



A Bold Vision for Transmission and Distribution

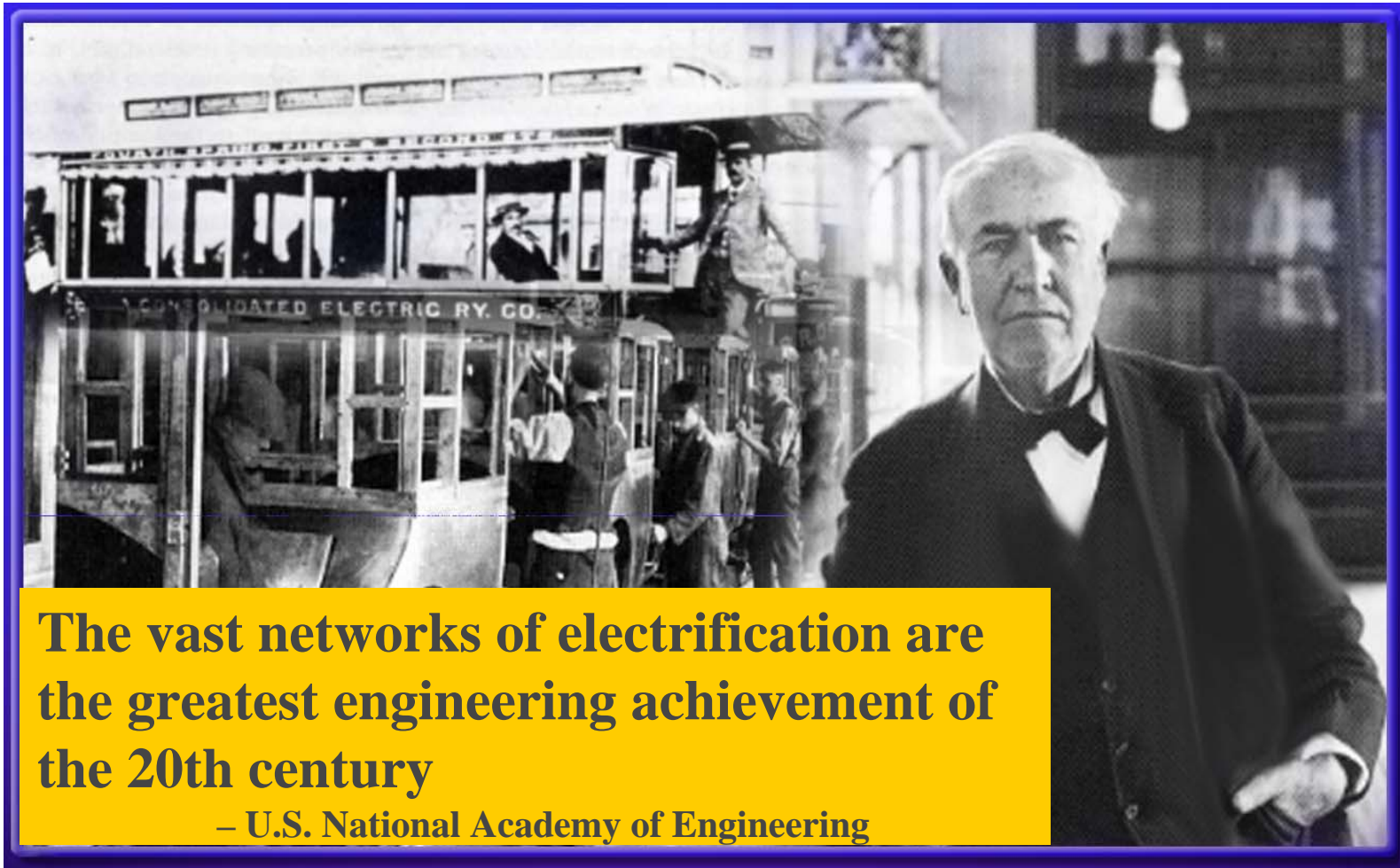
**Conference on Electricity
Transmission in Deregulated Markets**

