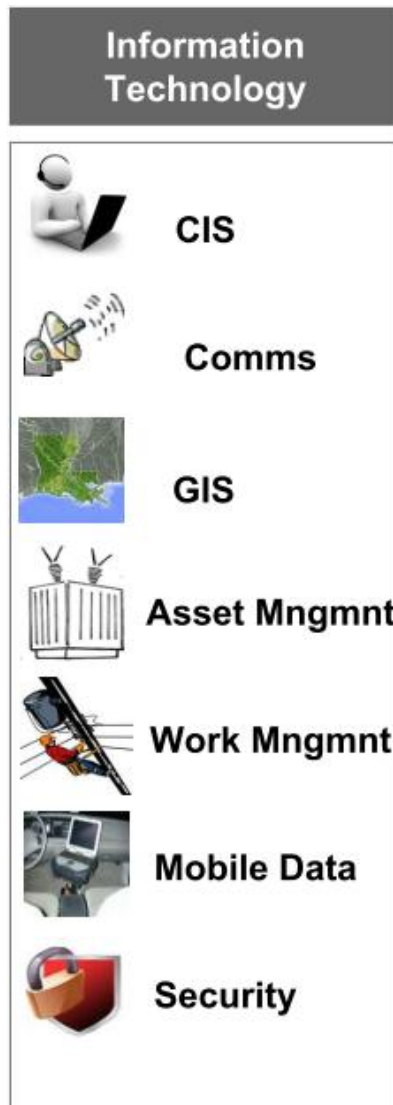


Sustainability



Customer Enablement

Smart Grid Solutions “Building Blocks”



Utility Information Technology and Systems that enables Smart Grid applications

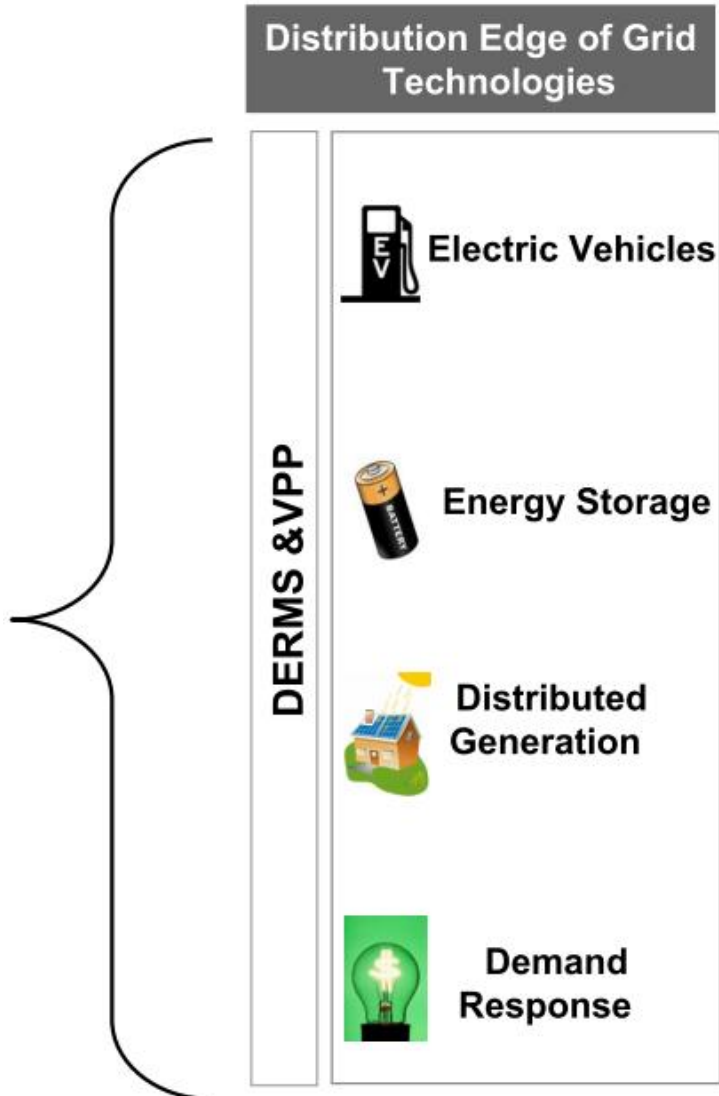
Smart Grid Solutions “Building Blocks”



