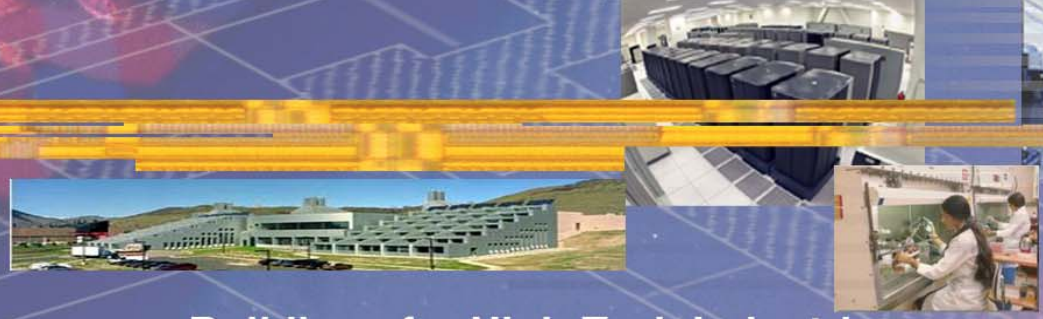


High-Performance Buildings for High-Tech Industries

High-Performance High-Tech Buildings Project
Laboratories, Cleanrooms, and Data Centers

August 4, 2005

Lawrence Berkeley National Laboratory
Bill Tschudi
Dale Sartor

http://hightech.lbl.gov

Public Interest Energy Research (PIER)
California Institute for Energy & Environment (CIEE)

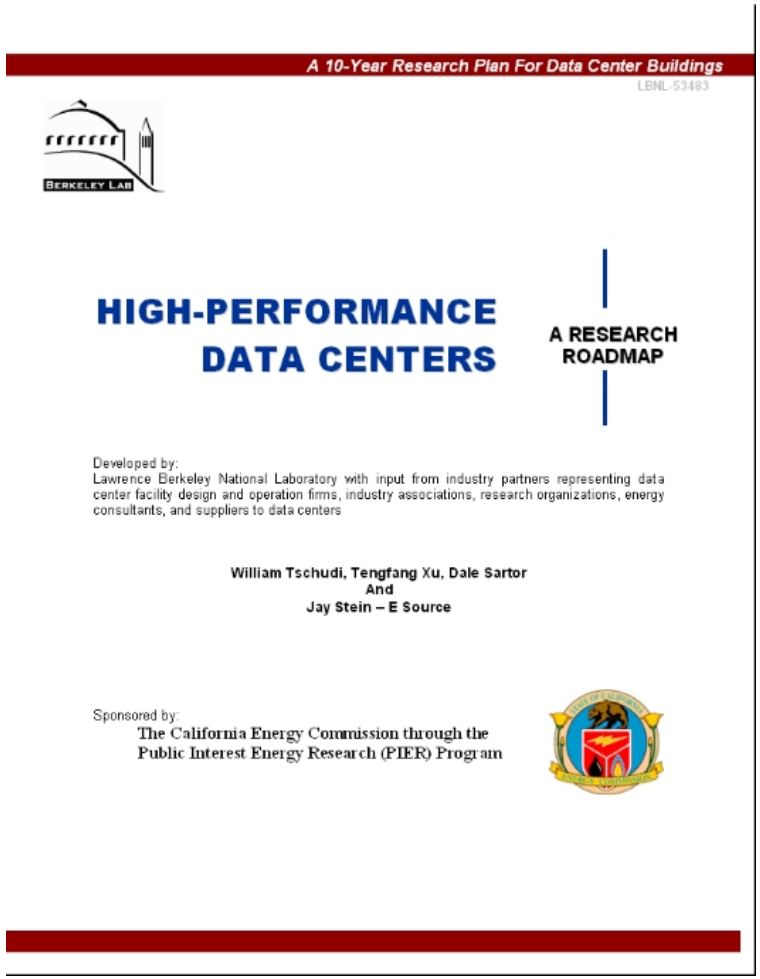
California energy research related to data centers

- Energy research roadmap
- Case studies and energy benchmarking
- Best practice identification
- Self benchmarking protocol
- Investigate efficiency of IT power supplies
- Investigate efficiency of UPS systems
- Metrics for computing performance vs. energy
- Technology transfer
- Demonstration projects

