

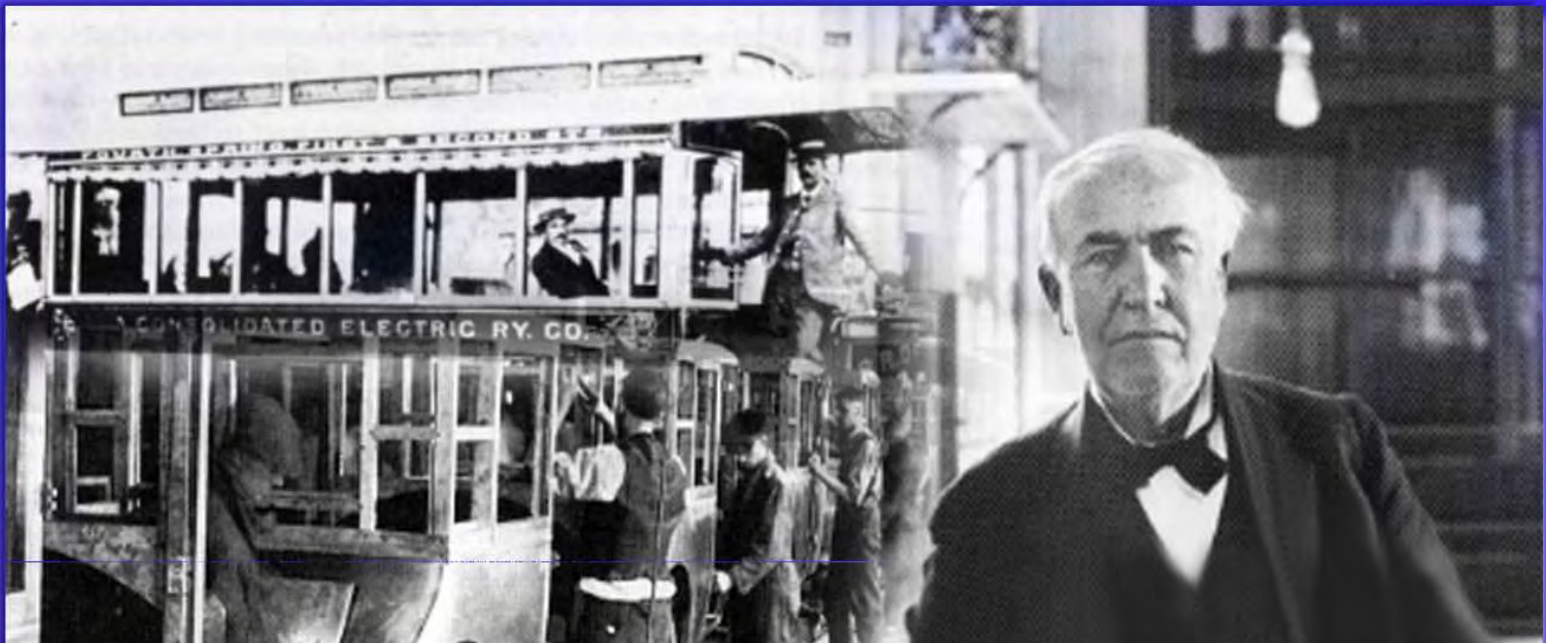
# **Transmission & Distribution 101**

**(With Apologies to Jeff Genzer)**

Presented at  
**NASEO**  
September 28, 2004

by  
Terry Surles, Vice President  
Electricity Innovation Institute

# Transforming Society

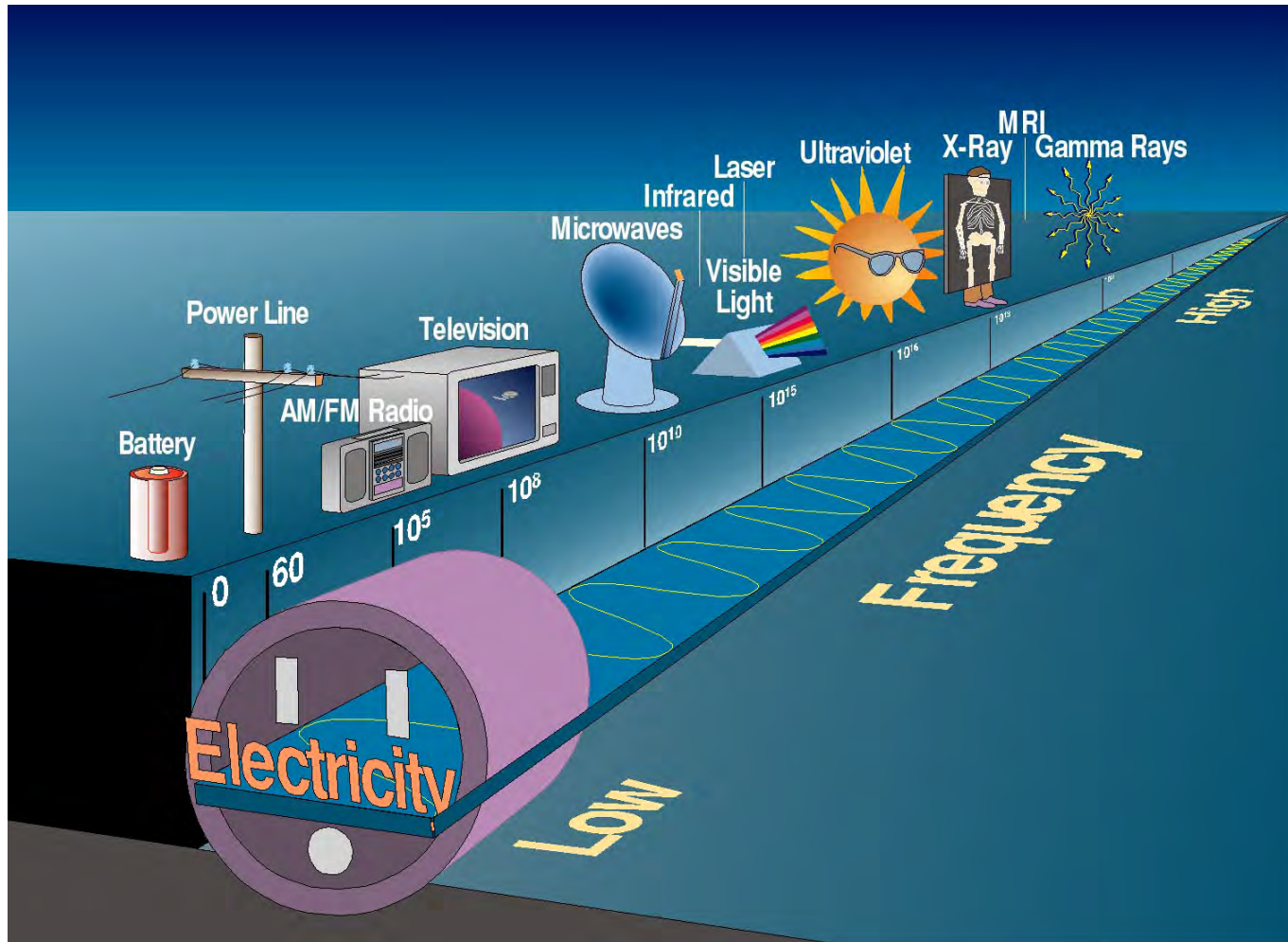


**The vast networks of electrification are  
the greatest engineering achievement of  
the 20th century**

