Demand Response: Paving the Way for New Energy Alternatives

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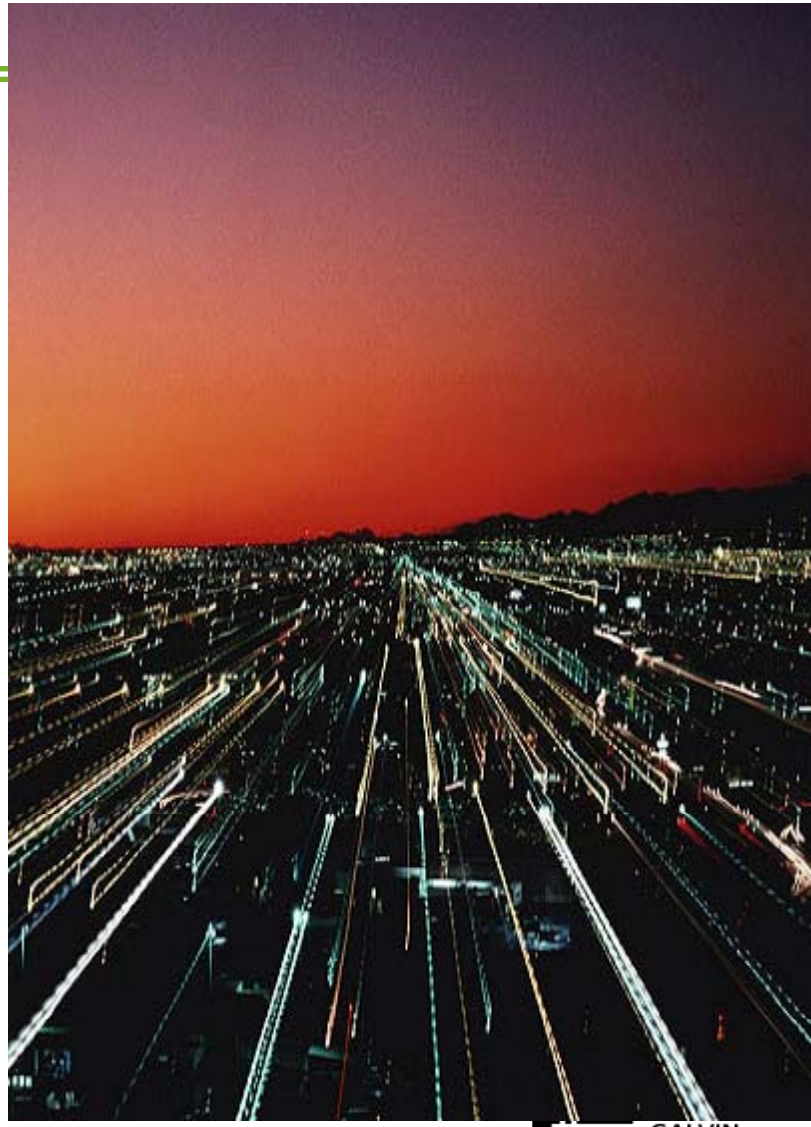
Forward to Fundamentals

