

Towards and Beyond Energy Efficiency: HPC System and Datacenters SC11 EE HPC WG Workshop November 14, 2011

Satoshi Matsuoka, Tokyo Institute of Technology

Alan Yoder, Net App

Anna Maria Bailey, LLNL

William Tschudi, LBNL

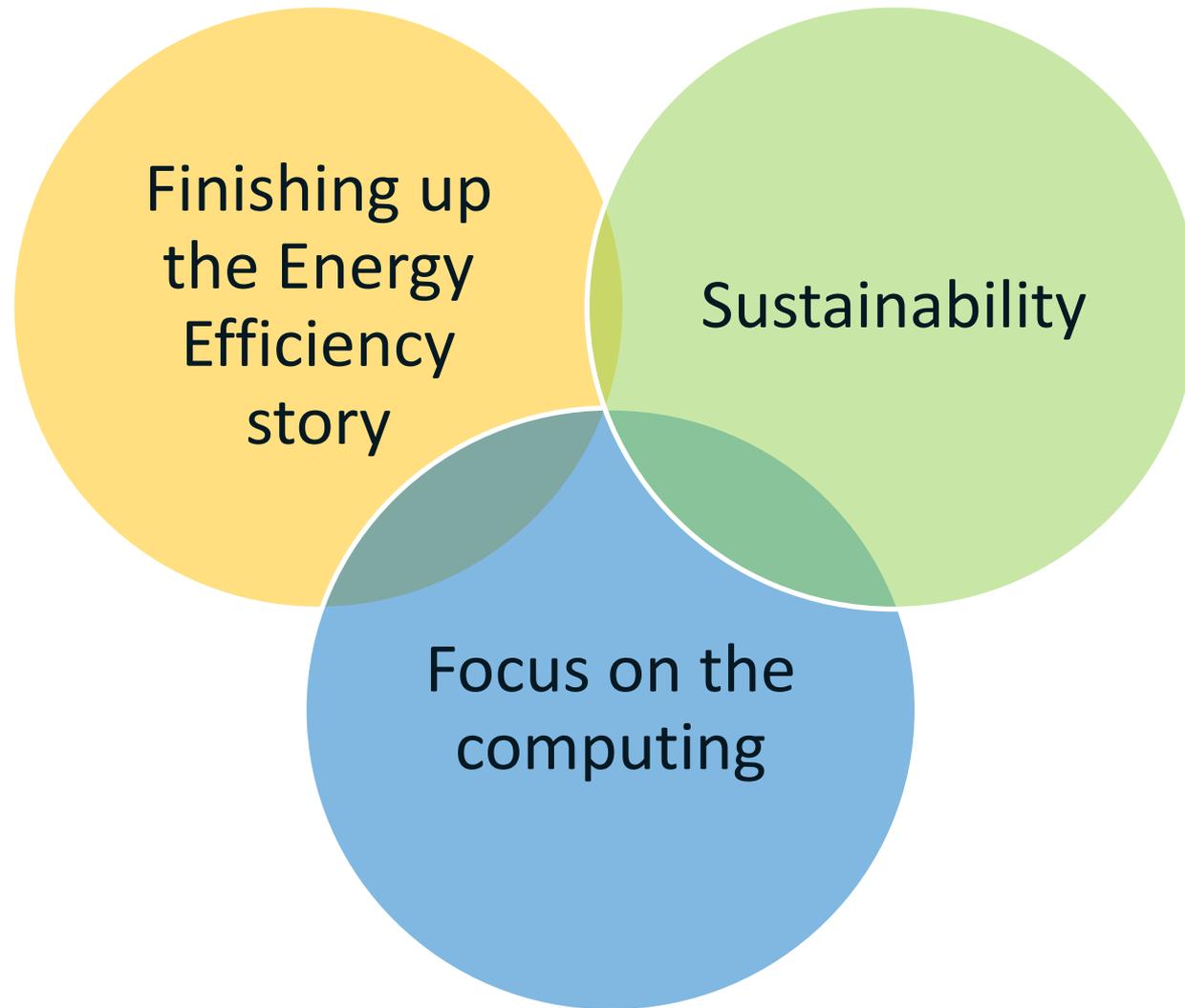
Michael Patterson, Intel

Ingmar Meijer, IBM

Nic Dube, Hewlett Packard

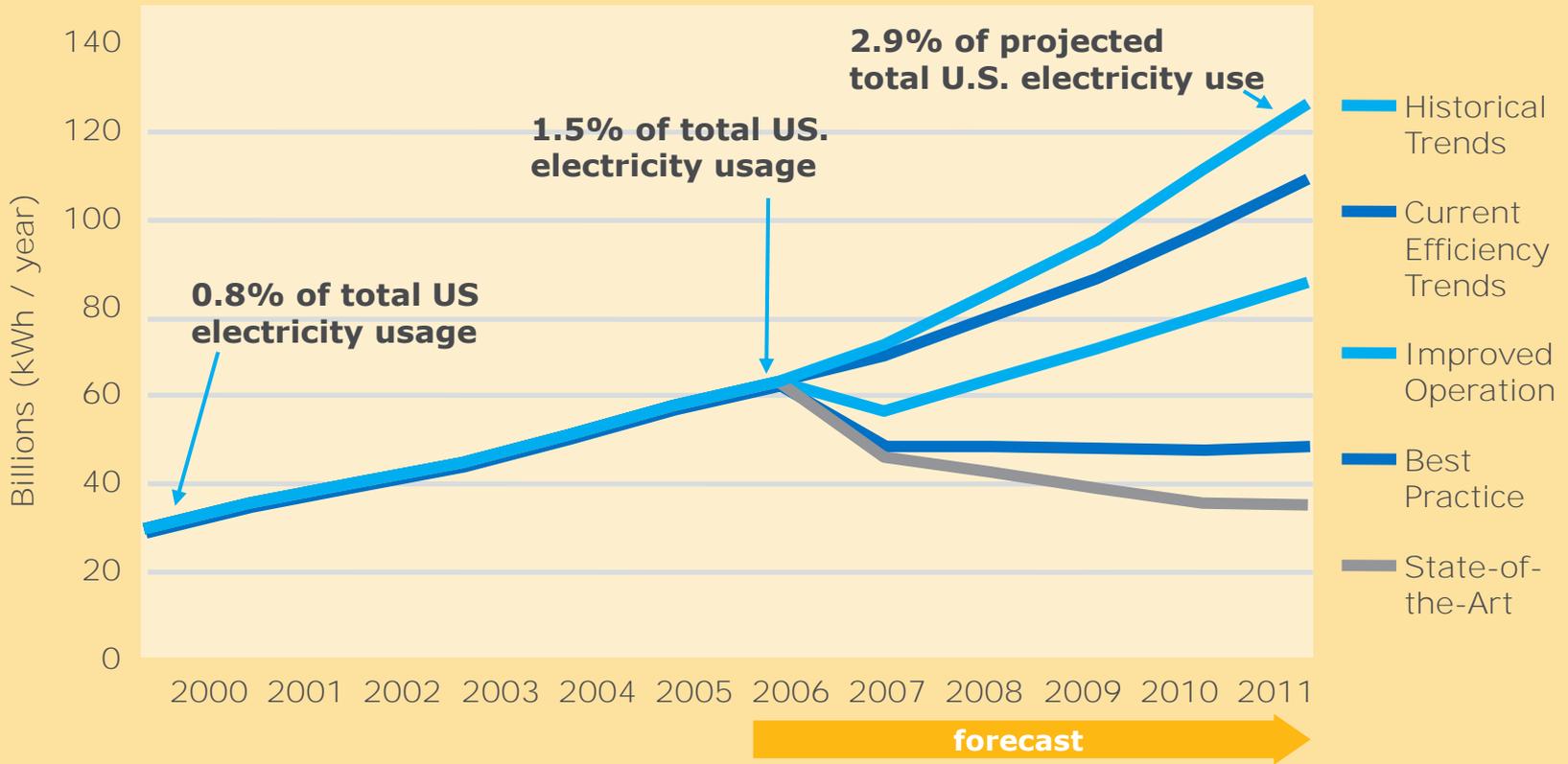
Natalie Bates, Energy Efficient HPC Working Group