**– U.S. National Academy of Engineering**



# Gateway to the Electromagnetic Spectrum



# Today's Infrastructure Is Inadequate

- 1900's design
  - 1950's technology
  - 21<sup>st</sup> Century end-users
- 
- Lack of capacity
  - Lack of quality/reliability
  - Lack of infrastructure security

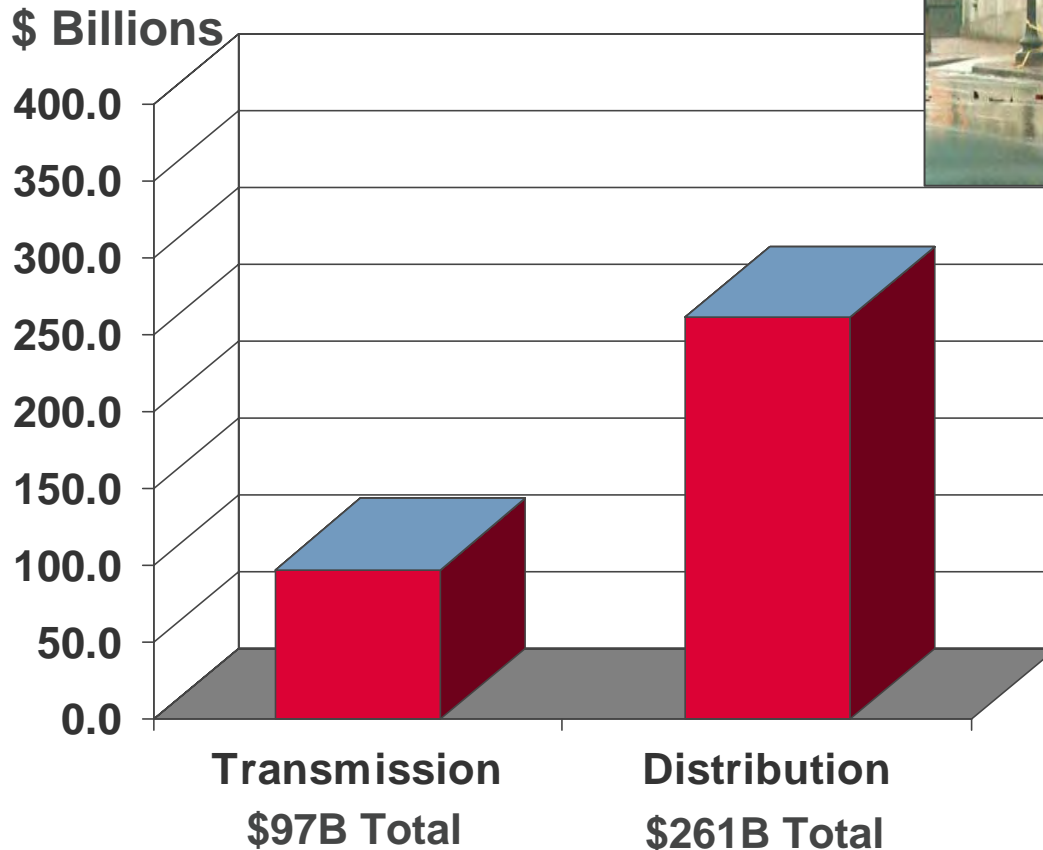
# Uncertainty Impedes Advances: System Owners Must Make Long-term Financial Commitments in an Uncertain Business Environment