Carnegie Mellon University

December 15, 2004

Kurt Yeager, EPRI

Transforming Society



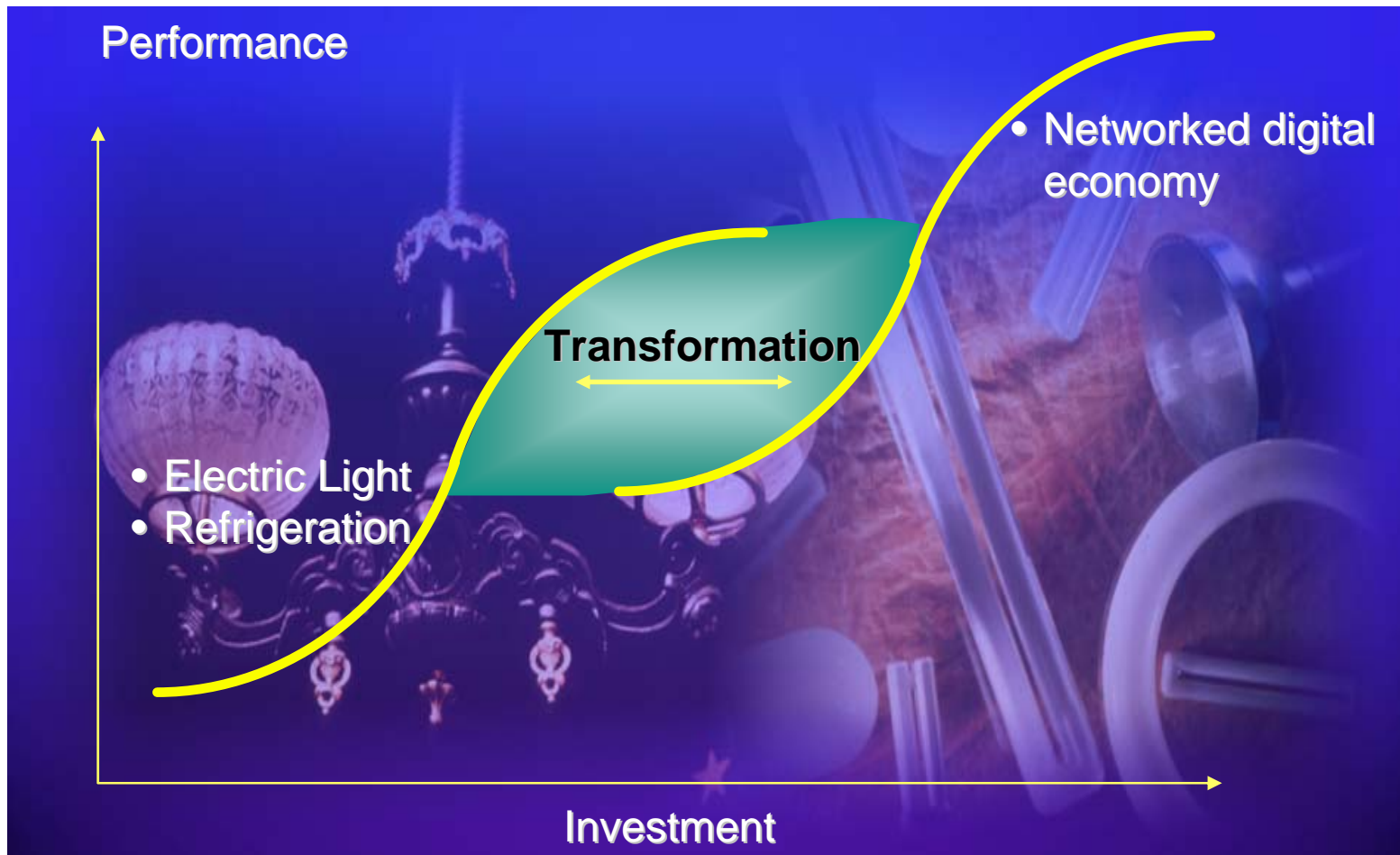
**The vast networks of electrification are
the greatest engineering achievement of
the 20th century**

– U.S. National Academy of Engineering



**The obligation to serve
remains alive and vital in
the public mind**

Breaking the Limits on Electricity Value

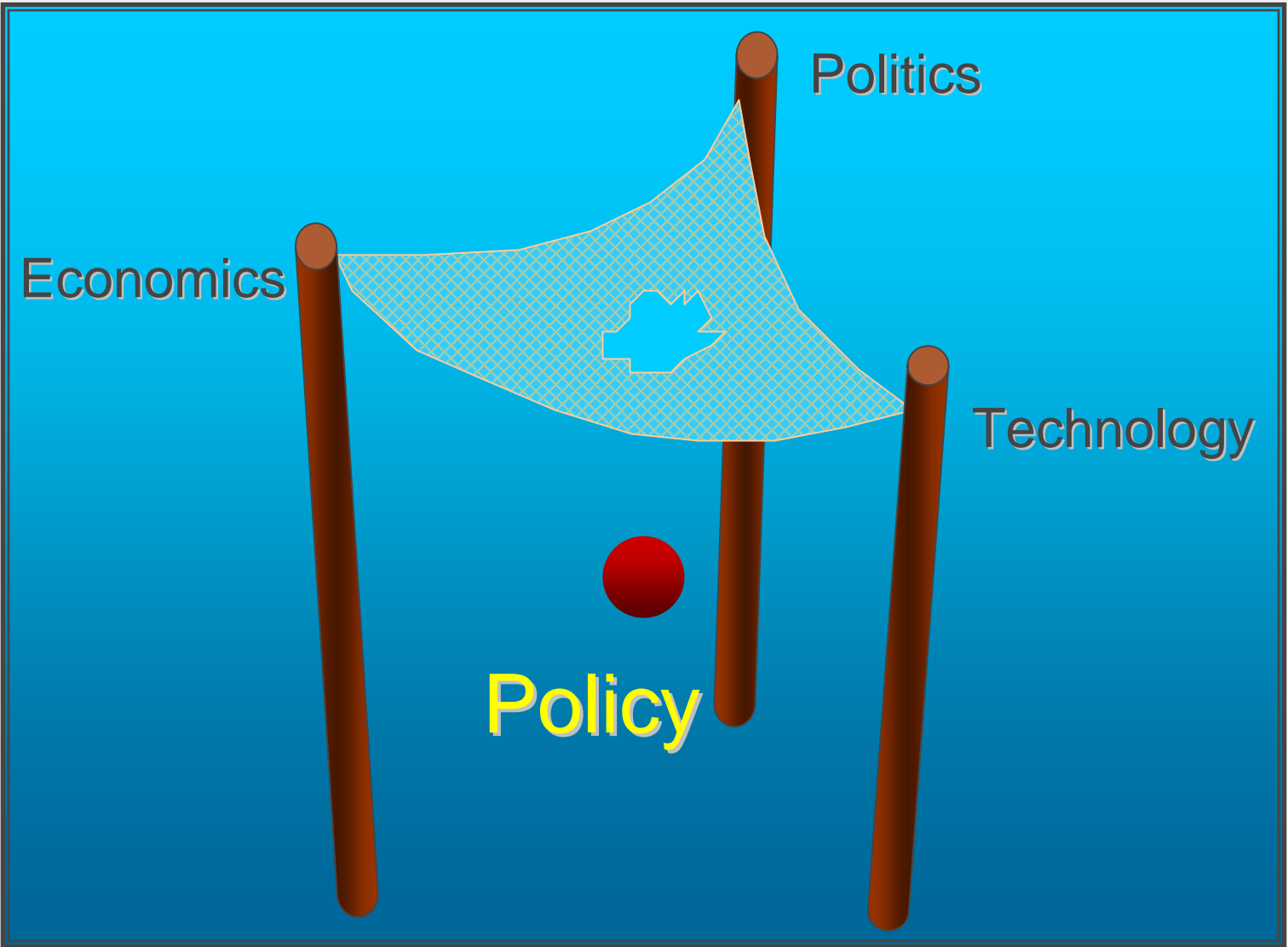


Pacing Issues to be Resolved

- 1. Poorly designed market reforms that ignore the laws of physics**
- 2. Depressed financial health reinforced by regulatory confusion**
- 3. Ineffective commingling of regulation and competition**
- 4. Lack of clear accountability and incentives for infrastructure development & investment**
- 5. Growing tension between electricity sector & national well-being**



