



# The Next Generation Grid: Electric Power T & D

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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**



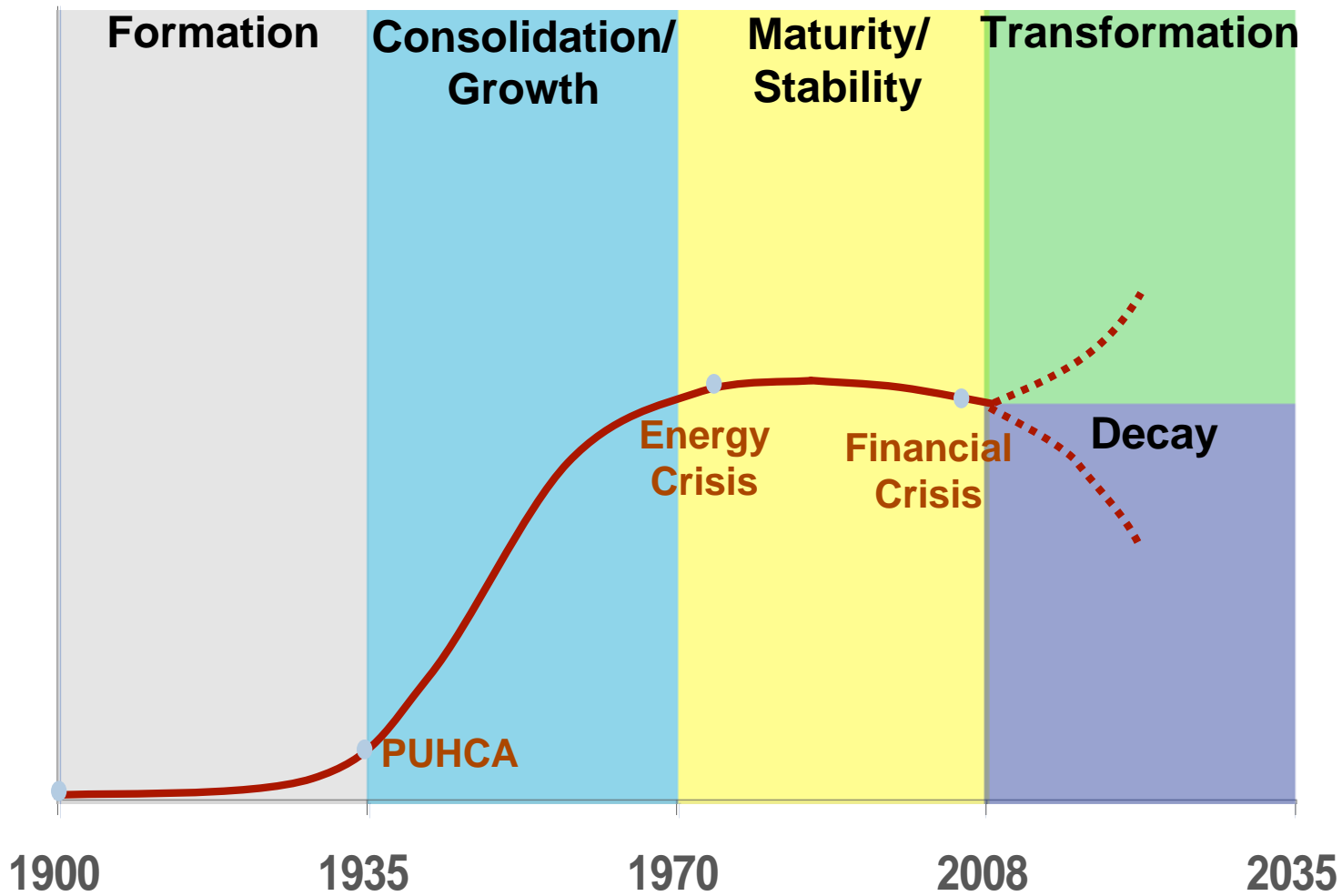
# A Perfect Storm of Challenges

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- **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

