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Energy issues across the energy sector

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Discussion

- Aging infrastructure and talent in utilities
- Digital revolution
- National imperatives: climate & economic growth
- Renewed vigor by feds and utilities
- Changing paradigm: consumers and renewables
- Grid Modernization
- Gaps that remain in technology

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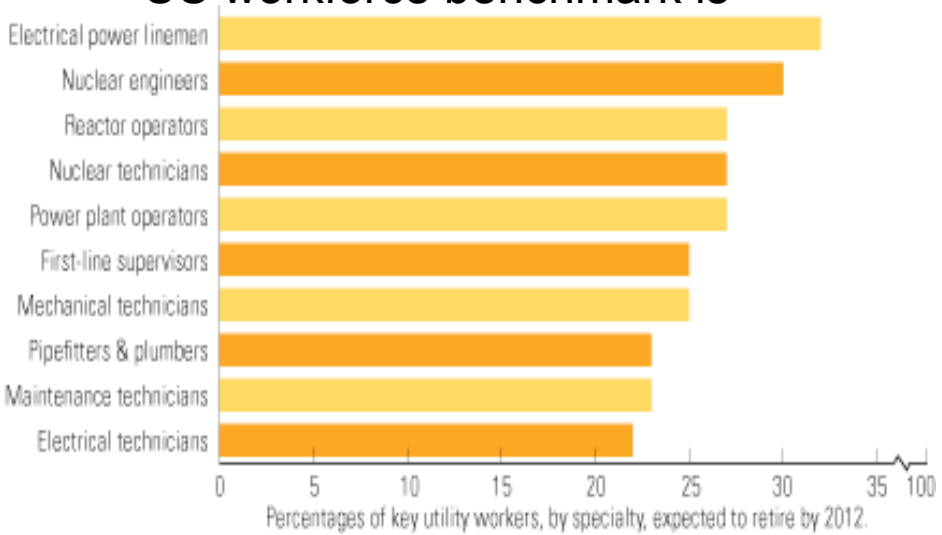
Aging infrastructure and talent in utilities

- Two decades of failing to build power plants and new transmission lines kept power prices artificially low.
- When it comes to energy pricing, the industry created a surreal environment.
- As our mistakes of the past come home to roost and create price shock on a fragile economy, we are correcting an errant course.
- The reality is we're catching up in big lumps.

- Three of our five economic sectors are exposed to above average levels of age and retirement risks. The historical US workforce benchmark for 55 and older was 15%. The current US workforce benchmark is



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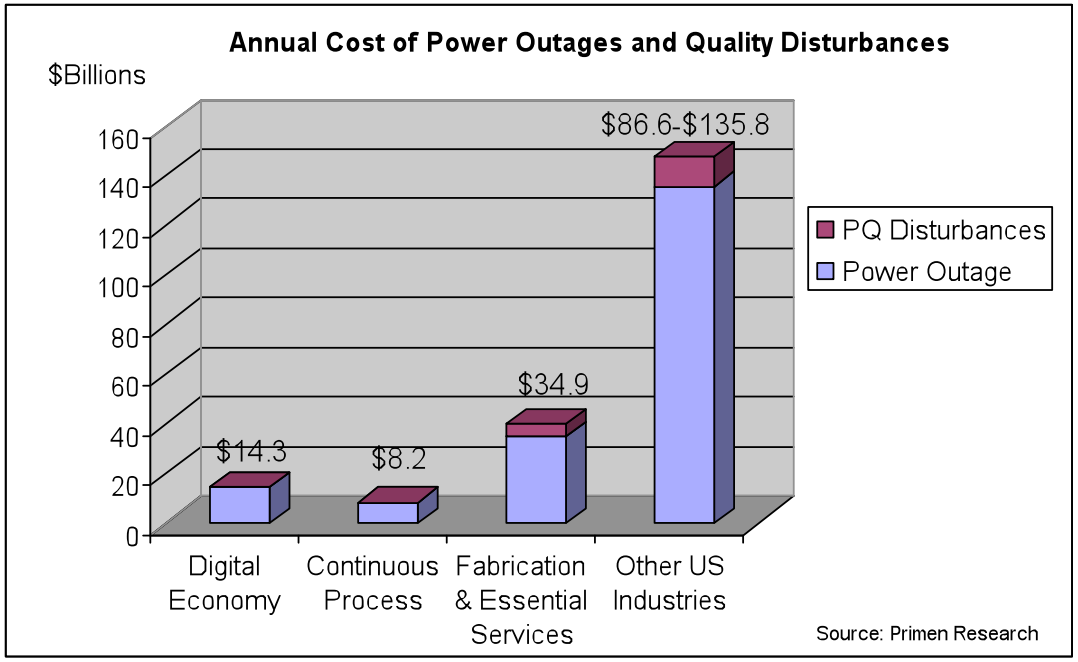
Digital revolution

