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The Green Grid Technical Forum

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Utility Incentive/Rebate Initiatives
Panel Session

Pacific Gas and Electric Company®

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Data Center Initiatives at PG&E

Mark Bramfitt, PG&E

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Topics

- The ABCs of utility energy efficiency programs:
  - Regulatory framework
  - Program principles
  - Program designs
  - PG&E leadership of national Utility IT EE Coalition

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About Us

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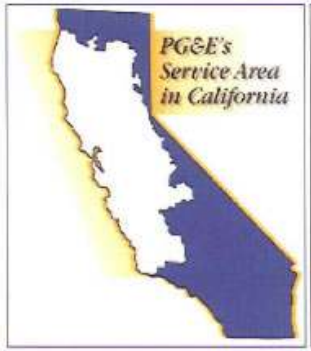
Pacific Gas and Electric Company (PG&E)



- $18 B+ Market Capitalization
- 20,000 Employees
- Provides energy to 15 million or nearly 1 in 20 people in the U.S.
- 70,000 square-mile service territory
- More than half of our electricity comes from sources that emit no CO2

Electric and gas distribution customers	5.0 MM electric 4.2 MM gas
Electric transmission circuits Electric distribution circuits	18,616 miles 120,000 miles
Gas transmission backbone Gas distribution	6,128 miles 40,123 miles
Electric generation capacity Nuclear (1), Fossil (2), Hydro (110) Plants	6,420 MW 22,544 Peak MW

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The Philosophical Question

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Why do we promote using less of our product?

Because we don't have a "traditional" business model. We don't earn money by increasing sales, and we are financially rewarded for cost-effectively delivering energy savings

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Regulation

- Utilities are "natural monopolies", with only marginal competition
- State agencies (PUCs) provide oversight and regulation, approving rates and business practices
- Most states have "basic" regulation; California is clearly trend-setting

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"Basic" Regulation

- Regulators focused on moderating rates by controlling utility cost structure
- Regulators can and do mandate/approve energy efficiency programs, but:
  - They are usually modest in scale
  - They are often targeted at residential customers
  - Utilities have no incentive to do anything more than what is required
- This is the paradigm in 46 states

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"Enlightened" Regulation

- Based on support from regulators, legislators, customers, utilities, environmental groups, and other interested parties
- Desire to promote energy efficiency, and to provide the regulatory environment that will make utilities succeed in delivering programs

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Regulatory Environment

- CA utilities are protected from sales swings – sales don't determine profits
- Energy efficiency is first in power supply "loading order"
- Utilities are financially rewarded for meeting EE targets

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Regulatory - Summary

- PG&E is **not** penalized for reducing sales
- PG&E **is** rewarded through a profit mechanism for energy efficiency programs
- Vast majority of utilities in US don't have either of these frameworks

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Program Design

- Key drivers:
  - Amount of energy savings
  - Cost-effectiveness
  - Customer acceptance
- Must meet regulatory requirements/principles:
  - Reward "premium" efficiency only
  - Based on defensible standards
  - Withstand evaluation, measurement, verification
  - Avoid "free ridership"

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Program Types

- Energy efficiency:
  - Training and education
  - Audits and technical support
  - Financial incentives and rebates
  - Innovative programs
- Demand response
- Self-generation

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Incentive Programs

- **Rebates** for mass market measures (equipment). Buy qualifying product, send in form and receipt, get set rebate
- **Incentives** for retrofit projects. File an application before the project is undertaken, supply engineering calculation or undertake pre- and post-measurement, paid on energy savings
- **Incentives** for new construction, submit application and engineering calculation showing performance beyond standards, paid on energy savings

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Innovative Programs

- Retro-commissioning: pay for energy savings for implementation of low- and no-cost measures, based on engineering calculations or measurement
- Direct install programs
- "Upstream" programs: incentives paid to manufacturers and/or retailers for sales of qualifying equipment

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Utility IT EE Coalition

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Pacific Gas and Electric Company

Southern California Edison — An Edison International Company

SDGE — A Sempra Energy utility

LA DWP — Los Angeles Department of Water & Power

Portland General Electric

BC hydro — For Generations

Austin Energy

TXU Energy

Oncor

City of Fort Collins Utilities

SRP

NSTAR

Duke Energy

LIPA — Long Island Power Authority

nationalgrid

Efficiency Vermont

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Contact

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Visit www.pge.com/hightech

Contact me with feedback and suggestions:

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Energy Efficiency in Data Center Facilities

Susan Andrews, NYSERDA

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Who Is NYSERDA?