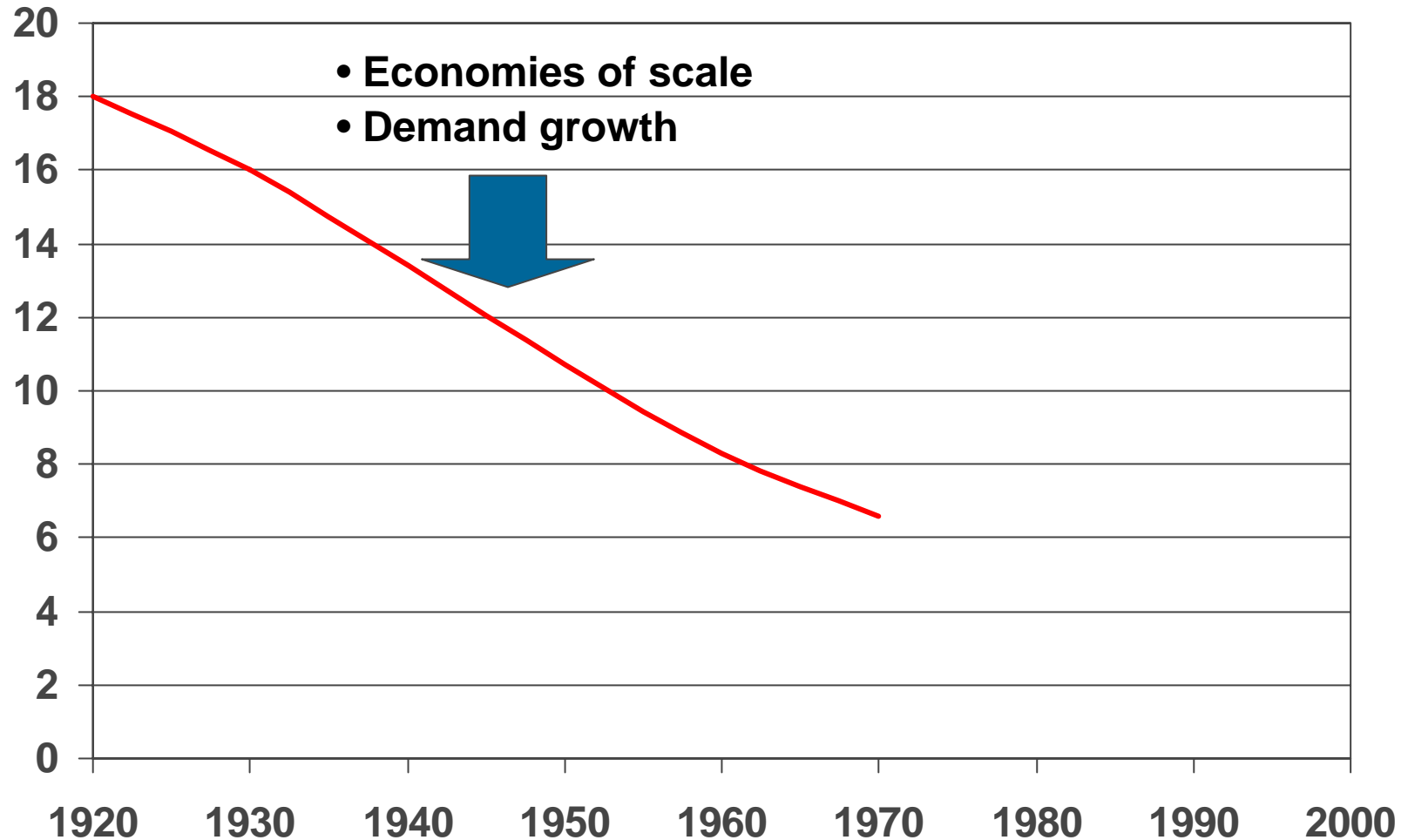
Restructuring Trilemma



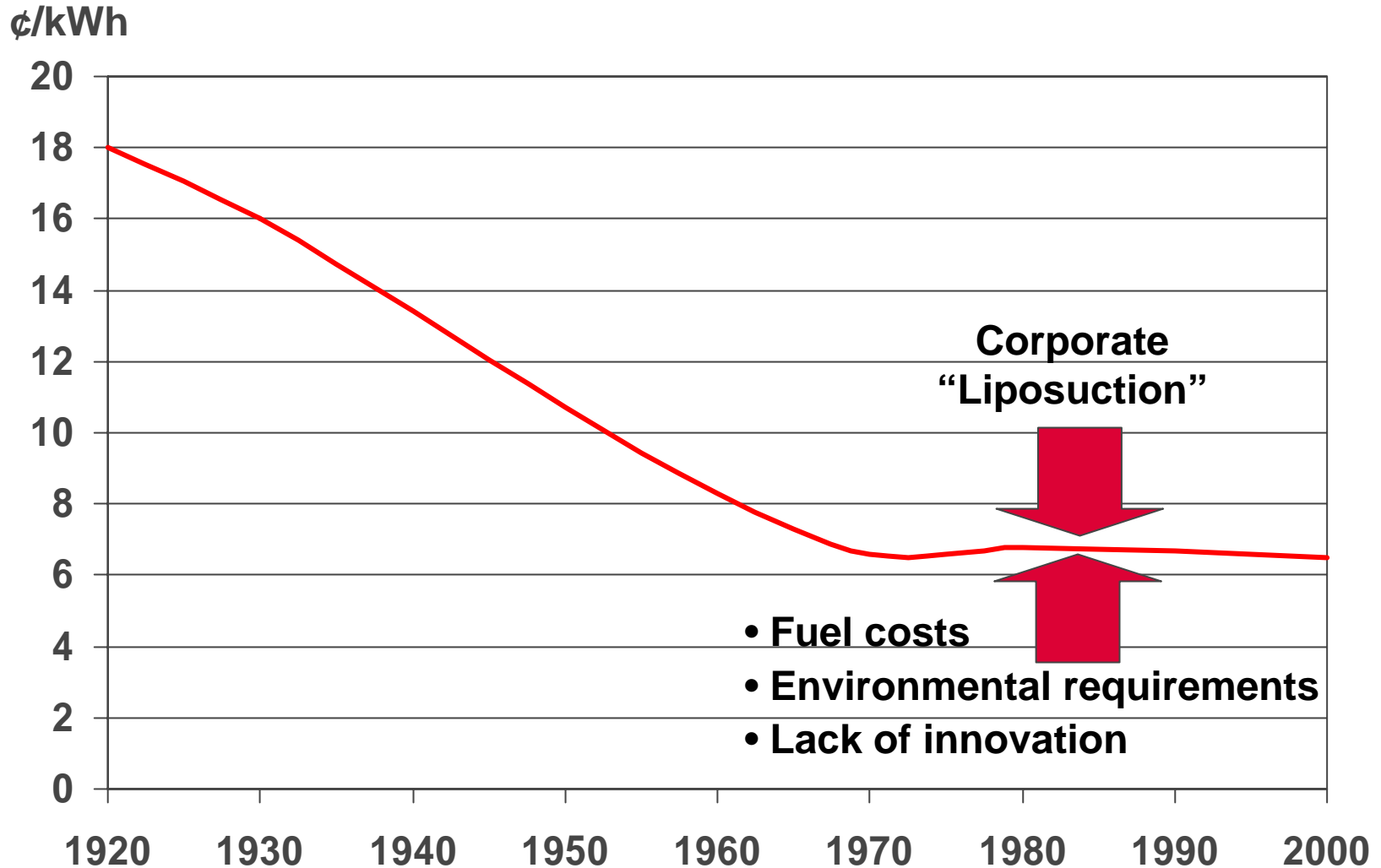
What is the root cause?

Average U.S. Price of