End-to-End
Smart Grid
applications,
integration of
OT and IT

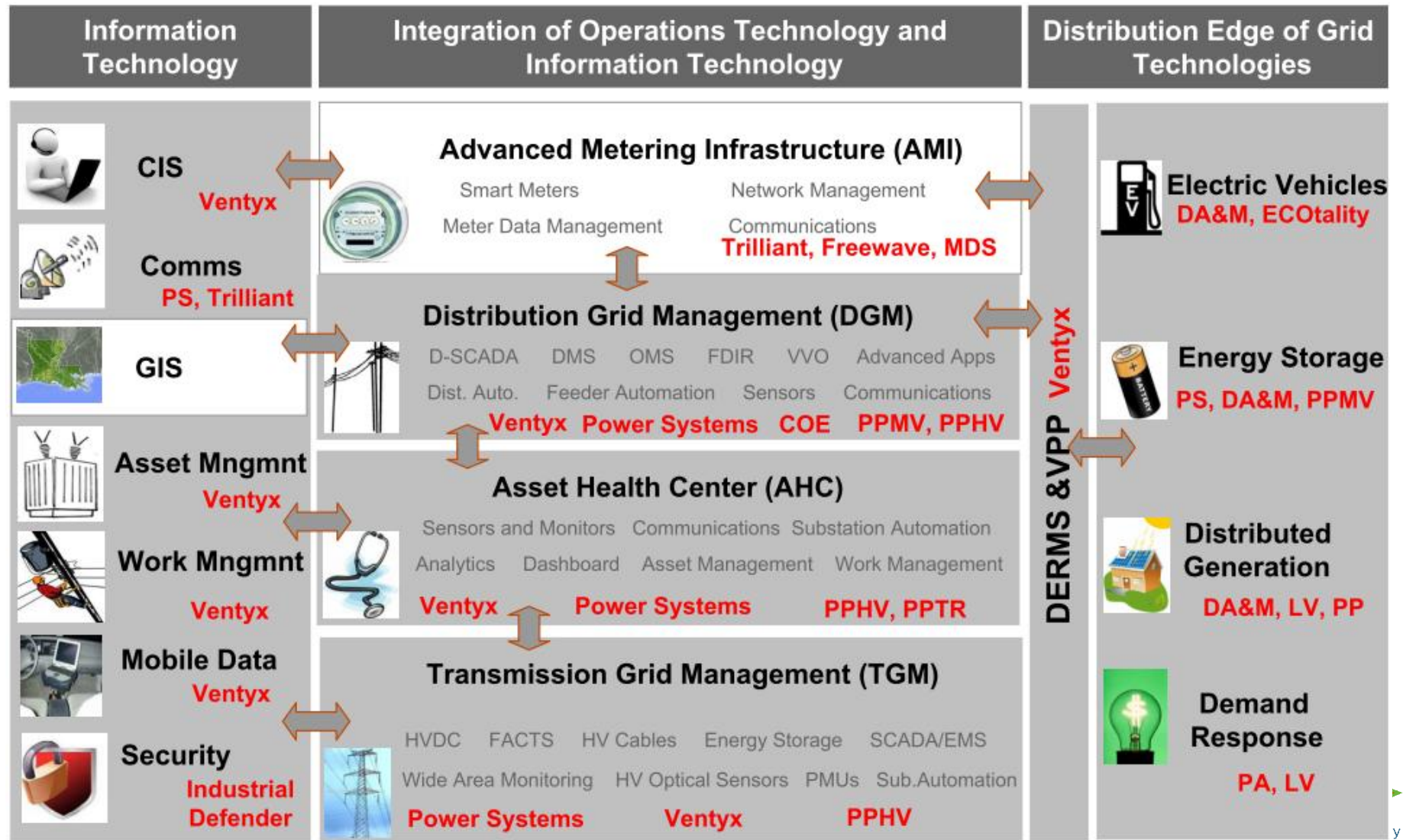
Smart Grid Solutions “Building Blocks”

Smart Grid technologies that have the potential to transform and/or disrupt the relationship between the Utility and their customers.



