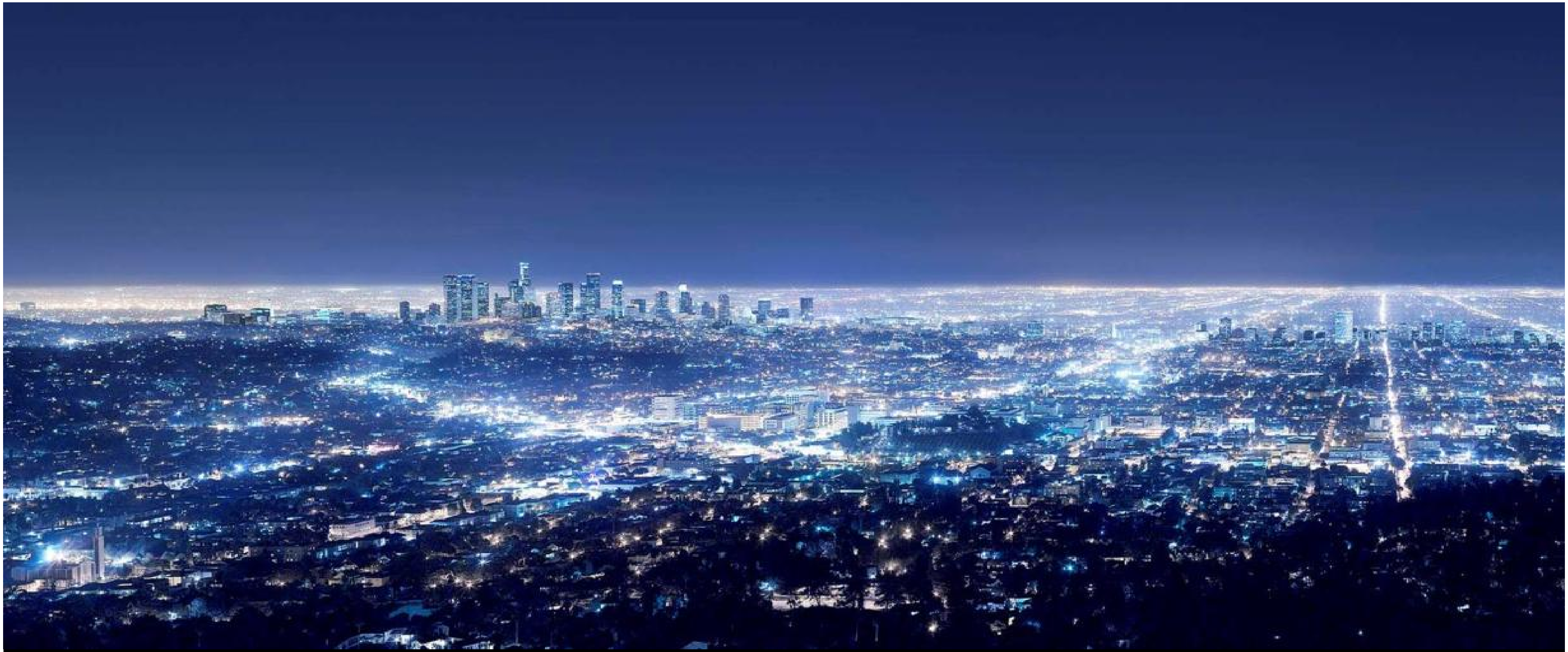


**Gary Rackliffe, March, 2009**

# Smart Grid Introduction
# PSERC Executive Forum

# Smart Grids Defined: DOE Workshop 6-08

- General agreement was reached among the major "thought leading" groups – GridWise Alliance, Electric Power Research Institute, Edison Electric Institute, Galvin Initiative, and the Modern Grid Strategy – on the seven major characteristics.
- A properly planned, designed, implemented, and operated smart grid will:

