# HPC Energy Efficiency Compute System Metrics

## *TOP500 – Green500*

*2010 Best Practices Workshop on Power Monitoring*

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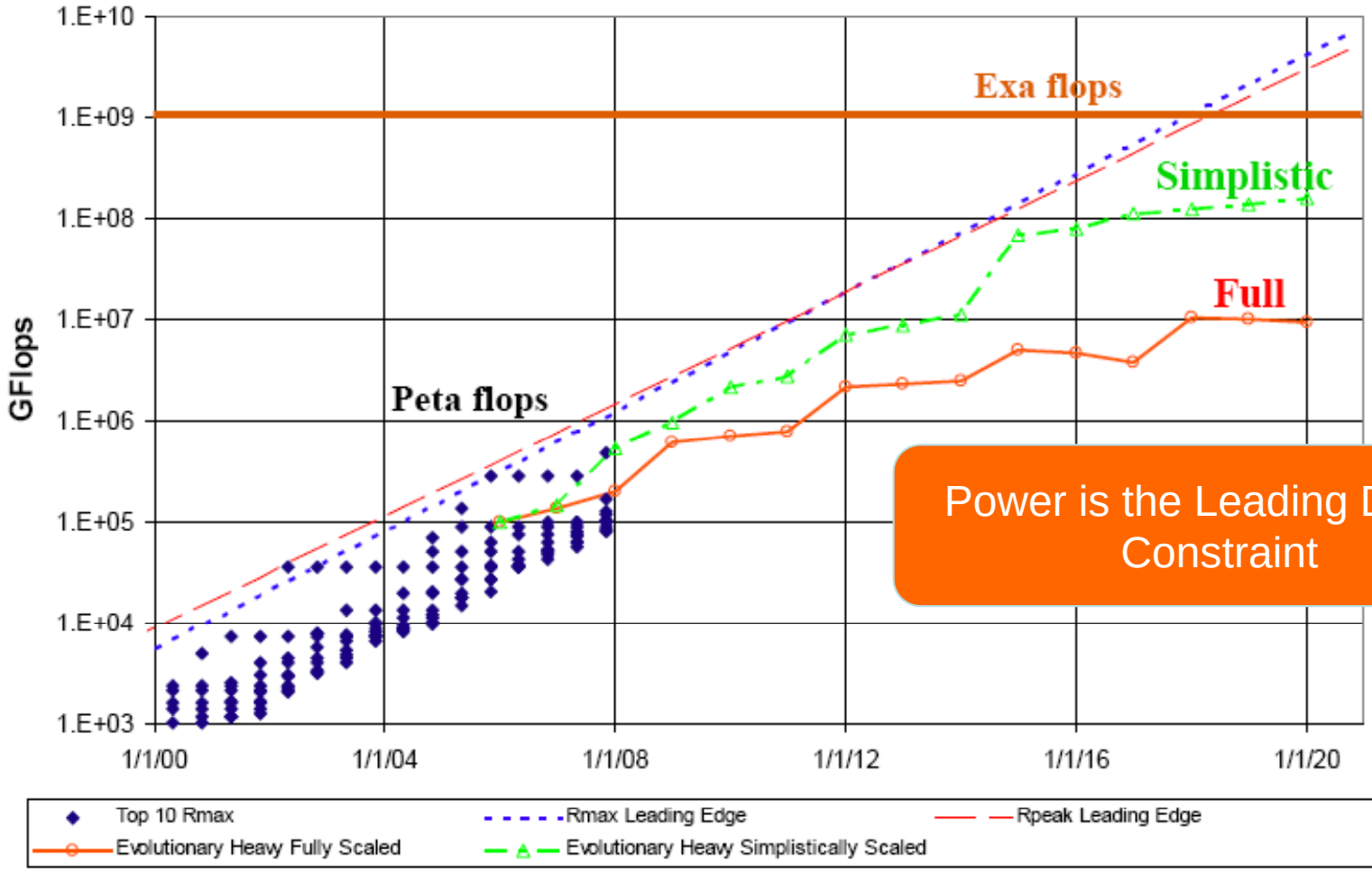
Wu Feng, Green500 and Virginia Tech
Tahir Cadir, HP and The Green Grid

