

# Modern Regulatory Frameworks for a Flexible, Resilient, & Connected Grid

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Technologies which provide Flexibility, Resiliency and Connectivity  
CIGRE Grid of the Future 2013 Technological Solutions to Regulatory Challenges  
October 21, 2013

# Observations on Regulatory Policy

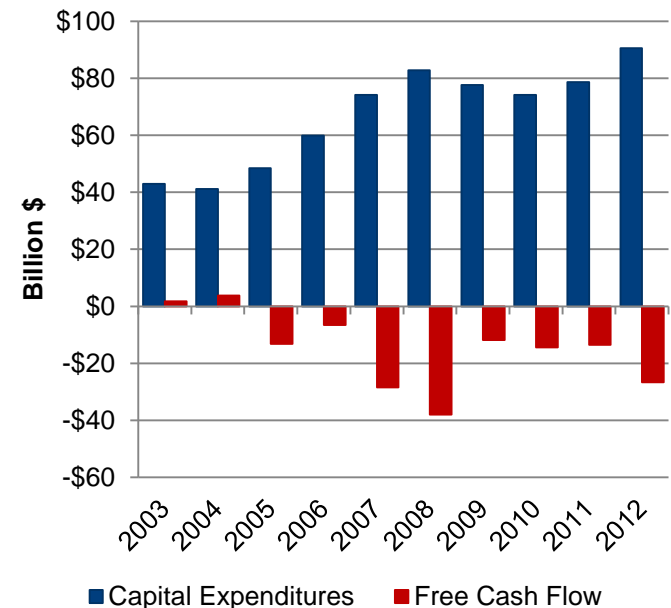
## 4 Challenges

## 3 Common Sense, Transformational Policy Approaches

# Investment Challenge

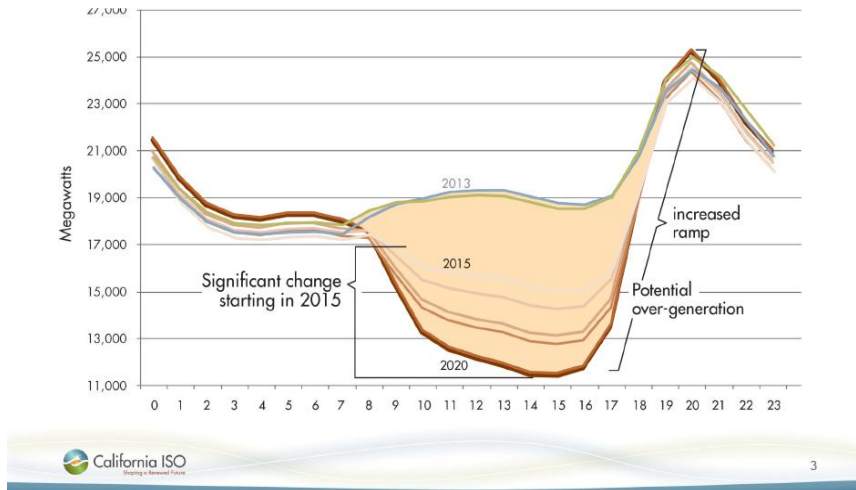
- **American Society of Civil Engineers: \$673 billion in new investment required by 2020 to maintain grid reliability**
  - Failing to close investment gap would increase service interruptions reducing U.S. GDP by \$496 billion and costing 529,000 jobs by 2020
- **Adverse investment environment:**
  - Low sales growth: Sales declined 1.8% in 2012 and have fallen in 4 of the last 5 years
  - More distributed resources: PV costs comparable to retail rates for up to 1/3 of U.S. by 2017
  - Negative free cash flow of \$26.7 billion in 2012 & \$132 billion from 2007 through 2012