Putting all Together

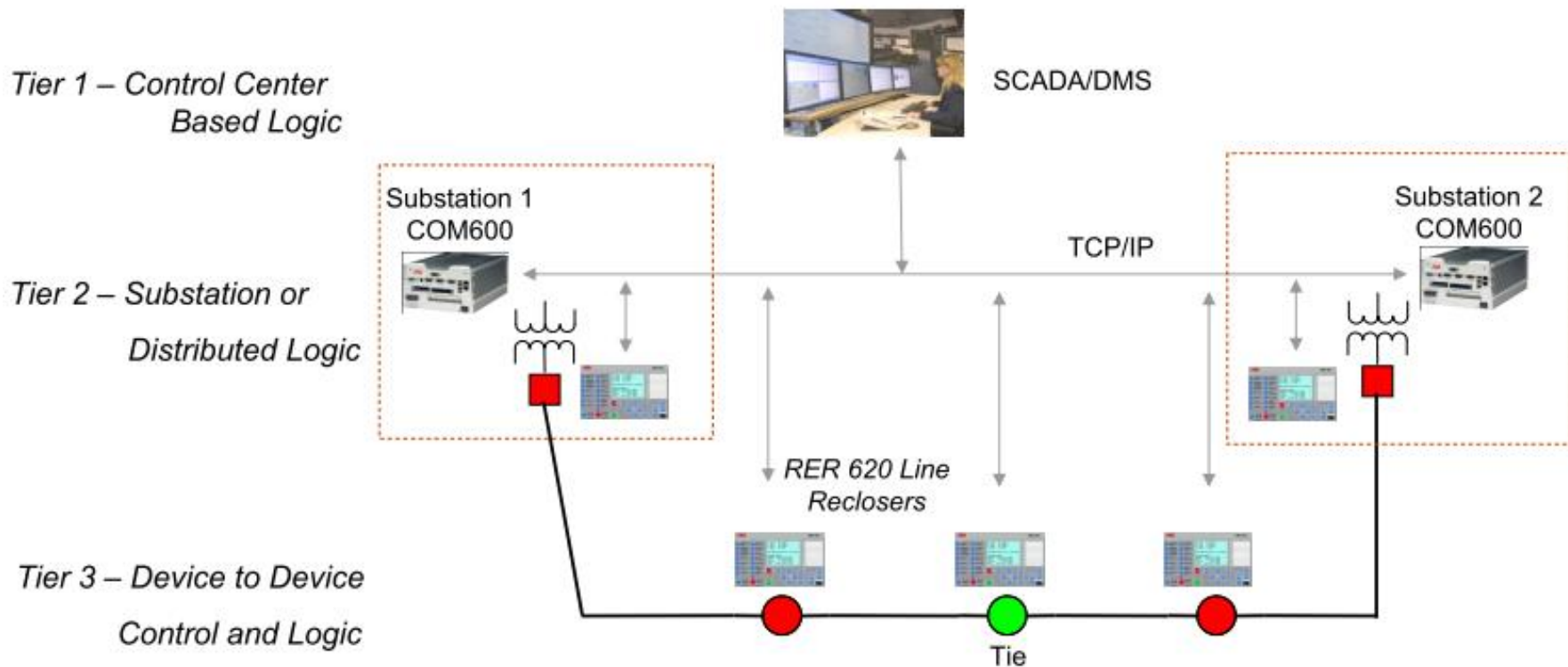
ABB Vision on the Coverage for the Smart Grid Landscape



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Fault Detection, Isolation and Restoration (FDIR)



Data/Logic/Control - Establishing Decision Tiers Using DNP 3.0 and IEC 61850

Volt / Var Control and Optimization

- Drives energy efficiency, up to a 5% increase
- Creates a virtual generator
- Improves asset utilization (higher load factor)
- Defers capital investments, or payments for firm capacity
- Reduces losses



Volt / Var Control – Two Levels

1. Local control

- Capacitor bank control based on local voltage, current, temperature, time of day
- OK for local control objectives (power factor, voltage)
- Control objective (power factor correction, voltage reduction) often inconsistent with loss or demand reduction
- Difficult to coordinate to achieve system level objective
- May not be able to verify capacitor is switching correctly
- Does not require feeder communications



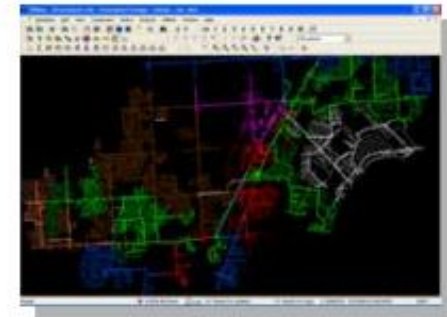
2. Distributed or centralized capacitor automation

- Capacitor control based on power factor correction
- Switch capacitors to keep voltages within allowed range
- Does not require full network model, only connectivity
- Requires reliable and secure two-way feeder communications
- May be done at multiple substations (distributed) or at DMS