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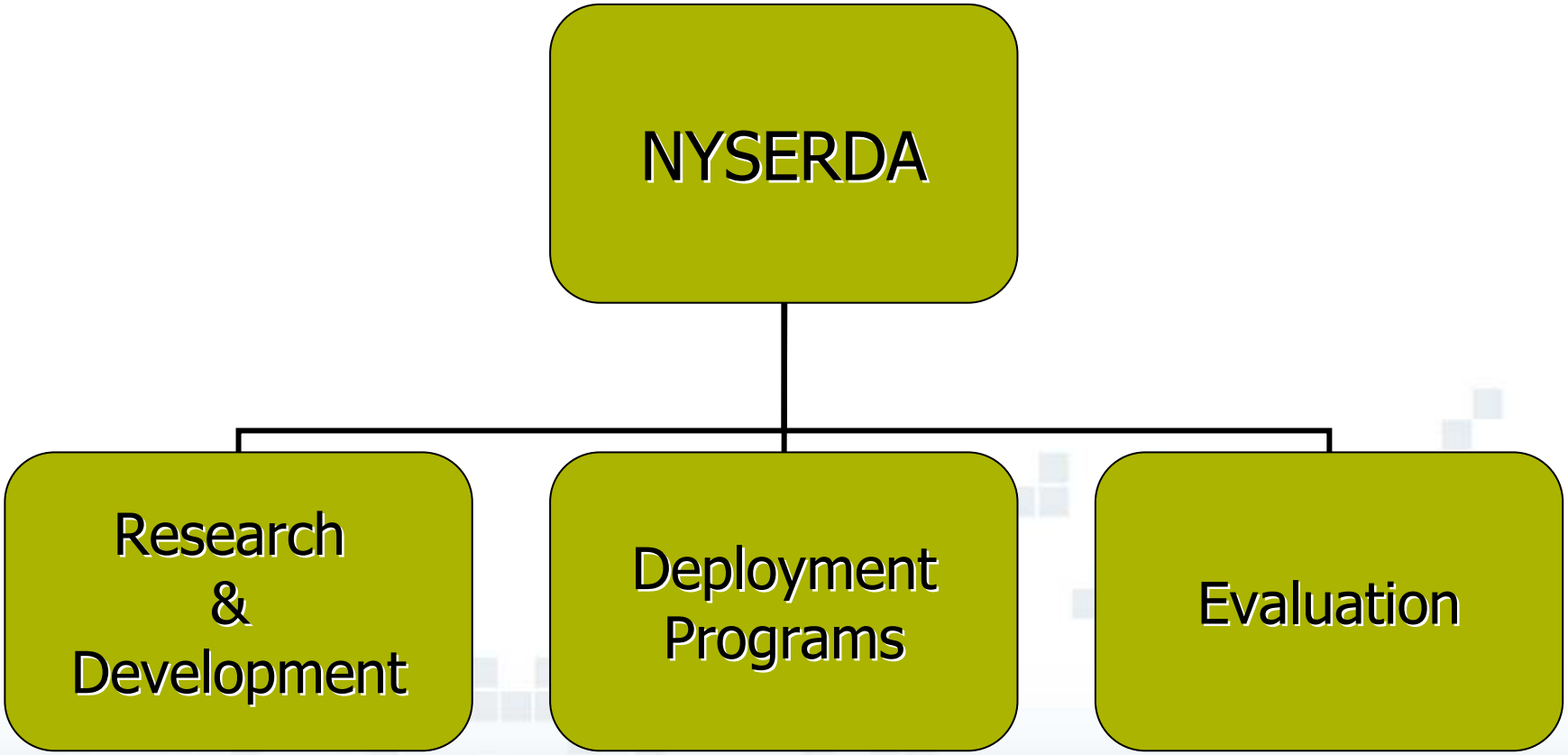