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



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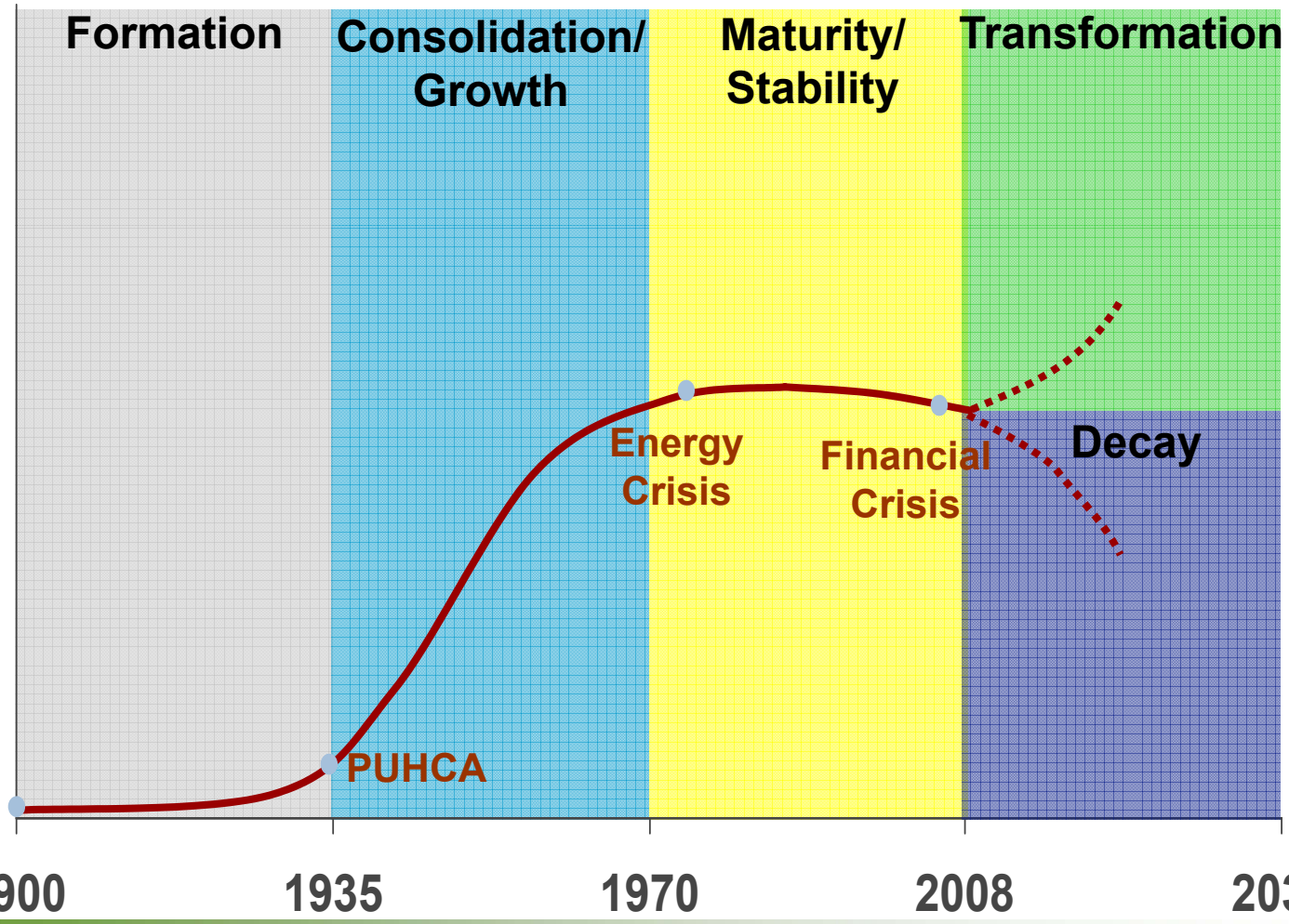
Key Issue to be Resolved

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?

Electricity Sector Life-Cycle

A Fork in the Road



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Key Findings

- **The electricity industry is transitioning to a demand-driven, dynamic-priced business**
- **Utility economics are driving AMI & DR**
- **Consumer-convenient "killer applications" are emerging and new players are entering**
- **Both the commercial and residential markets will become web-enabled and consumer controlled**
- **Widespread real-time energy management will significantly improve efficiency and reliability**

A Perfect Storm of Challenges

- **Costs** – fuel and capital costs have doubled
- **Demand Growth —** power quality and quantity
- **Energy Security —** vulnerability and dependence
- **Climate Change —** greater demands for efficiency and renewables