Efficiency Ideas

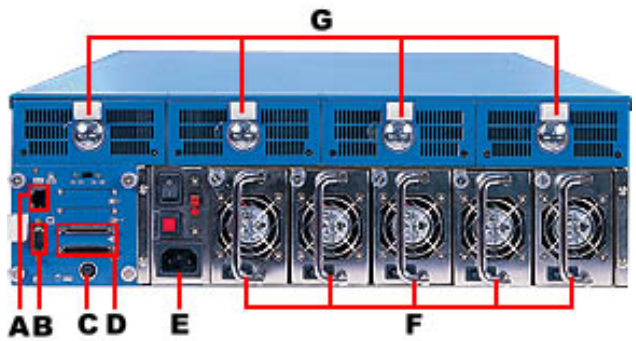
Many areas for potential efficiency improvement are suggested in the research roadmap – available here:

http://datacenters.lbl.gov/docs/RoadmapFinal.pdf



Current PIER data center & IT equipment activities

- Benchmarking and Best Practices identification
  - Research-directed benchmarking
  - Self-benchmarking protocol
  - Summary of best practices observed
- Improve uninterruptible power supplies (UPS)
- Develop performance metrics
- Improve power supplies in IT equipment



Preliminary findings:

- Infrastructure is typically oversized by factors of 4 or more for today's loads
- Heat intensity is rising however computing capability is rising faster
- There is wide variation in intensity and efficiency
- Well studied efficiency measures (chilled water optimization, lighting controls, etc.) are not implemented
- Controversy over use of some technologies
- Industry is concerned – but more for ability to cool rising heat intensity – not efficiency

High-tech demonstration projects

- LBNL scoped 15 potential demonstrations

- 5 demonstrations were selected including DC powering rack of computers

DC Power Demonstration Project Team

LBNL

- Bill Tschudi (PI)
- Dale Sartor
- Evan Mills
- Steve Greenberg

Subcontractors

- Ecos Consulting/EPRI Solutions (Power Supply and UPS evaluations)

Industry partners

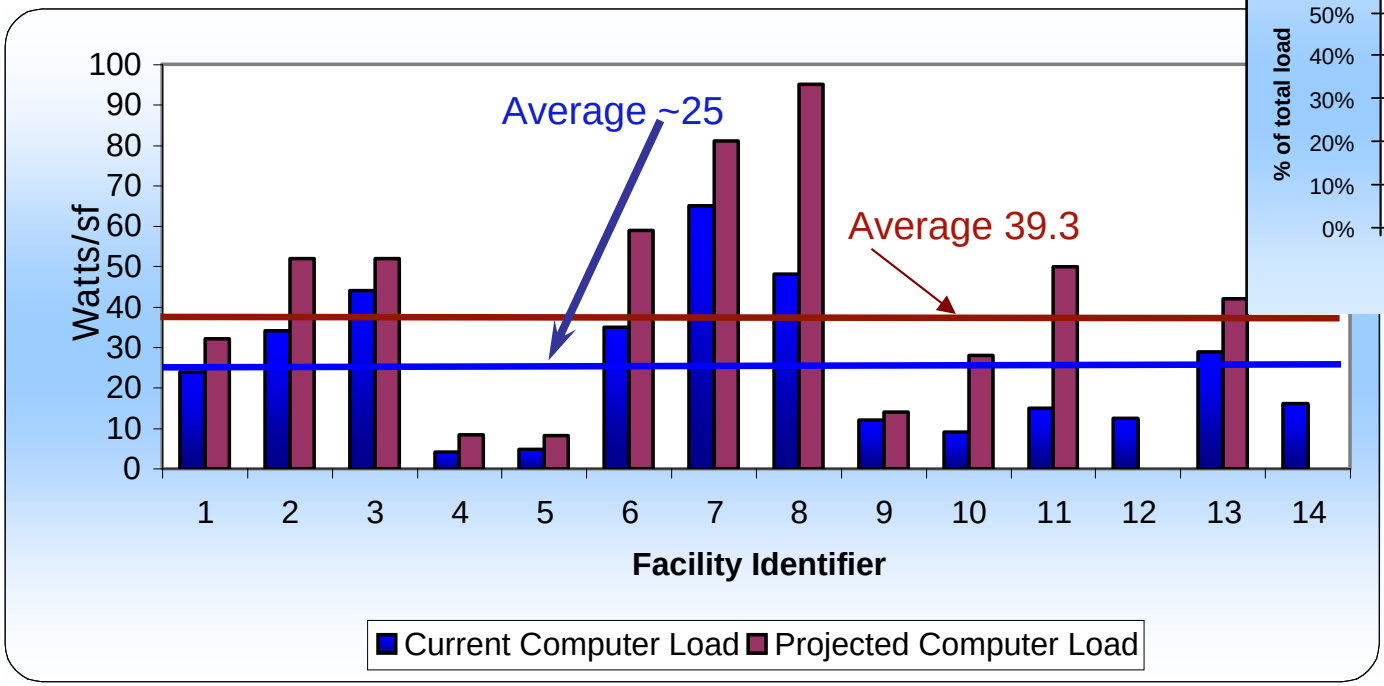
- EYP Mission Critical Facilities (Data center benchmarking data collection)
- TBD - Cost sharing required