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NYSERDA Assistance

- **Implementation: Turn opportunities into actions**

- The NYSERDA Approach:
  - Comprehensive testing and benchmarking
  - Objective and un-biased technical review of energy efficiency opportunities
  - Appropriately balance risk, complexity, and potential cost savings
  - Partner with industry and trade groups
  - Market Development / Education
  - Sector-based

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NYSERDA Programs

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Deployment:

- FlexTech/Technical Assistance
- Enhanced Commercial/Industrial Performance Program
- New Construction Program
- Peak Load Reduction Program
- New York Energy $mart SM Loan Fund

Research & Development:

- Product Development
- Demonstration
- Technology Feasibility
- Education
- Market Development
- Advanced Concepts (Enterprise Class Systems)

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Deployment Programs

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FlexTech and Technical Assistance

- Use either pre-qualified list of engineering & consulting firms or consultant of your choosing
- Cost-share services include:
  - Feasibility studies
  - Detailed analysis of specific projects
  - Process improvements
  - Energy operations management
  - Retrocommissioning (RCx)
  - Combined Heat & Power (CHP)
  - "Energy Manager For Hire"

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Deployment Programs

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Enhanced Commercial & Industrial Performance Program

Customer or service provider have the option for cost-shared assistance in three ways

1. Prescriptive measures - Pre-qualified, generally for smaller projects
2. Custom-path technical study - Incentives based upon kWh saved or therms saved after performing a technical engineering analysis. Use a NYSERDA contractor or your own
3. Measured performance improvement - performance-based incentives for energy projects with verifiable annual electric energy savings. Measurement and verification is required

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Deployment Programs

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New Construction Program

- Available for both new construction and substantial renovation projects
- Financial incentives
- Technical assistance & computer modeling
- Commissioning
- Additional funding for LEED® rated buildings

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Deployment Programs

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Peak Load Reduction Program

- Focused on load reduction
- Incentives are kW "demand"-based, not kWh
- Open to both service providers and end users (customers)
- Funded recipients must agree to participate in the New York State Capacity Market
- Excellent opportunity for more precise measure and control of your facility's energy use (via advanced metering)

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Deployment Programs

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New York Energy $mart SM Loan Fund

- Interest rate buy-down
- Over 70 participating lenders
- A "flexible-fit" program that can be used in combination with other NYSERDA incentives

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Research & Development

- Product Development – direct cooling, liquid cooling, solid-state cooling, smart cooling, modular cooling
- Demonstration – of any new technology
- Technology/Feasibility – free cooling (use of outside air), energy efficient power conversion and distribution
- Education & market development – training, educational materials
- Advanced concepts data center project – demonstrate multiple technologies and agree to tech transfer (site visits, etc.)

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Research & Development

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Data Center and Server Technology

- Program Opportunity Notice PON 1206
- Seeks proposals to support the development and/or demonstration of innovative and emerging data center and server technologies
- Must demonstrate energy and economic benefits of technologies (basic research is ineligible). NY focus.
- $3 million available for Two Rounds (April 17, 2008 and November 13, 2008)

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80PLUS and Opportunities for Incentives

Brian Fortenbery, Electric Power Research Institute (EPRI)

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EPRI Overview

- The Electric Power Research Institute was established in 1973 as an independent, nonprofit center for public interest energy and environmental research

- EPRI brings together members, participants, the Institute's scientists and engineers, and other leading experts to work collaboratively on solutions to the challenges of electric power

- These solutions span nearly every area of electricity generation, delivery, and use, including health, safety, and environment