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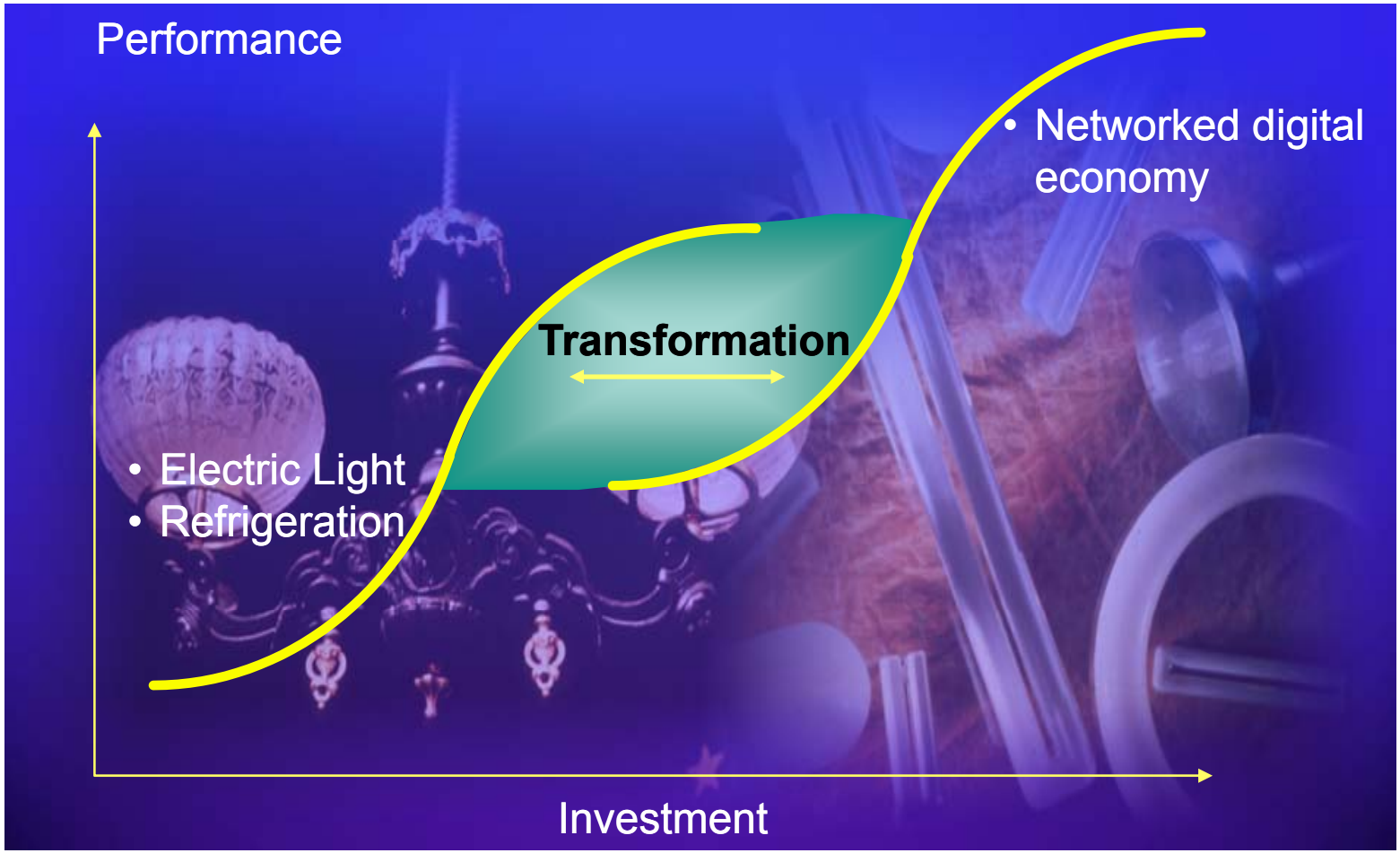
Value Lost to the U.S. Economy
($ billion per year)

- **Unreliability — 150**
- **Inefficiency — 100**
- **Productivity Penalty — 1,000+**

