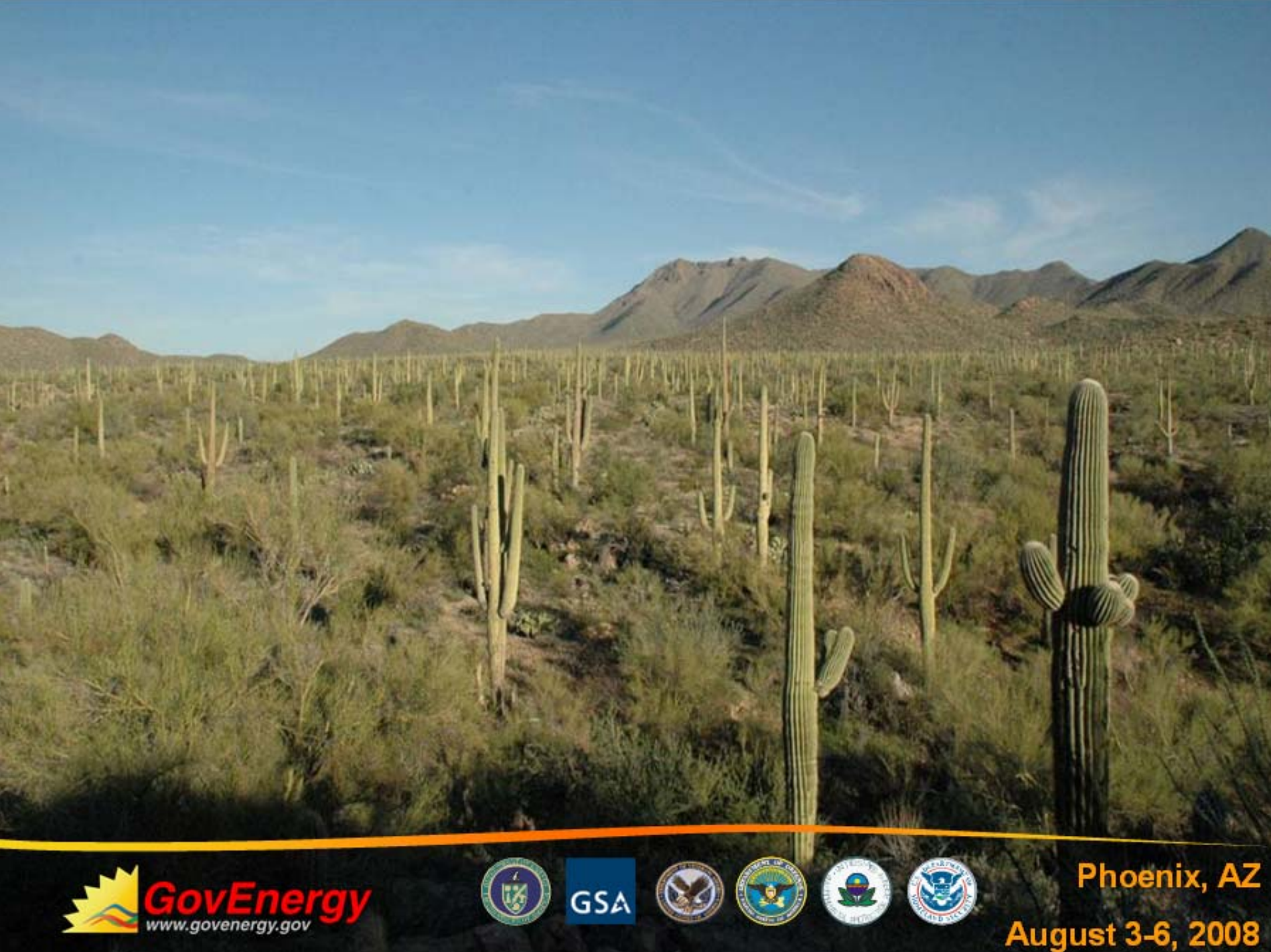
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GovEnergy 2008
Mission Critical Energy Security
A MicroGrid Solution

August 7, 2008

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Agenda

- Definitions
- PQR Trends
- Energy Security Dilemma
- Recent Large Area Outages
- Grid Reliability Trends
- Renewable Energy Influence: Wind
- Renewable Energy Influence: Solar
- Energy Security Solutions
- MicroGrid: Fort Detrick

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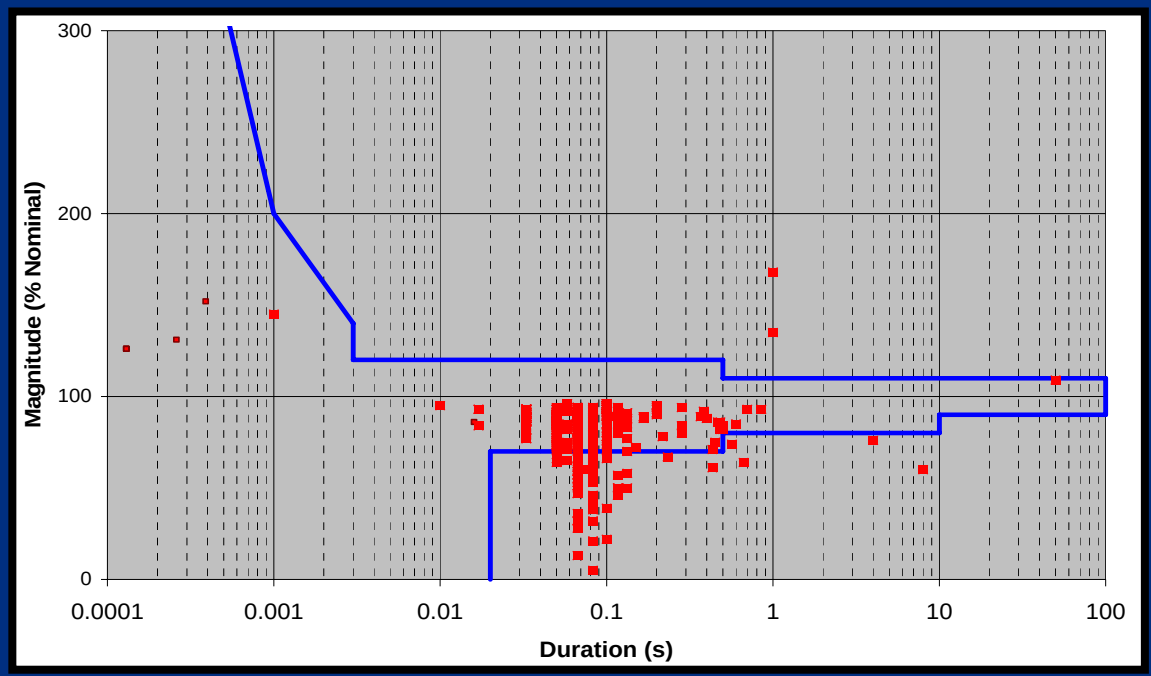
Definitions

- What is “Energy Security”
  - Google – 2,330,000 hits
  - Wikipedia
    - Geopolitics / Prices / Terrorism / Peaking Supplies
- For this presentation “Energy Security” will be defined as:
  - “A flow of energy of sufficient reliability and quality so that mission is not negatively impacted.”
- Limited to electrical energy
- Energy Security = Power Quality & Reliability (PQR)