- EPRI's members represent over 90% of the electricity generated in the United States. International participation represents nearly 15% of EPRI's total research, development, and demonstration program

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EPRI Facts

- 33-year history
- 450 participants in over 40 countries
- 66 technical programs
- 1600+ research and demonstration projects annually
- 10 to 1 average funding leverage

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Extensive Technology Portfolio

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Generation & Distributed Resources

- Environmental Controls
- Major Component Reliability
- Combustion Turbines
- Maintenance, Operations and Workforce
- Advanced Coal Plant Portfolio
- Distributed and Renewable Generation Resources
- Generation Planning: Economics and Fuels

Nuclear Power

- Material Degradation/Aging
- High Performance Fuel
- Radioactive High-Level Waste & Spent Fuel Management
- NDE & Material Characterization
- Equipment Reliability
- Instrumentation & Control Hardware and Systems
- Nuclear Asset-Risk Management
- Safety/Risk Technology & Application
- New Nuclear Plant Deployment
- Environmental Benefits
- Low-Level Waste & Radiation Management

Power Delivery & Markets

- Strategic Initiatives
- Security
- Power Markets & Risk
- Assets, Planning & Operations
- Power Quality
- Transmission Reliability & Performance
- Distribution Reliability & Performance
- Electric Transportation and Energy Utilization
- Enterprise Asset Management

Environment

- Air Quality
- Global Climate Change
- Land & Groundwater
- Water and Ecosystems
- EMF Health Assessment and RF Safety
- Occupational Health and Safety

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80 Plus Program Concept

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- Market barriers prevented widespread manufacture and use of highly efficient power supplies
- 80 PLUS is a manufacturer buy-down program for efficient power supplies in desktop PCs and desktop-derived servers – designed as a multi-year, utility funded approach
- 80 Plus power supply qualifications
  - 80% efficiency at 20%, 50% and 100% load
  - True PF greater than 0.9 at 100% load
- Energy Star computer specification (July 2007) includes these levels.
- "Computers" section on www.energystar.gov contains latest information on spec.