Annual Cost to Correct — 25

Breaking the Limits on Electricity Value



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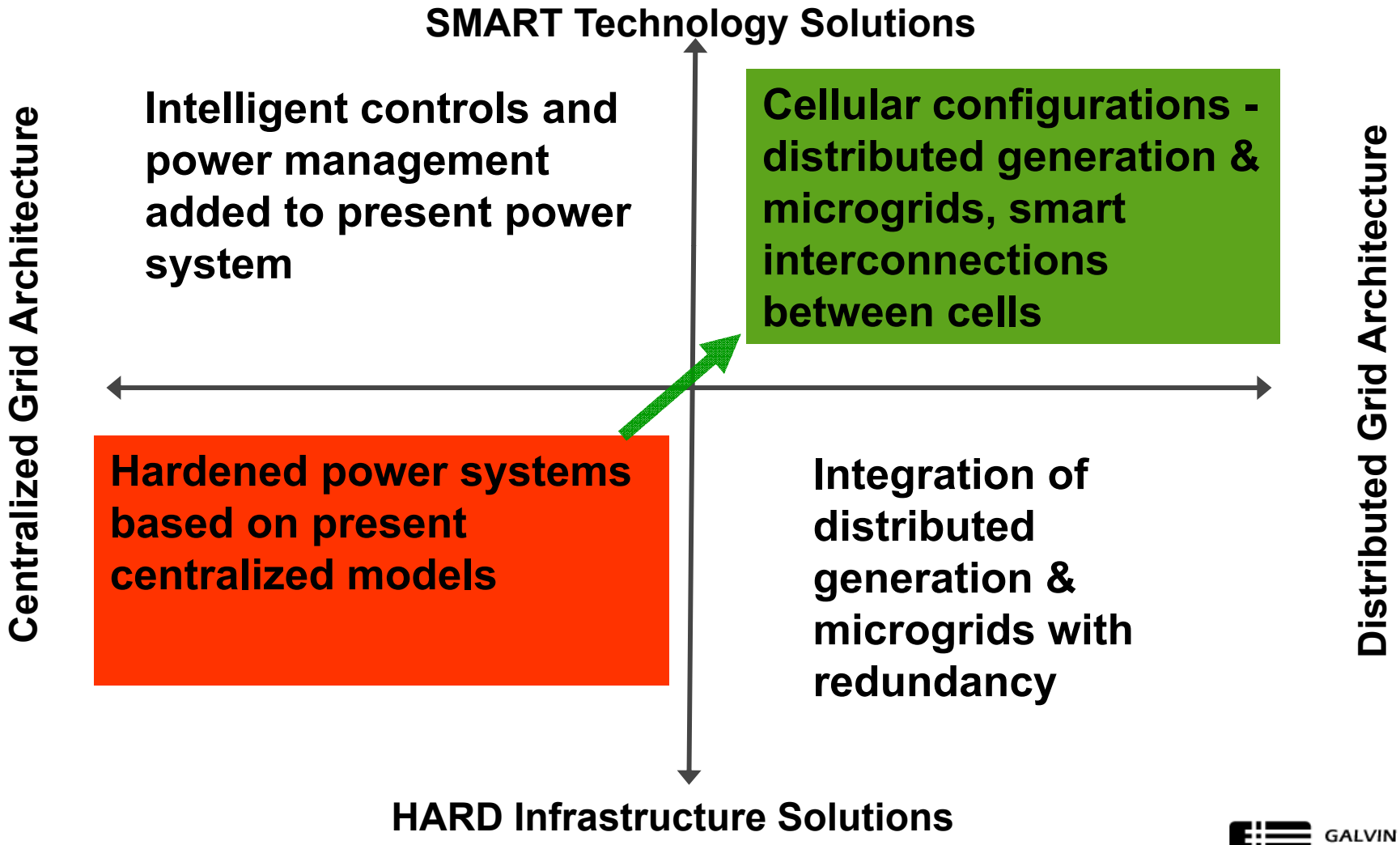
Conceptual Framework for Alternatives



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Transforming the Electricity Grid for the 21st Century

Electronically monitor & control the power system

Integrate electricity & communications

Transform meter into a two-way consumer services gateway

Enable smart buildings & end uses

Incorporate Renewable & Distributed Resources

Reintroduce Direct Current (DC) Circuits for Efficiency & Reliability

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Value of the 21st Century Transformation