Definitions

Power Quality

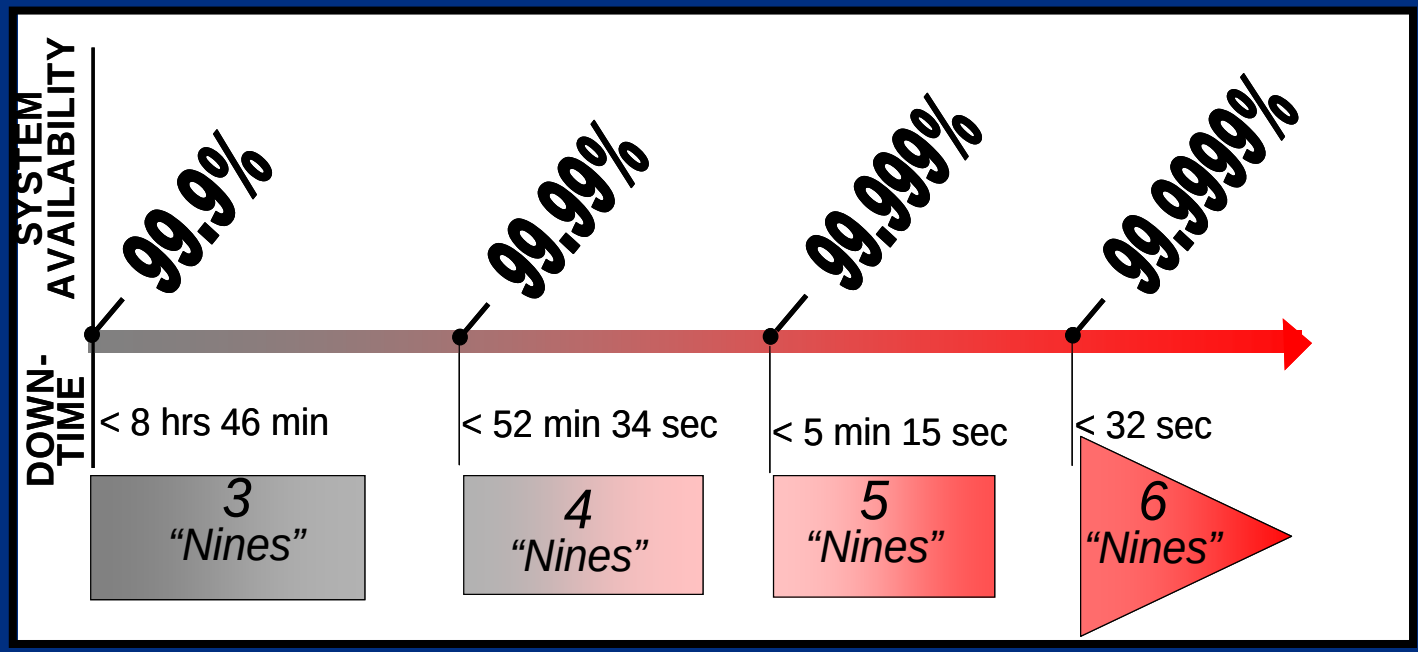
- Sags / Swells / Transients / Harmonics
- Metrics – CBEMA / ITIC Chart



Definitions

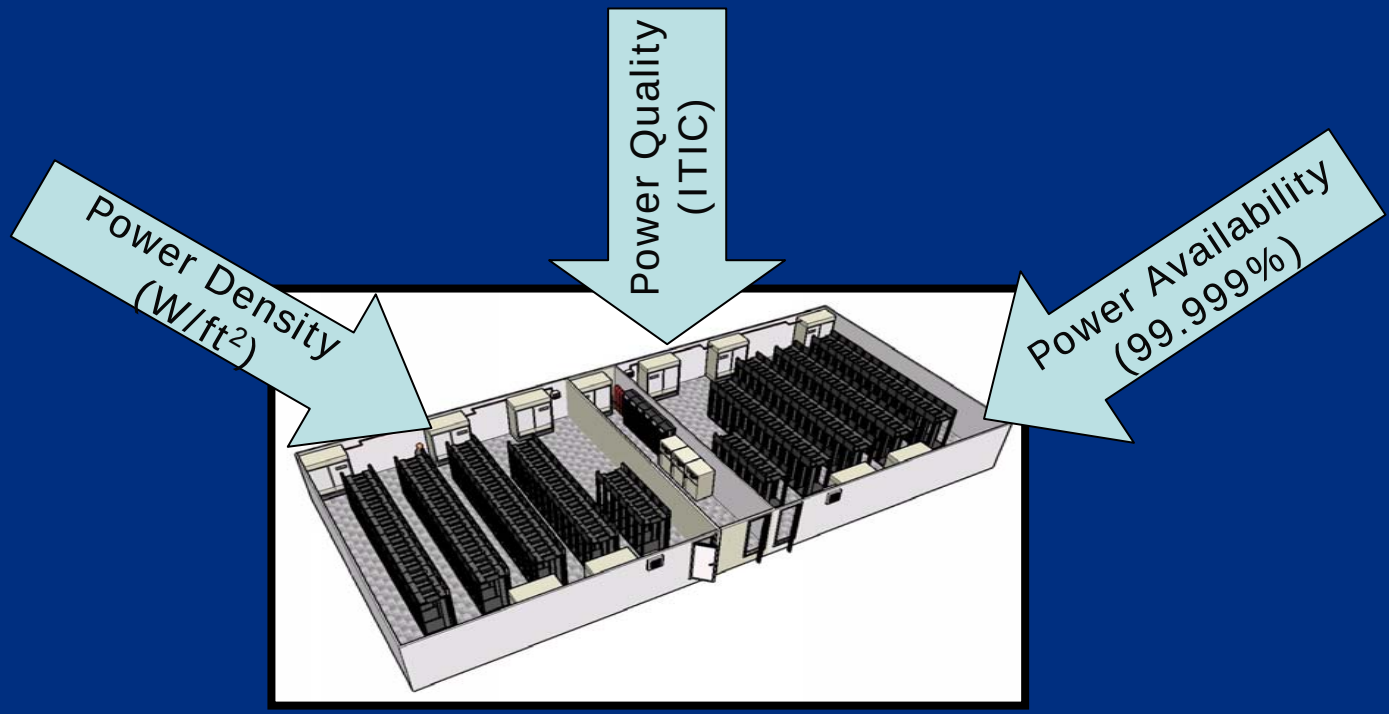
Power Reliability

- Interruptions / Outages
- Metrics - Availability



PQR Trends

- "Data Center Convergence"



- Increasing PQR requirements for traditional loads

PQR Trends Increasing Power Quality Requirements

- Driven by Connected Load Sensitivity
- DOD C^4ISR Facilities
  - Command – Intelligence – Surveillance – Reconnaissance
  - Control
  - Communications
  - Computers
- DOD Industrial Facilities
  - Process Control Devices
  - Facility Control Devices (VFDs, etc)
  - Environmental Stability (+/- 5% RH)
  - Uptime Environment / Costs
- Labs / Medical / Other
  - Inspection Devices
  - Cycle-time risks
  - Safety