- Power starts out as a smooth "sinusoidal" waveform. Moving from the generator to the customer's equipment, it can be affected by a variety of perturbations, causing:
  - Harmonics
  - Sags
  - Spikes
- Sources of power quality problems:
  - T&D disturbances
  - Modern electrical loads
- Sensitive electronic loads represent an increasing portion of the total power system load
- Power quality will be of growing importance in the 21st century
- The stakes are high--power-related problems may cost U.S. companies more than $100 billion a year



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National imperatives: climate & economic growth

Renewable and clean energy

Vehicle to Grid

- Electric Vehicles
- Plug-in hybrid Electric Vehicles

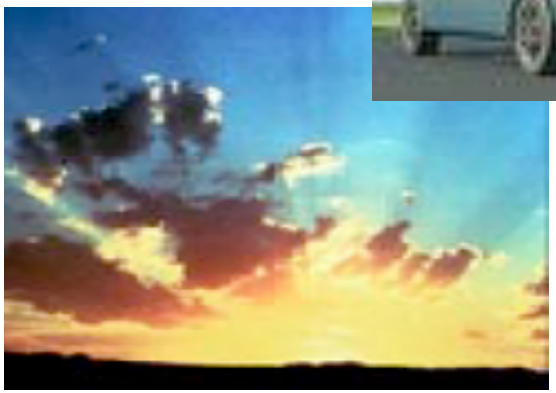
Reduce spinning reserves

Alternative energy supplies

- Reduces dependence on foreign oil

Customer choice

- Photovoltaics



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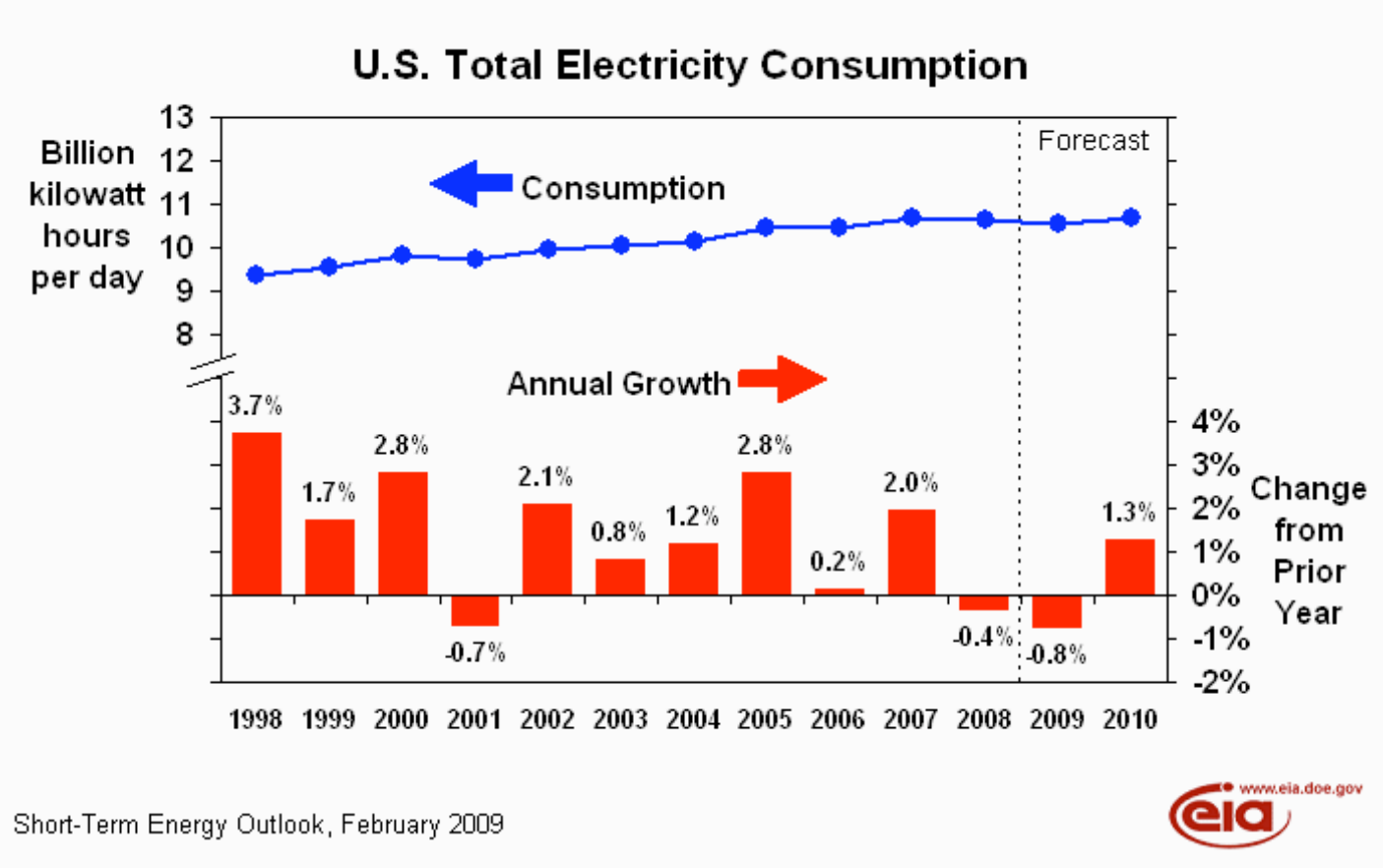
Energy Demand Growth