**U.S. Investor Owned Electric Utility Capital Spending & Free Cash Flow**

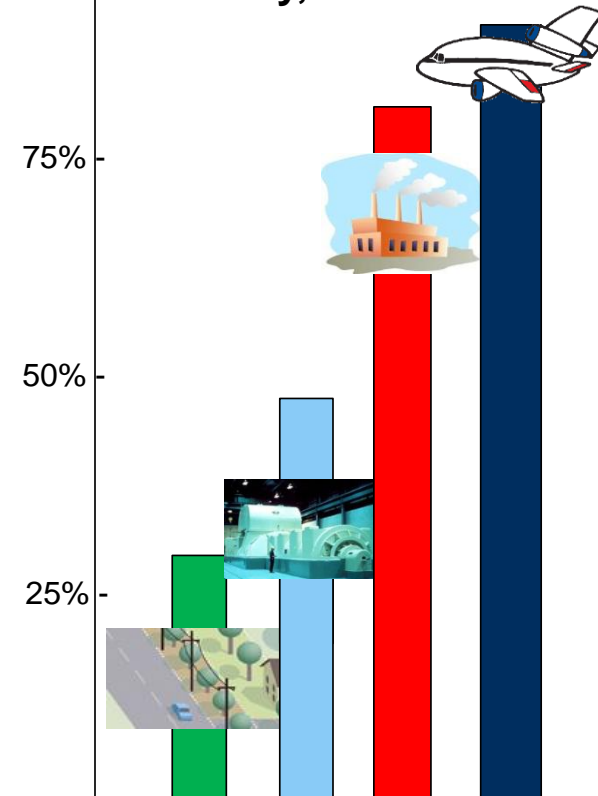


# Asset Challenge

- Average generation capacity factor <50%, T&D asset utilization often lower
- Average asset utilization: Capital intensive industries >75%, airlines >85%
- Solar & wind variability can require large shifts in generator output
- PV impact: California net load could ramp from <14,000 MW to >26,000 MW in 3 hours by 2020  
**CA >12,000 MW Shift in Net Load by 2020**



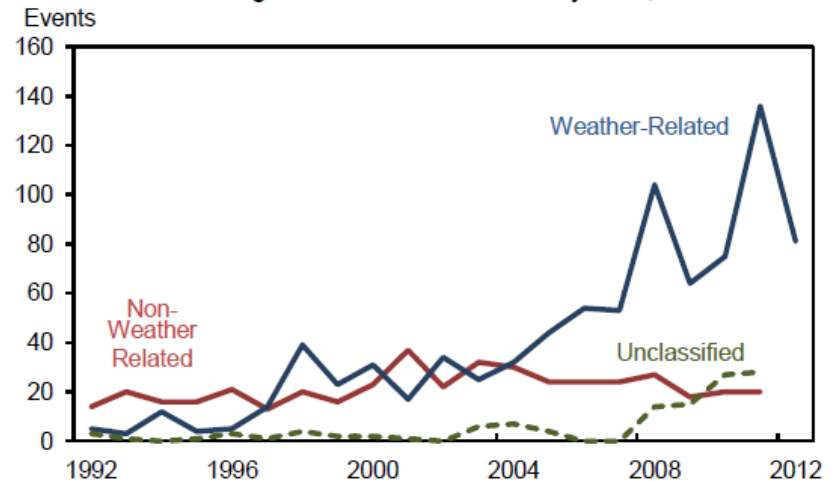
## Asset Utilization T&D, Generation, Industry, Airlines