Residential Electricity Service (1984 \$)

¢/kWh

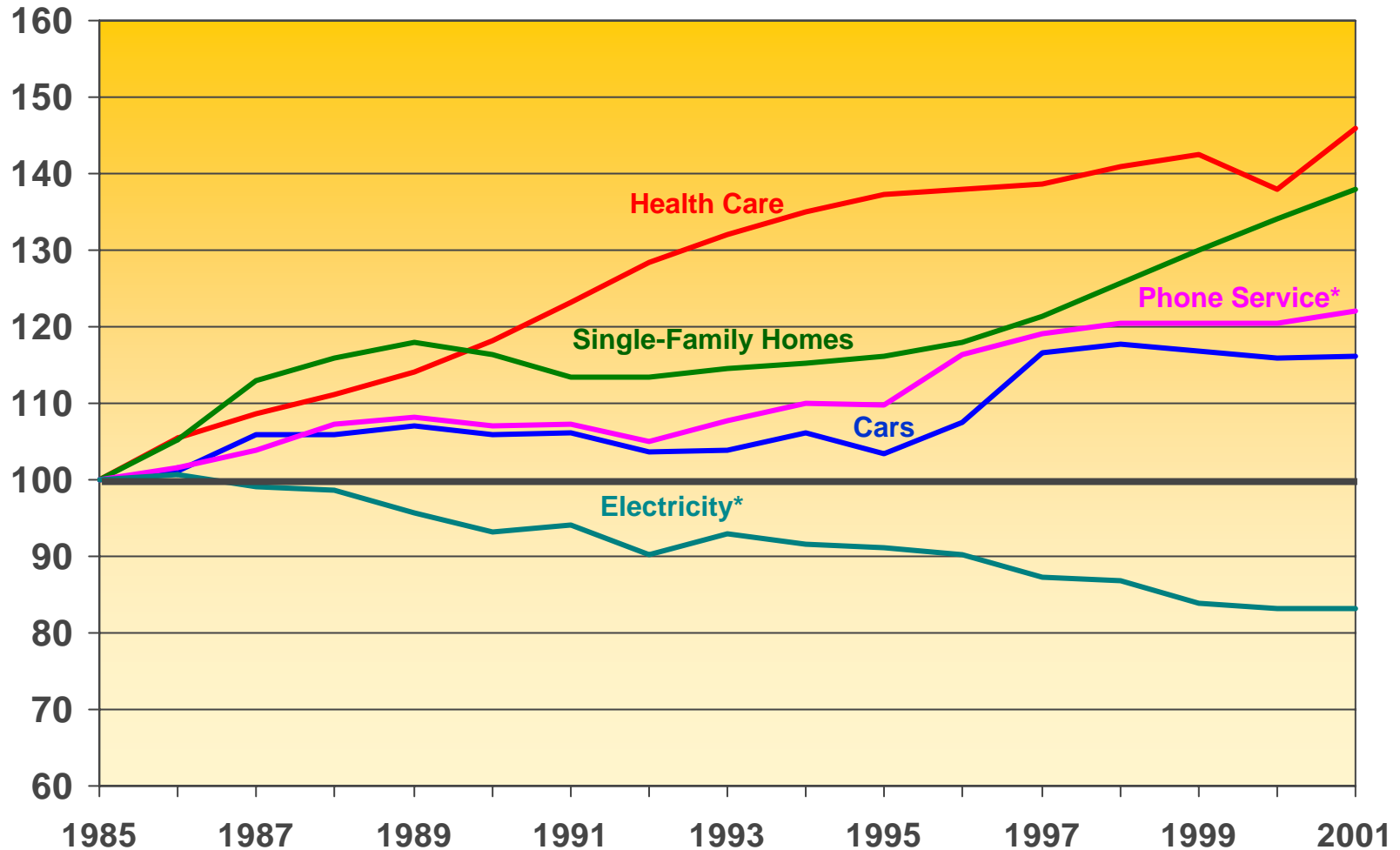


Average U.S. Price of Residential Electricity Service (1984 \$)