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

Transformed power system security & functionality

Increased U.S. productivity & GDP growth rates

Substantially improved energy efficiency & electricity intensity

Accelerated reduction in carbon emissions

Reduced cost of infrastructure upgrades & expansion

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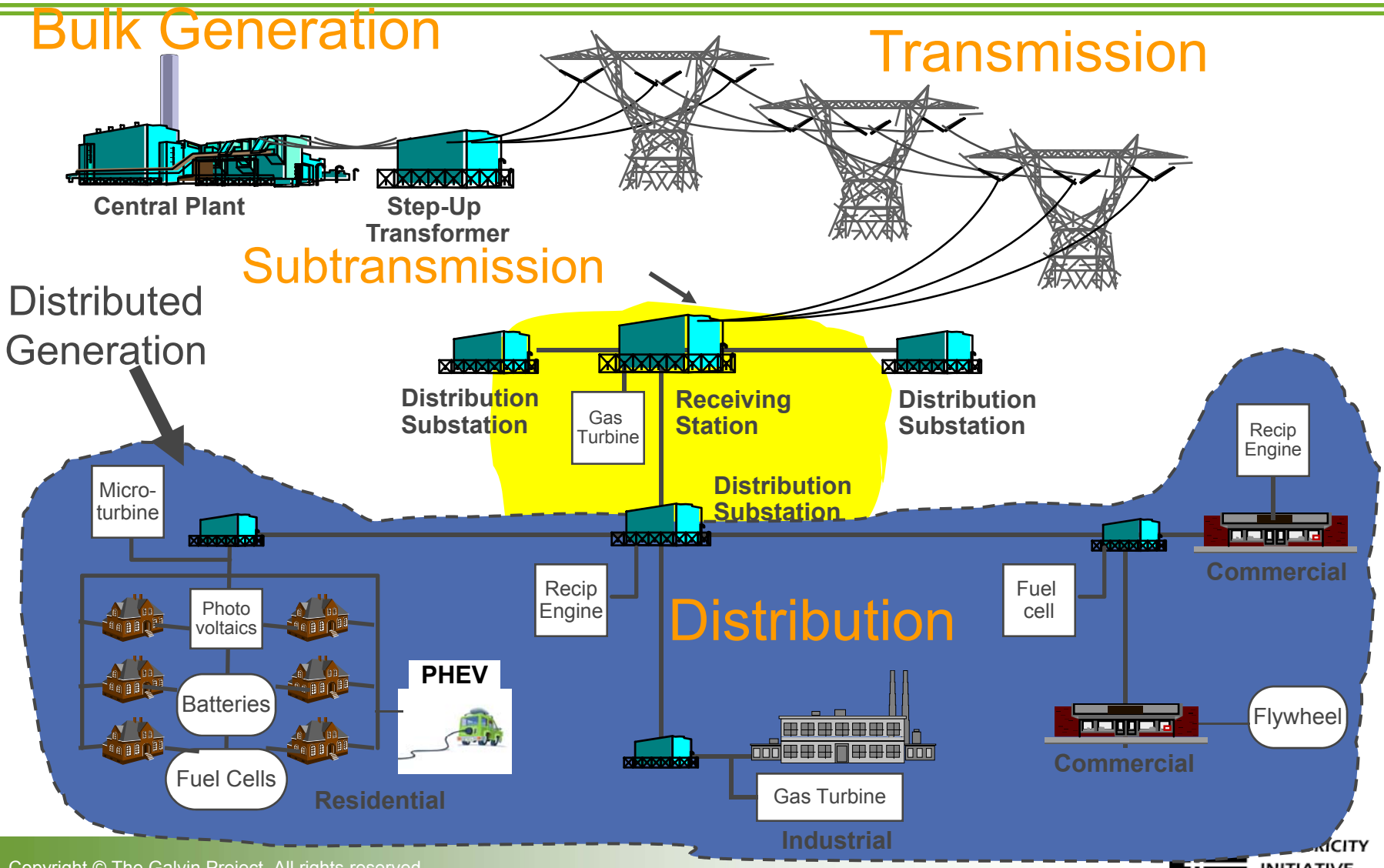
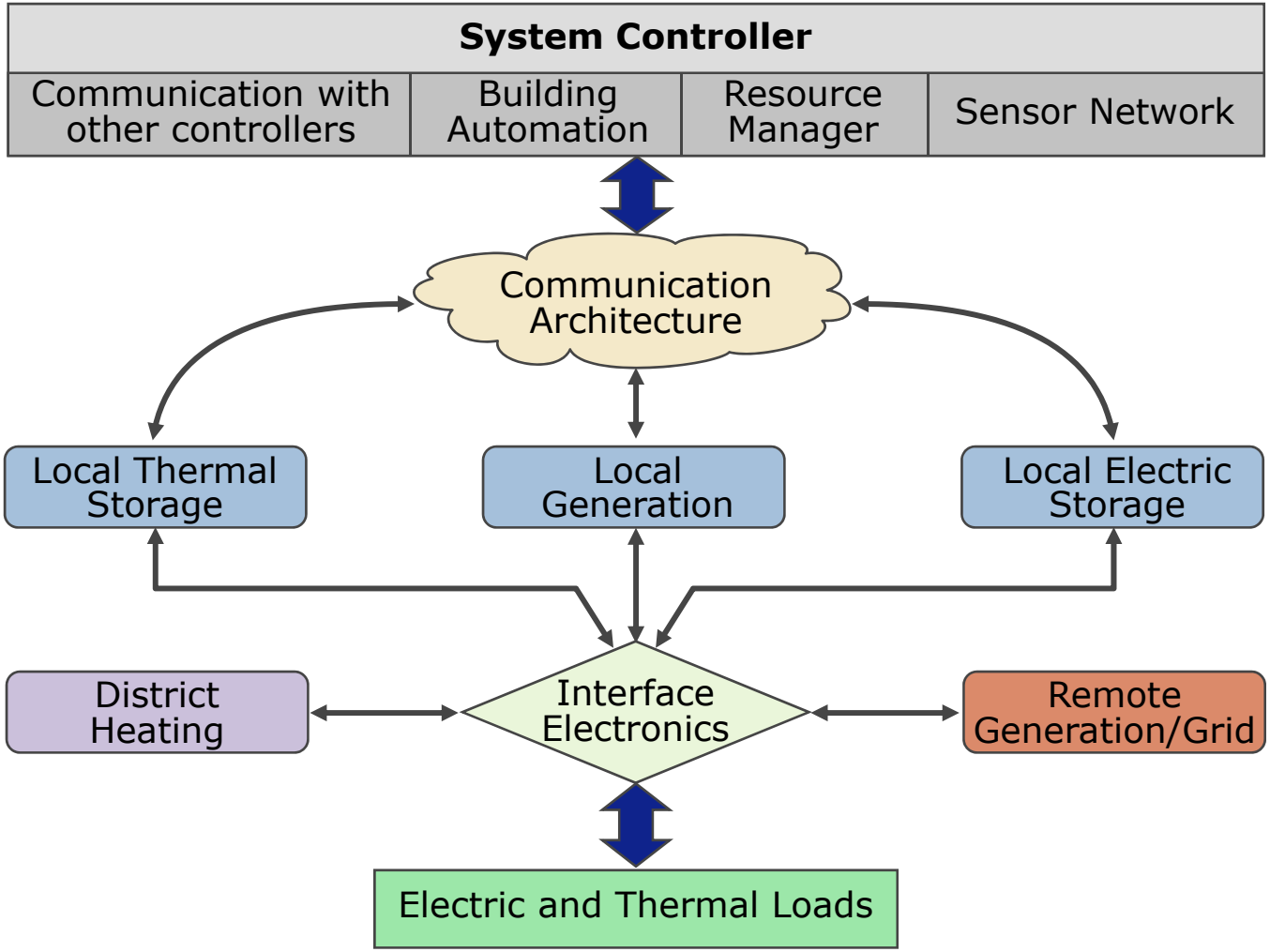
A SmartGrid accommodates economies for the grid investment- distributed generation