Total electricity sales are projected to continue to increase.
Electricity sales are strongly affected by the rate of economic growth.

DOE Report,

February 2009



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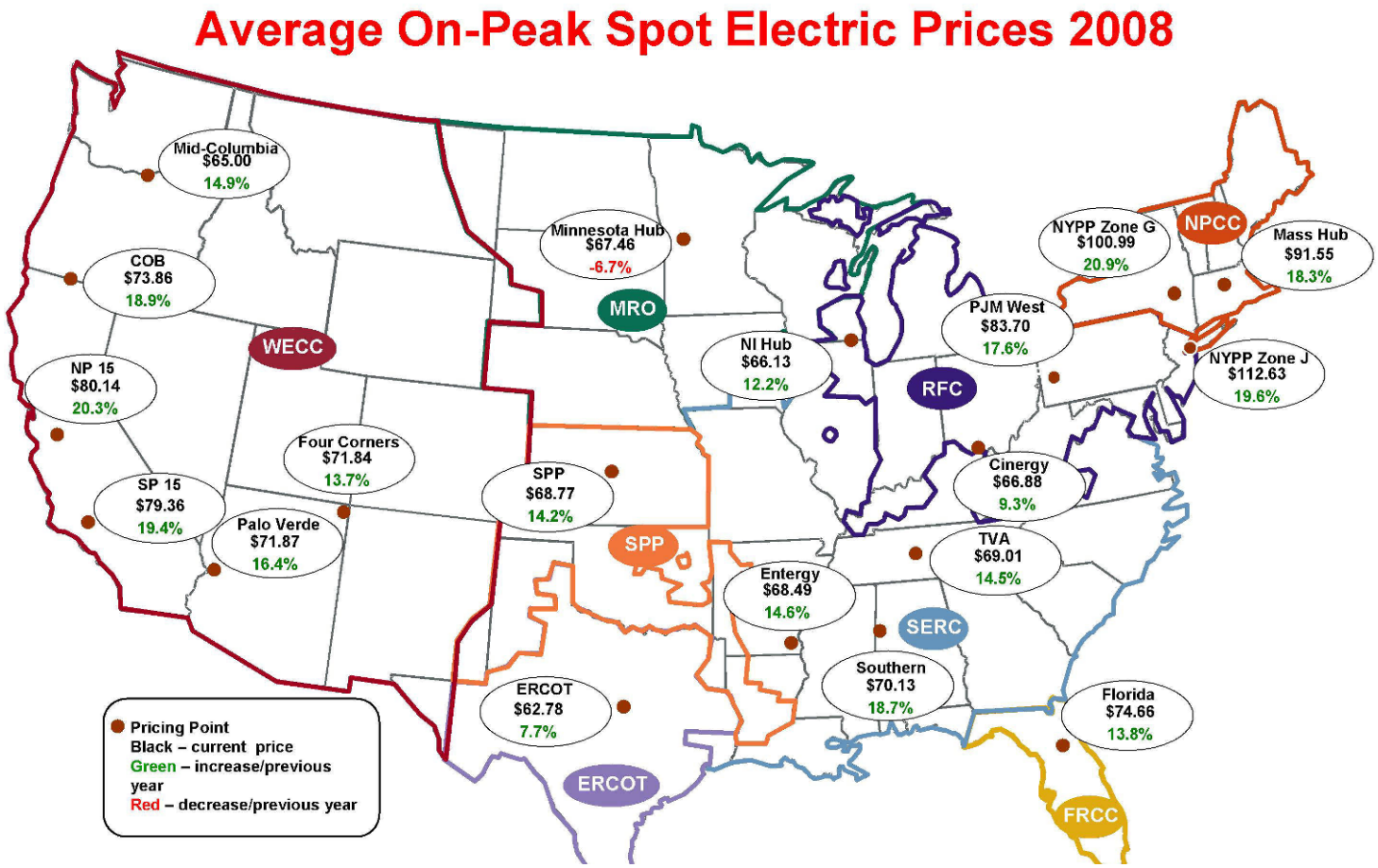
Energy Prices



Electricity prices are a straightforward signal of anticipated price pressures between last year an this year. The map illustrates recent key summer 2008 electricity prices. In almost all, markets are signaling double-digit electricity price increases this summer over last.