Relative Consumer Prices, 1985-2001

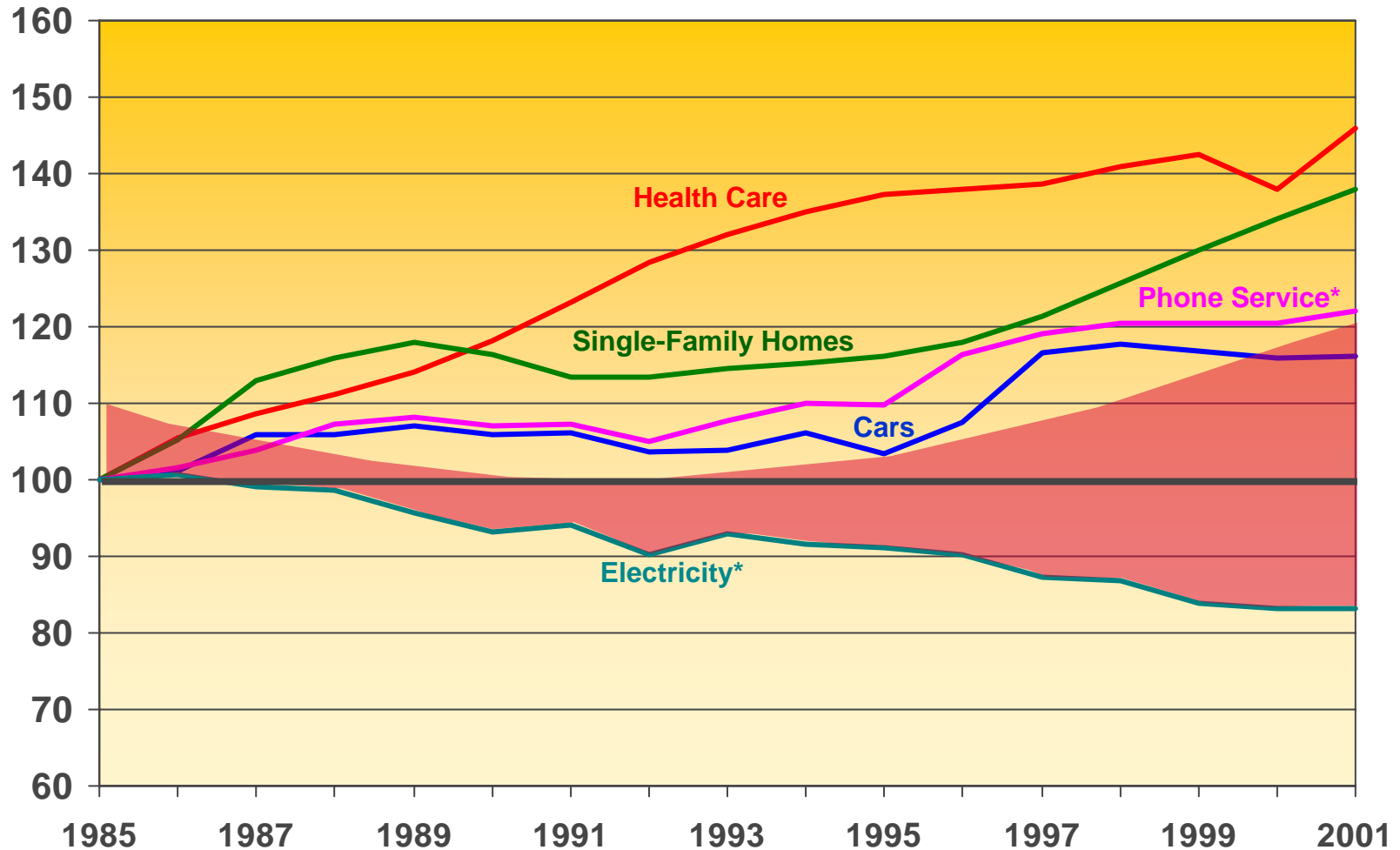
(Prices calculated in 2001\$, 1985=100)