- Ownership issues
- Regulation / deregulation
- Financial community wariness
- Environment / permitting issues

# T&D Plant



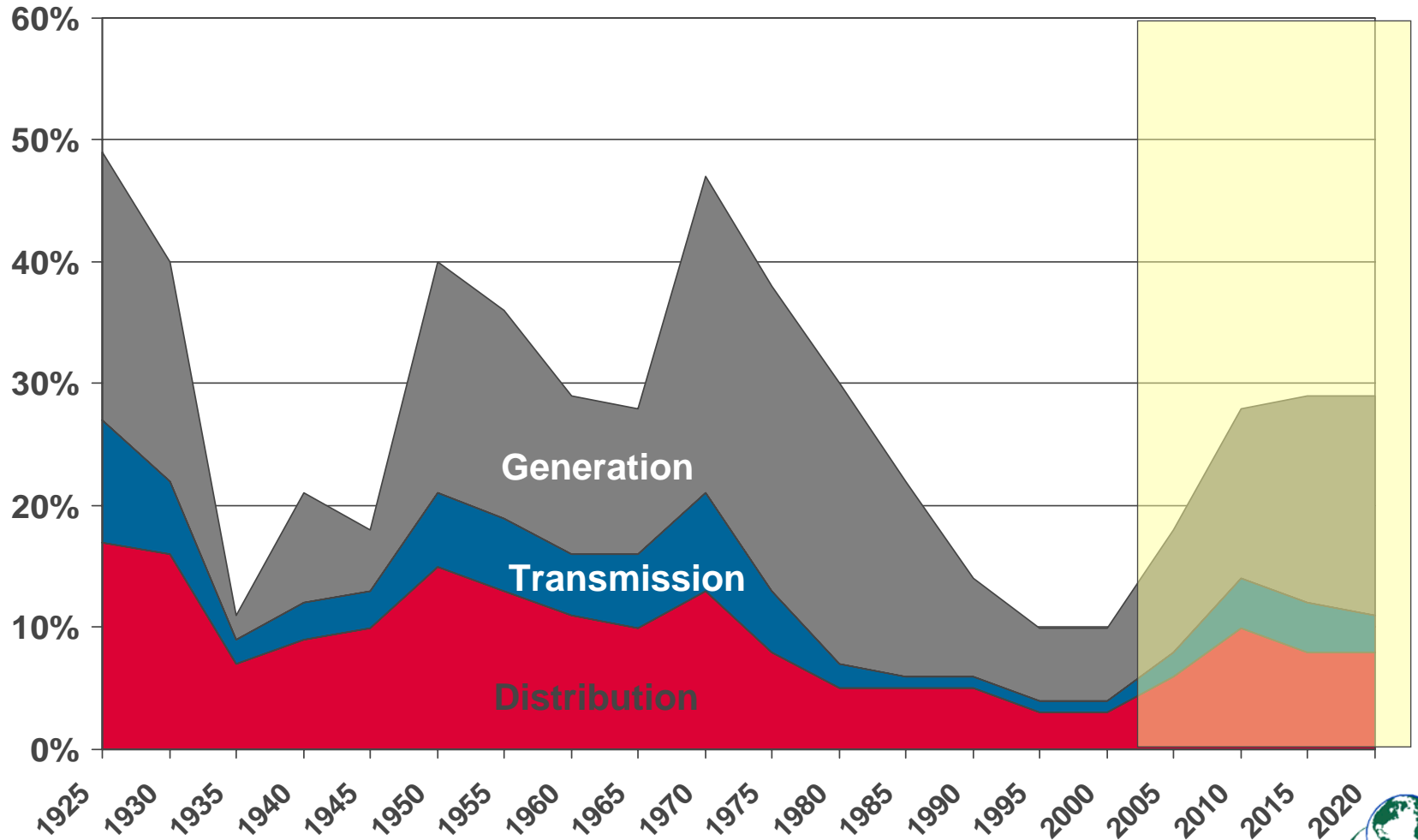
Copyright Washington Post



- 1950's technology
- Installed over the last 30–40 years
- Substantial upgrading required