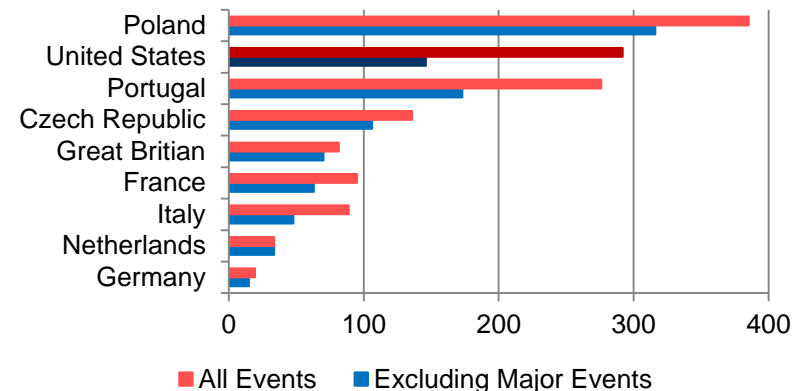
# Reliability Challenge

- **Grid Resilience Critical to Society**
  - Sandy changed consideration of reliability
  - Critical infrastructures & customers dependent on digital information & control technology
  - National Climate Assessment: increased potential for extreme weather, peak electric demands, coastal flooding, & cooling water shortages
- **Value of uninterrupted service is seldom quantified**
  - Reliability investments based on inconsistent heuristics

Observed Outages to the Bulk Electric System, 1992-2012

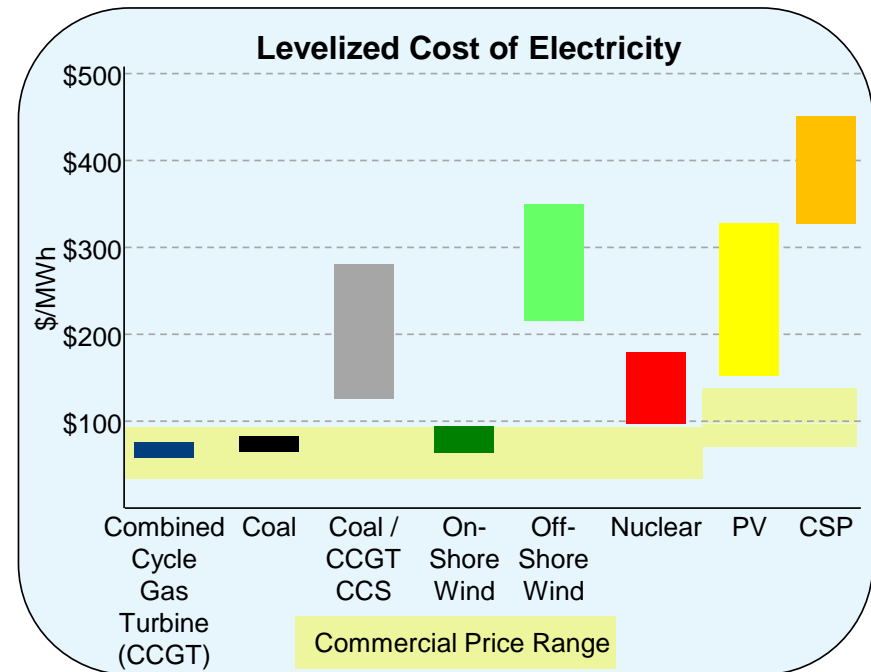


Average Minutes of Service Interruption Per Customer

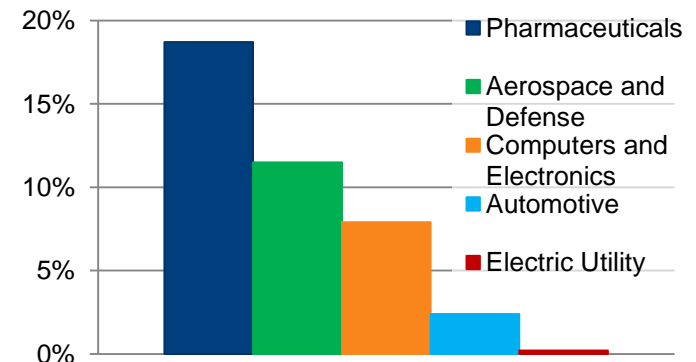


# Innovation Challenge

- **IPCC 5<sup>th</sup> Report: Cumulative emissions budget to stabilize at 2°C warming = 1trillion T carbon**
  - Coal fired generation in developing world could break budget in 30 years
- **Low carbon electric generation remains more costly than higher emitting sources**
- **Electric utilities spend approximately 0.2% of revenue on research and development**
  - This is less one-tenth the average rate of 3.6% for all sectors of the U.S. economy and much lower than in the most productive sectors