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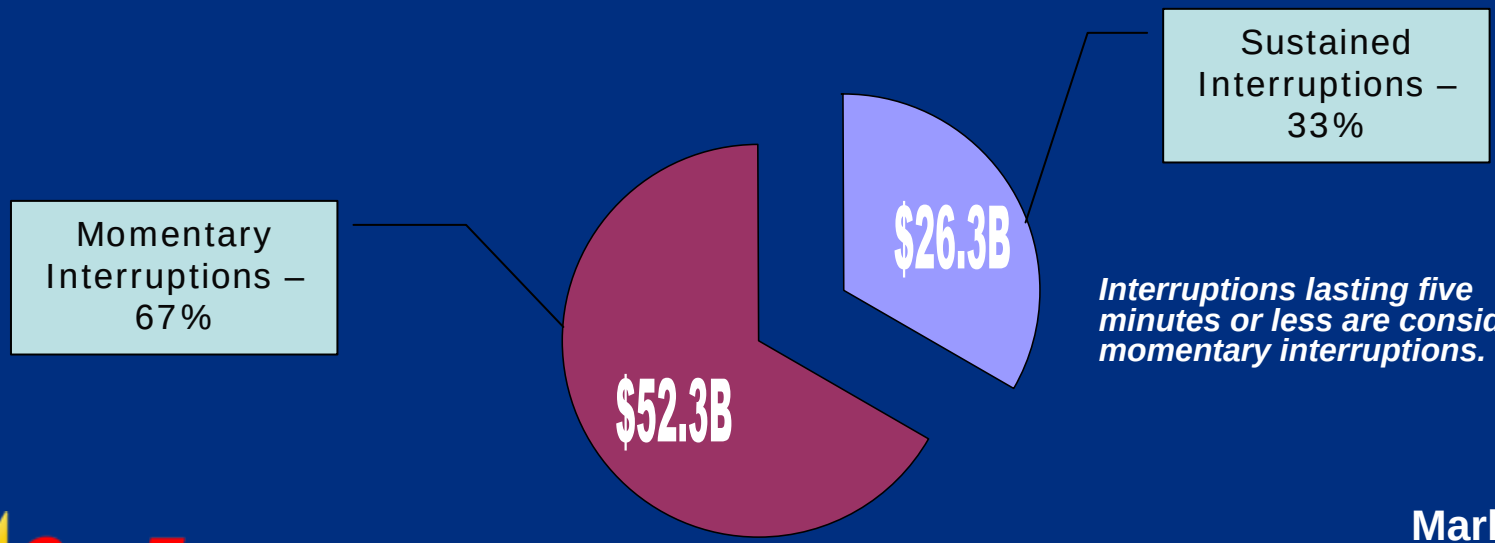
PQR Trends Increasing Power Reliability Requirements

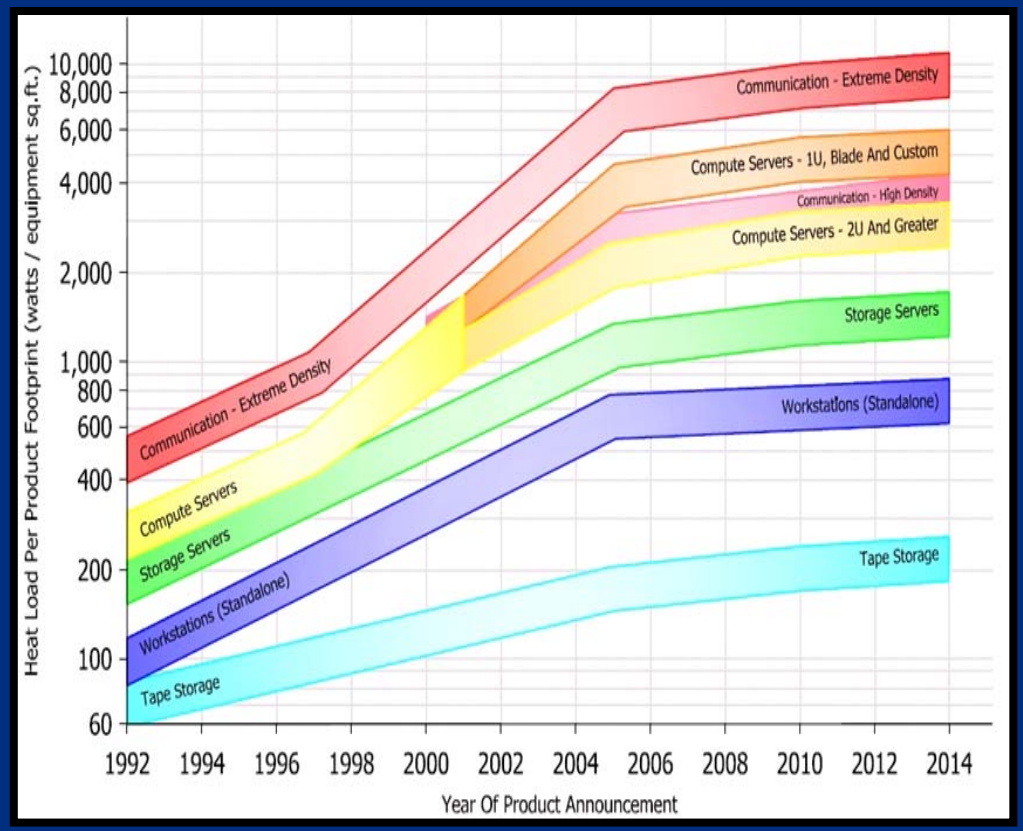
- Driven by business, mission needs
- Driven by business, mission cost
  - EPRI estimate of the cost of power interruptions by types of interruption
  - Cost to U.S. $79 billion annually (2002)



Interruptions lasting five minutes or less are considered momentary interruptions.

PQR Trends Increasing Power Densities

- Driven by greater:
  - Staff density
  - Equipment density
  - Computing density
  - Shorter cycle-times
- Office/HQ facility
  - 12W/ft^2