- *FERC 2009 Market Oversight*

Renewed vigor by feds and utilities

Environment

- Green House Gas
- Energy Independence
- Economic Recovery

Legislation

- EPACT 2005
- EISA 2007
- EESA 2008
- ARRA 2009

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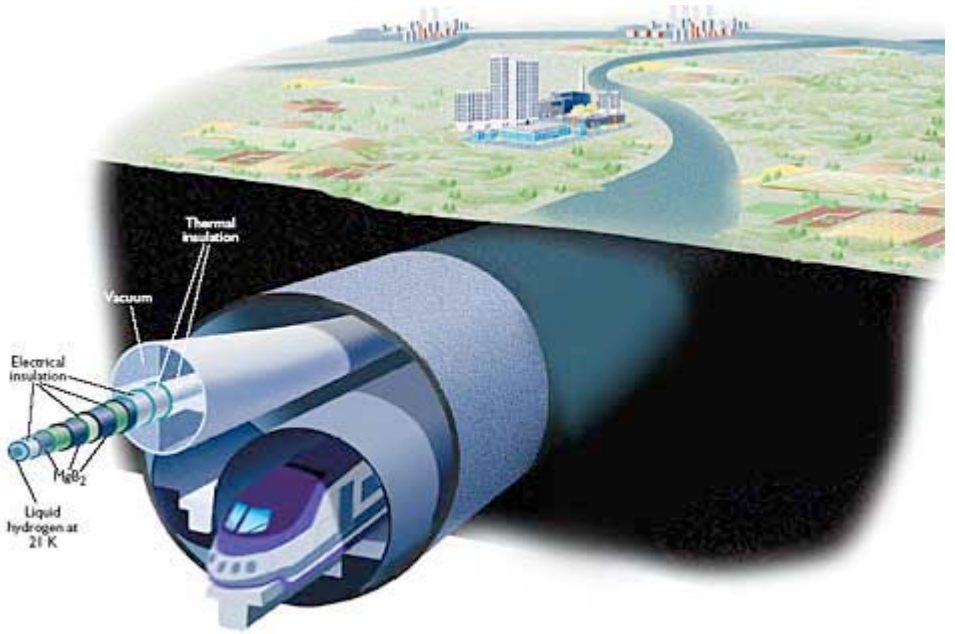
Vision

Electric grid evolves

- Ubiquitous communications backbone
- Operational technologies
- Information technologies



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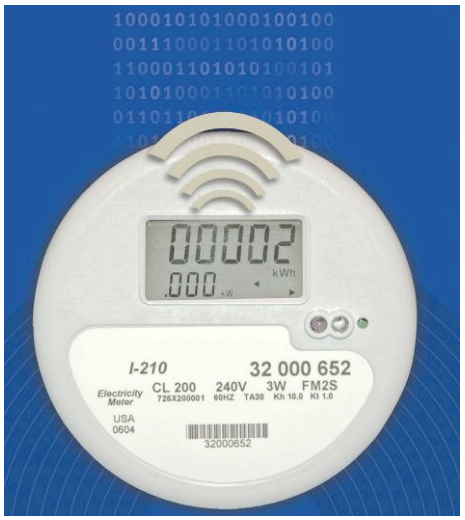
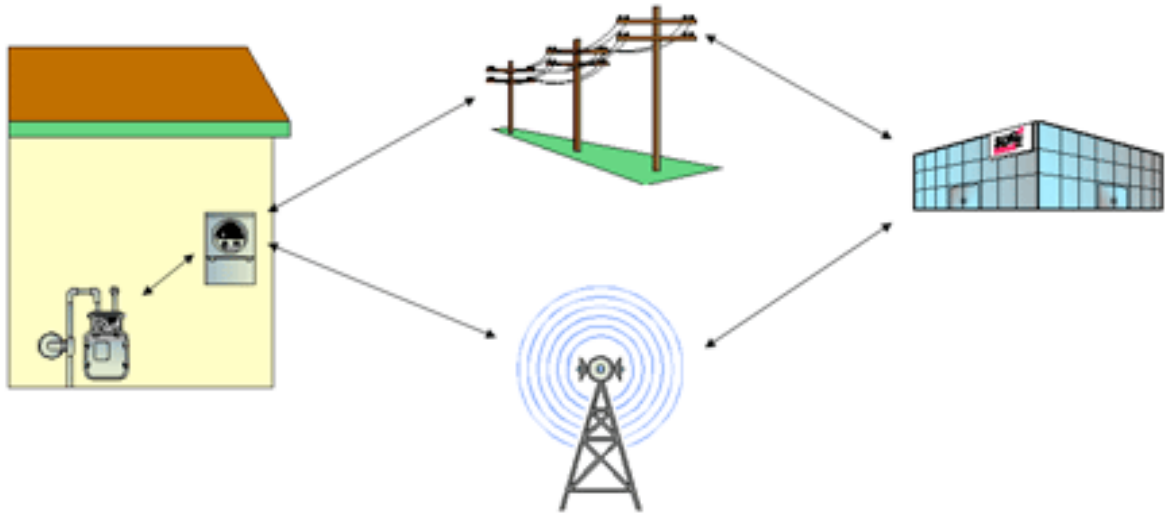
Advanced Metering Infrastructure (Smart Meters)