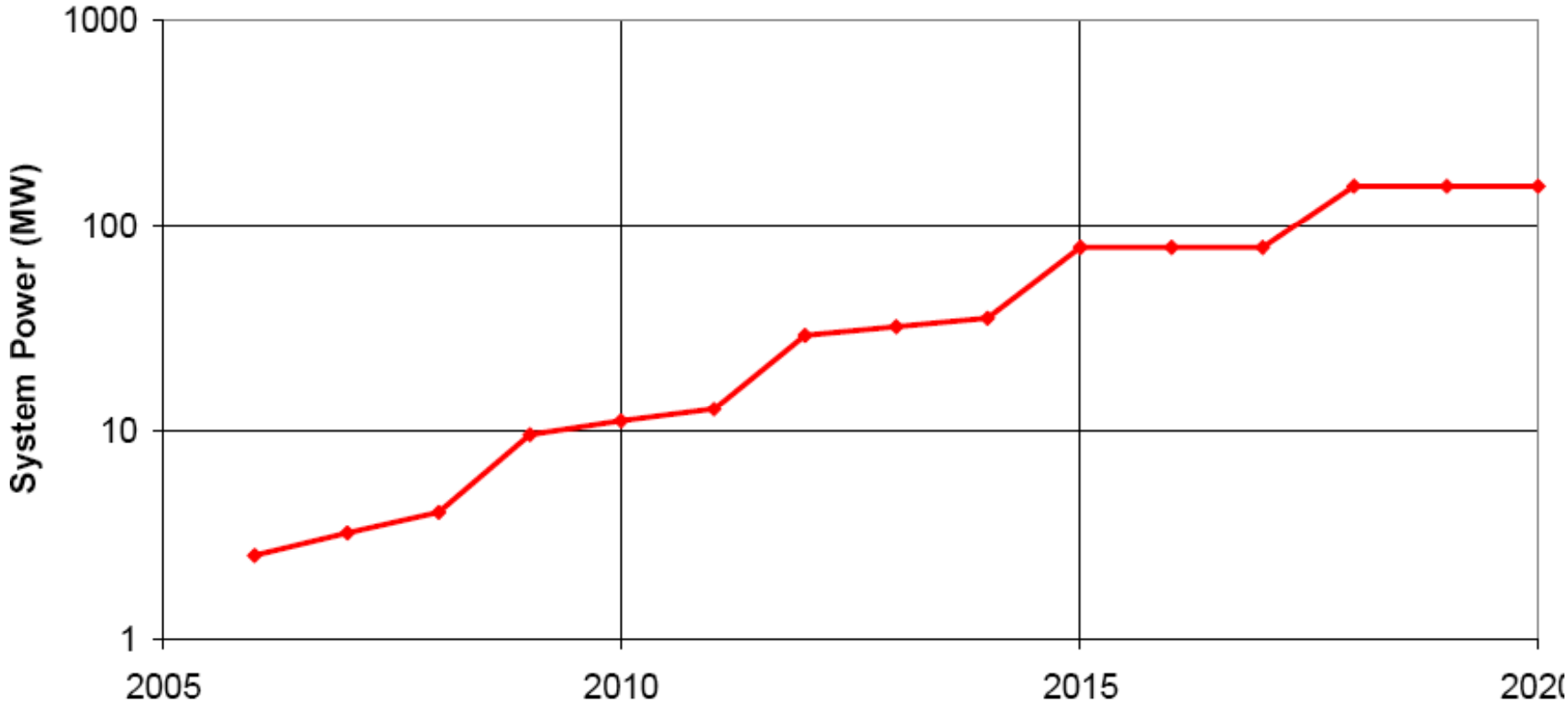
# Current Technology Roadmaps will Depart from Historical Gains