# Electricity Sector Life-Cycle

## A Fork in the Road



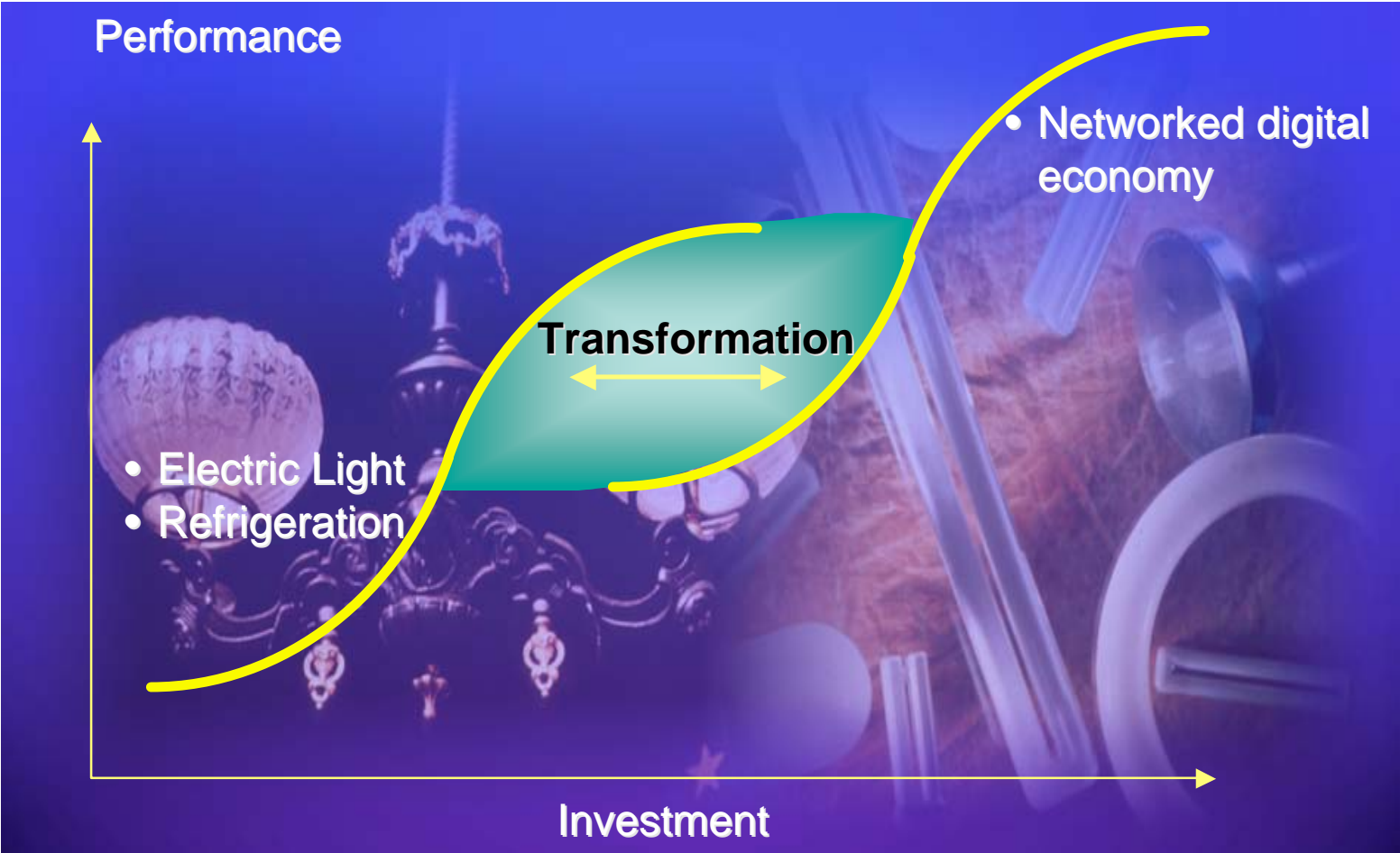
## Value Lost to the U.S. Economy (\$ billion per year)