- Advanced Metering Infrastructure – replacing mechanical meters with solid state interval meter/hourly meter reads.

- Provides customer control of energy use, potentially lower bills and improved outage management.



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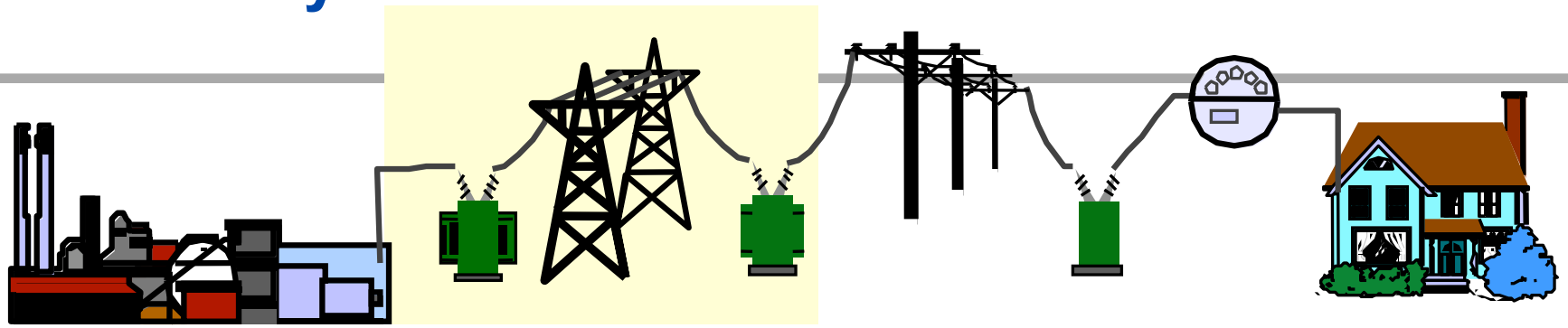
Electric System Overview



Generation

- Electric Restructuring required utilities to divest over 20,000 MW previously subject to CPUC oversight (utilities retained nuclear and hydro).
- Utilities are beginning to own new generation again – e.g., SCE: Mountainview; SDG&E: Palomar Energy Center (550 MW) and 45 MW Miramar peaking plant
- Utilities purchase remaining supply needs on short and long-term basis.

Transmission

- Utilities own and maintain
- Under control of California Independent System Operator (ISO)
- Ratemaking and regulation by FERC
- Siting by CPUC if utility-owned; otherwise by local agencies.
- Many munis operate transmission separately from ISO

Distribution

- Utilities own and operate
- Subject to CPUC regulation
- Delivery to end users

Retail Customers

- Utilities provide delivery service
- Multiple retail suppliers subject to different rules, oversight, responsibilities, and costs.
  - Investor-owned utilities
  - Municipal utilities
  - Direct access providers
  - Community Choice Aggregators

Projects

San Diego Gas & Electric - Smart Meters, Smart Grid, Smart Home, Business Transformation

