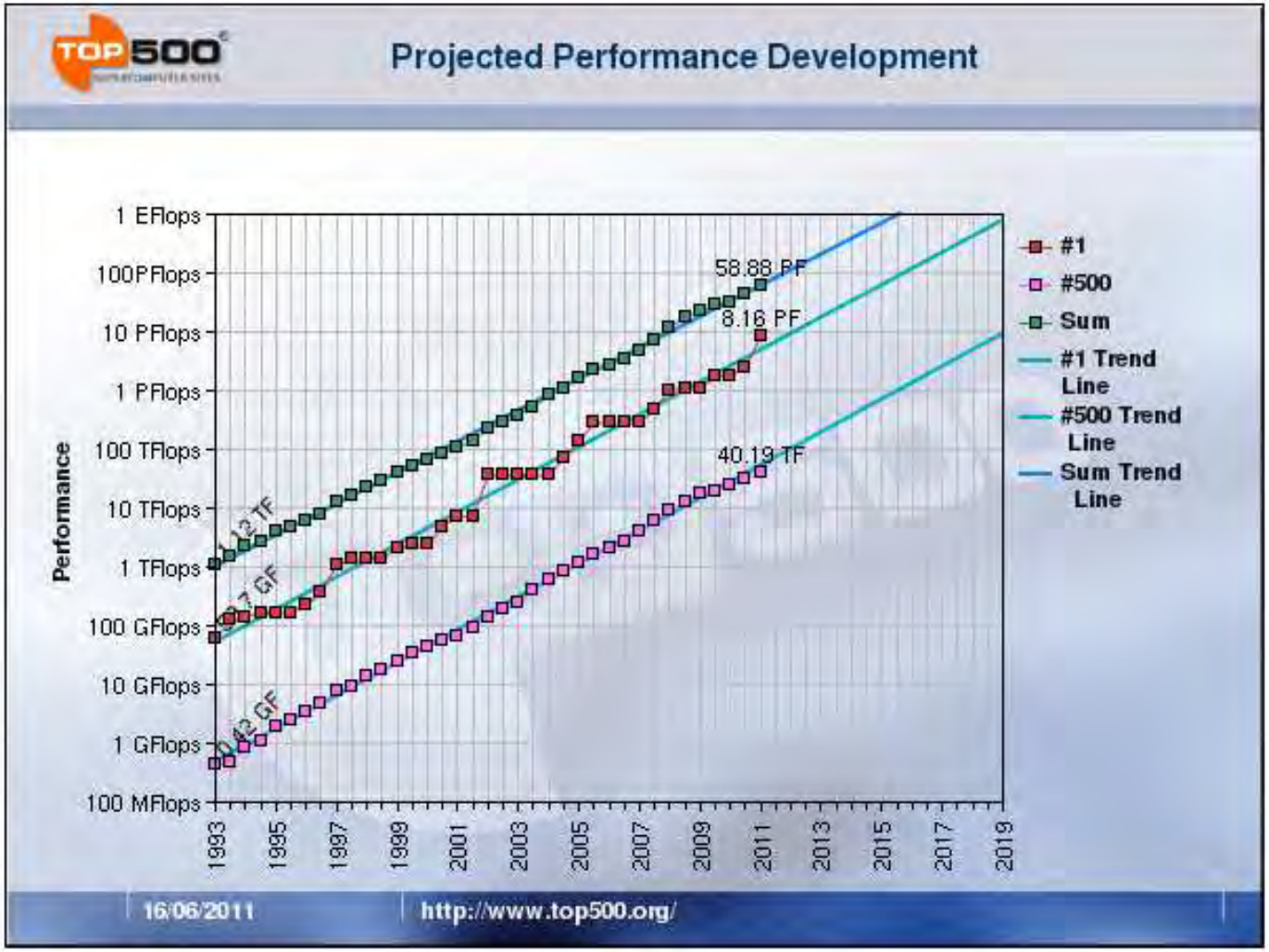
‘Building’ Energy Efficient High Performance Computing

The Energy Efficient HPC Working Group

17 NOV 13

SC13 - Denver

An amazingly constant trend...



