‘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
"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

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

Table and photo adapted from H. Huber, LRZ

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

Power Bill K-Euros/TF

€2308
€113
€7
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=Session Eval&id=sess190](https://submissions.supercomputing.org/?page=Session Eval&id=sess190)
  - QR Code URL
  - [https://submissions.supercomputing.org/sc13_qrc/workshop_eval/sess190.png](https://submissions.supercomputing.org/sc13_qrc/workshop_eval/sess190.png)

- **MONDAY:**
  - [https://submissions.supercomputing.org/?page=Session Eval&id=sess191](https://submissions.supercomputing.org/?page=Session Eval&id=sess191)
  - QR Code URL
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