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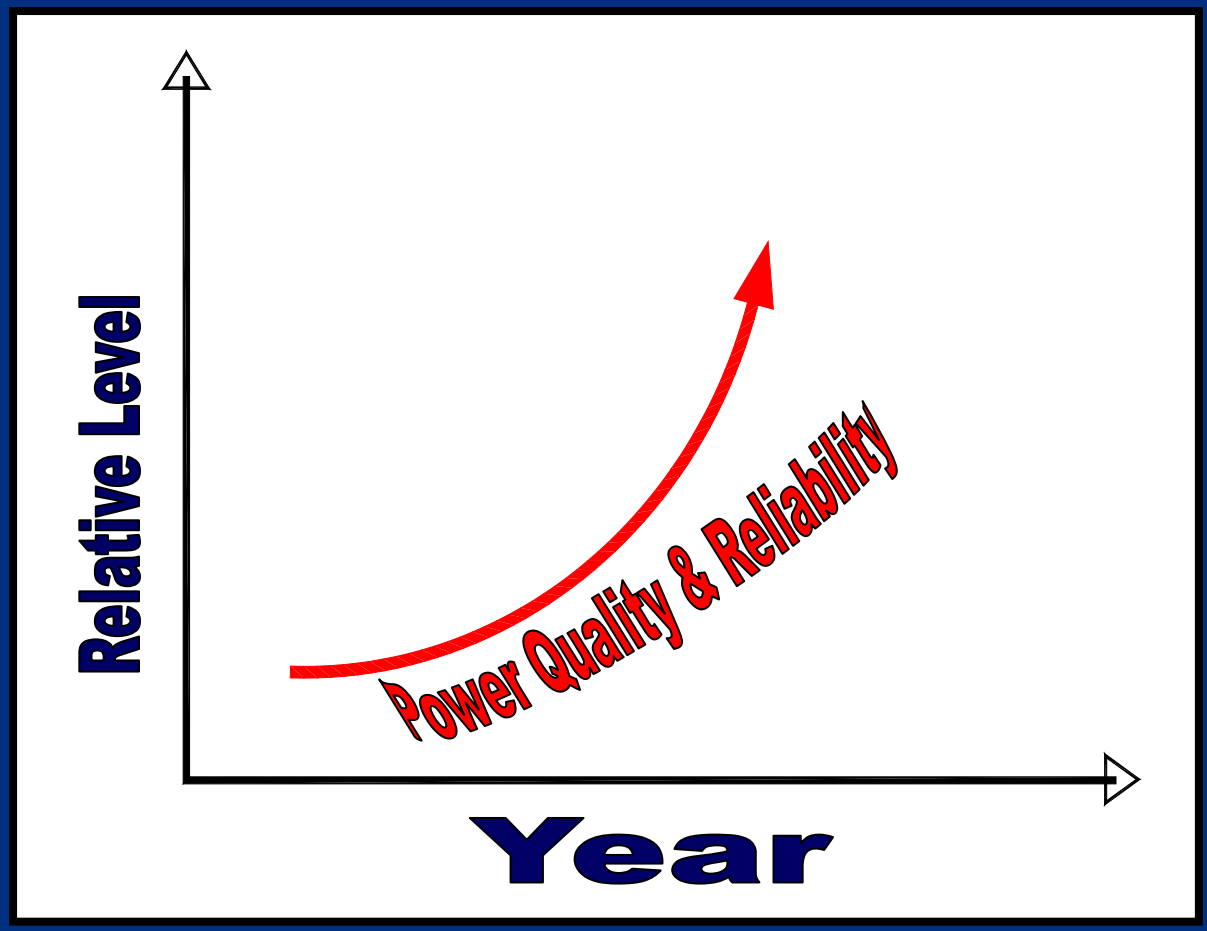
Energy Security Dilemma



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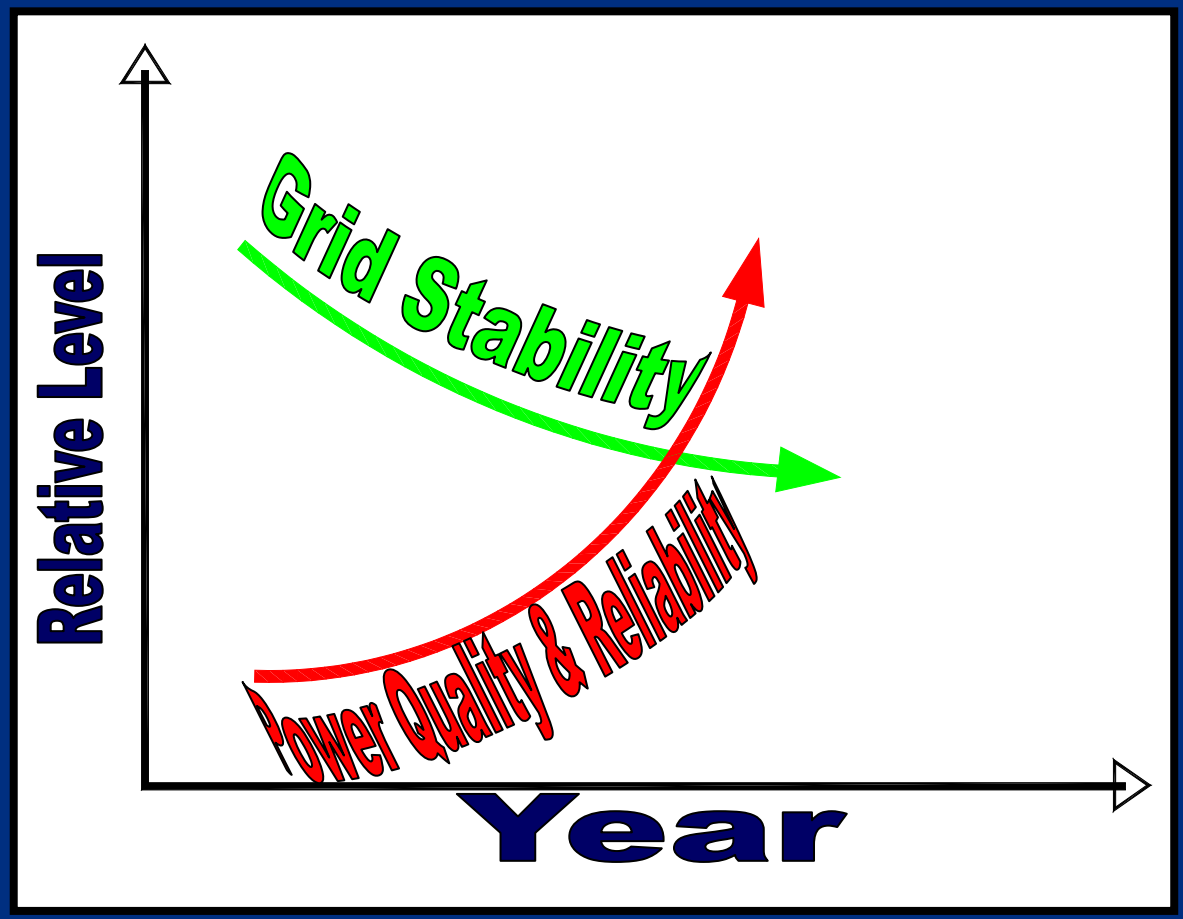
Energy Security Dilemma



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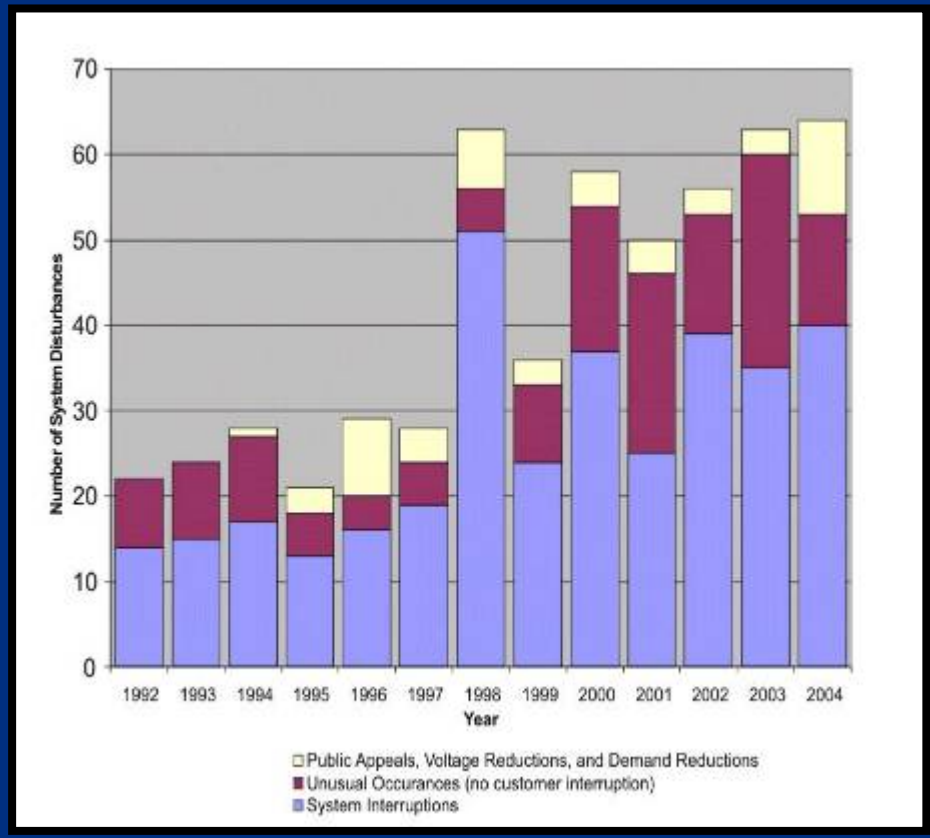
Recent Large Area Outages