Duke Energy - Utility of the Future

Southern California Edison - Distribution Automation

Olympic Peninsula, Pacific Northwest National Labs, IBM – Intelligent Devices

CenterPoint and Manhattan – BPL

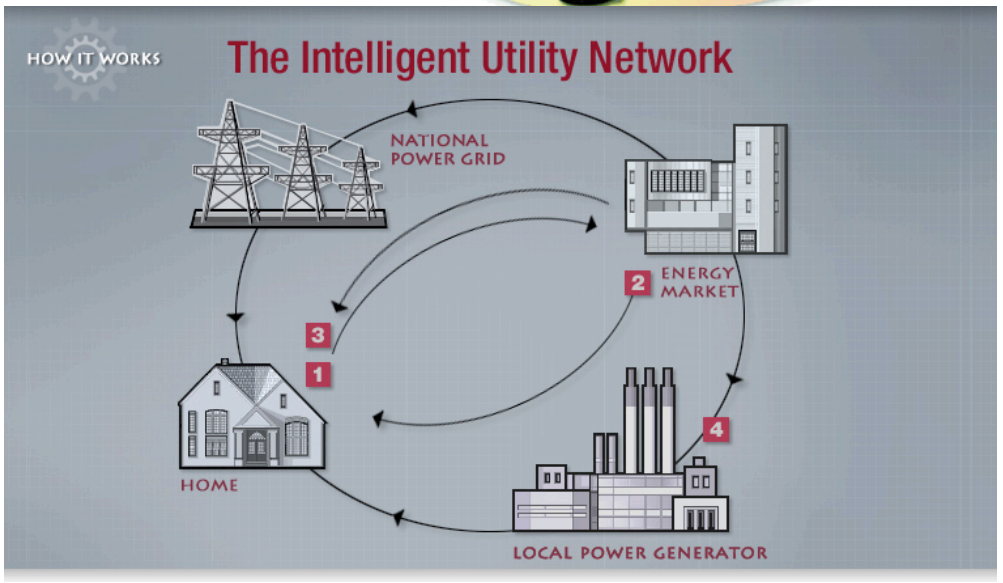
TXU – Asset Optimization

PJM – 15 year Development Plan

IBM – Intelligent Utility Network

Smart Meter Deployments

- Ontario
- PG&E
- SCE
- SDG&E
- Hydro One
- TXU
- CenterPoint
- Many more…



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Changing paradigm: consumers and renewables

DR Benefits

- NY ISO has measured benefit ratios exceeding 5:1 with their emergency Demand Response (DR) program.
- PJM has stated that 20,000 MW of its load is served only 1 % of the time. There is huge value of shifting this load to lower use periods.
- ISO New England has shown that DR programs can be very responsive, reaching committed reduction levels in less than 30 minutes.
- Increased investments in energy efficiency will be a longer term benefit.
- Various Critical Peak Pricing programs have shown peak load reductions of from 35% to over 40%.

Technologies and Features

- Advanced metering and communications allowing consumer interaction with grid operations
- New pricing regimens enabling consumer choice and planning
- Grid friendly appliances that can be centrally coordinated
- Proactive power outage management and consumer interaction
- Possible non-utility added-value functions (ISP, home security, etc)
- Enhanced information for grid operations and planning

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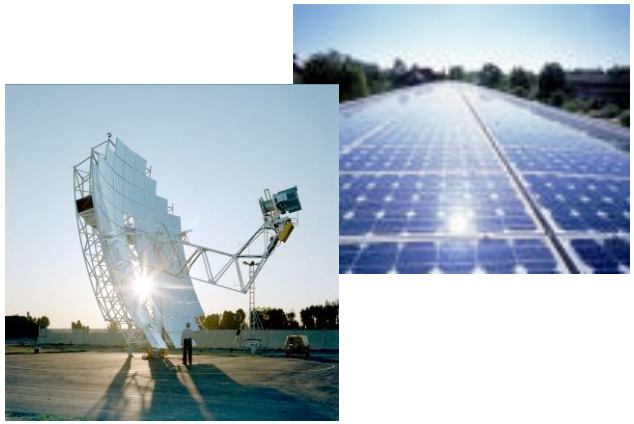
Renewable Energy & Local Power Plants

Renewable energy is being added today to meet 20 % mandate by 2010.

Includes wind, biomass and biogas.

Access to cost-effective wind and geothermal requires transmission upgrades.



SDG&E new generation added to meet local reliability.

- 45 MW peaker plant at Miramar (on line)
- 550 MW Palomar power plant in Escondido (on line)
- 560 MW Calpine power plant in Otay Mesa (2009)

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Grid Modernization

Key Characteristics

Self-healing
- A grid able to rapidly detect, analyze, respond and restore from perturbations.

Empower and incorporate the consumer
- The ability to incorporate consumer equipment and behavior in the design and operation of the grid.

Tolerant of attack
- A grid that mitigates and stands resilient to physical and cyber security attacks.

Provides power quality needed by 21st century users
- A grid that provides a quality of power consistent with consumer and industry needs.

Accommodates a wide variety of generation options
- A grid that accommodates a wide variety of local and regional generation technologies (including green power).

Fully enables maturing electricity markets
- Allows competitive markets for those who want them.

Optimizes assets
- A grid that uses IT and monitoring to continually optimize its capital assets while minimizing operations and maintenance costs.

