Cisco Smart Grid
Powering End-to-End Communications

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Smart Grids Emerging Markets
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Emerging Markets Challenges

Demand Growth 2003-2007

Emerging Markets: 25.00%
US: 5.00%
EU: 10.00%

Grid Losses 2007

Emerging Markets: 20%
EU: 18%
North America: 12%

Source: World Development Indicators Database 2007, Emerging Markets Utility Intelligence
Aging Workforce

- 50% of Utility Workforce will retire over the next decade
- Turnover occurring during the industry transformation creating significant knowledge management issues
- NERC has identified as having a “severe” impact on grid reliability
- Utility workforce of the future education, training and development key priorities
Other Business Challenges

- **Low Power** Quality
- **CapEx** Growth & Requirements
- **Uncertainty** of Government Actions
  - Regulatory Constraints on Rate Increases & Equity Returns
New and Emerging Technologies

- Demand Response
- Distributed Generation
- Information & Communication (ICT)
- Sensors
- Energy Storage
- Plug-in Electric Vehicles (PEV)
Demand Response

- Opportunity to **expand the role of DR** in wholesale market operations and grid management

- “Controllable” DR will require enabling **Information Communications Technology** to integrate DR resources on parity with dispatchable generation

Source: NERC
## The Future History of the Grid

<table>
<thead>
<tr>
<th>Wave</th>
<th>Goal</th>
<th>Focus</th>
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<tr>
<td>1: Smart Monitoring</td>
<td>Operational efficiency</td>
<td>Instrument the grid via sensor networks and an IP overlay to continually improve the efficiency and effectiveness of the legacy infrastructure</td>
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<tr>
<td>2: Demand Management</td>
<td>Energy Efficiency &amp; Load Shaping</td>
<td>Leverage bldg control systems, home energy management systems, AMI, variable pricing, and demand response signaling for load reduction and shifting</td>
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<td>3: Utility Solar/Wind</td>
<td>Clean Generation</td>
<td>Meet market demand and regulatory requirements for incremental energy from renewable sources through major investments in new generation and transmission</td>
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<td>4: Distributed Generation</td>
<td>Local Self-Sufficiency</td>
<td>Commercial and residential property owners broadly deploy solar generation to gain greater independence from an increasingly high-cost energy grid</td>
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<td>5: Electric Vehicles</td>
<td>Energy Independence</td>
<td>Prepare the business for new operations and models to support the rapid growth in plug-in electric vehicles via smart-distribution solutions and smart endpoints in homes and businesses</td>
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<td>6: N-Way Smart Grids</td>
<td>Green – Reliable Grid</td>
<td>Broad deployment of any-to-any smart grid enables automated optimization of power flows to increase grid efficiency and resiliency plus enable broad market participation</td>
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<td>7: Virtual Power Plants</td>
<td>Perfect Power</td>
<td>Integrate distributed generation, community storage and smart endpoints into campus and communities to create higher levels of electric service reliability and enable broad market participation</td>
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<tr>
<td>8: Distributed Storage</td>
<td>Dynamic Power Smoothing</td>
<td>Grid-scale storage solution using distributed storage solutions through upgraded distribution network to manage grid stability for intermittent green power</td>
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### Horizon Timeline

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<tr>
<th>Horizon</th>
<th>2010-2014</th>
<th>2010-2019</th>
<th>2012-2025</th>
<th>2017-2029</th>
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<tbody>
<tr>
<td>Wave 2: Demand Management</td>
<td>Wave 4: Distributed Generation</td>
<td>Wave 6: N-Way Smart Grids</td>
<td>Wave 8: Distributed Storage</td>
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Emerging Technology Adoption Risks

- Adoption before standards defined
- Technology integration, performance issues & gaps
- Internal change management
- Customer adoption & change management
- Project cost overruns
- Benefits realization
Convergence will Simplify Complexity
Operation and Information Technologies

- Customer choice & broader market participation will drive infrastructure complexity and initially increase customer experience & operational complexity.

- However, convergence of ICT & OT will lead to simplification for customers and operations management.
Developing the Smart Grid architecture
Use-case based methodology

- Business Priorities
- Use Case Compilation
- Use Case Analysis
- Use Case Library
- R'qmnts Analysis
- Requirements Library

- Functional Architecture
- System Architecture
- Application Architecture
- Data Architecture
- Comms Architecture
- Security Architecture
- Mgmt Architecture
End-to-End Smart Grid Architecture

- Architecture needs to consider integration broadly
- More than one type of network, but convergence required for scope and scale
- Integration of legacy networks and effective migration planning
Transformation of the Grid

- Adoption at the Pace of Value
- Innovation Breeds New Energy Applications & Services
- Potential to Profoundly & Positively Impact Society & Environment
Evolving Business Models

New Business Models
- Energet Service Provider
- Perfect Power: MicroGrid
- Energy Hub Operator
- Informational Power
- Premise Energy Services

Potential Business Challenges
- Resource Scarcity
- Digital Energy Divide
- YouTubed
- Free

current business models will fundamentally change and a smarter grid will enable future success.
Applying Lessons Learned
From Internet to Smart Grid

Think Security Day One

- Ability to Scale Is Critical
- Simplicity Over Perfection
- Open Standards
- Government Support