* Average Household Monthly Bill

Relative Consumer Prices, 1985-2001

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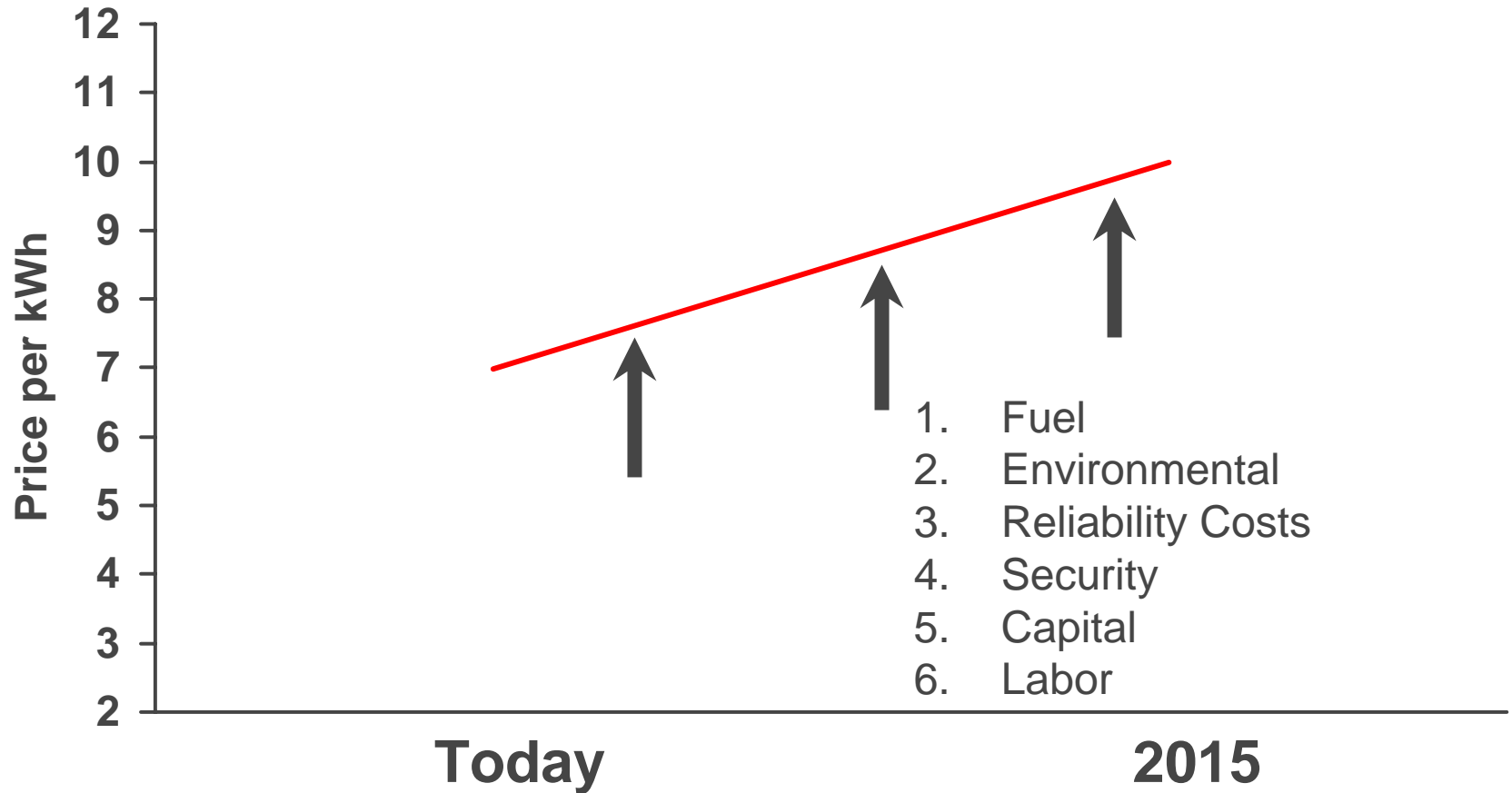
Four Areas of Vulnerability



SQRA

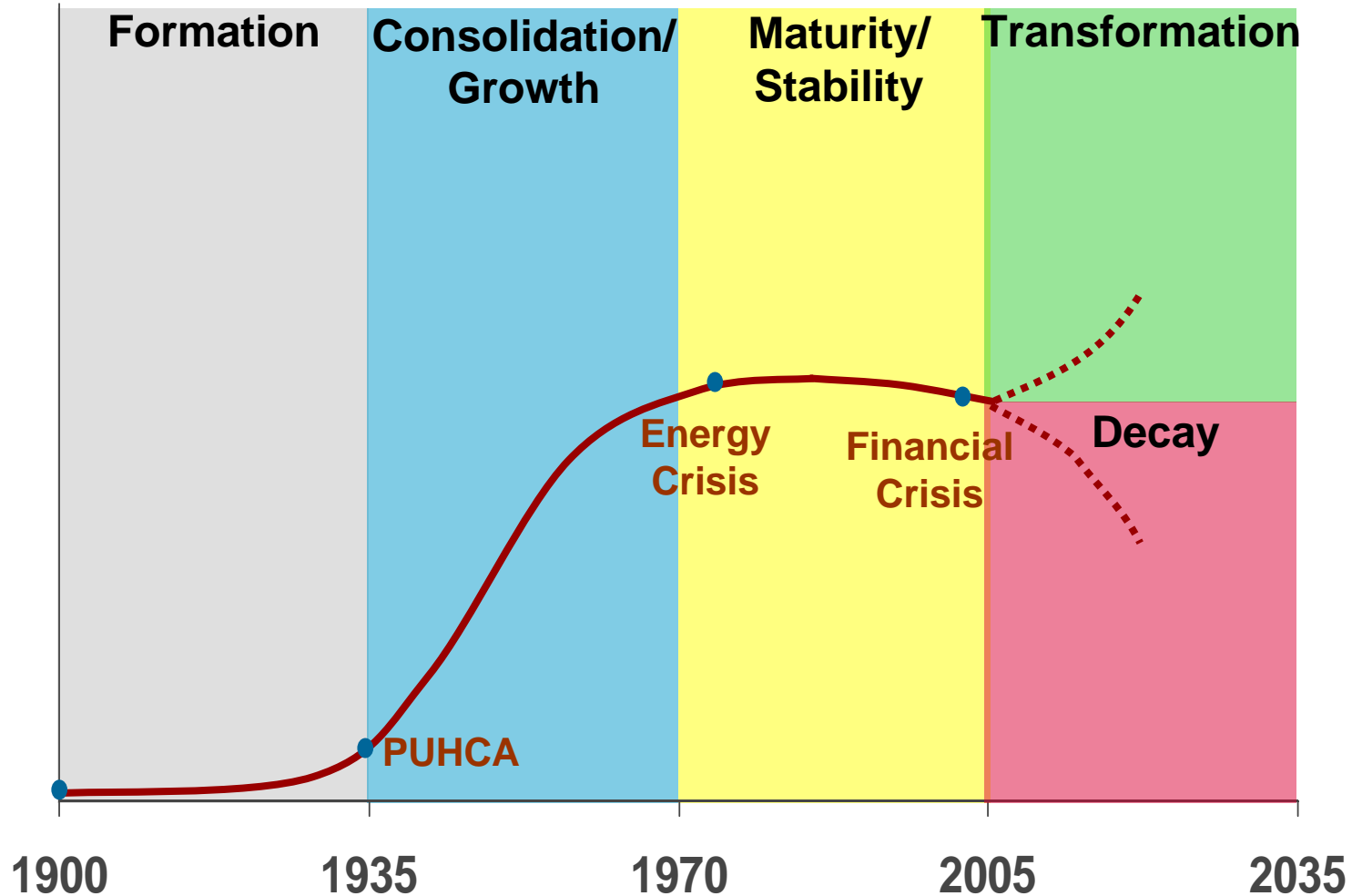
- Security of power delivery and market systems
- Quality of power supplied
- Reliability of power supplied
- Availability of high value energy services