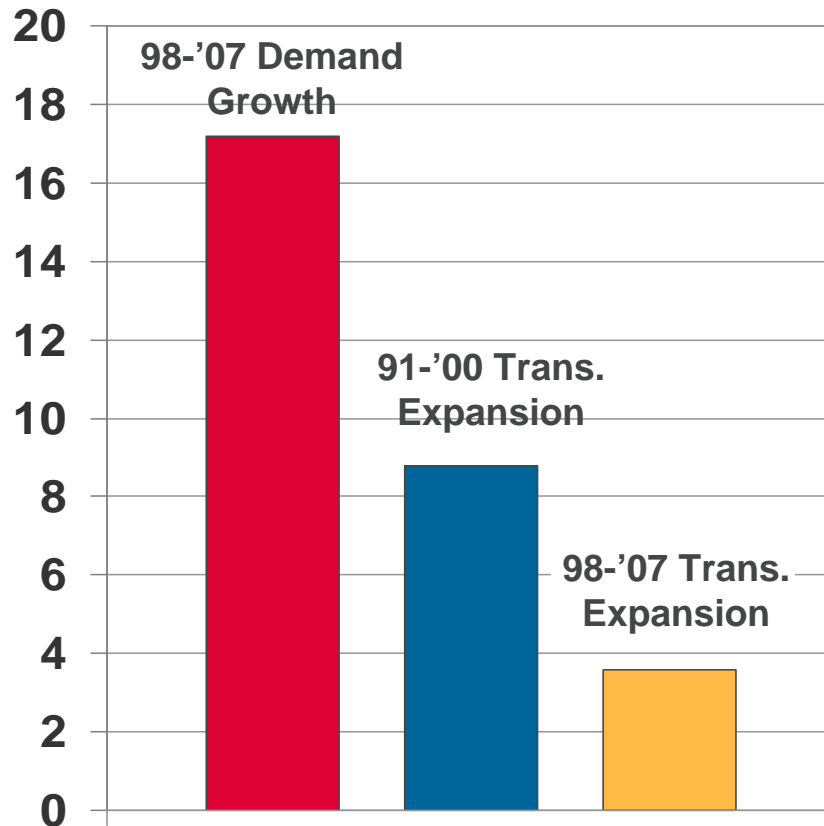


# Capital Invested as % of Electricity Revenues

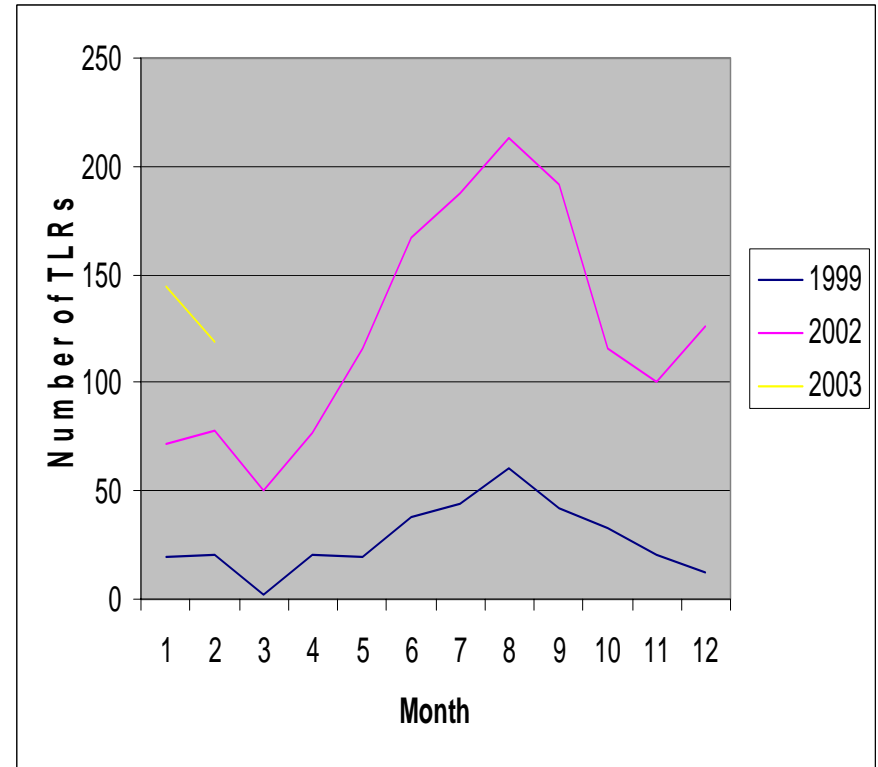


# Symptom: Inadequate Capacity