Distributed Power Systems



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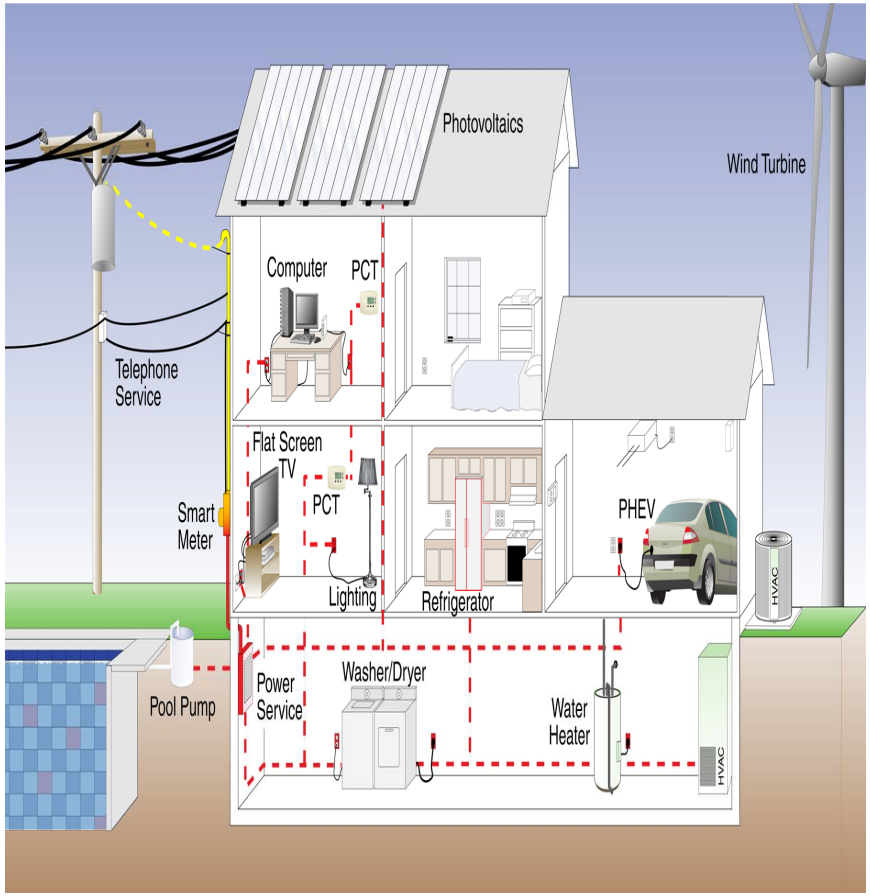
New technology opportunities abound

Set it, and forget it homes



Hyper-Efficient Technologies

Residential

Heat Pumps

Ductless Cooling

Appliances

Commercial

VFC Cooling

VFC Cooling

Data Centers

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Unlocking Smart Grid Benefits Requires