Cost Pressures on the Electricity Sector



Electricity Sector Life-Cycle

A Fork in the Road



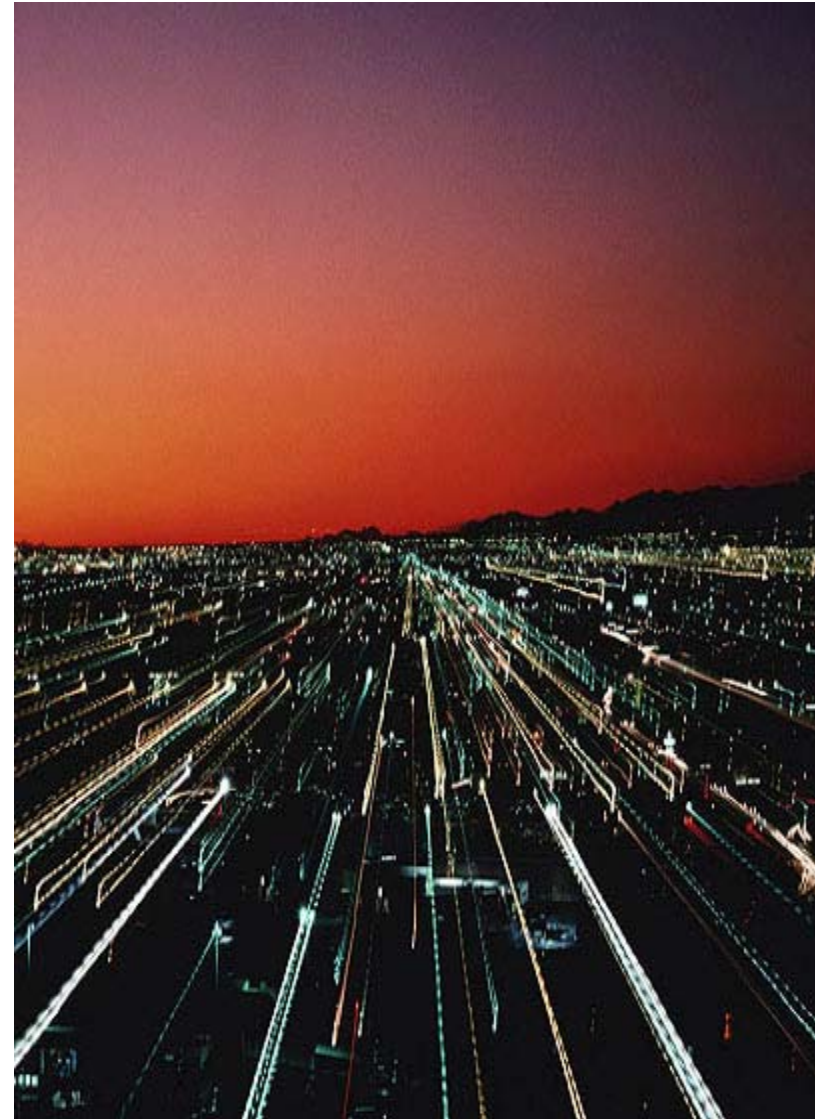
Key Issue to be Resolved



Will the bulk electricity system evolve to become the critical infrastructure supporting the digital society of the 21st century, or be left behind as an industrial relic of the 20th century?

Forward to Fundamentals

- **Electricity is the engine of prosperity and quality of life**
- **Electricity is a consumer service- based enterprise**
- **Technology can relieve cost pressures through elevation of electricity service value**
- **Realizing these opportunities requires transformation of the electricity infrastructure**



Needed: An Interstate Electricity Communications Superhighway



The Transformed Electricity Enterprise for the 21st Century

- Digitally control the power system
- Integrate electricity and communications
- Transform meter into a two-way consumer services gateway
- Integrate distributed resources
- Accelerate end-use efficiency
- Enable a robust advanced generation portfolio



Value of the 21st Century Transformation



Increasing the functionality and value of electricity through consumer benefits that far outweigh the cost

- Increased U.S. productivity and GDP growth rates
- Substantially improved energy efficiency and electricity intensity
- Accelerated reduction in carbon emissions
- Improved power system security and functionality
- Reduced cost of infrastructure upgrades and expansion