Power is the Leading Design Constraint

From Peter Kogge, DARPA Exascale Study

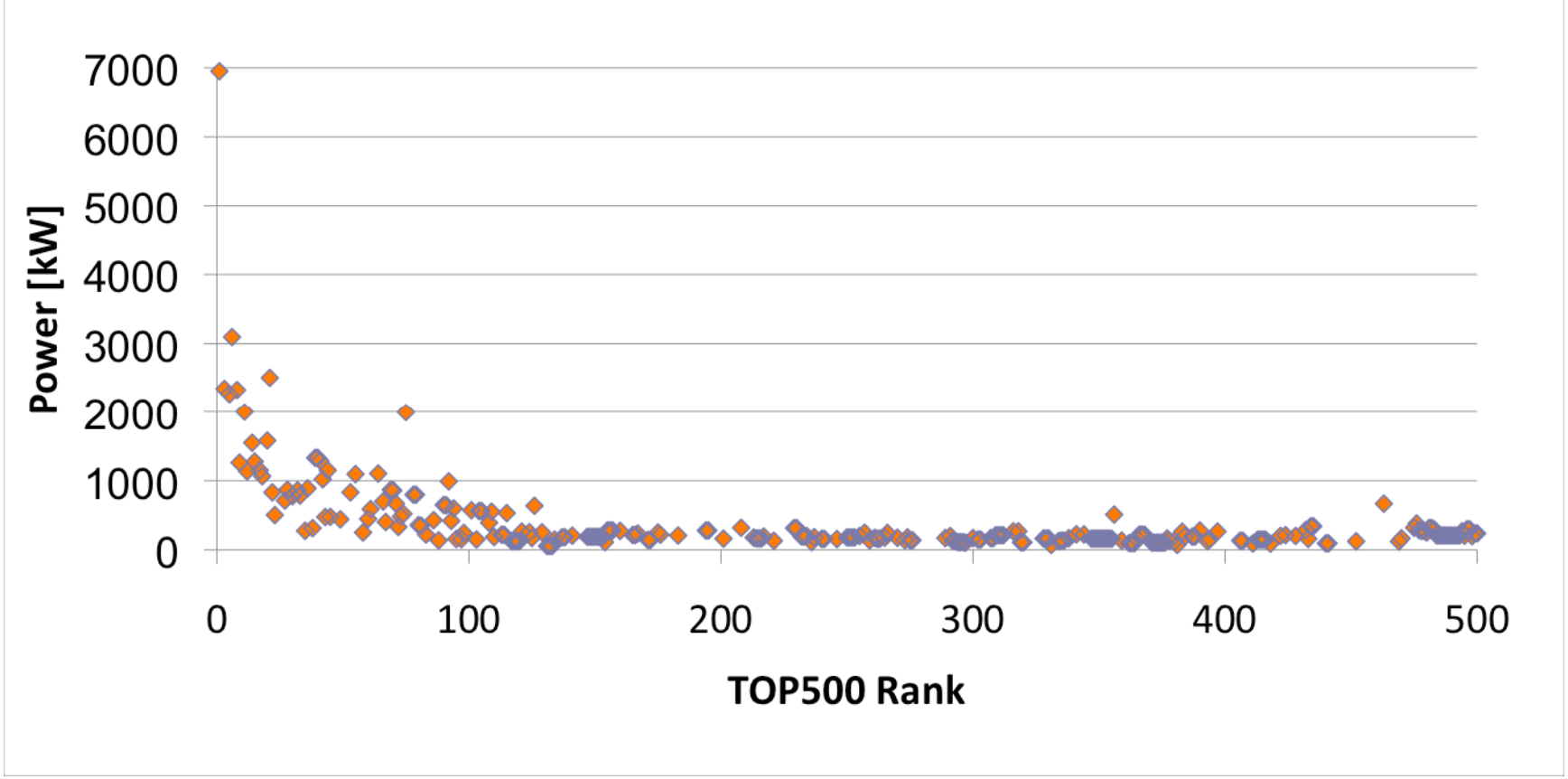
# … and the power costs will still be staggering