## Percent Change

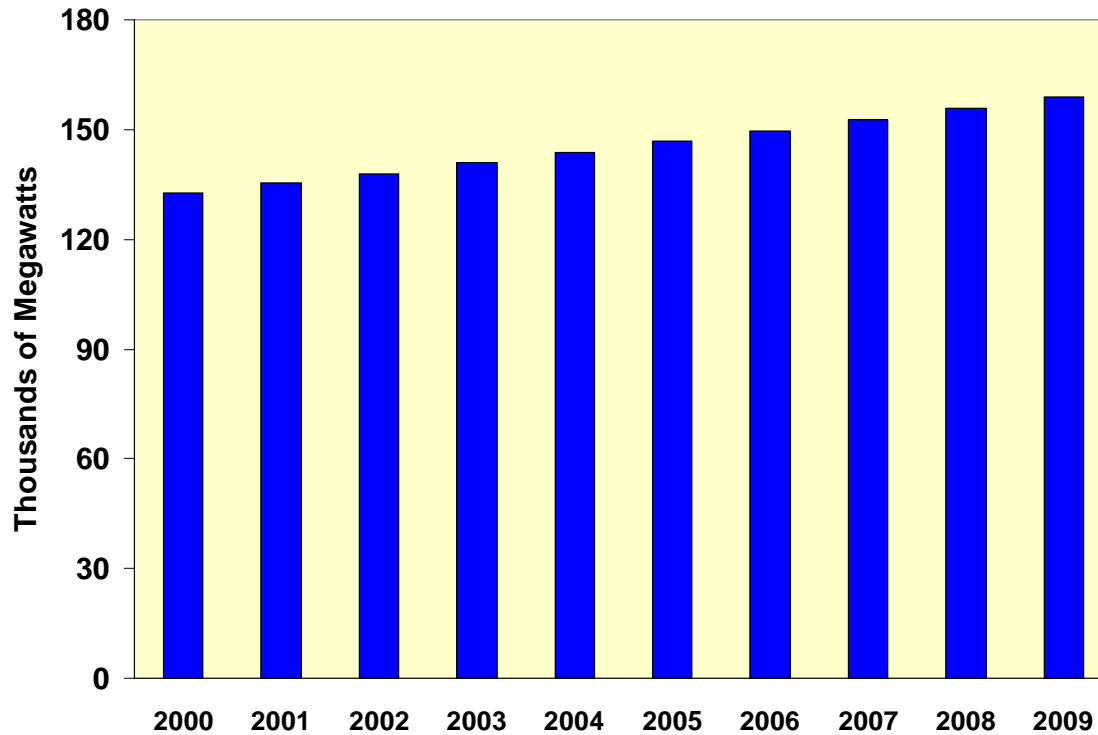


## Number of TLRs\*



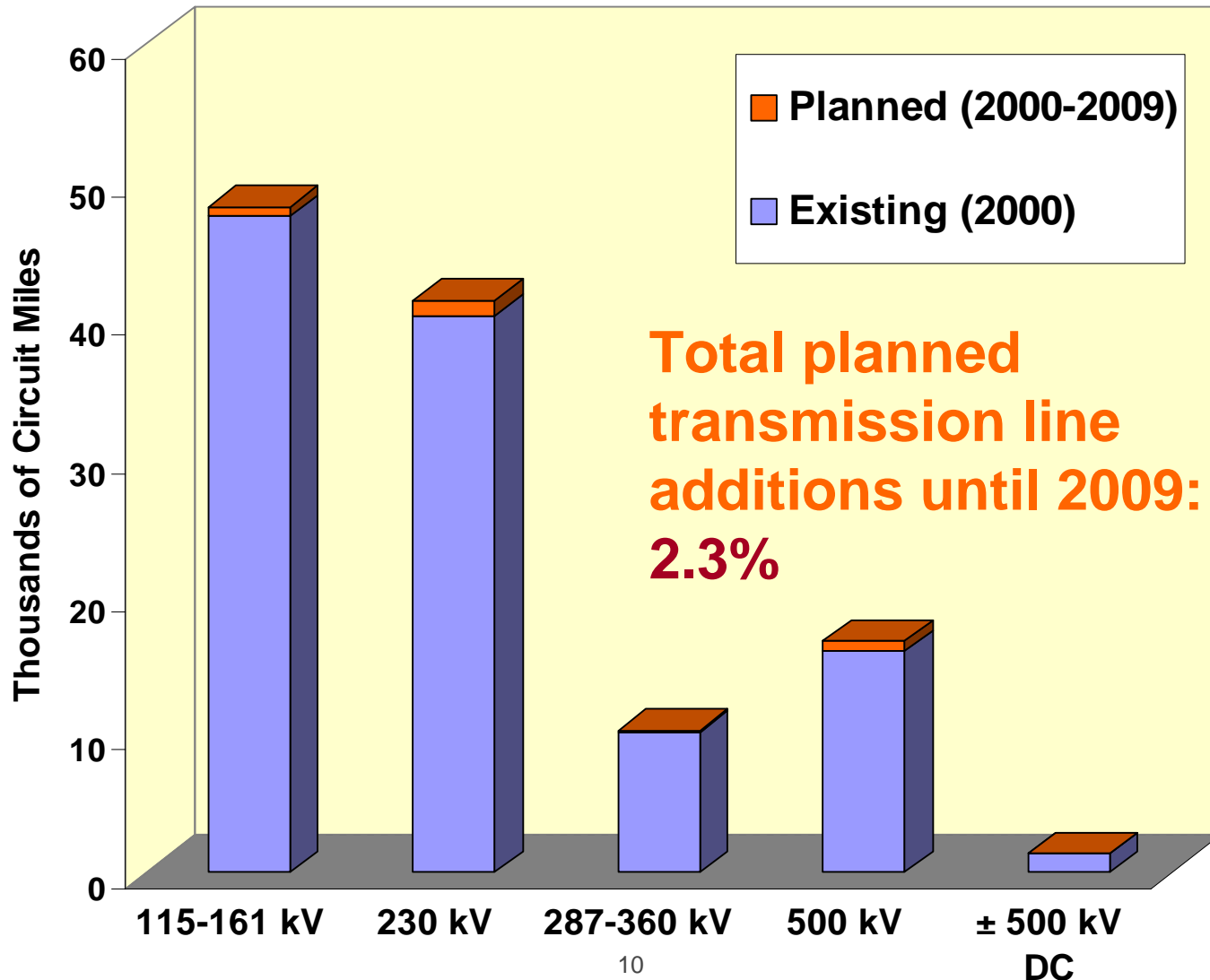
\*Calls for Level 2 or higher Transmission Relief