Year	Date	Location(s)	Occurrence	Affect
2005	Aug 29	LA, MS, AL	Hurricane Katrina	All electricity lost
	Oct 24	S and SW Florida	Hurricane Wilma	3.2 million users initially lost power with hundreds of thousands without power for over a week. Power not completely restored until November 11.
	Dec 15	Atlantic Coast	Winter weather with extensive ice damage	Power loss
2006	July 18	NE U.S., Delaware Valley	Violent storms, wind damage	> 365,000 without power
	Nov 30	St. Louis, MO	Winter storm	Power lost for 1-2 days
	Dec 1	Long Island, NY	Fire in Electrical Department	Power lost for all residents
	Summer	East Coast	North American Heat Wave	>50,000 without power for up to a week. Power restoration compromised by power lines and transformer catching on fire, melted, or failed.
	July 19	St. Louis, MO	Heat wave with temperatures reaching 104°F	> 486,000 without power, with some affected for up to 9 days
2007	Jan 12-24	Across US	Snow and ice storms	Loss of power: ▪ Atlantic Canada to TX – 1 million ▪ MO – 330,000 ▪ MI – 200,000 ▪ OK – 120,000
	June 27	NY	Power failure	136,700 without power
	Dec 8-12	OK to NE	Snow and ice storms	> 1 million without power
2008	Jan 4	CA	Winter rainstorm	1.6 million without power
	Jan 29	Dallas County, TX	Strong wind gusts	70,000 without power
	Feb 26	Miami, FL	Failed switch and fire at electrical substation	4 million without power

Grid Reliability Trends

- Typical grid selection outage chart
- Increasing frequency of outages
- IEEE “Gold Book” grid availability
  - 99.97% available
  - = 2.6 hrs/yr outage
  - Does **NOT** include “momentary” (<5 min) outages
- Major influencing factors
  - Greater demand
  - Aging infrastructure
  - *RENEWABLES*



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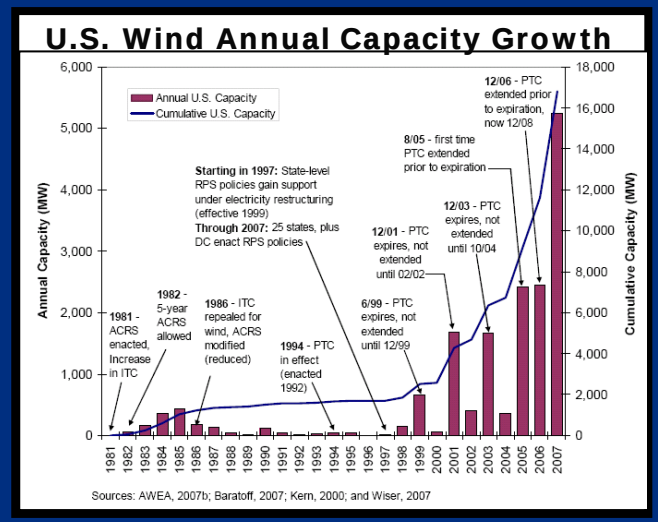
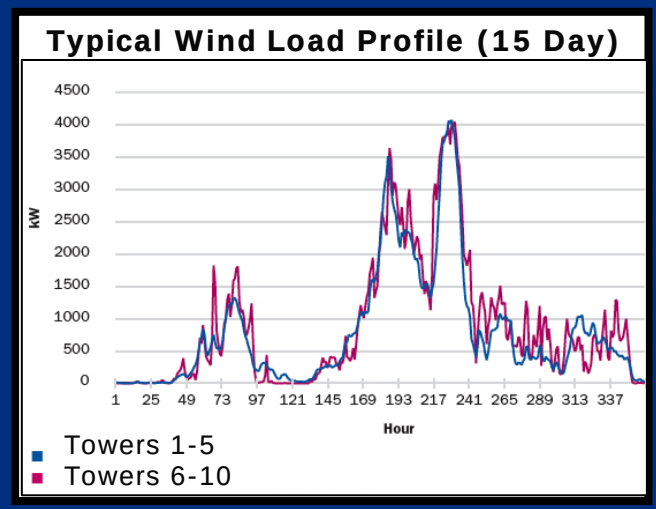
Renewable Energy Influence: Wind

- Huge capacity ramp
- 2007 1.7% of electrical U.S. production and growing
- Highly variable capacity factor
- Grid volatility & instability
  - West Texas (ERCOT) February 2008





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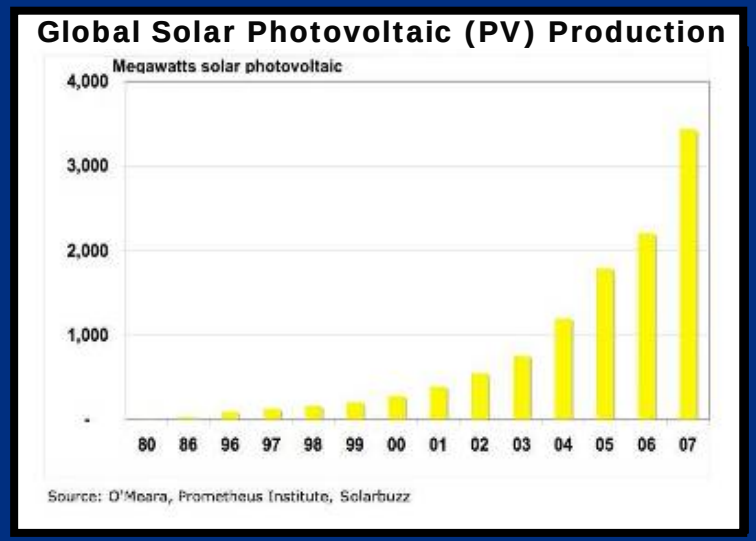
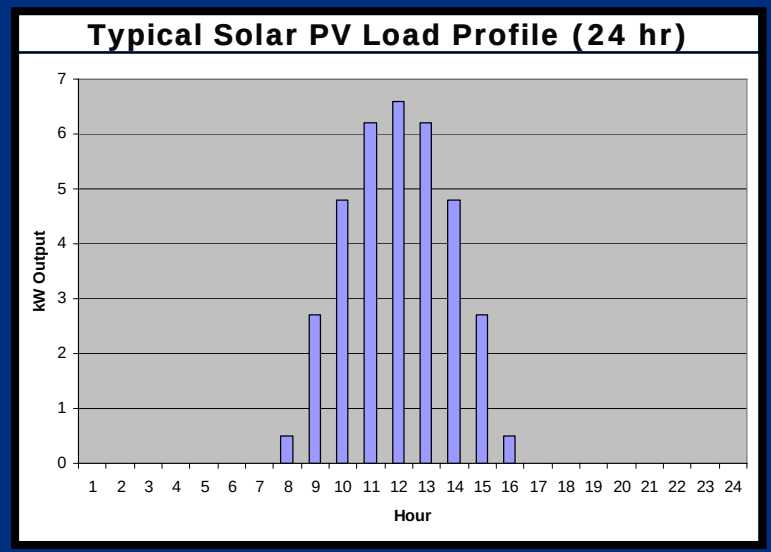
Renewable Energy Influence: Solar