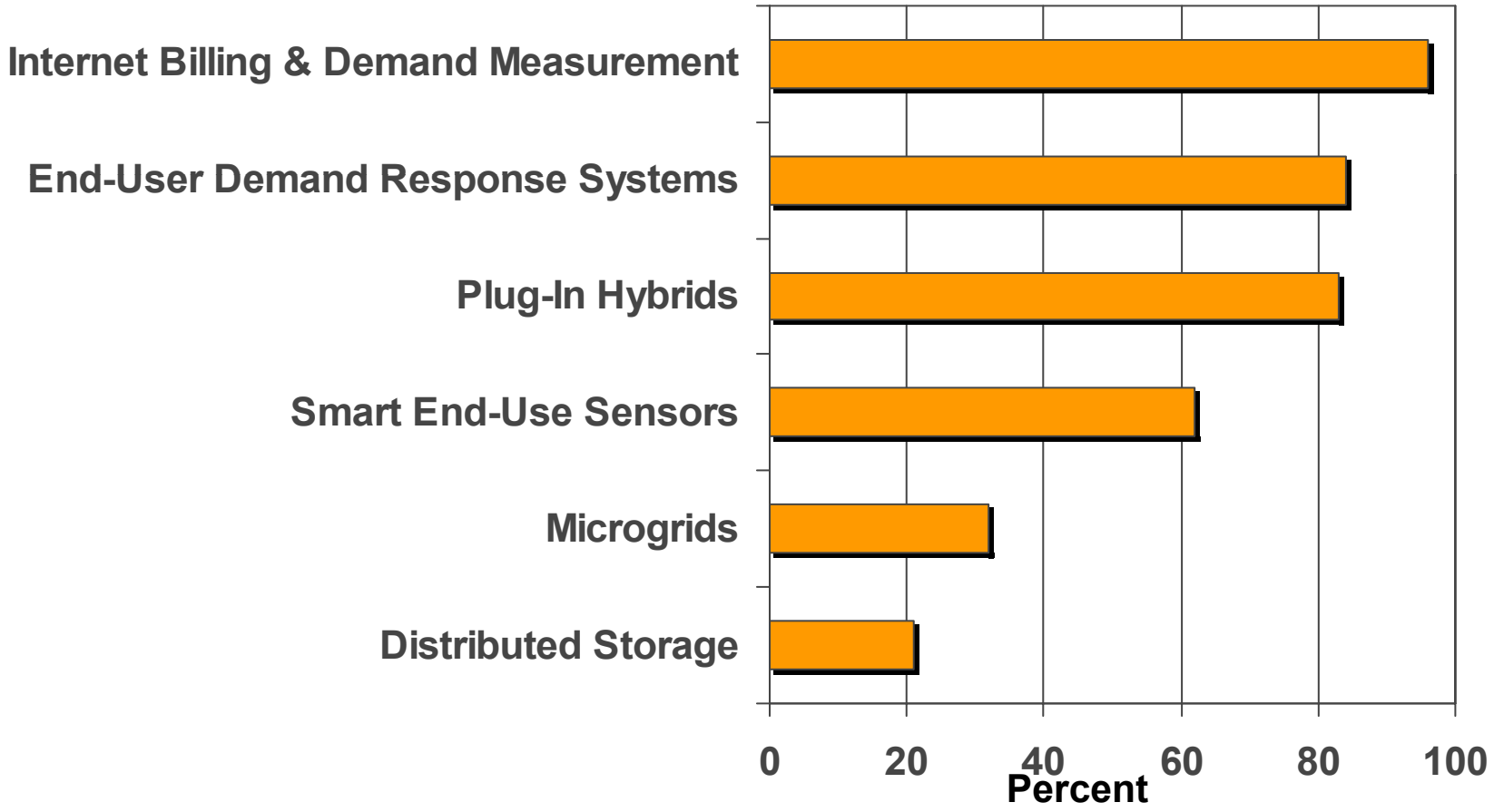
- **Smart Technology**
- **Smart Policy**
- **Empowered Consumers**

Key Characteristics of Smart Microgrids

- **Self-healing.** Grid Rapidly Detects, Analyzes, Responds and Restores.
- **Empowers and Incorporates the Consumer.** Ability to Incorporate Consumer Equipment and Behavior in Grid Design and Operation.
- **Provides Power Quality Needed by 21st Century Users.** Grid Provides Quality Power Consistent with Consumer and Industry Needs.
- **Tolerant of Attack.** Grid Mitigates and Resilient to Physical and Cyber Attacks.
- **Accommodates Wide Variety of Supply and Demand.** Grid Accommodates Variety of Resources (Including DR, CHP, Wind, PV).
- **Fully Enables Maturing Electricity Markets.** Allows for and is Supported by Competitive Markets.