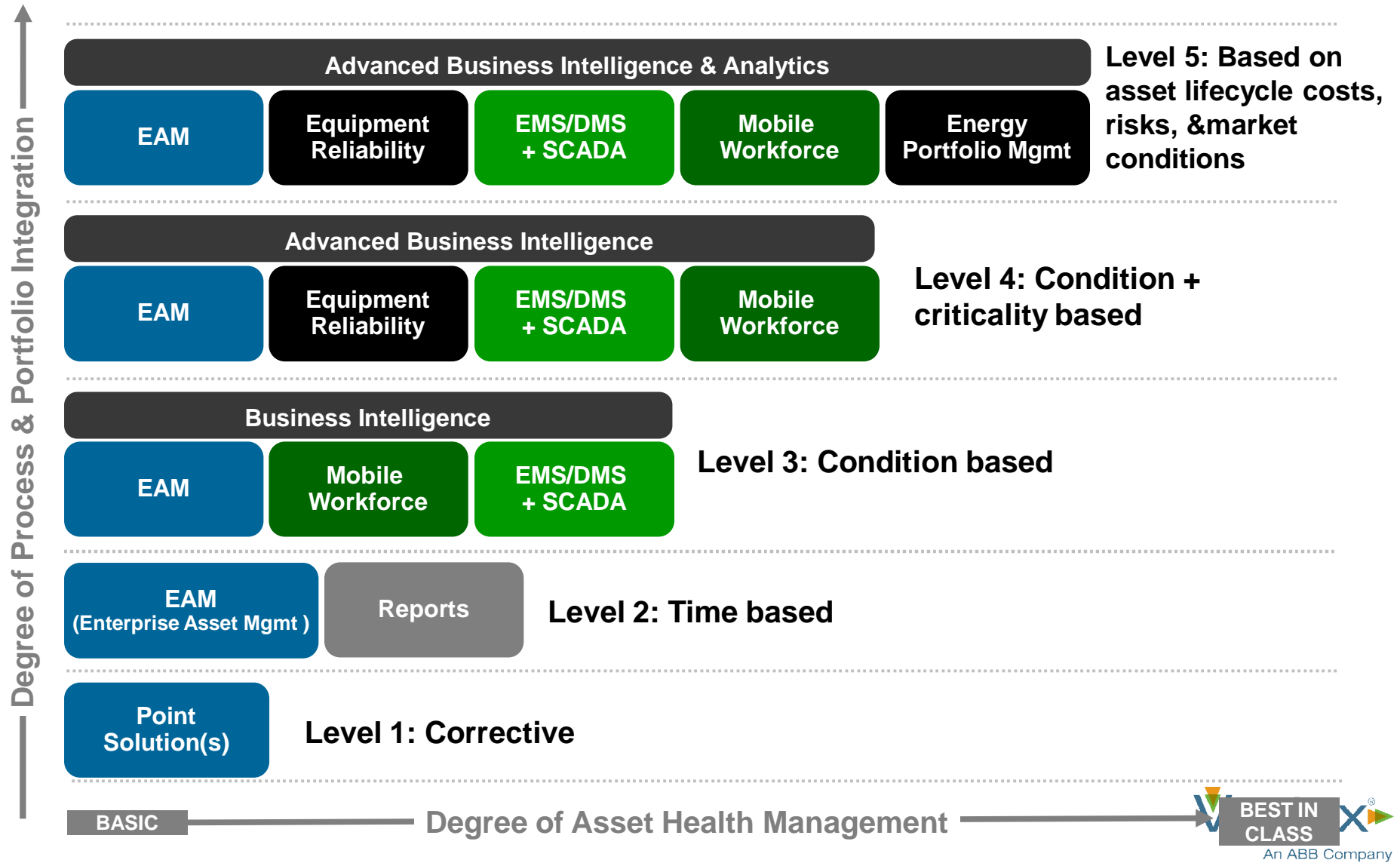


Volt / Var Optimization – The Next Level

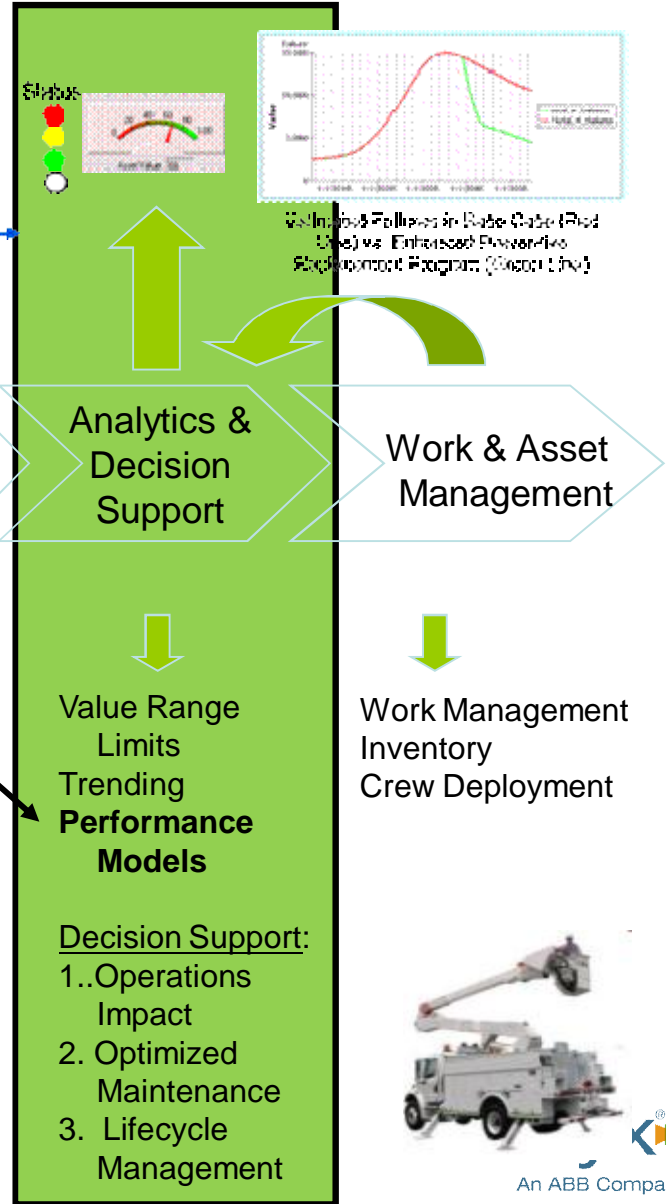
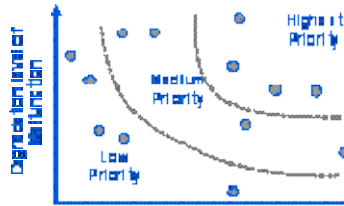
- **Minimize (MW loss or MW demand) + Voltage or Current violations**
- **Subject to**
 - Power flow equations (multi-phase, multi-source, unbalanced, meshed system)
 - Voltage constraints (phase to neutral or phase to phase)
 - Current constraints (cables, overhead lines, transformers, neutral, grounding resistance)
 - Tap change constraints (operation ranges)
 - Shunt capacitor change constraints (operation ranges)
- **Solution**
 - MINLP – mixed integer non-linear problem
 - Integer decision variables (cap bank switching statuses, regulator tap positions)
 - Non-linear objective (loss or demand) and constraints (power flow)
 - Requires network model – impedance and connectivity
 - Requires reliable and secure two-way feeder communications



Asset Health Analysis – A key enabler to Smart Grid



Asset Health: End-to-End Solution to Drive Asset Performance



Performance models are key to the process
Objective is to leverage data to:

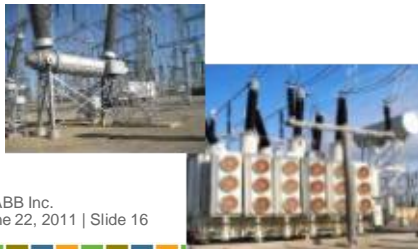
- Define risk factors
- Quantify them
- Recommend mitigation options
- Optimize spending