From Peter Kogge,
DARPA Exascale Study

***$1M per megawatt per year! (with CHEAP power)***

# Absolute Power Levels

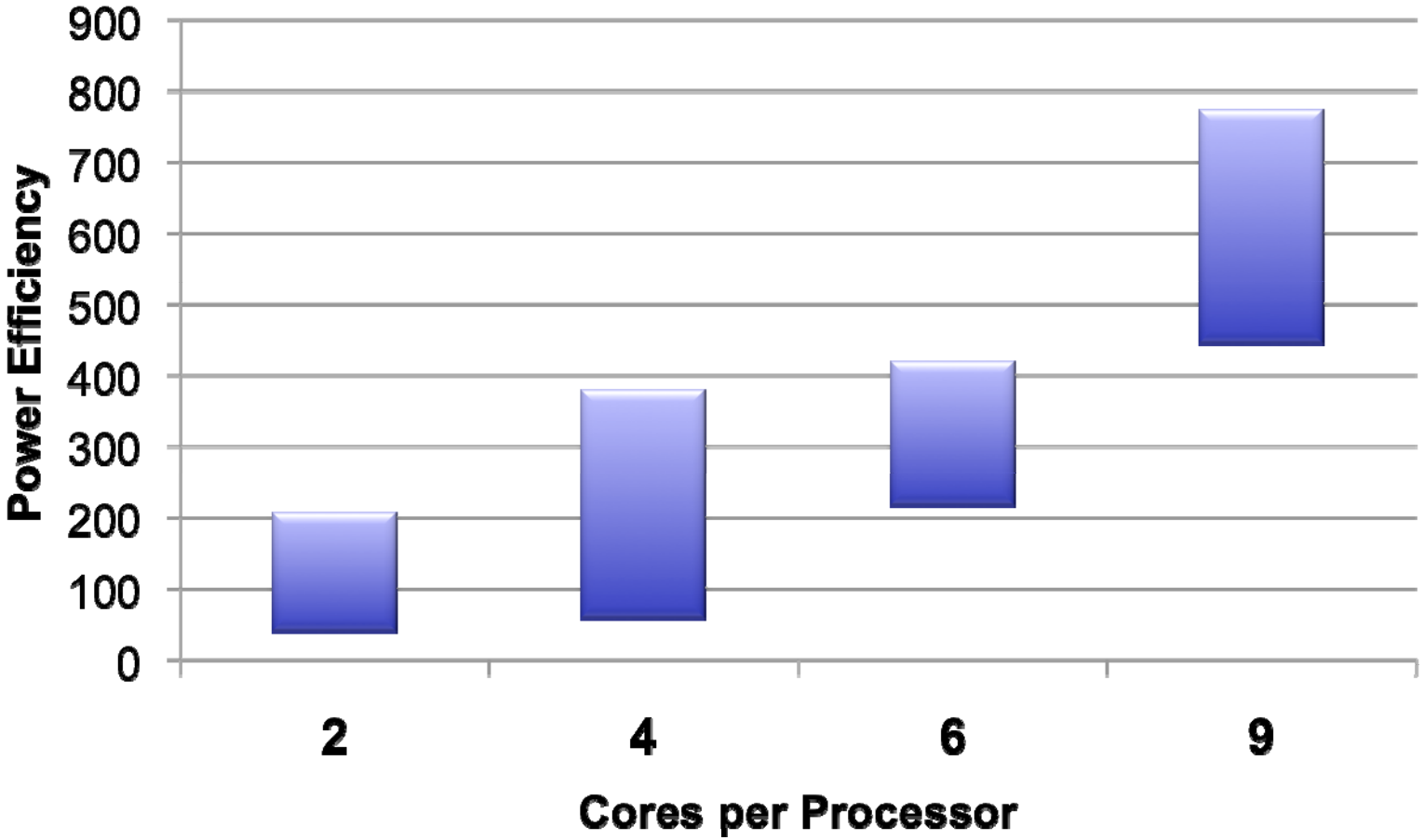