For More Information
http://www.80plus.org/

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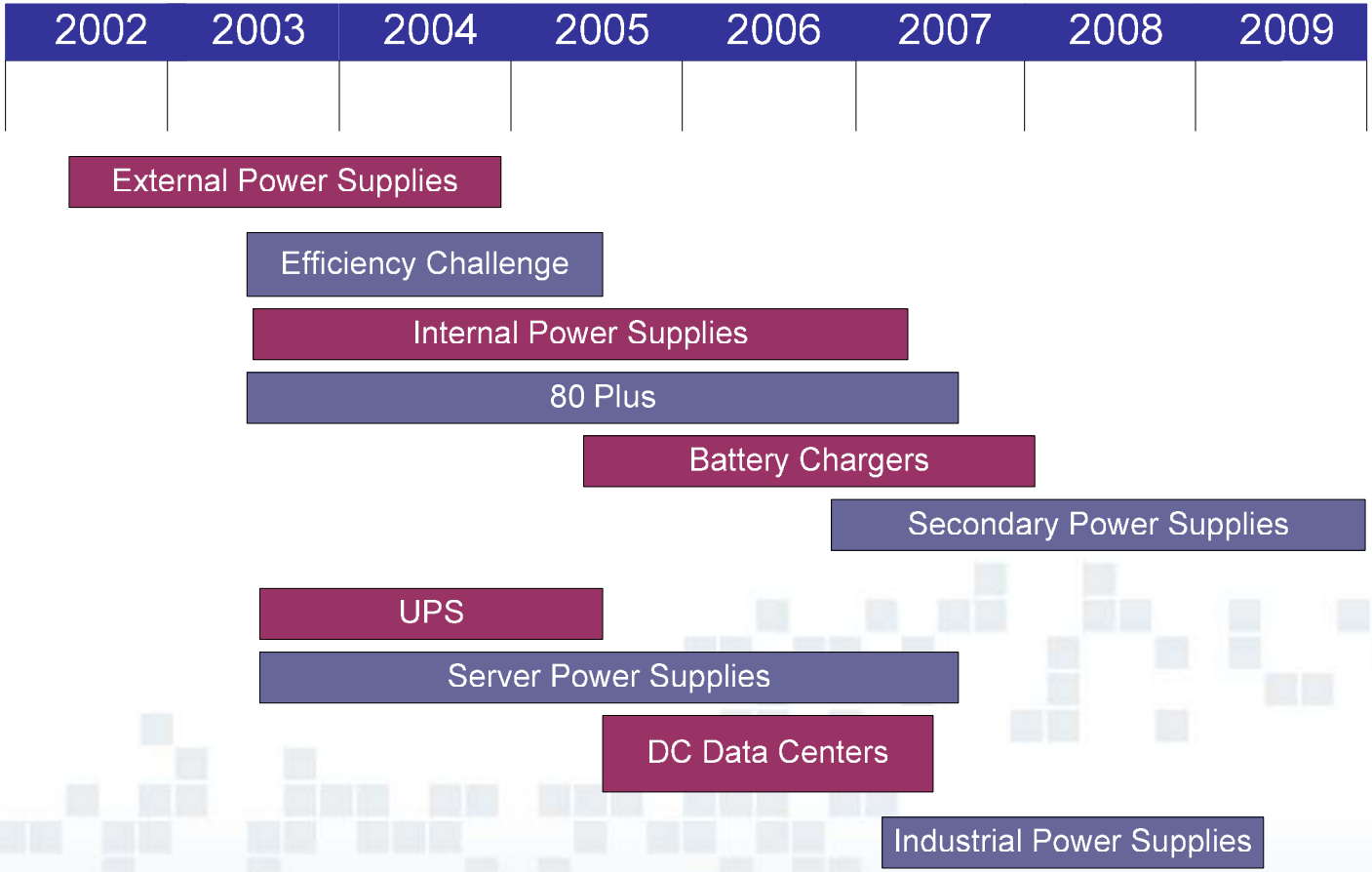

Power Supply Research

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Power Supply Savings Opportunities

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- More than 3.1 billion power supplies now in use in the U.S.
- Annual U.S. sales of about 450 to 600 million units

- About 6 to 10% of U.S. electricity use is converted from high voltage AC to low voltage DC in power supplies: (200 to 340 billion kwh/year worth $16 to $27 billion/year

- About 3 to 4% of U.S. electricity use is consumed inside power supplies: (100 to 140 billion kwh/year worth $8 to $11 billion/year)

- More efficient power supplies could save 1 to 2% of all U.S. electricity use – about $3.4 to $6.8 billion/year!