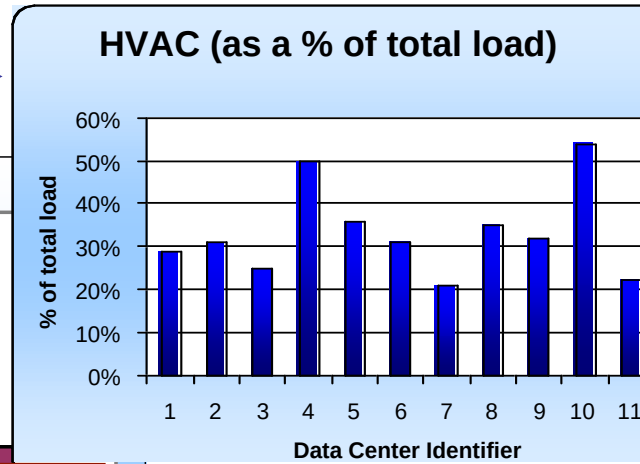
New additions to the project:

- DC powering rack of computers (why we are here)
- Design process – issues in planning a supercomputer center
- One year schedule

Wide range of efficiencies:

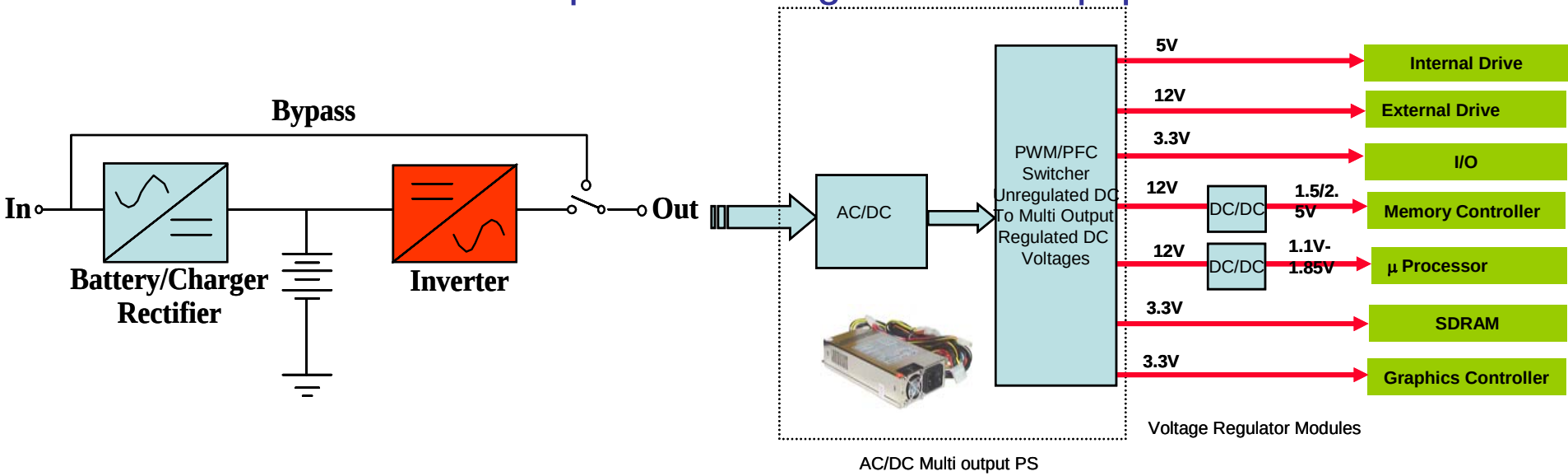