"The number of transistors incorporated in a chip will approximately double every 24 months."
--Gordon Moore, Intel co-founder

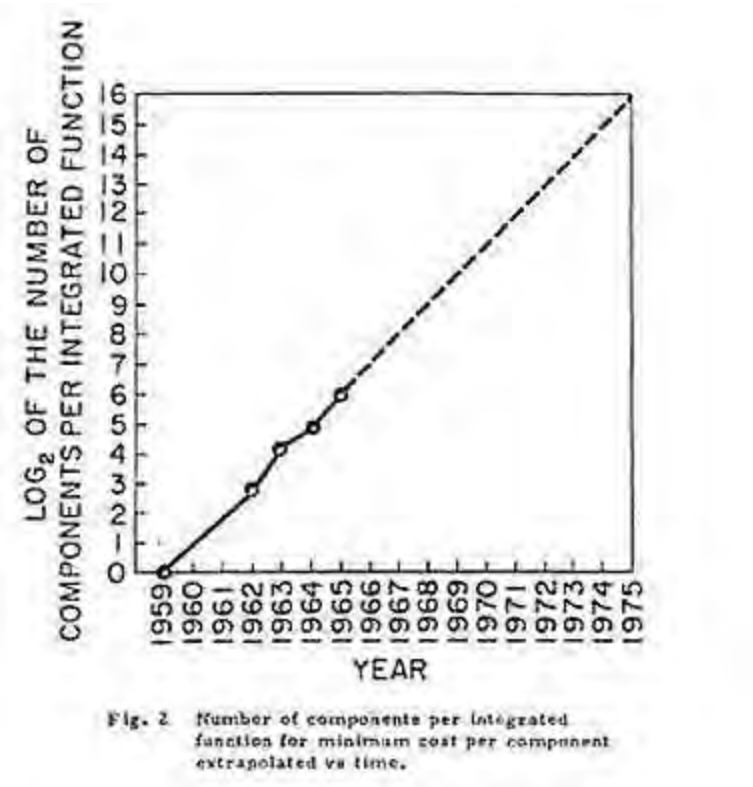


Fig. 2. Number of components per integrated function for minimum cost per component extrapolated vs time.

"If something cannot go on forever, it will stop,"
--Herbert Stein

- **Herbert Stein (1916 –1999)**
- senior fellow at the American Enterprise Institute
- board of contributors of The Wall Street Journal
- Chair of the Council of Economic Advisers under Nixon and Ford
- A. Willis Robertson Prof of Economics at the University of Virginia

LRZ – Moore's Law meets Stein's Law

Economic forces opposing technical advances

Power consumption and **operating costs** of LRZ supercomputers

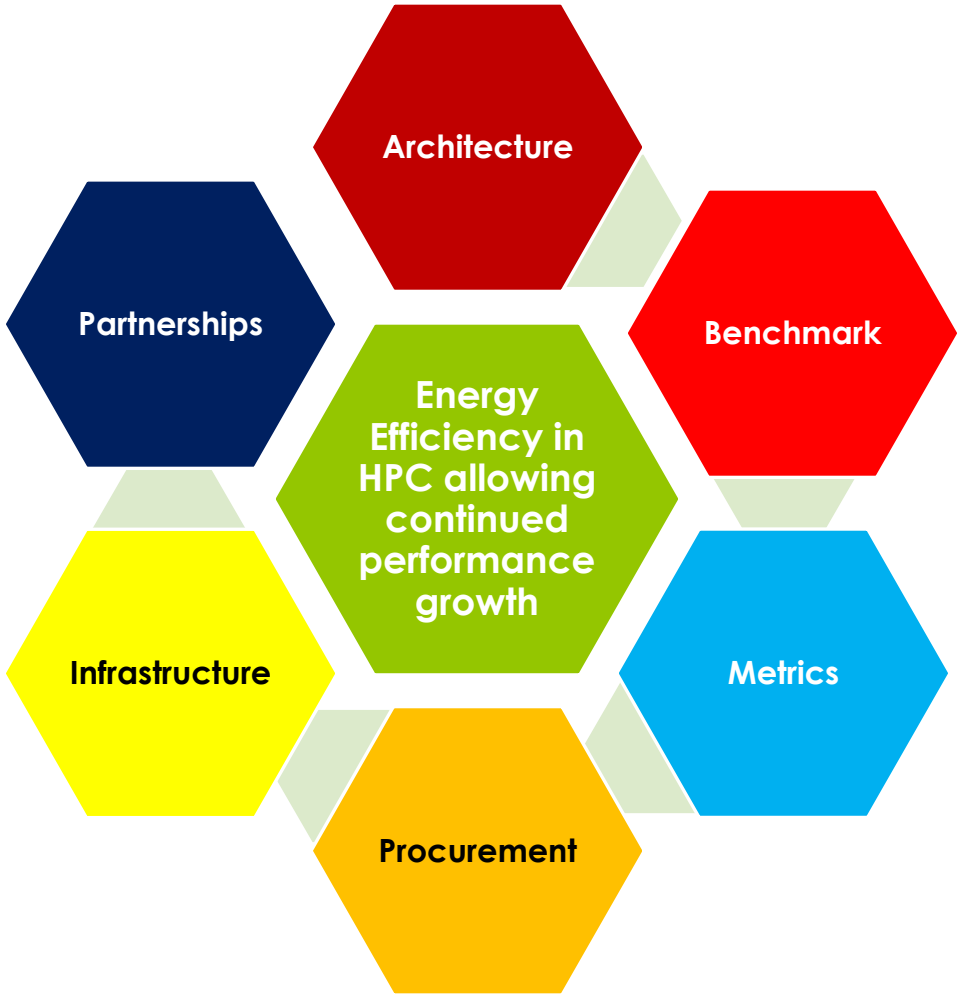
System	Era	Peak Performance	Power Consumption	Investment Costs	Operating Costs	Power Bill
HLRB I: Hitachi SR8000	2000 - 2006	1.3 TFlOp/s	0.5 MW	29 M€	13 M€	3 M€
HLRB II: sgi ALTIX 4700	2006 - 2011	62 TFlOp/s	1 MW	35 M€	16 M€	7 M€
SuperMUC: IBM iDataPlex	2012 - 2016	3000 TFlOp/s	3 MW	48 M€	35 M€	20 M€