1. **Optimize asset utilization and operating efficiency**
2. **Accommodate all generation and storage options**
3. **Provide power quality for the range of needs in a digital economy**
4. **Anticipate and respond to system disturbances in a self-healing manner**
5. **Operate resiliently against physical and cyber attack and natural disasters**
6. Enable active participation by consumers
7. Enable new products, services, and markets

Sample U.S. SG Programs

## Sempra

OpEx 20/20 reinvents key systems (GIS, OMS, DMS, CBM, customer), and processes (work management, dispatch). Also drives new initiatives (PHEV, meter automation, SG design, advanced conductor R&D)

## Oncor

Advanced metering with a comprehensive consumer education program and in home displays. Also installing world's largest cluster of Static Var Compensators (SVCs) to provide high-speed voltage support and increased transmission capacity and efficiency, enabling generation options

## AEP

gridSMART is a strategic initiative to address environment concerns, aging workforce, customer service and programs, and operational effectiveness. A three model city program will demonstrate viability of smart grid and AMI technologies, build regulatory and consumer acceptance an confidence, verify the cost-benefit model, and establish a foundation for integrating technologies.



ABB

# What drives the introduction of smart grids?

Increasing electricity consumption

Environmental concerns - Reduction of $CO_2$

Security of energy supply
Reduced dependency on fossil fuels from sensitive regions

Reliability of electricity supply

- Aging infrastructure
- Aging workforce
- IT security

Growing share of renewable power generation

Wind will grow from 111TWh in 2005 to 1'300-1'800TWh in 2030

Solar will grow from 3TWh in 2005 to 160-350TWh in 2030

Energy efficiency

T&D losses – target reduction of 2% in 2020 (EU)

Significant shares of the renewable power will be distributed and intermittent

Open energy market

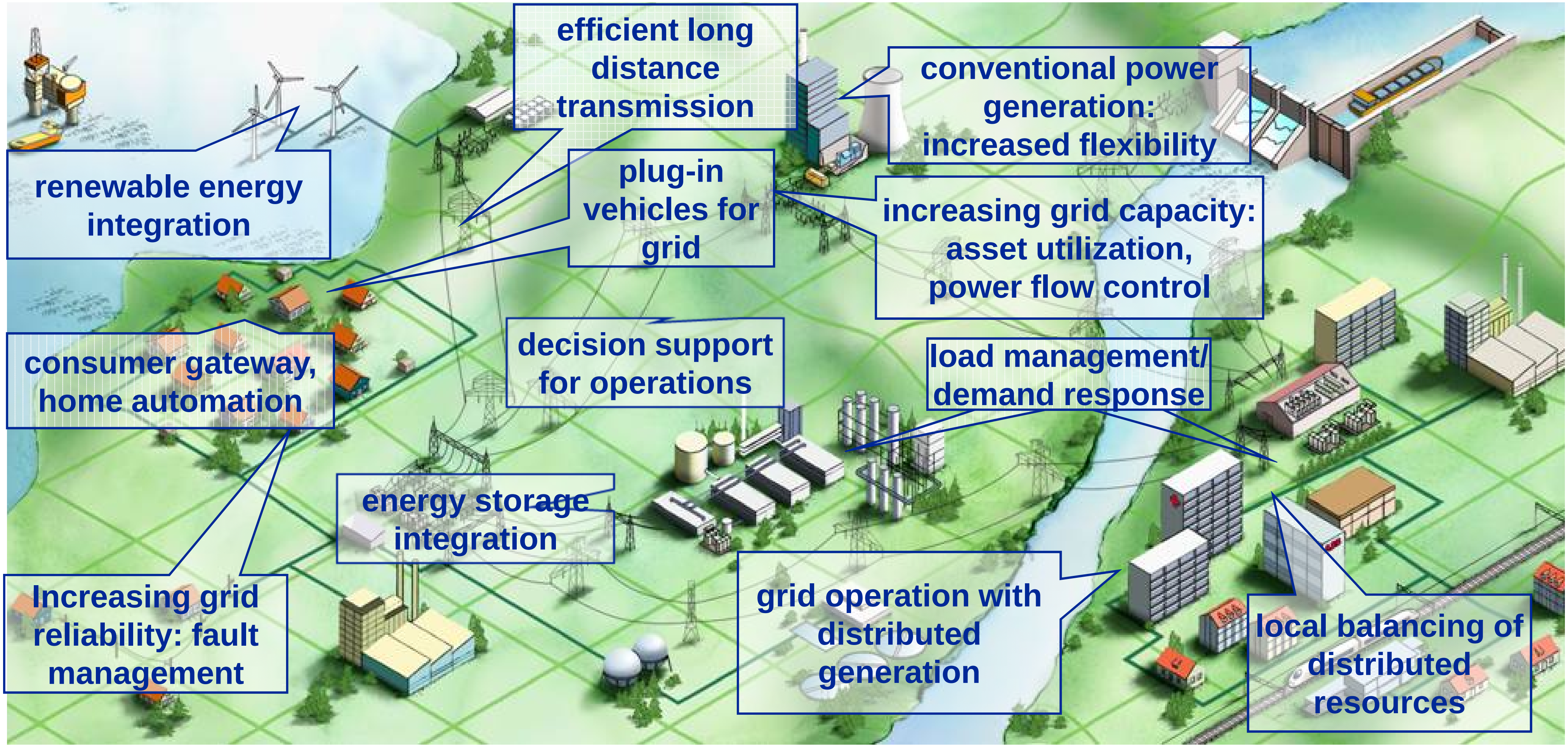
Consumer pricing to foster Demand response