The Intelligrid: The Power Delivery System of the Future

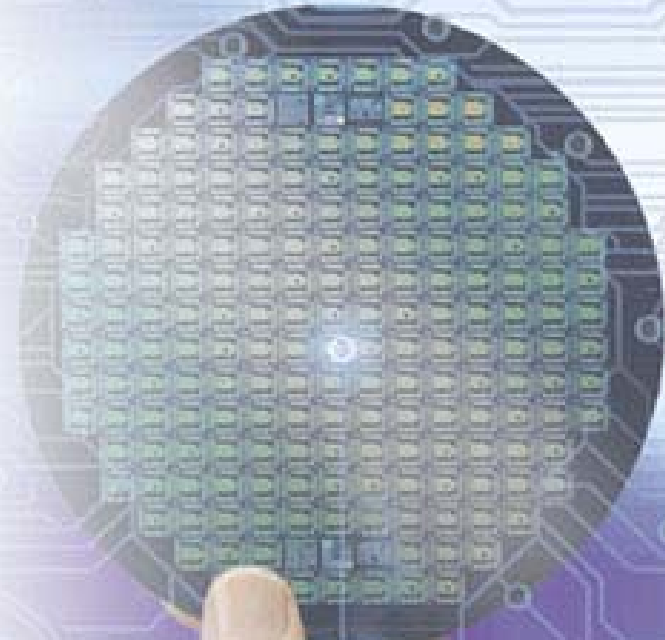
- “Smart”: With sensors
- “Flexible & Resilient”: An intelligent network w/real-time monitoring & control
- “Self Healing”: Capable of predicting and immediately containing outages
- Established Standards: Enabling “plug & play” distributed resources and digital appliances & devices



The Intelligrid Technology Program

Intelligrid is centered around five active projects:

1. **Integrated Energy and Communications Systems Architecture**
2. **Advanced Distribution Automation / Distributed Energy**
3. **Resources / Fast Simulation and Modeling**
4. **Customer Portal**
5. **Power Electronics**

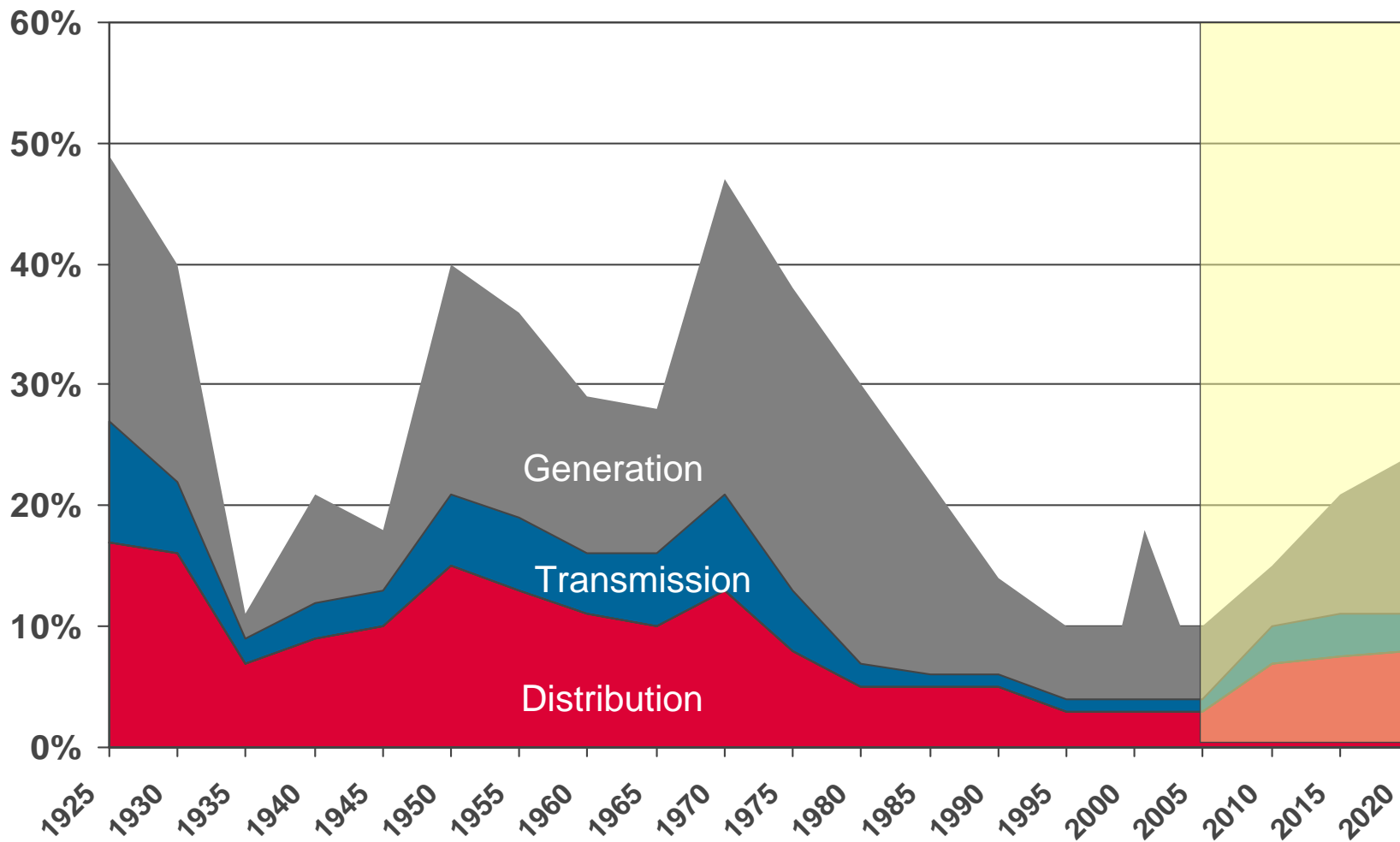


What Will it Take to Achieve this Vision?



- A modernized power delivery infrastructure will cost ~\$15 billion a year for 20 years
- Broken down per household, the cost is equivalent to one medium pizza each month!
- Consumers would save \$100s per year in cost of goods and services, and enable \$1000s more in personal income

Capital Invested as % of Electricity Revenues



The Plan of the Best Minds in Electricity R&D

“Every node in the power network of the future will be awake, responsive, adaptive, price-smart, eco-sensitive and interconnected with everything else”



“Consumers and businesses need reliable supplies of energy to make our economy run -- so I urge you to pass legislation to modernize our electricity system,...”

*George Bush -
State of the Union
1/20/2004*