- Similar capacity ramp
- Similar capacity variability
- Less utility scale generation
- Loss grid volatility (for now)

Contra Costa Community College District (CCCCD) PV Panels





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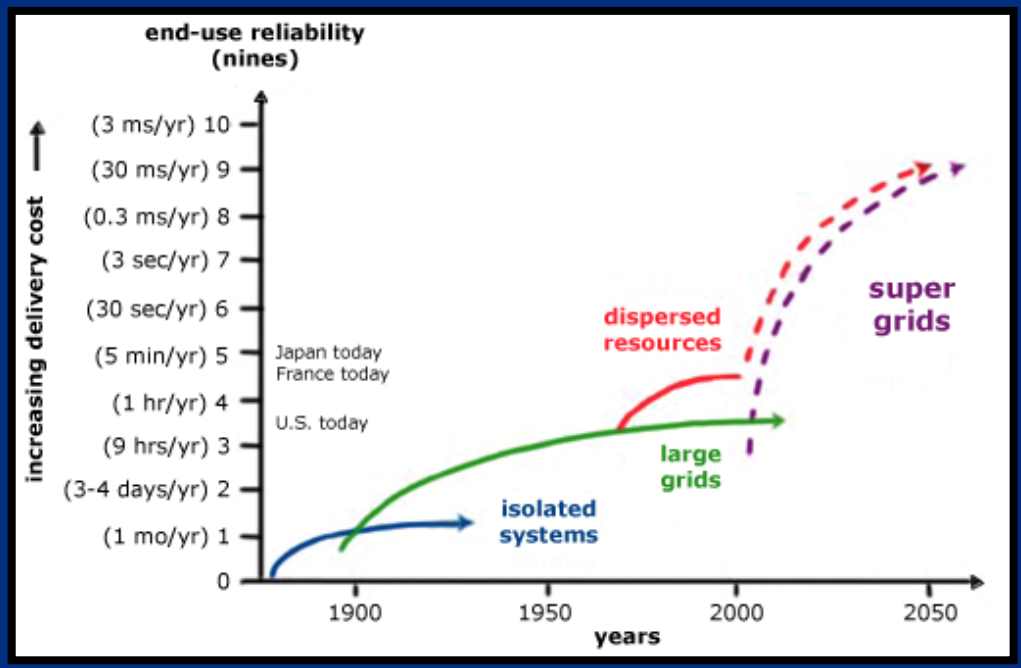
Energy Security Solution

DOE PQR – Power Quality and Reliability Studies

- "SuperGrids" required in future to address mission-critical loads with ever increasing power quality requirements
- Significant infrastructure & capital needed by 2030
- What can be done **NOW**?



U.S. Department of Energy

MicroGrids and Heterogeneous Power Quality and Reliability - 2007

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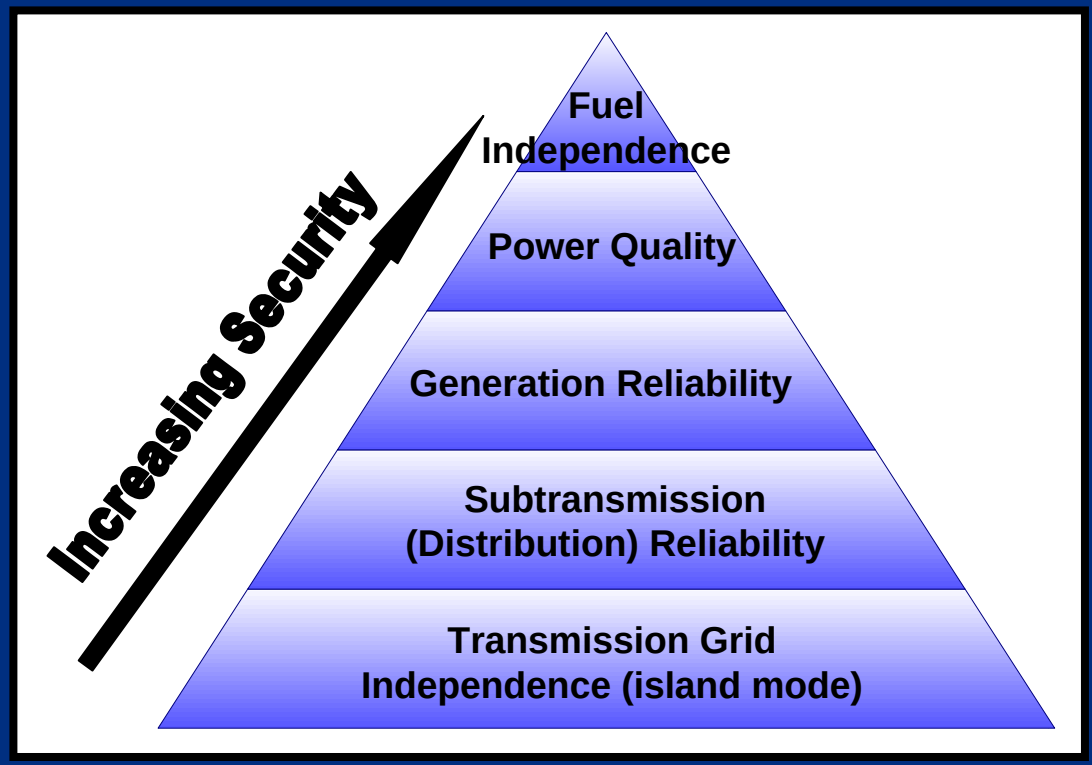
Energy Security Solution: MicroGrids