Transformers
Breakers
Batteries
HVDC and FACTS

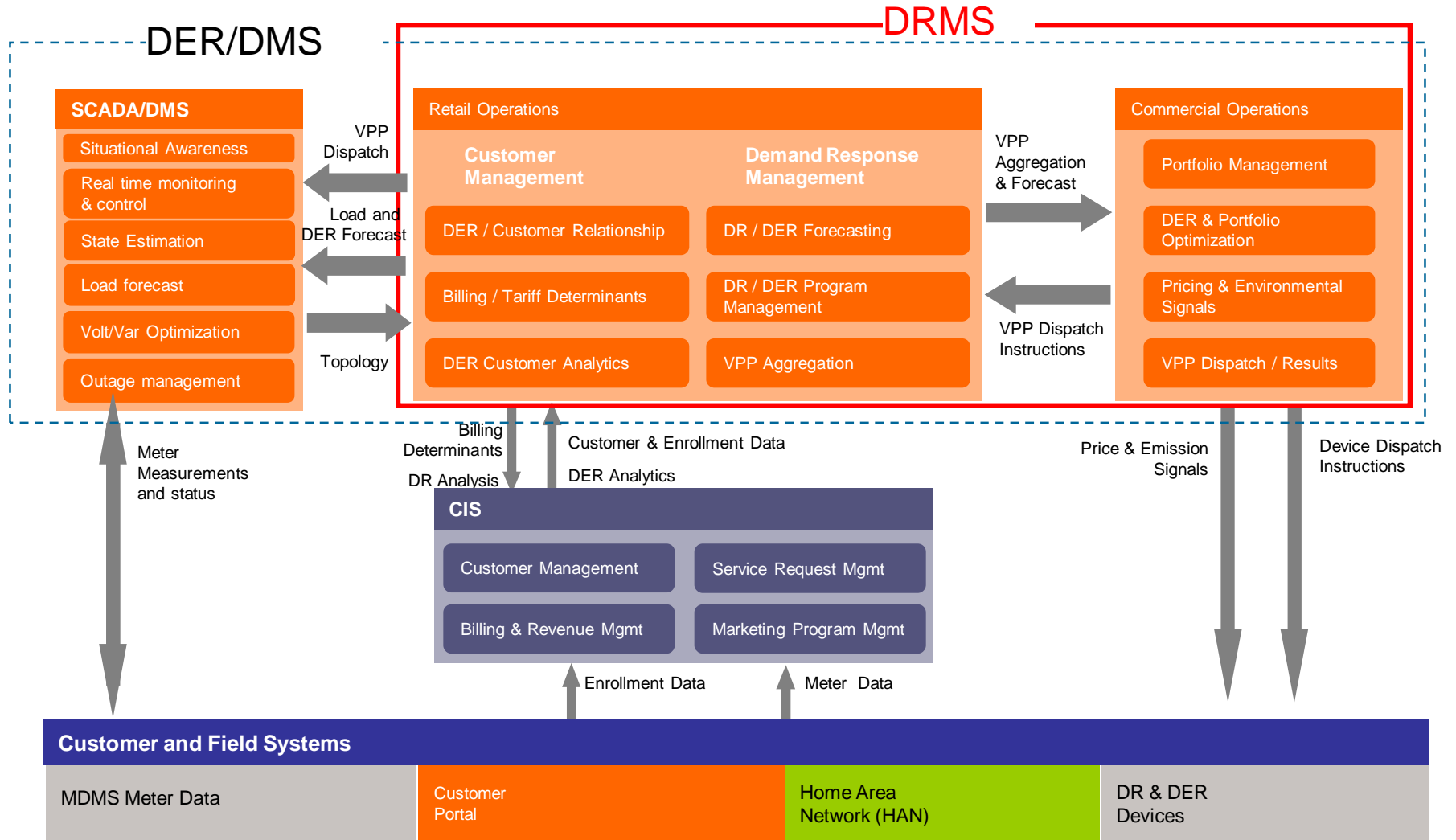
TEC
CBS
Battery Monitors
IEDs

Substation
Automation
Data Concentration
Communications

Equipment specs
Failure data
Test results
Service records

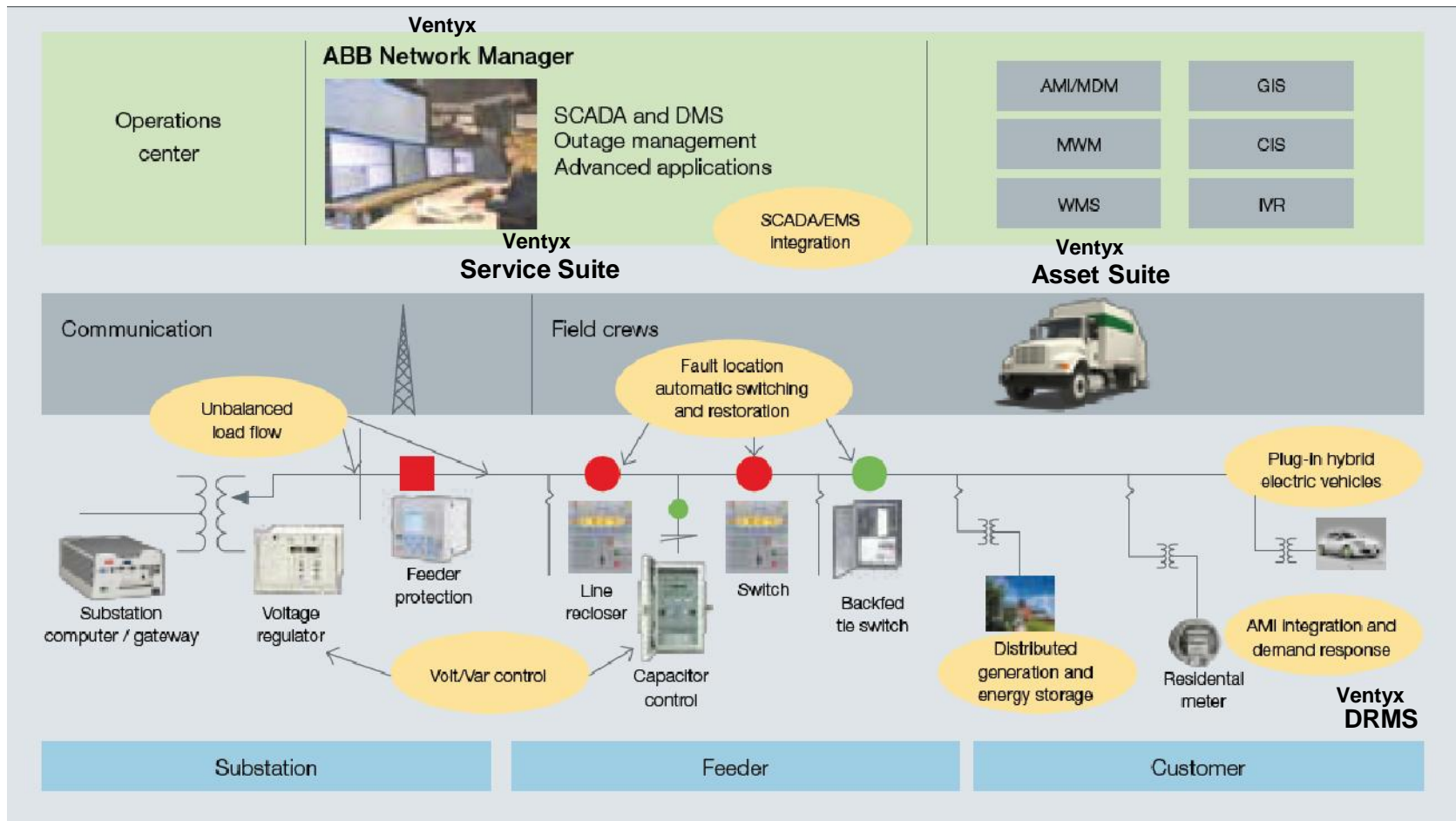


Distributed Energy Resources and Demand Response

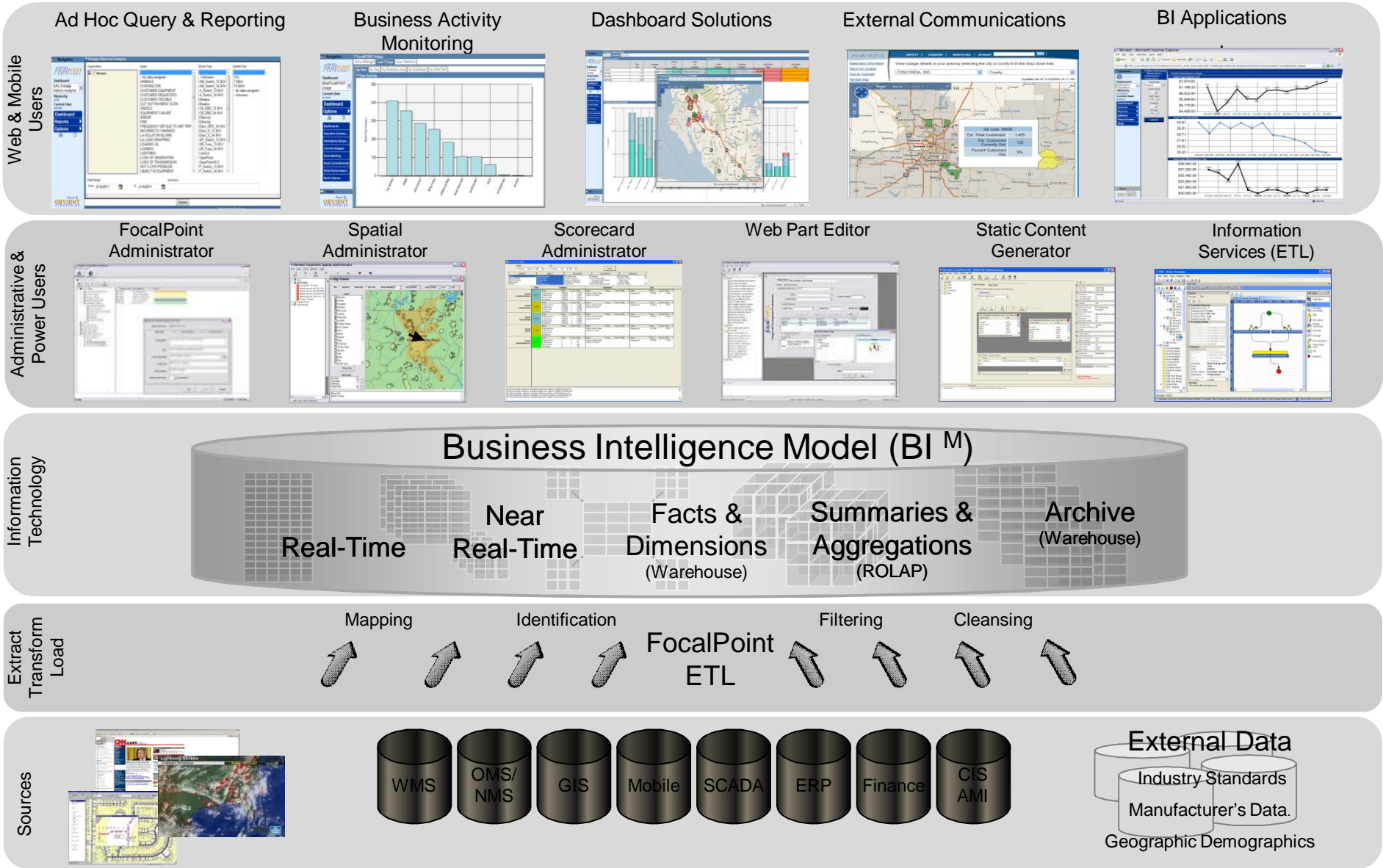


Smart Grid Control Center

Integrating all into a Single Uniform View



FocalPoint Business Intelligence Solution