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

**Annual Cost to Correct — 25**

# Breaking the Limits on Electricity Value



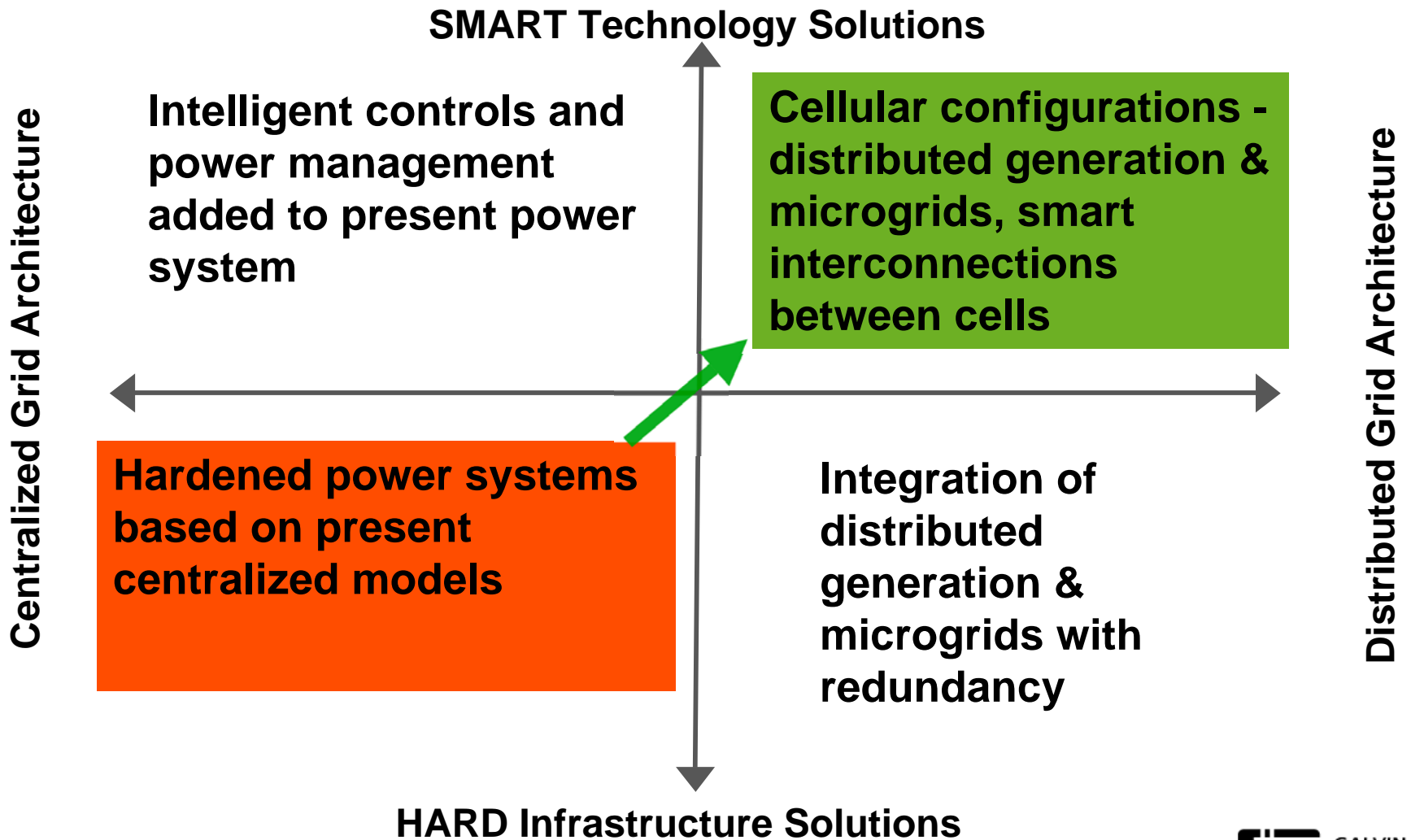
# Meet Sad Socket

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

# Conceptual Framework for Alternatives



# Transforming the Electricity Grid for the 21<sup>st</sup> Century

**Electronically monitor & control the power system**

**Integrate electricity & communications**

**Transform meter into a two-way consumer services gateway**

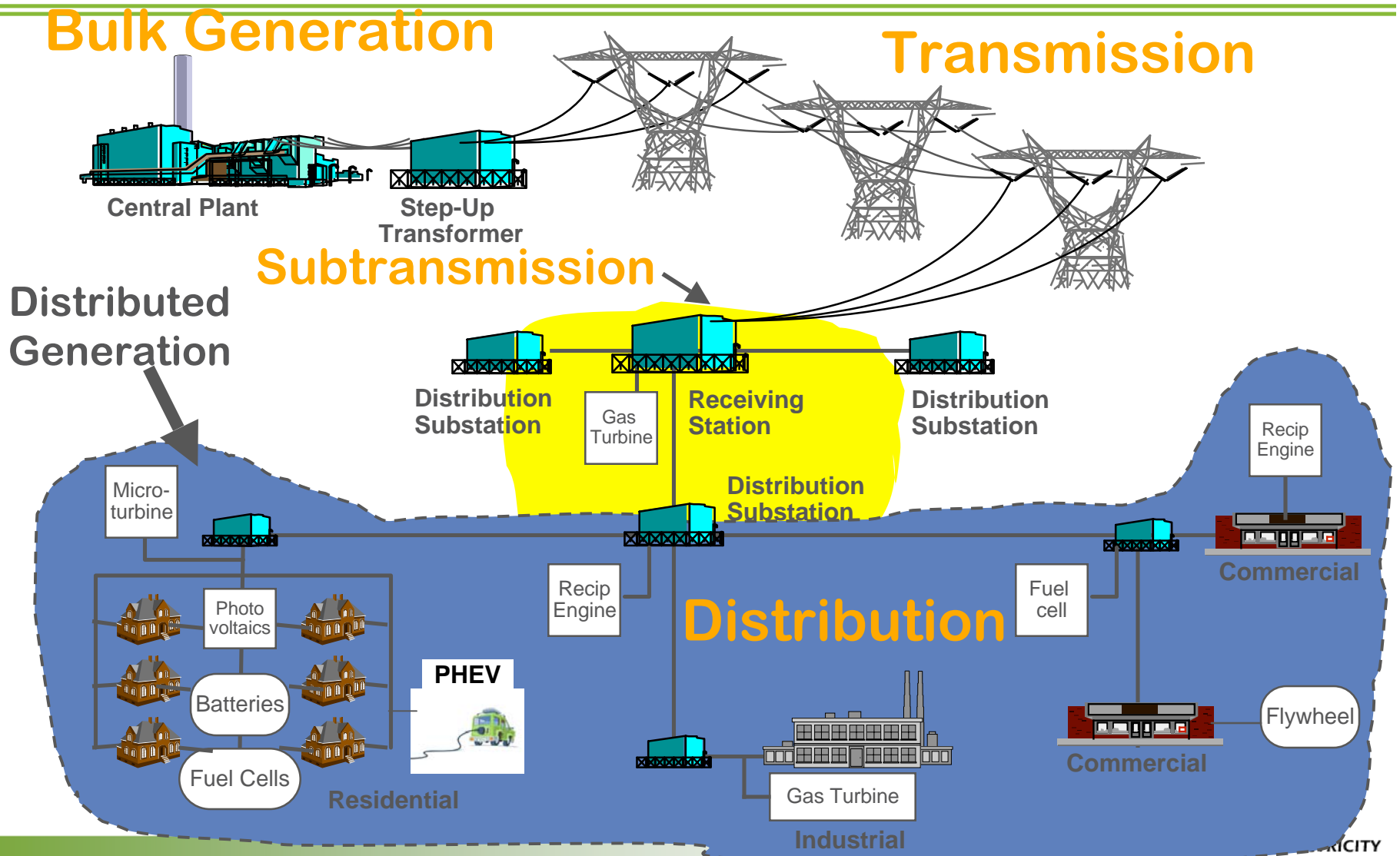