New Technology Will Change Electricity Consumption and Management

CEO Expected Innovations This Decade



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Constraints to Transformation

- **Lack of Change Leadership and Consumer Knowledge**
- **Obsolete Cost/Benefit Accounting rules**
- **Dysfunctional Building Design & Construction Processes**
- **Utility and Regulatory Resistance to Change**
- **New Entrant Barriers – Discriminatory Rules & Tariffs**

Reaching the Tipping Point (~ 2012)

- **Building intelligence in over half of new commercial building**
- **Home automation systems are a staple offering**
- **Active DR programs are widely used**
- **> 40% of aggregate load is AMI served**
- **Grid interoperability is broadly (85%) activated**

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SMART GRID POLICY IMPLICATIONS

- **A Smart Grid is a *transactive* network, seamlessly connecting producers and consumers**
- **Price-responsive end-use devices enable autonomous consumer control: *empowerment***
- **A Smart Grid requires looking beyond the regulated monopoly business model**
  - **Remove barriers to retail competition**
  - **Remove barriers to non-utility technology investments**

The result significantly increases both consumer and producer benefits

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Smart Grid Policy Barriers

- **Obsolete, "New Deal", State Utility Regulations**
  - **Reward utilities for selling more electricity**
  - **Hold consumers captive behind iron curtain meter**
  - **Deny time-of-use pricing and incentives**
  - **Ignore true economic and environmental benefits**
  - **Prevent innovative market electricity service**
  - **Severely limit use of renewable energy**
- **Tax Rules that Penalize Utility Innovation**

Principles of a New Electricity Constitution

- **Compensate Utilities Based on their Reliability, Efficiency and Customer Service Quality**
- **Require Fundamentally Higher Distribution Reliability Standards**
- **Provide all Consumers with Dynamic Electricity Rates & Incentives**
- **Enable Municipalities to Access & Invest in the Electricity Distribution Infrastructure**
- **Eliminate Utility Monopoly Restrictions on Smart Microgrids and Distributed Generation**
- **Establish Truly Competitive Retail Electricity Service Markets**

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Meet Sad Socket

You'd be sad, too, if you had to power **digital-age** businesses on **1950s technology**

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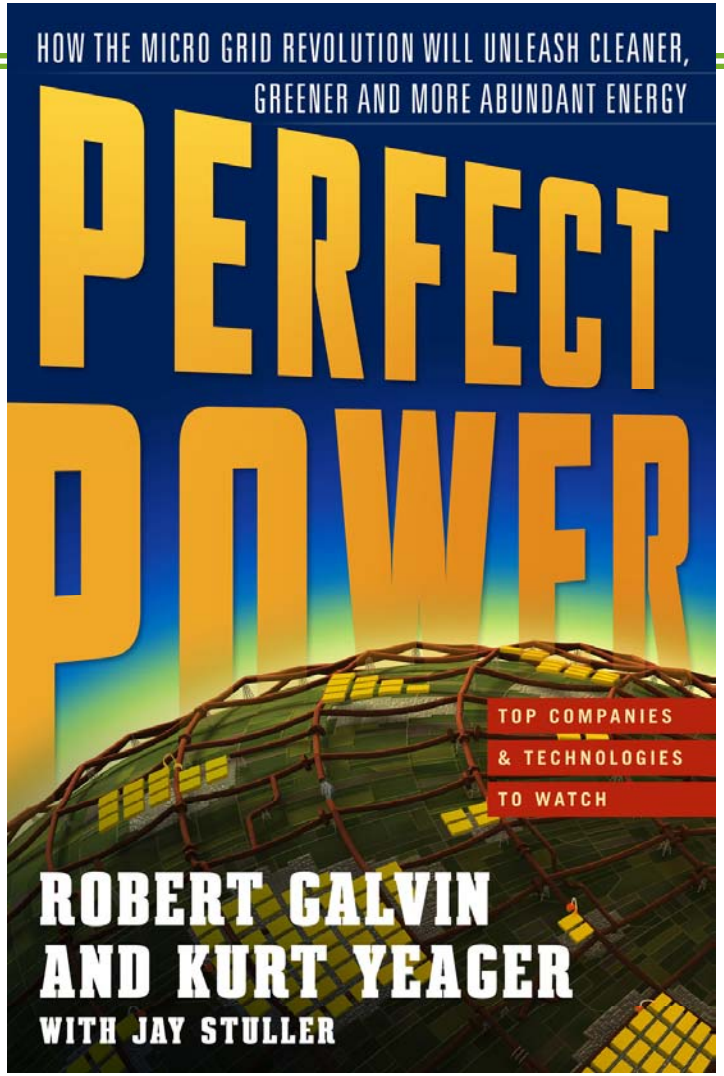

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