Strategizing the Grid: Who Should Worry About the Long Term?

Mariann Jelinek, Ph.D.
The Richard C. Kraemer Professor of Strategy
Mason School of Business
College of William & Mary
On February 26, 2008, a technician performing a checking function at a substation in mid-Florida shut down two safety systems to carry out a task.

Moments later, the substation failed, and

Power was cut to two nuclear power stations, which shut down, and

2 to 3 million Florida customers were left in the dark
More, Bigger Outages?

- There seem to be “more” big outages, and more than statistically predicted: outages map to power law distributions
- Outages, interruptions and “dirty power” (spikes and sags) have more impact because of computerized “everything” in homes, offices, hospitals, factories …
- 2002-2004 outages affected more than 130 million worldwide
How Come?
The “Usual Suspects”

- “Old” grid infrastructure connected, stressed by growth, trading, bottlenecks, economic disincentives to investment

- Poor maintenance or operating practices

- “Deregulation’s” unanticipated consequences:
  - Decoupled generation, transmission, utilities, trading
  - Escalated transmission (with no infrastructure relief)
  - Exacerbated “Minimize cost/Maximize revenue” thinking
What to do?
The Usual Responses

- "Old" infrastructure: *Build more, newer infrastructure*
- Poor maintenance or operating: *Train, penalize, enforce*
- "Deregulation’s” unanticipated consequences: *Reconsider deregulation, tweak it or roll it back*
BUT:

- All of these assume the same general pattern, technology and system – essentially unchanged
- Fundamental rethinking is dismissed as impractical
- Looming Threats and Opportunities are out of sight
Electricity’s Wicked Problem

- **The Grid Itself:** Its system links, behavior and performance characteristics, interconnection, potential for entrainment and cascade effects

- **The Consequences of Outages:** Currently borne entirely by ratepayers, with little/no enforcement on reliability

- **Security Implications of Increasing Dependence:** consequences (increasingly frequent) low probability, high impact events

- **Technology and Convergence:** Potential for blind-siding the industry
Critical Issues:

- Reliability and security of a given firm’s grid
- Reliability, security and robustness of grid as a whole
- $100 \text{ bbl} + \text{Oil, Expensive Natural Gas, Environmentally-Constrained Coal & Nuclear}
- The Attractiveness of alternatives accelerates …
- The potential for Different Regulatory Regimes
Strategizing the Grid

- **Geography of Demand** has driven supply location, rather than survivability of localized grid segments.

- **The Physics of Electricity** is rooted in the system that is; Alternatives? 90-sec cascade sequence vs femto sec switches, buffers, and automated controls.

- **Multiple Technology Factors**: Solar thermal, wind, geothermal and auto load shedding, isolation, phase match.
Overview of Grid

Power Grid
  Maps past
  Supply-Demand, Technology & Regulations

Technology
  Coal, Oil & Nuclear Centrally-Generated & Transmitted

Institutional Structure
  Regulations on Pollution, Recoverable Costs, Ownership, Trading

New Technology Set

New Institutional Set
Strategic Vulnerabilities

- Older, in-place technology, capital investments, P&E
- Human resources trained in older technology and business models
- “Learned Strategic Blindness” (cf Bethlehem Steel versus the minimills, or the Big Three versus Japanese automakers)
- “Incomprehensible” New Analysis Tools and Business Models
Without power, our cities are essentially uninhabitable

Grid Vulnerabilities are potential targets: choke points and transmission lines, even individual plants

Capacity issues make the Grid vulnerable to gaming: Enron spiked prices by overloading transmission lines and diddling supply by closing plants

Unacknowledged vulnerabilities are subject to Murphy’s Law
Company Security

- Complexity Science suggests the current system is “at the edge of chaos” – more, bigger outages are likely
- Simulations say outages follow Power Laws, not Normal distributions
- Network Analytics suggest alternative designs: an Internet-like Grid with multiple paths
- Pent-up customer resentment plus burgeoning technical possibilities generate rapidly change
Let the Games Begin!