**Enable smart buildings & end uses**

**Incorporate Renewable & Distributed Resources**

**Reintroduce Direct Current (DC) Circuits for Efficiency & Reliability**

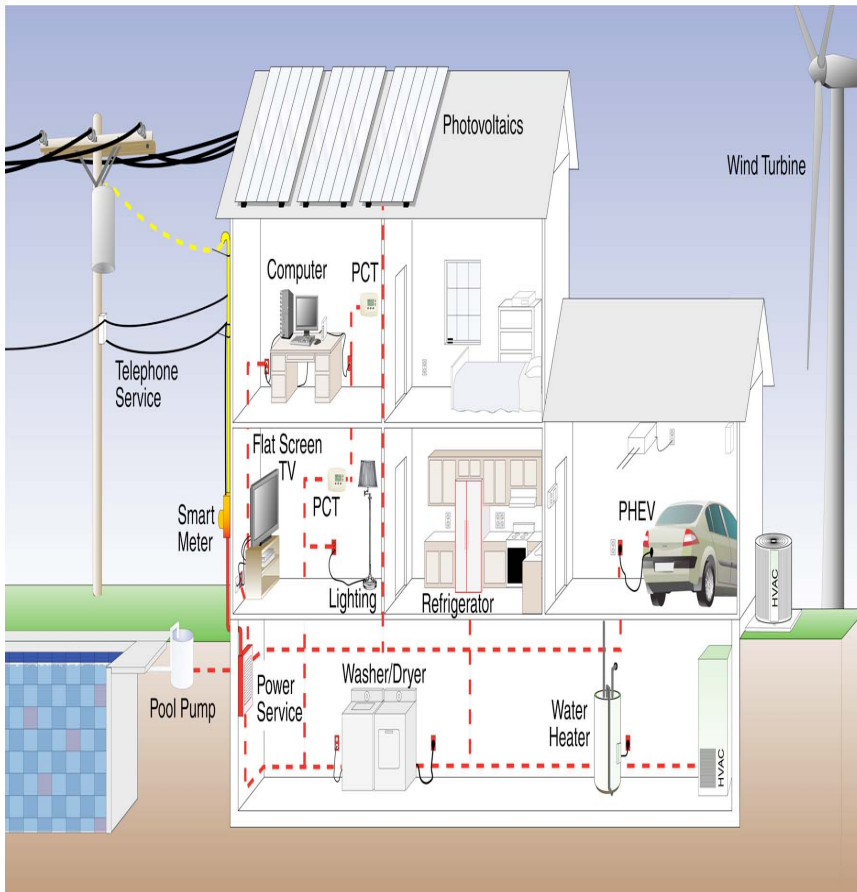


# A SmartGrid accommodates economies for the grid investment- distributed generation



# New technology opportunities abound

## Set it, and forget it homes



## Hyper-Efficient Technologies

### Residential



Heat Pumps



Ductless Cooling  
**Commercial**



Appliances