Impact on grid stability and efficiency

## Introduction of Smart Grids

- Information & control technologies to achieve required stability
- Requires regulatory support (only exceptional business cases) and development of standards

# Smart Grid includes applications supporting the whole electricity supply chain



# Impact of smart grids – main challenges

## General

- **Efficient operation** in line with new and changing regulatory framework
- **Reliable power system** with both centralized and decentralized generation
- Increased **integration** with maintained security
- **Energy efficiency** with improved power quality
- Manage **consumer choice** and increased service requirements
- Improve **asset utilization** with aging infrastructure
- Maintain **system integrity** with aging workforce

***Smart Grids technologies needed to handle these challenges!***

## Generation

- Optimize ‘spinning reserves’ with increased amount of renewable energy and demand response

## Transmission grids

- Maintain grid stability with increased amount of renewables
- Reduce transmission losses

## Distribution grids

- Maintain protection system integrity with increased amount of distributed renewable energy
- Demand response (regulatory demand) - Real time price information

## Consumers

- Demand Management
- Optimize electricity consumption – home automation

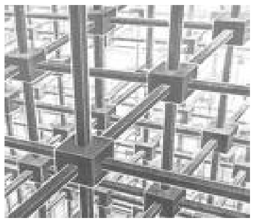
# Smart Grid Maturity Model – Levels, Descriptions and Results

**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***

***An evolution through a phased-in approach***




ABB

# The Smart Grid Will Provide Opportunity for the Utility to Achieve Their Key Business Strategic Goals

- ↑ Optimize CAPEX Spend
- ↑ Optimize OPEX Spend
- ↑ Improve Reliability
- ↑ Improve Operating Efficiency
- ↓ Reduce Operating Risk
- ↑ Improve Security & Compliance
- ↑ Improve Customer Satisfaction
- ↑ Increase Shareholder Value

# Smart Grid Value

- **System Reliability**
  - Maximize customer service quality
  - Maximize grid reliability
- **Operational Efficiency**
  - Minimize distribution system line losses
  - Maximize network performance
  - Optimize resources, time and repair actions
- **Asset Utilization**
  - Minimize risk of failures
  - Deferred capital spending
  - Prioritize equipment and facility for repairs
- **Generation Flexibility**
  - Renewables
  - Energy storage
  - Demand response
  - Distributed generation
  - Transmission technologies