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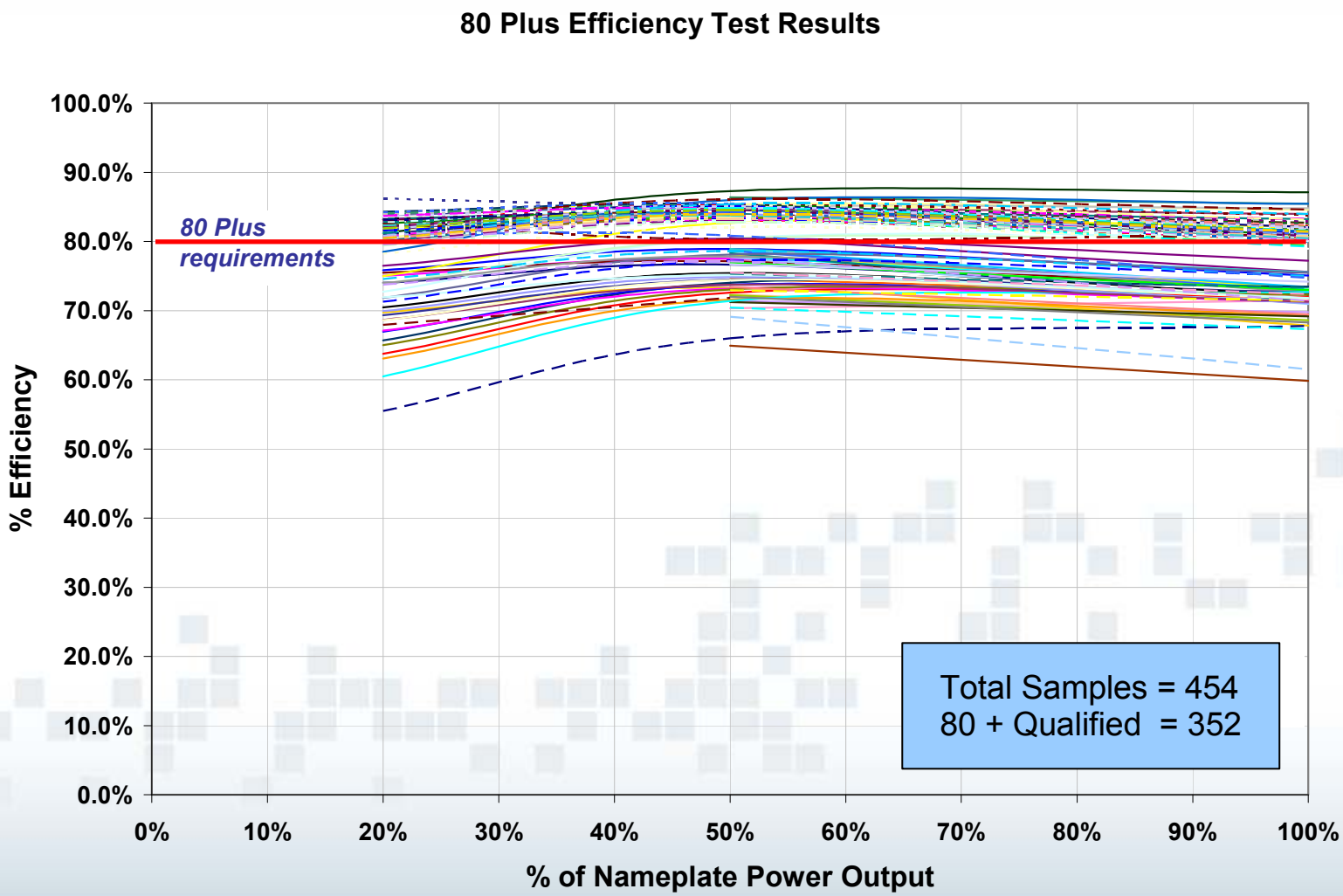
Today – 352 Compliant Models from 66 Manufacturers ! !



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Data Center Power Delivery

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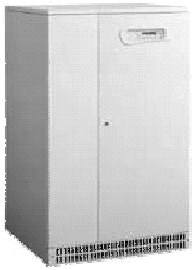
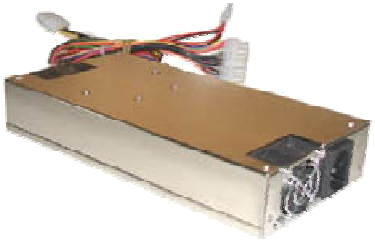
UPS
85 - 92%

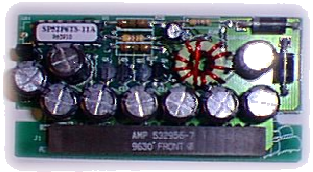


Power Dist
98 - 99%

Power Supply
68 - 72%



DC/DC
78 - 85%



The heat generated from the losses at each step of power conversion requires additional cooling power