# June 2010: Green500 Top 10

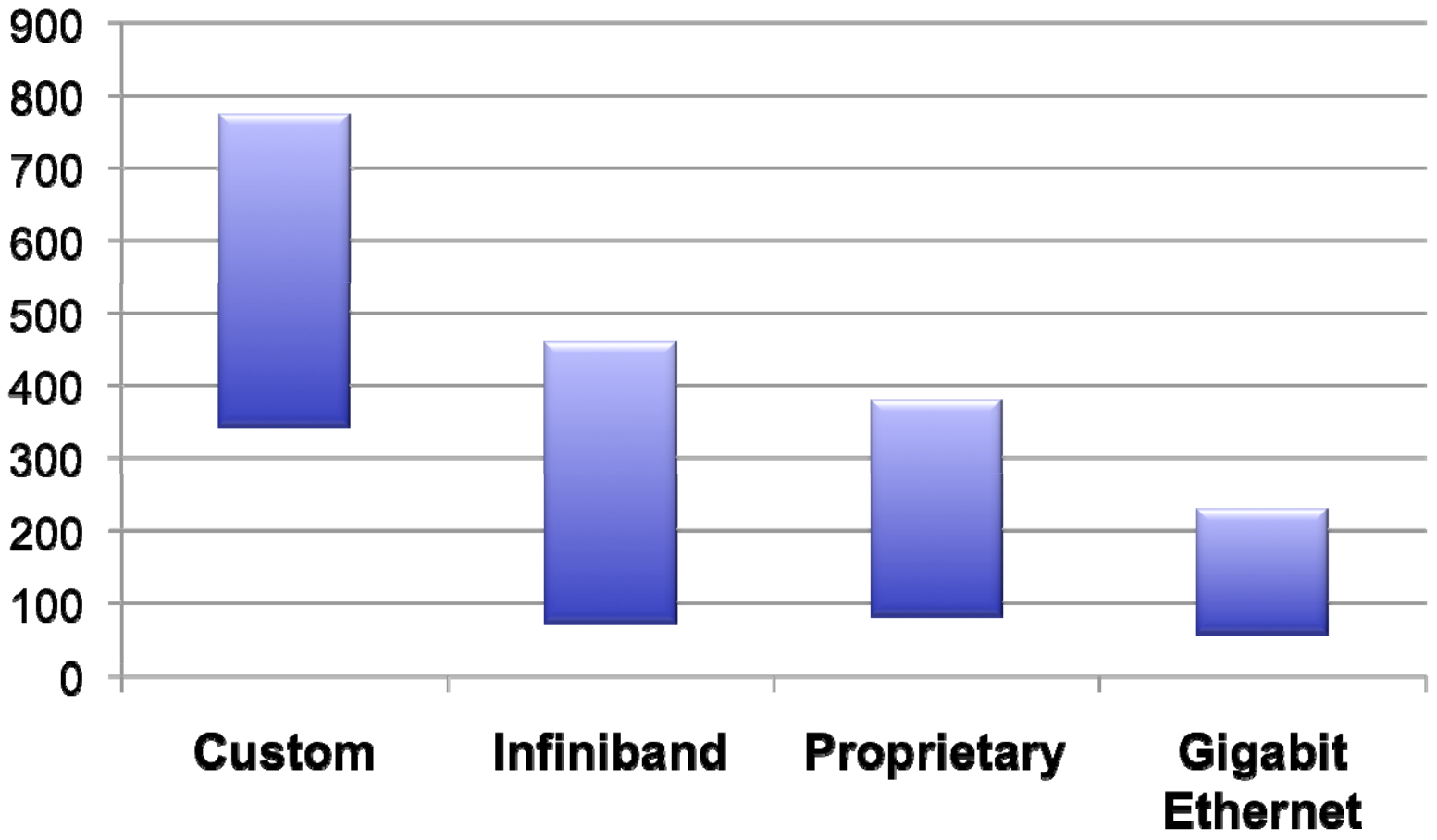
- Accelerator-based supercomputers now occupy the top eight slots
- Three IBM (QPACE) machines tie for first place