# WSCC Projected Peak Load Growth 2000 - 2009

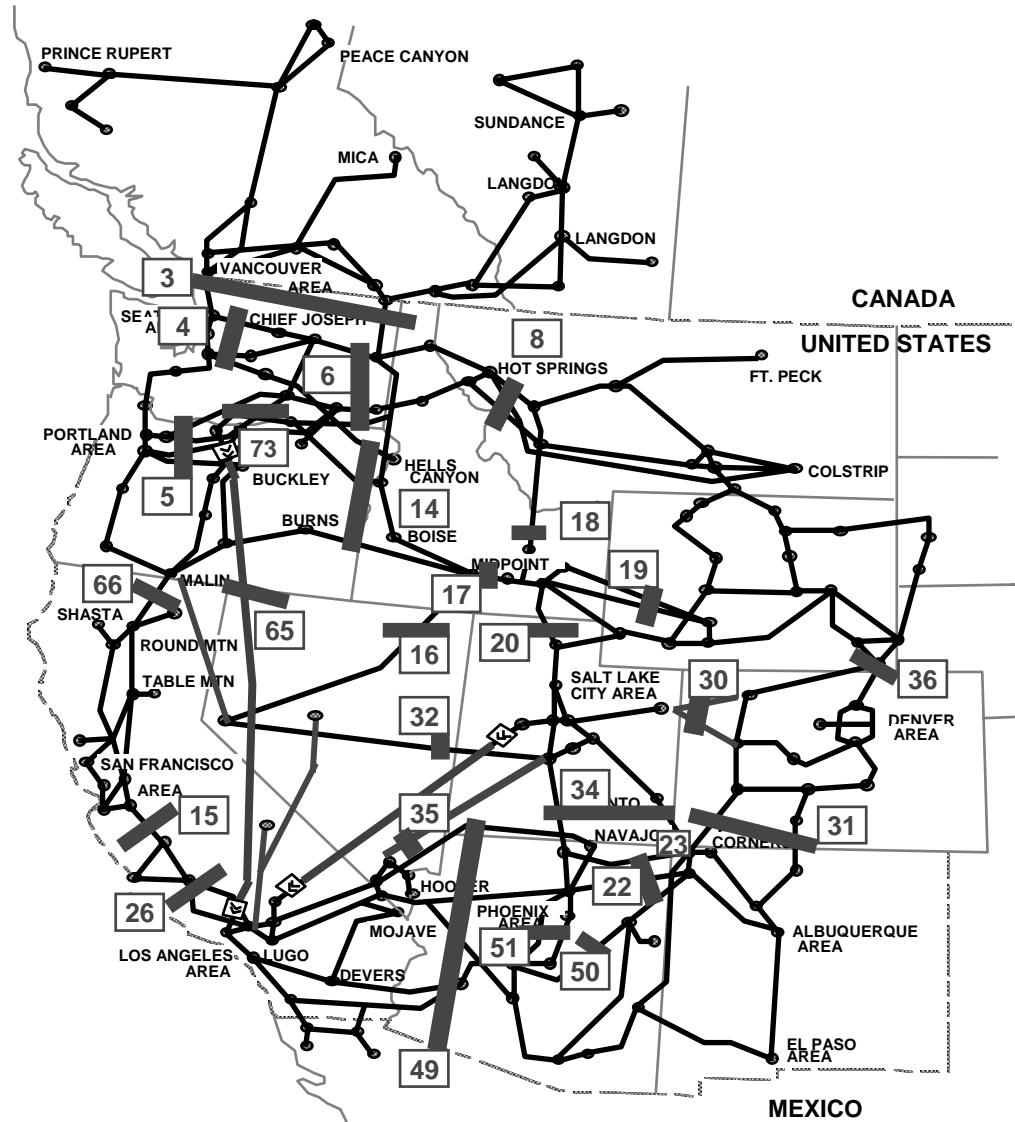


**Total expected  
peak load growth  
until 2009: 20%**

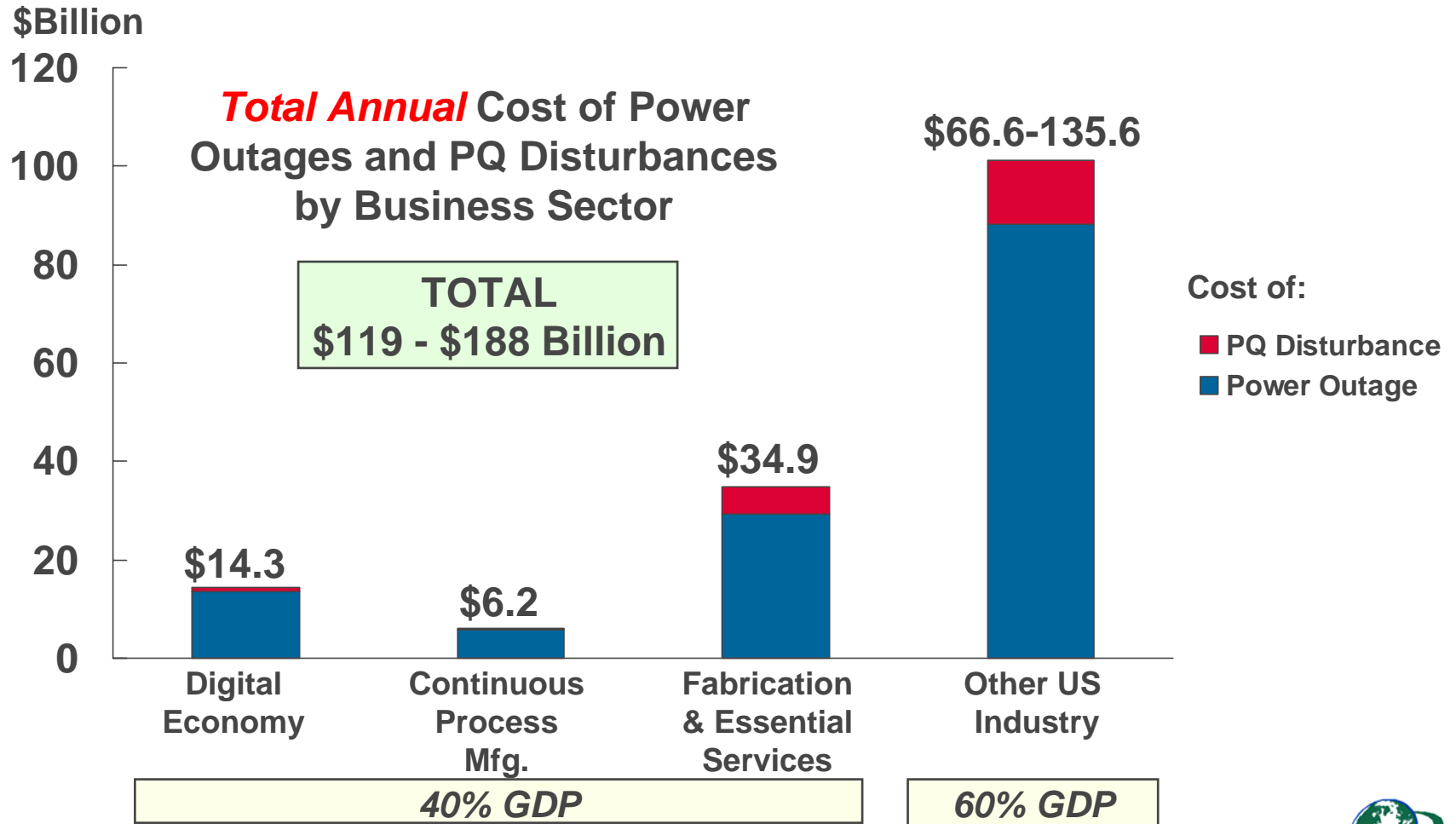
# WSCC Transmission (Existing/Planned)



# WSCC Transmission Constrained Paths



# A Toll Felt Throughout the U.S. Economy



Source: Primen Study: The Cost of Power Disturbances to Industrial & Digital Economy Companies

# We Need to Modernize the Grid to Address 21<sup>st</sup> Century Realities

- Increase system capacity
- Improve asset utilization