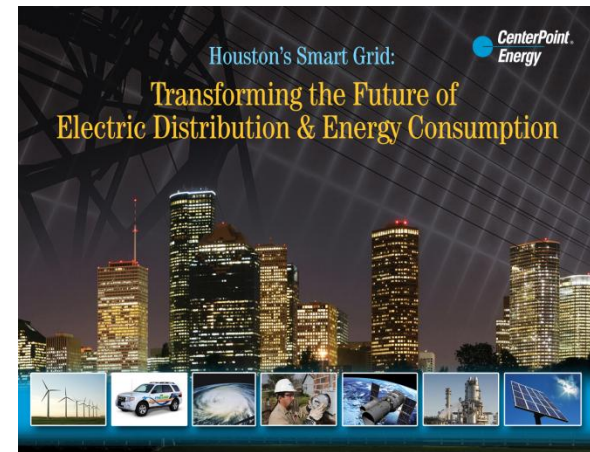
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CenterPoint (Houston, TX)– ADMS Smart Grid Project (SCADA/DMS/OMS & MWM)

► Scope of Requirements

- ▶ Improved power quality and reliability
 - ▶ Self-healing grid
 - ▶ Improved fault detection
 - ▶ Diagnostics for outage prevention
- ▶ Optimized life of electrical assets
- ▶ Help offset decline in workforce
- ▶ Reduced costs
- ▶ Improved customer satisfaction
- ▶ Extended life of electrical assets
- ▶ Transform Information Technology / Operations Technology into a more end-to-end service management organization



► Solution Being Delivered

- ▶ DMS/ OMS/ SCADA Solution replaces manual grid monitoring and status system (Graphical Switching) and Outage Analysis System
- ▶ Implement Volt-Var and Self Healing (Auto Restoration) capability on the distribution grid
- ▶ MWFM integrated with DMS/OMS for faster crew deployment