Installation Level MicroGrid

- MicroGrid Electrical Supply Chain



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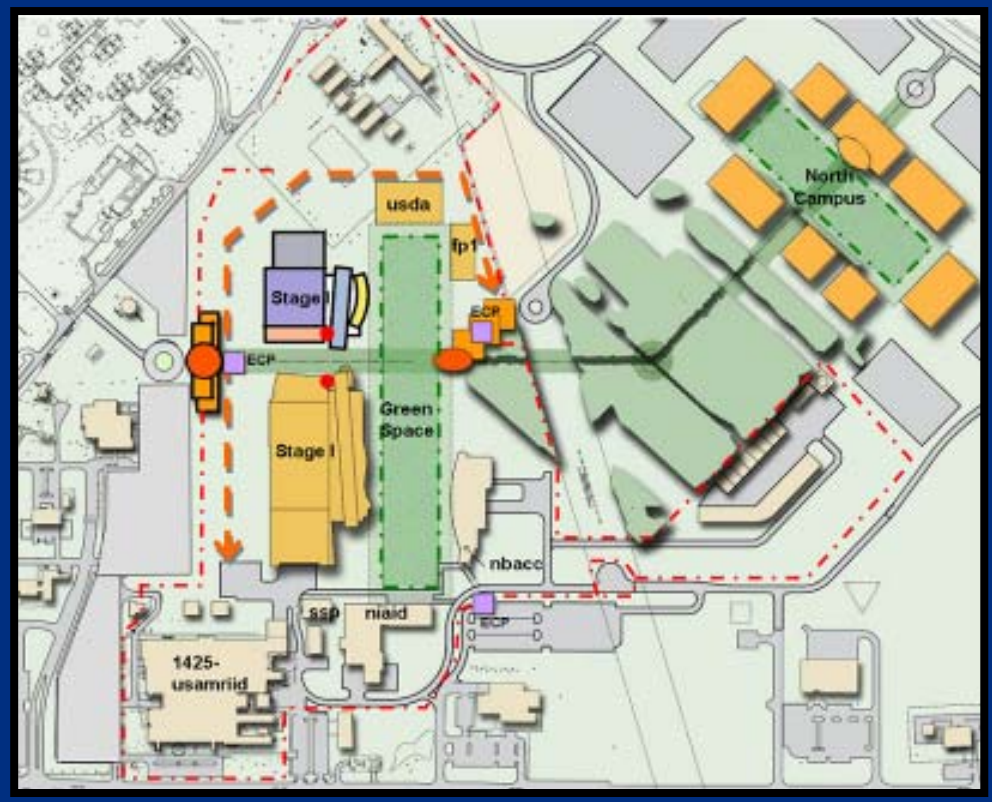
MicroGrid Solution Example: Fort Detrick

- National Interagency Biodefense Campus
  - National Institute Allergy and Infectious Diseases – Integrated Research Facility ***NIAID-IRF***
  - National Biodefense Analysis and Countermeasures Center ***NBACC***
  - United Stated Army Medical Research Institute for Infectious Diseases ***USAMRIID Stage 1***
- High PQR Requirements
  - BSL-4 Labs



Proposed NIBC Final Facility Build-Out

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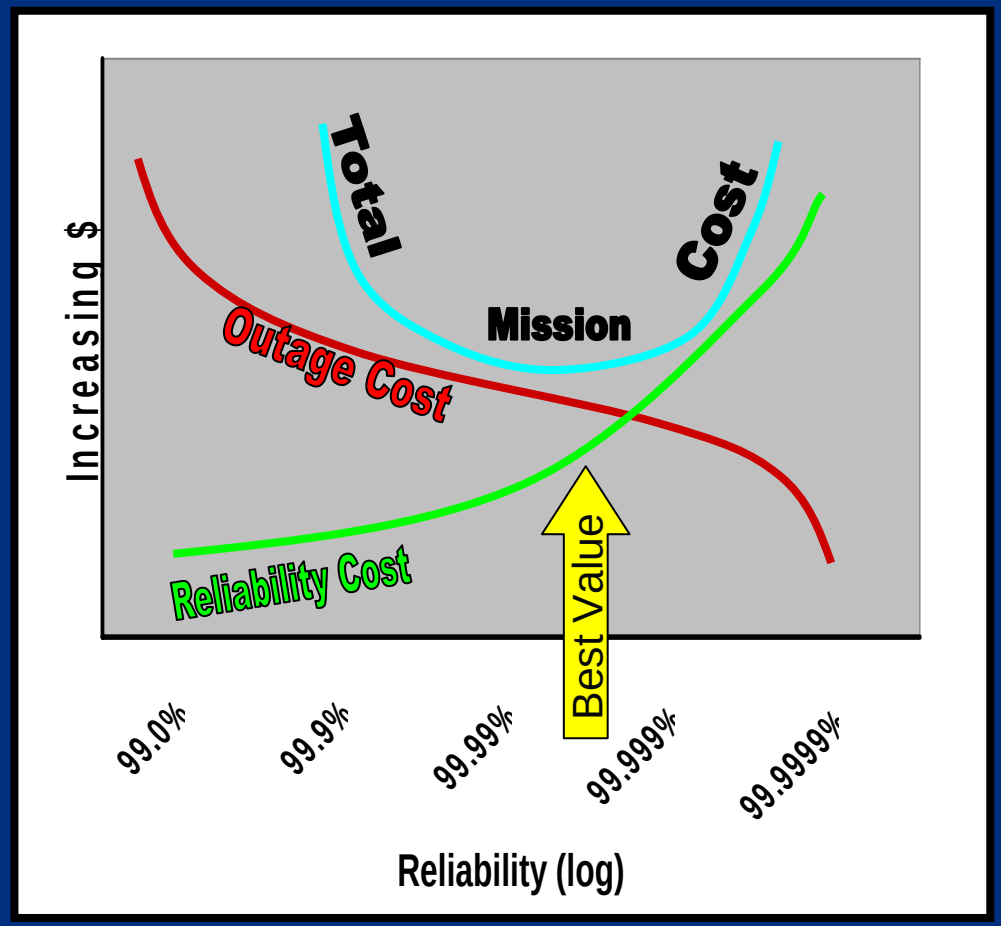
Critical Steps

Determine PQR requirements, quantitate reliability, find best value balance point

- Avoid qualitative reliability specifications (N+1, 2N, etc)
- Probabilistic Risk Analysis (PRA)
- Target Costing
- Determine low point in Total Mission Cost curve



Energy Security, Transmission Grid Independence

- 100% of load on standby generators
- Whole campus islanding
  - 5 X 1.67 MVA
  - 2 X 2.0 MVA
- Bump-free transitions
  - No 10-second delay
- Long-term fuel storage
  - 140,000 gallons

Detrick CUP

Detrick Diesel UPS

Detrick Fuel Oil Storage

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Energy Security, SubTransmission Reliability

- N+N redundancy for all underground feeders
- 3 of 4 feeder failures required prior to facility impact