#1 Forschungszentrum Juelich (FZJ)
#1 Universitaet Regensburg
#1 Universitaet Wuppertal
#4 National Supercomputing Centre in Shenzhen
#5 IBM Poughkeepsie Benchmarking Center
#5 DOE/NNSA/LANL
#7 DOE/NNSA/LANL
#8 Chinese Academy of Sciences
#9 Mississippi State University
#10 Banking (M)

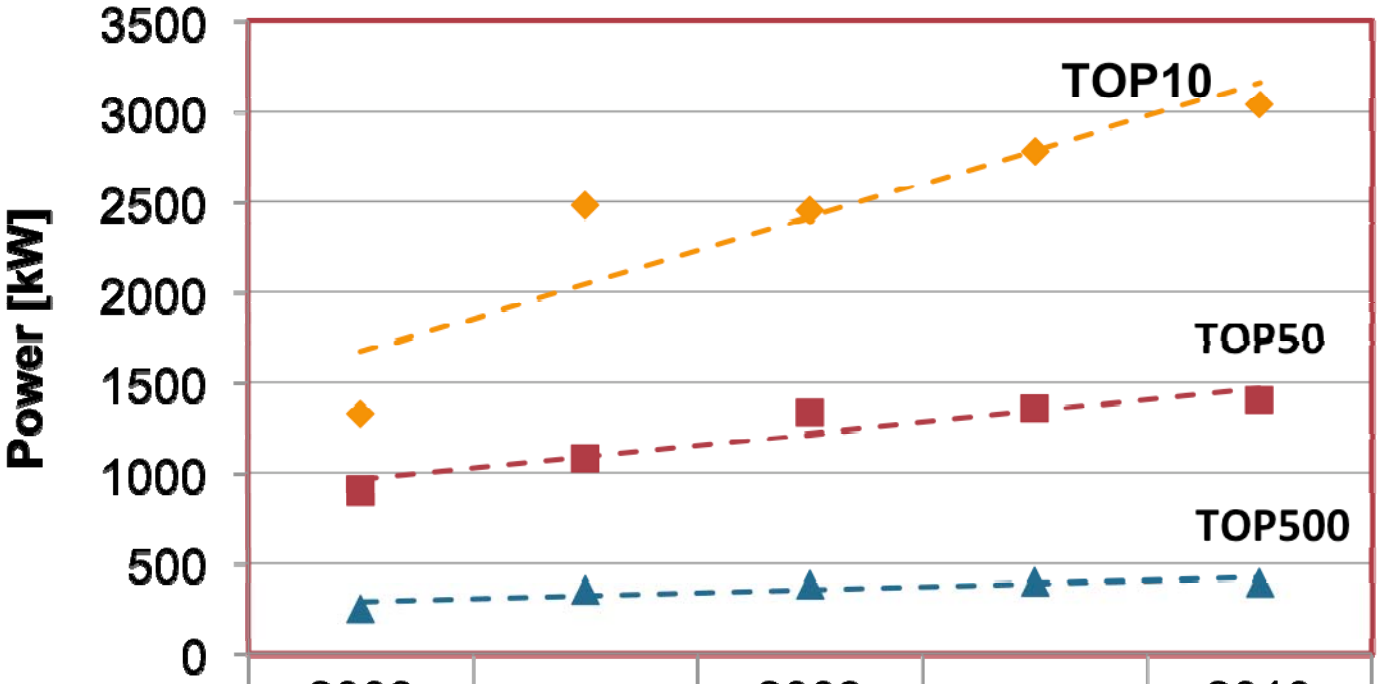
# Power Efficiency related to Processor Generations



# Power Efficiency related to Interconnects



# Power Consumption




| | 2008 | | 2009 | | 2010 |
|---|---|---|---|---|---|
| Power 10 | 1324 | 2480 | 2452 | 2786 | 3041 |
| Power 50 | 908 | 1080 | 1332 | 1355 | 1401 |
| Power 500 | 257 | 358 | 387 | 403 | 397 |