VFC Cooling



VFC Cooling



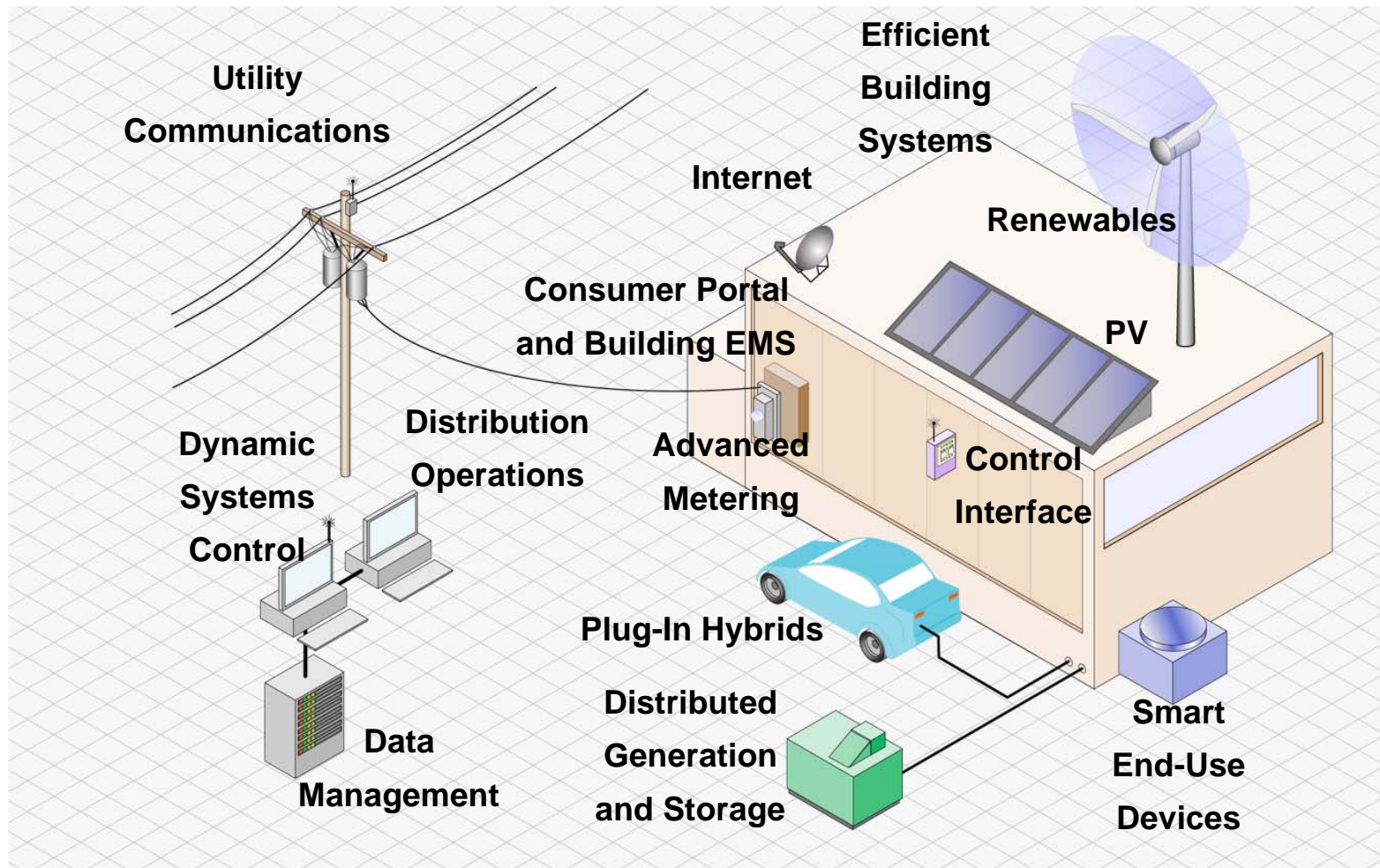
Data Centers

# Unlocking Smart Grid Benefits Requires

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

# The Micro Grid & Its Role in Helping Meet These Challenges



# Key Characteristics of Smart Microgrids

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- **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 21<sup>st</sup> 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.

# Constraints to Transformation

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- **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**

# Principles of a New Electricity Constitution

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- **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**

# GOAL

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“The perfect power system will ensure absolute and universal availability of energy in the quantity and quality necessary to meet every consumer’s needs. It is a system that never fails.

Bob Galvin