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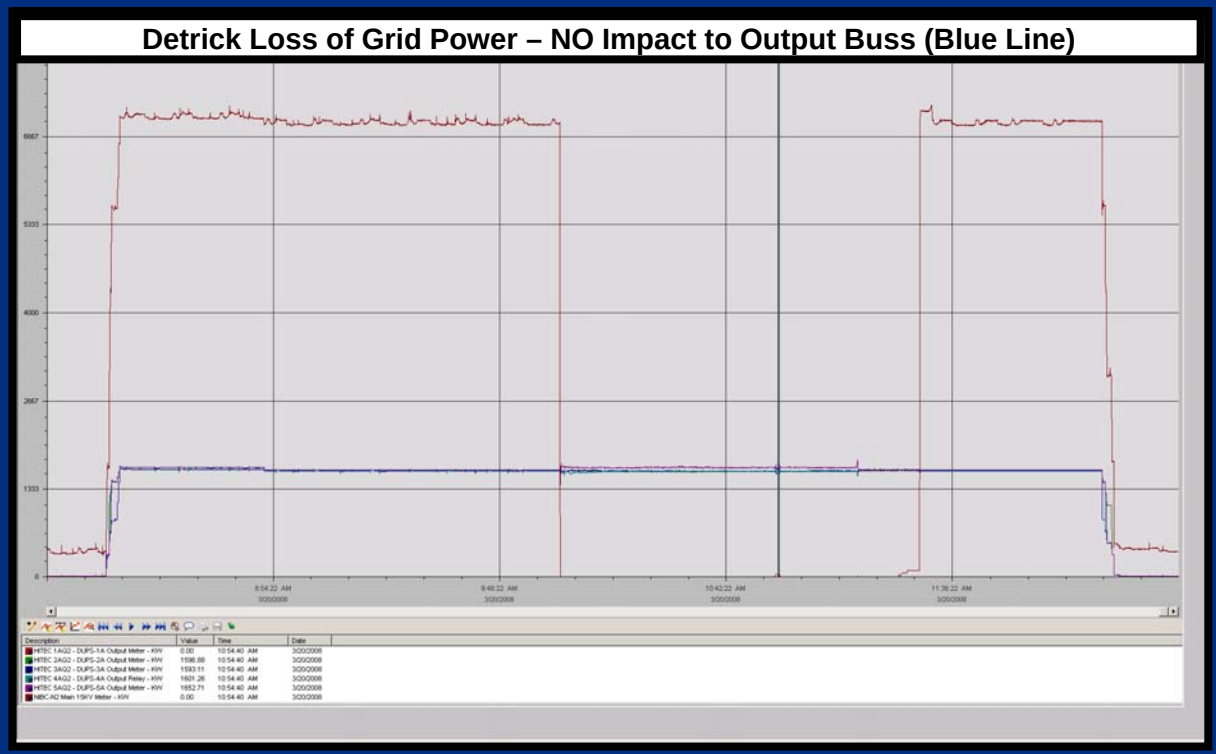
Energy Security, Generation Reliability

Iso-Parallel electrical topology

- Shared redundancy
- Turns 2 into 5 feeders
- Security & flexibility
- Critical load is shared among all DUPS systems
- Equalized loading on the systems

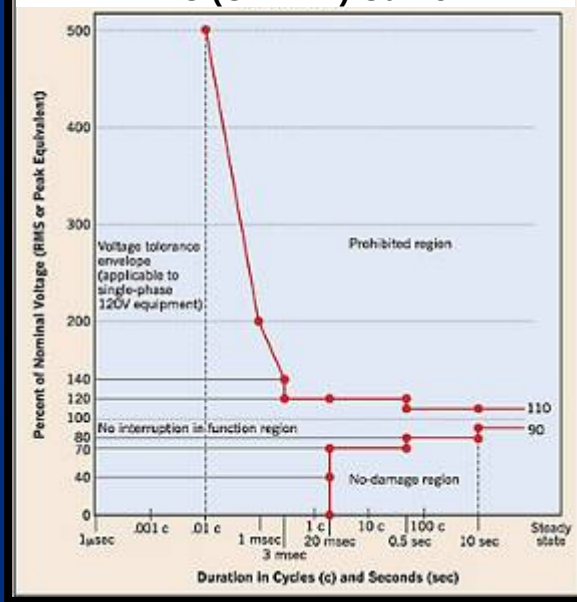


Energy Security, Power Quality

- "Rock Solid" Electrical Supply for Stable Operations
- Diesel UPS (Rotary or "flywheel")
  - Filters utility disturbances
  - Spikes, sags, transients
  - Seamless utility transitions
- Power Purchase Agreement
  - Must meet ITIC
  - Outside ITIC considered unavailable
  - Must be minimum 99.999% available

Diesel UPS Cutaway – Induction Coupling

ITIC (CBEMA) Curve



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Energy Security, ATFP (extra credit)

Satisfies anti-terrorism force protection requirements while meeting NIBC aesthetics

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Final EPC Results

- Fast-track design-build-operate
  - Overall schedule: 21 months
  - 14-month duration from mobilization to utility flow
  - < 6 months lead time for all equipment
- On time
- On budget

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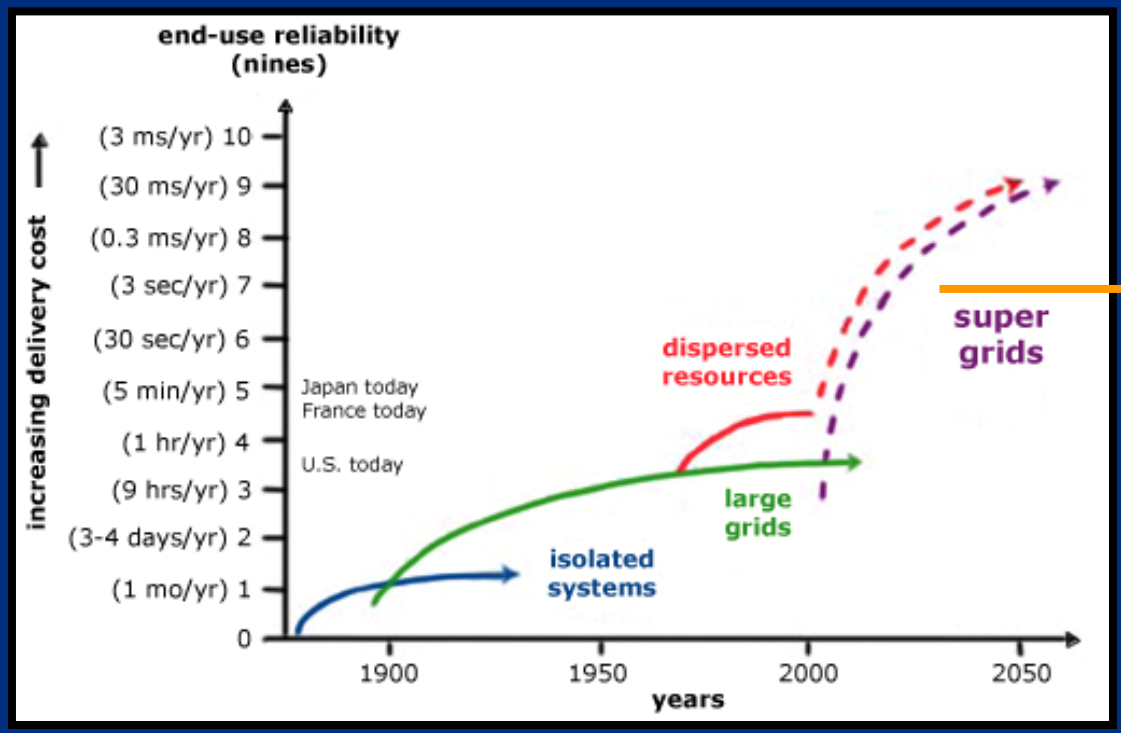
Energy Security, Power Quality & Reliability Results

Fort Detrick CUP and MicroGrid presently most secure district energy plant in DOD

- **Modeled at 7 “nines” availability (99.99999%) to ITIC (CBEMA) Power Quality Standards**
- **Only district energy plant providing comprehensive long-term availability warranties backed by liquidated damages.**



Current SuperGrid

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Fort Detrick MicroGrid

Questions?

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For More Information

- Would you like to know more about this session?

Mark Vilchuck
Chevron Energy Solutions
2600 Eagan Woods Drive, Suite 300
Eagan, MN 55121
mvilchuck@chevron.com

Don’t forget to fill out and drop off your session evaluations!