HVAC effectiveness varies →



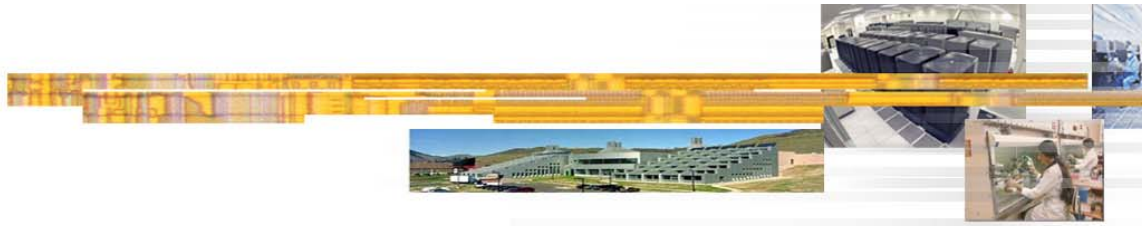


The opportunity: power conversion

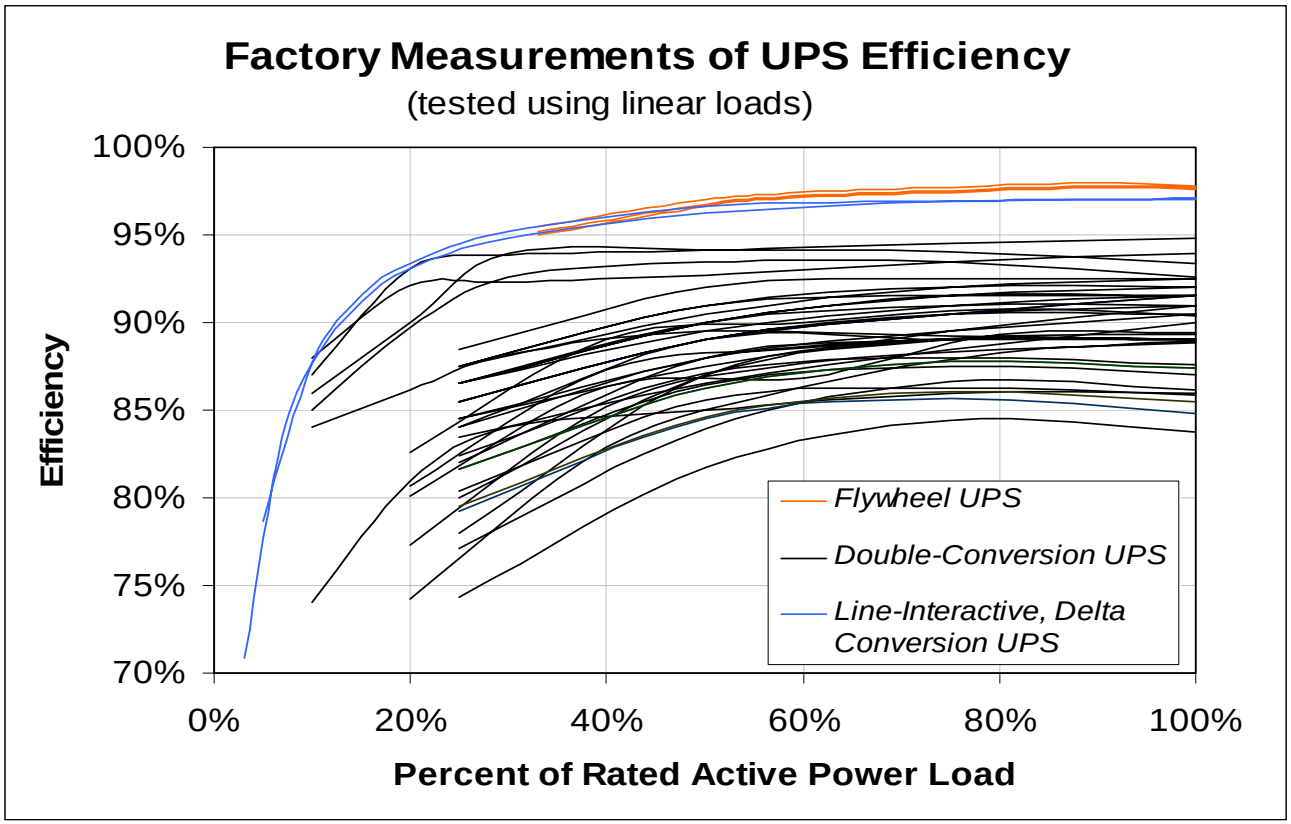
The loss in electrical power through conversion of AC to DC to AC to DC occurs for all power flowing to the IT equipment.