Power Bill K-Euros/TF
€2308
€113
€7

System power is becoming a first class constraint for supercomputing
Energy and cooling efficient technologies will be key for future HPC

Table and photo adapted from H. Huber, LRZ

Our goal? Push Stein's Law a few more years down the road…



Thanks for all you do!

Natalie Bates…
….our fearless leader.

Energy Efficient HPC Working Group

- Driving energy conservation measures and energy efficient design in high performance computing.
- Demonstrate leadership in energy efficiency as in computing performance.
- Forum for sharing of information (peer-to-peer exchange) and collective action.
- Membership: Open to all interested parties.
- natalie.jean.bates@gmail.com
- http://eehpcwg.lbl.gov

Sunday

- **Liquid Cooling Commissioning**: Dave Martinez, SNL, Detlef Labrenz, LRZ, Tom Durbin, NCSA and Marriann Silveira, LLNL
- **Break 10-10:30**
- **Electric Grid and HPC**: Anna Maria Bailey, LLNL, Josip Loncaric, LANL, Jim Rogers, ORNL and Bob Conroy, OSISoft
- **Infrastructure Energy Efficiency Toolkit**: Bill Tschudi, LBNL
- **Lunch 12-1:00**
- **Procurement Considerations**: Steve Martin, Cray, Jim Laros, SNL, Daniel Hackenberg, U. Dresden, Chung-Hsing Hsu, ORNL
- **Energy Re-use Approaches**: Steve Hammond, NREL, Gert Svensson, KTH, Paul Brenner, U. Notre Dame, Bill Tschudi, LBNL
- **Break 3-3:30**
- **Total Power Usage Effectiveness (TUE)**: Mike Patterson, Intel
- **HPC and Data Warehouse Computers**: Dan Reed, University of Iowa & Chris Malone, Google
- **Wrap-up 5:15**

Monday

- **Open 9:00**
- **Opening Remarks**: Herbert Huber, LRZ
- **Architecture Trends and Energy Efficiency**: John Shalf, LBNL
- **Break 10-10:30**
- **Benchmarking and Energy Efficiency**:
  - Erich Strohmaier, LBNL & Top500
  - Wu Feng, Virginia Tech & Green500
  - Steve Poole, ORNL
  - Jack Dongarra, University of Tennessee

More EE HPC WG SC13 Technical Sessions

- Visit Research Booth #4503
- BoF: Best Practices for Commissioning Liquid Cooling Infrastructure. 12:15-01:15PM. Tuesday. Room 404
- BoF: Total Power Usage Effectiveness: A New Take on PUE. 12:15-01:15PM. Wednesday. Room 210/212
- BoF: The Green500 List and Its Evolution. 05:00-07:30PM. Wednesday. Room Mile High

Workshop Evaluation Forms

- **SUNDAY:**
- https://submissions.supercomputing.org/?page=SessionEval&id=sess190
- QR Code URL
- https://submissions.supercomputing.org/sc13_qrc/workshop_eval/sess190.png

- **MONDAY:**
- https://submissions.supercomputing.org/?page=SessionEval&id=sess191
- QR Code URL
- https://submissions.supercomputing.org/sc13_qrc/workshop_eval/sess191.png

Enjoy the workshop!

- Logistics
- Q/A – goal is to allow interaction
- Breaks – line up with SC to enhance networking
- Phones – on vibrate please
- Slides will be posted after the Workshop