Technologies

Grid-wide integrated communications

- Internet for the power grid

Sensing, metering, measurement

- Digital two-way communication devices
- Enable generation connect and disconnect
- Enhance operator information

Advanced control capabilities

- Computer based grid monitoring
- Enables dispatch of distributed resource

Advance grid components

- Energy storage
- Distributed generation

Decision Support

- Analytics to guide grid operators
- Semi-autonomous agent software

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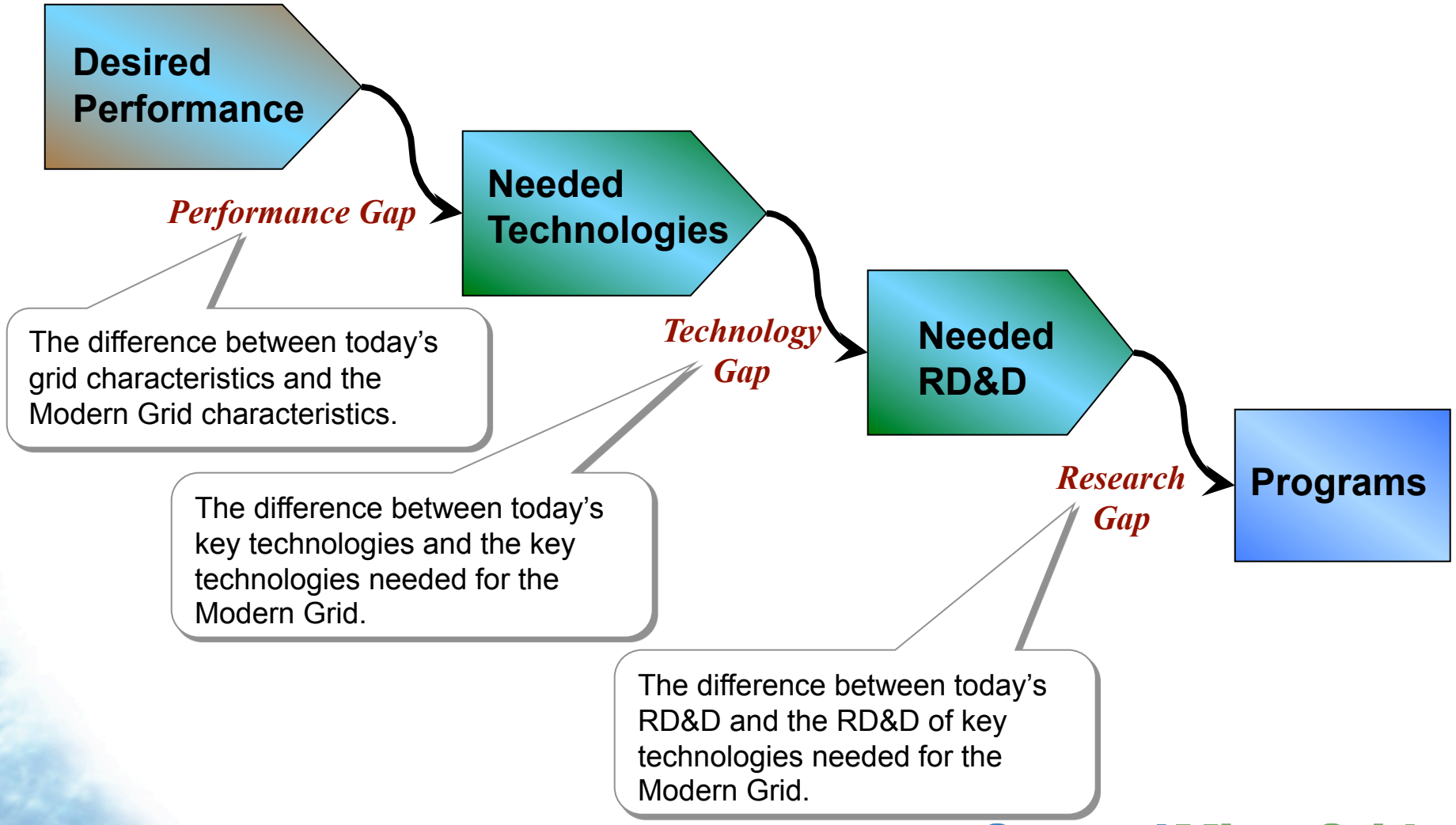
Characteristics and Key Technologies

● = high influence ◒ = medium influence ○ = low influence

Characteristic → / Mutual Influence ↓ To Key Technology	Self Healing	Empowers Consumer	Attack Tolerant	Power Quality	Generation Options	Enables Energy Markets	Asset Optimization
Integrated Communications	●	●	●	◒	●	●	●
Digital Power System	●	●	●	◒	◒	●	●
Automated Distribution	●	○	●	●	◒	○	●
Transformed Metering	●	●	○	●	◒	●	●
Integrated DER	●	◒	●	●	●	●	◒
Enhanced Efficiency	◒	◒	○	○	●	○	◒