- Enable self-healing
- Relieve bottlenecks
- Address power quality needs of a digital society

# Increase System Capacity

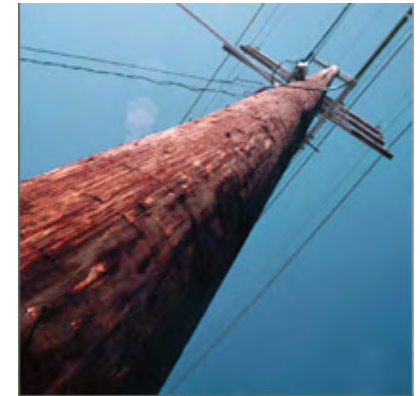
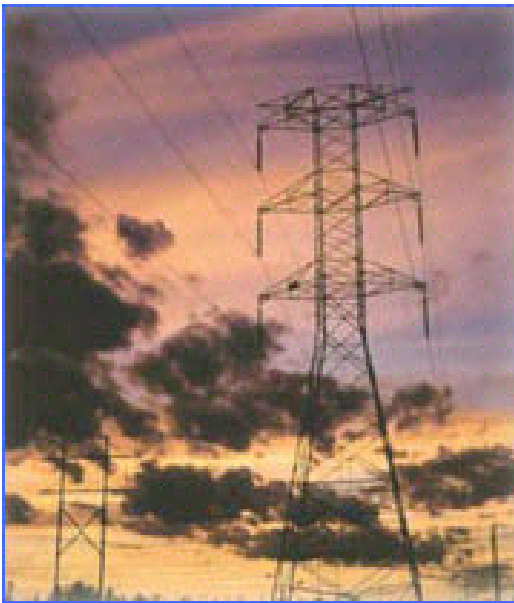


- Build more transmission circuits
- Substations and lines up standards
- Data infrastructure improvements
- Upgrade control centers
- Update protection schemes and relays

# Improve Asset Utilization



- New rights-of-way are limited by lack of power line corridors
- Enhance asset utilization through advanced power electronics