HVAC: Additional Power Loss for Cooling

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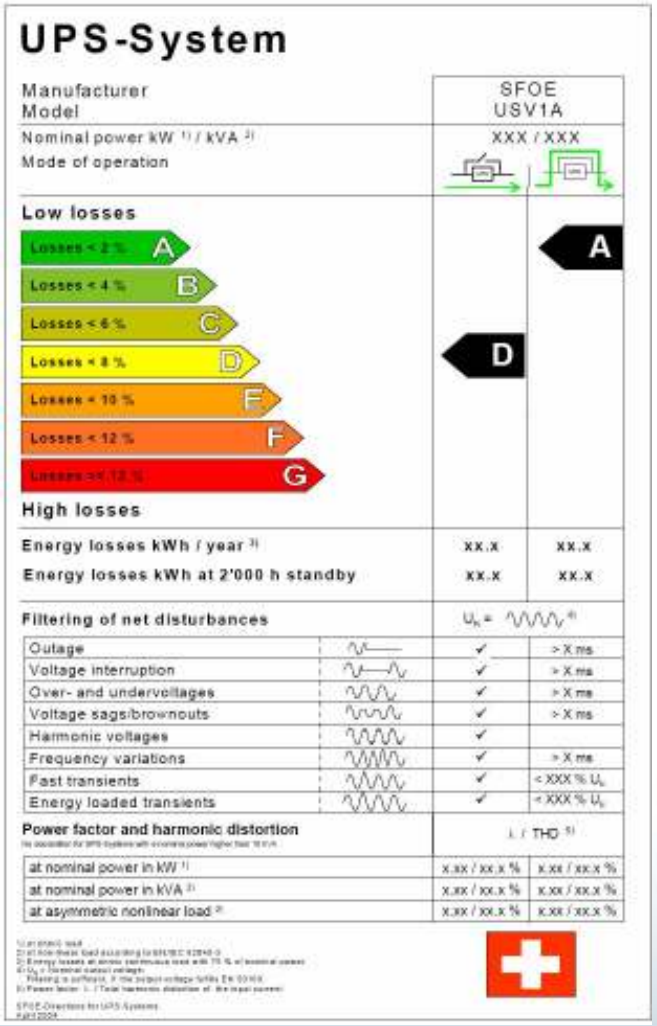
Swiss UPS Labelling Program



UPS-System

Manufacturer Model	SFOE USV1A	
Nominal power kW [1] / kVA [2] Mode of operation	XXX / XXX	
Low losses		
Losses < 2 % A		A
Losses < 4 % B		
Losses < 6 % C		
Losses < 8 % D	D	
Losses < 10 % E		
Losses < 12 % F		
Losses >= 12 % G		
High losses		
Energy losses kWh / year [3]	xx.x	xx.x
Energy losses kWh at 2'000 h standby	xx.x	xx.x
Filtering of net disturbances	U_N = [4]	
Outage	✓	> X ms
Voltage interruption	✓	> X ms
Over- and undervoltages	✓	> X ms
Voltage sags/brownouts	✓	> X ms
Harmonic voltages	✓	
Frequency variations	✓	> X ms
Fast transients	✓	< XXX % U_N
Energy loaded transients	✓	< XXX % U_N
Power factor and harmonic distortion	λ / THD [5]	
at nominal power in kW [1]	x.xx / xx.x %	x.xx / xx.x %
at nominal power in kVA [2]	x.xx / xx.x %	x.xx / xx.x %
at asymmetric nonlinear load [6]	x.xx / xx.x %	x.xx / xx.x %

- Q/E matrix
- Quantifies power quality capability
- Quantifies efficiency

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EPRI Proposed Labelling for Consideration