Addressing Key Technology Gaps



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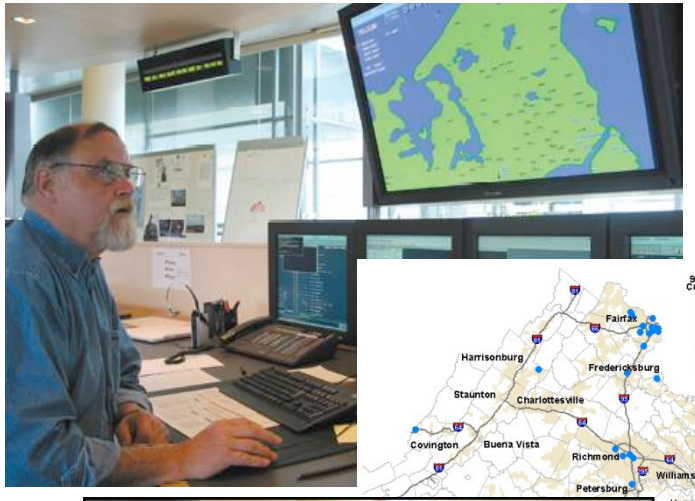
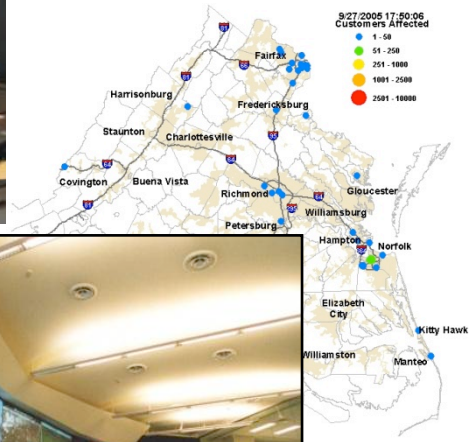
Gaps that remain in technology

Modernized utility

- Advanced communication
- Self healing distribution system
- Lots of sensors
- Automated control
- System Architecture
- Broadband where needed
- Multiple levels of control
- Sees into the customer's systems





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Characteristics

- Low Power technology
- Standards-based hardware adapted to fit the problem resulting in lower overall cost
- Wireless infrastructure for monitoring and control
- Service architecture with three layers – Edgeware, Middleware and Centralware
- Open architecture for easy integration
- Plug-and-Play approach to the network installation.
- Reconfigurability – The capability of the technology to be reconfigurable allows OTA (over the air) upgrade of the firmware to be able to handle different and devices, applications, sensors, controllers, thermostats, etc.

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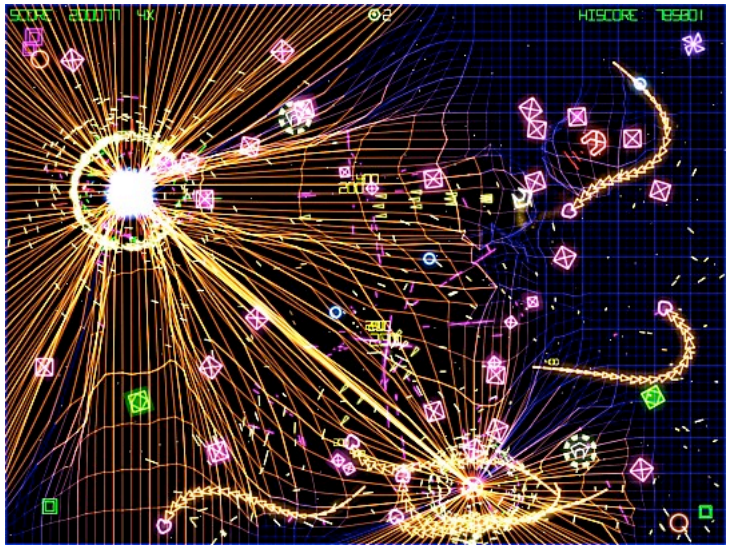
New Opportunities

Smart Grid

- Arbitrage distributed energy trading
- Motes, Sensors, Monitoring, Video
- Network Management
- System Integration – System of systems
- Distribution-side Management
- Outage and Management
- Cyber Security
- Geographic Information Systems
- Storage versus variable renewables



Smart Meter

- Digital Components
- Portals, Network Management, Installation Services
- Tracking, Geocoding, Quality Design Services
- Mesh Radios, Cellular WAN, Broadband
- Network Design, System Integration

Smart Home

- Channel partner offerings (i.e. media+home protection)
- Calculate Carbon Credits
- Remote and On-site Home Monitoring & Control

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