# Address Infrastructure Security



- Electric power systems are targets of terrorist attacks:
  - Physical
  - Cyber

# Enable Self-Healing Grid To Improve Reliability



- Adaptive islanding – development of microgrids
- Enable an integrated control architecture – need for standardization

# Relieve Bottlenecks

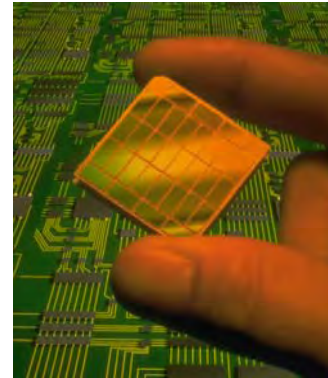
- Increase power flow
- Dynamic circuit operation
- Enhance voltage support
- Manage fault currents
- Utilize energy storage
- Develop demand response mechanisms



# Microprocessors: Harbingers of the 21<sup>st</sup> Century Digital Society



Increased Productivity



Improved Energy Efficiency



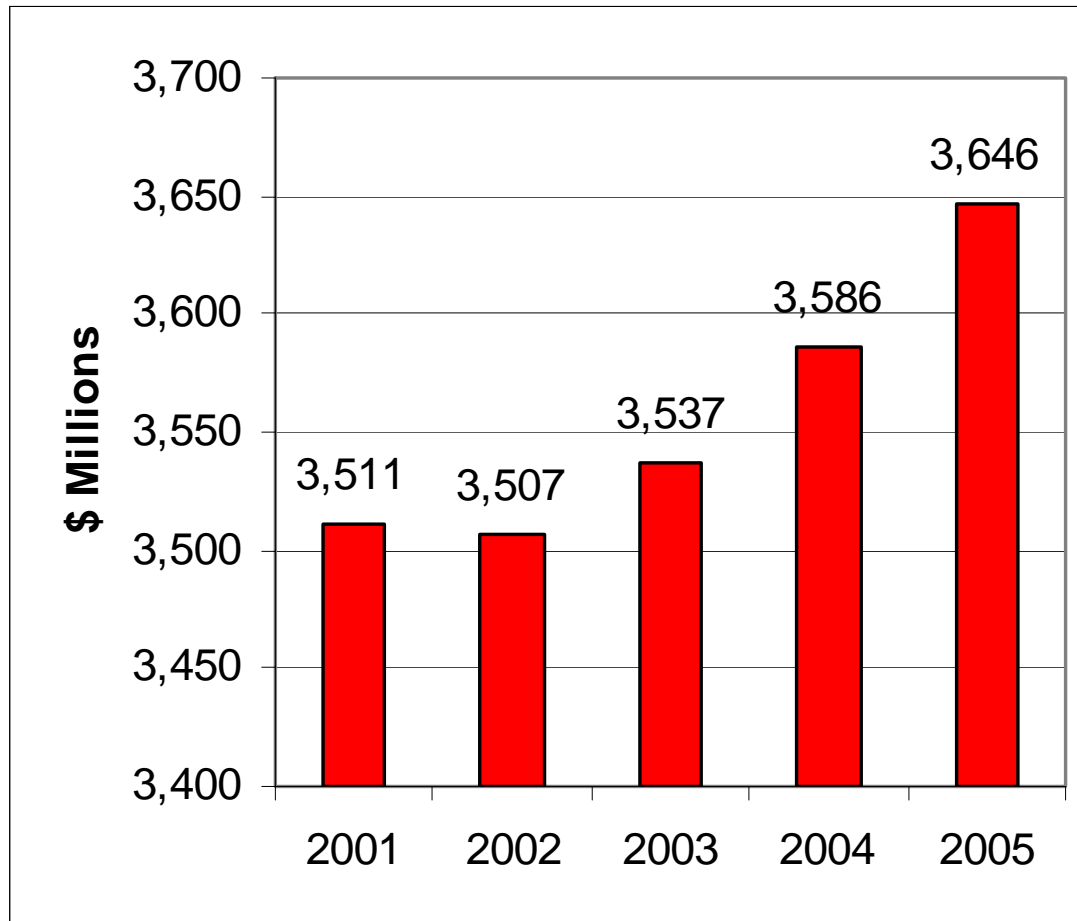
“Always On”

# Bring Exogenous Technologies into the Electricity System



- Sensors
- Communications
- Integrated Architecture
- Fast Simulation and Modeling
- Visualization

# Revenue from Telecom Equipment and Services Sold to Utilities



Source: UTC Research, 2002 [WWW.RESEARCH.UTC.ORG/STATS&DATA](http://WWW.RESEARCH.UTC.ORG/STATS&DATA)

# Manage The Power System by Widely Deploying Power Electronics Controls

- “Intelligent” transformers
- Power electronics-based controllers
- Fault current limiters



# Connect With Consumers



- Connect consumers to electricity markets
- Enable electricity – related services
- Provide consumers choices
  - Level of power quality
  - Demand response choices for real-time pricing

# What Are Roadblocks to Achieving Grid of the Future

- Standardization
- Connectivity
- Regulation
- Technology



# Envisioning the Future: Serving the Electricity System and Consumers' Needs for Tomorrow