Efficiency gains have a magnifying effect by reducing need for HVAC (e.g. 10% saving at the UPS level could mean 20% saving for the datacenter)



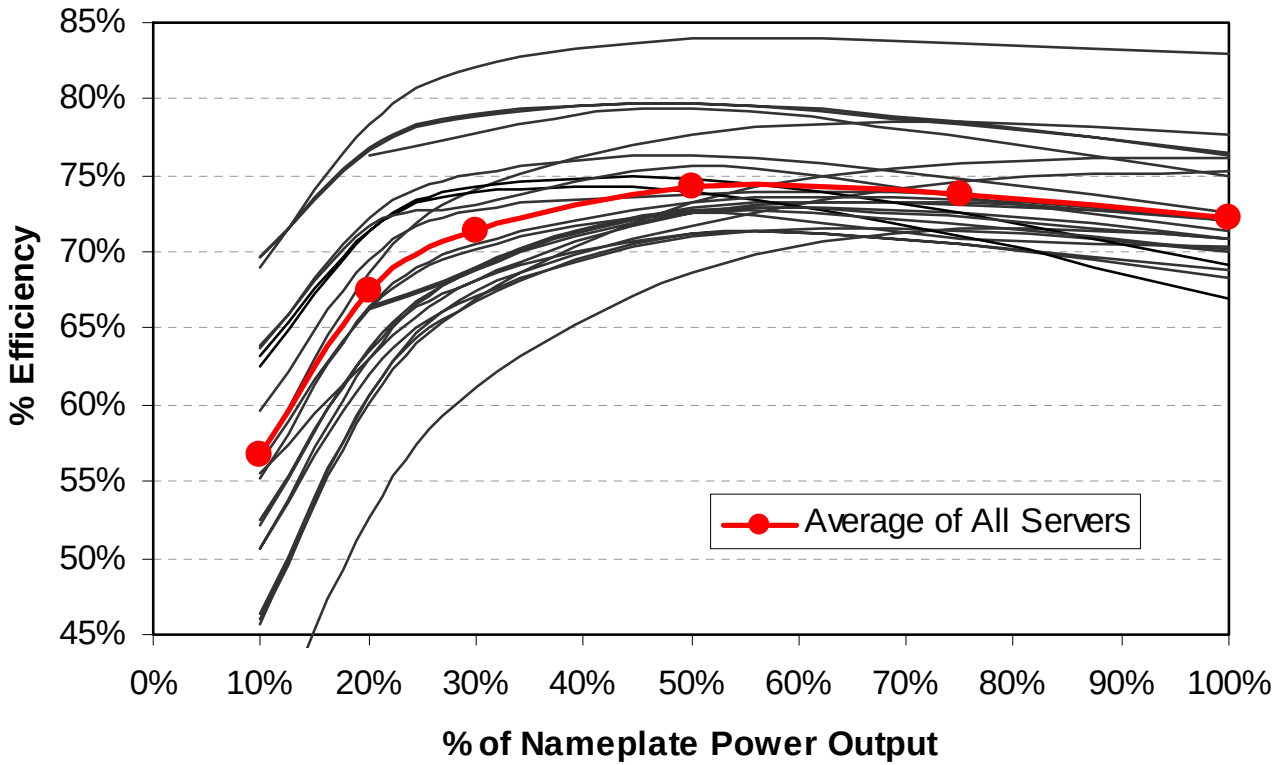
UPS measured efficiency



Typical operat
range 30-50%

Double conversion efficiency ranged from 86% to 97% at peak load, but efficiency under typical operating loads ranges from 81% to 93%

Power Supply Findings:



Typical operating range is 30%-50% to provide redundancy

20% variation in worst to best

Today's goal:

Help us define demonstration project

Identify Industry partner roles and resources

Identify barriers and plans to overcome them

Clear action plan

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