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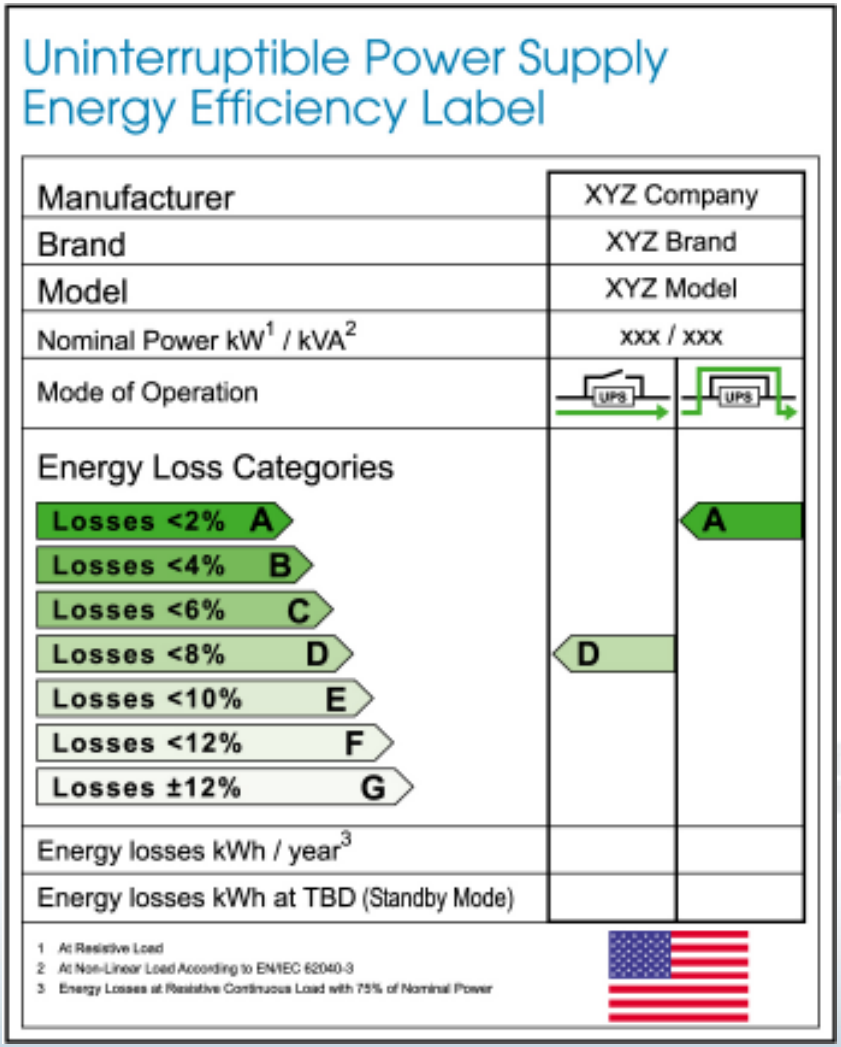

Uninterruptible Power Supply
Energy Efficiency Label

Manufacturer	XYZ Company	
Brand	XYZ Brand	
Model	XYZ Model	
Nominal Power kW[1] / kVA[2]	xxx / xxx	
Mode of Operation	UPS	UPS
Energy Loss Categories		
Losses <2% A		A
Losses <4% B		
Losses <6% C		
Losses <8% D	D	
Losses <10% E		
Losses <12% F		
Losses ±12% G		
Energy losses kWh / year[3]		
Energy losses kWh at TBD (Standby Mode)		

1 At Resistive Load
2 At Non-Linear Load According to EN/IEC 62040-3
3 Energy Losses at Resistive Continuous Load with 75% of Nominal Power

- Evaluates for normal mode and "eco" mode
- Quantifies Efficiency for both Modes

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Conclusions

- Independent, third-party test procedure development, testing, and product certification to ensure fair, comparable results. All of our testing is conducted by individuals and organizations with no financial stake in the individual manufacturers, to ensure unbiased results
- Inclusion of low load conditions and power factor criteria to capture "real-world" energy savings valued by utilities and facilities managers
- Electrical components are not the only ones – CRAC units, Chillers, and other equipment on the mechanical side can also be included for efficiency certification

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Conclusions (continued)

- Simultaneous, branded levels of efficiency to reward manufacturers with the most innovative products as soon as they can bring them to market
- Testing in the field to verify real-world energy savings resulting from power supply efficiency improvement
- All the above will provide specifications necessary to enable incentive programs

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