## R&D Spending as a Share of Sales



# Regulate for Future Results

*“The single most widely accepted rule for the governance of the regulated industries is regulate them in such a way as to produce the same results as would be produced by effective competition, if it were feasible.” - Dr. Alfred Kahn, *The Economics of Regulation: Principles and Institutions* (1970)*

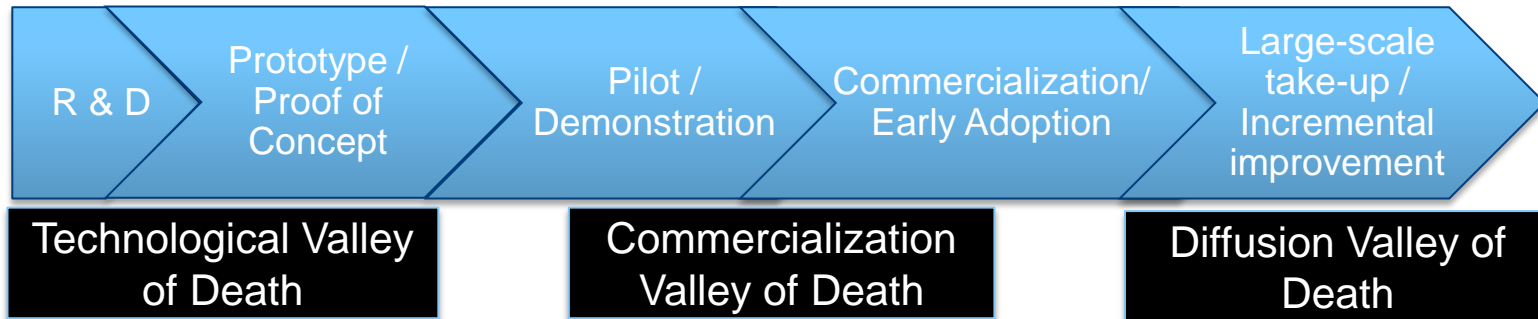
- **Conventional regulation focuses on minimizing utility costs to ensure reasonable rates consistent with adequate service – *Static Efficiency***
  - If rising costs + low growth, disincentive to investment & cost savings
  - Lengthy regulatory reviews thwart innovation
- **Connectivity & advanced technology = *Dynamic Efficiency***
  - Connected, modern grid is producing significant benefits
- **Results Based Regulation: Contract for future performance**
  - Regulator reviews utility business plan & sets performance Incentives
  - Multi-year revenue plan can incent cost savings that could be shared with customers
  - Funding can be provided for innovation projects

# Make Prices Transparent to Every Device, Anywhere, All the Time, As Inexpensively as Possible

- **Energy’s “Holy Grail” – Storage Capabilities of End Use Devices**
  - Most uses have thermal inertia (heating, cooling, water heating, & refrigeration) and/or flexibility (pumping loads, industrial batch processes, pool pumps, dishwashers, clothes driers, & charging of vehicles & battery powered devices)
  - Could shift power usage without materially impacting the services to consumers
- **Broadcasting in standard formats cuts the cost of engaging devices**
  - FM data channels reach virtually any location at fraction of AMI to HAN costs
  - Unit cost to receive, authenticate & identify signal for device location <\$1 per device
- **Relative Prices = Useful Information: A few hours of indicative look-ahead interval prices could efficiently position demand**
  - Just as KAYAK can find low air fares or Pandora can match musical preferences, millions of electricity consuming devices could automatically find low cost power consistent with customer preferences for heat, cooling, hot water, & other services



# Strengthen Innovation Systems



- **Needed: Globally Affordable, Low Carbon Options that can be Rapidly Deployed**
  - Flexible power systems to support their integration
- **Utilities can be key players in a larger initiative:**
  - Expanded R&D Programs
  - Anchors for regional innovation clusters
  - Test beds for demonstrating new technology
  - Accelerating standards development
  - Supporting learning by doing
  - Partners in international initiatives



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