Themes in the HPC Data Center... the day ahead



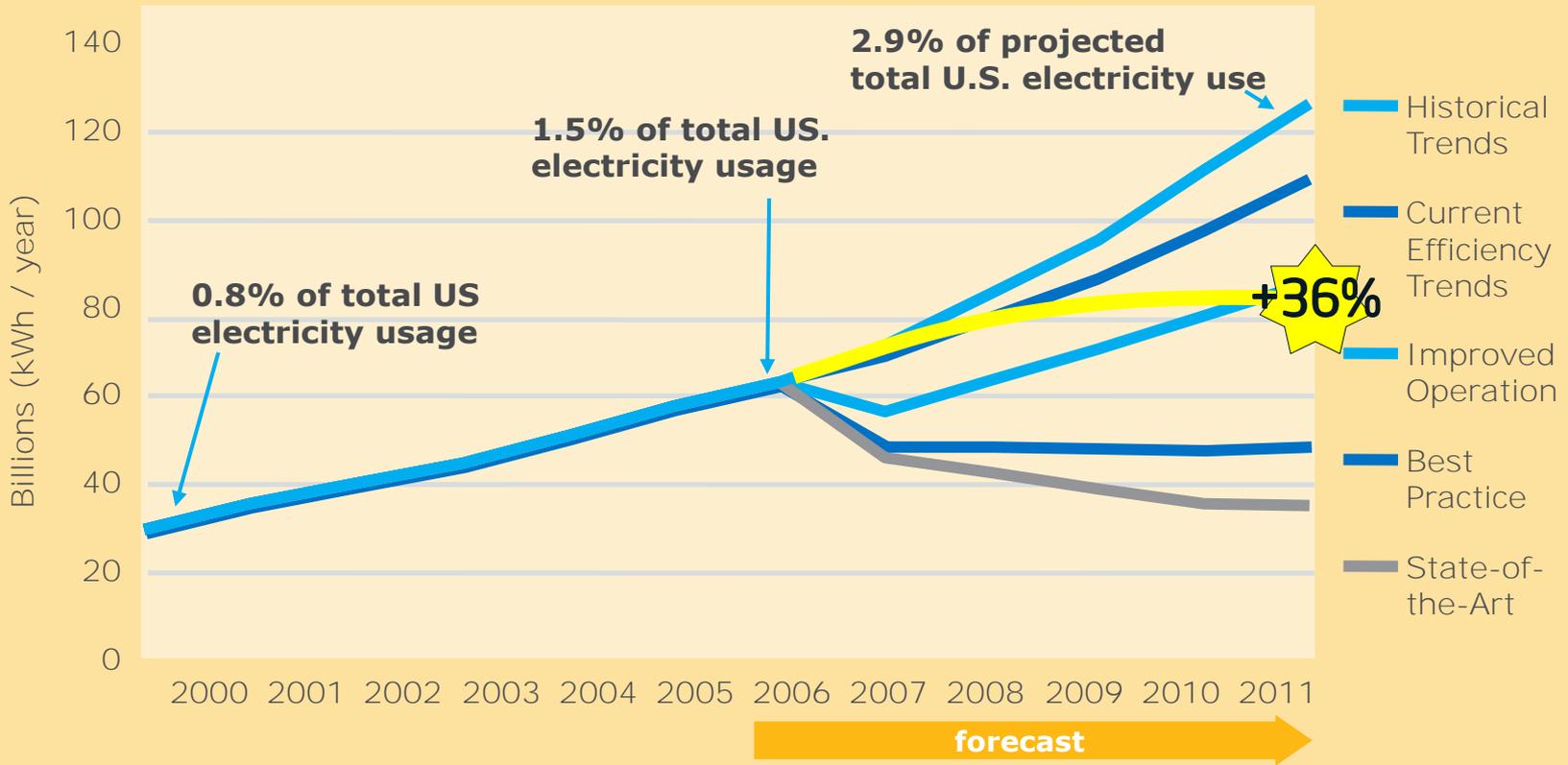
A Data Center Crisis...or Opportunity?

Projected Data Center Energy Use Under Five Scenarios



A Data Center Crisis...or Opportunity?

Projected Data Center Energy Use Under Five Scenarios



Koomey, 2011, estimates 36% growth

How we did it? Where do we go next?

- Economic Downturn
 - Impacted growth to some extent
- IT equipment performance per watt improvements
 - Moore's Law continues
- Data Center Improvements
 - Design and Operational
 - Metrics; PUE awareness and improvements

BBC News Science and Environment, 7NOV11

Late last week, Oak Ridge National Laboratory (ORNL), which hosts the US's official emission-counting agency, released data showing a huge surge in carbon dioxide emissions from 2009 to 2010.

Now, consultants Pricewaterhouse Coopers (PwC) has an analysis showing that greenhouse gas emissions rose by more than economic growth.

Economic activity expanded by 5.1%; CO2 output by 5.8%.

TECHNOLOGY AND THE ENVIRONMENT

Drive Computing to
Be More
Energy Efficient

~2%

~2%

Opportunity

Use Computing to Improve
Energy Savings Outside
Information and
Communications Technology

98%

The Big Opportunity



Does HPC have a Carbon ROI?
Should we explore it?

Carbon Accounting

We will talk about a lot of metrics but here is one that we might want to develop...

$$COP_{Carbon} = \frac{\textit{Total Carbon Reduced}}{\textit{Total Carbon Used}}$$

Who Needs a Treadmill - Cat uses slide as trademill

moetocool

6 videos

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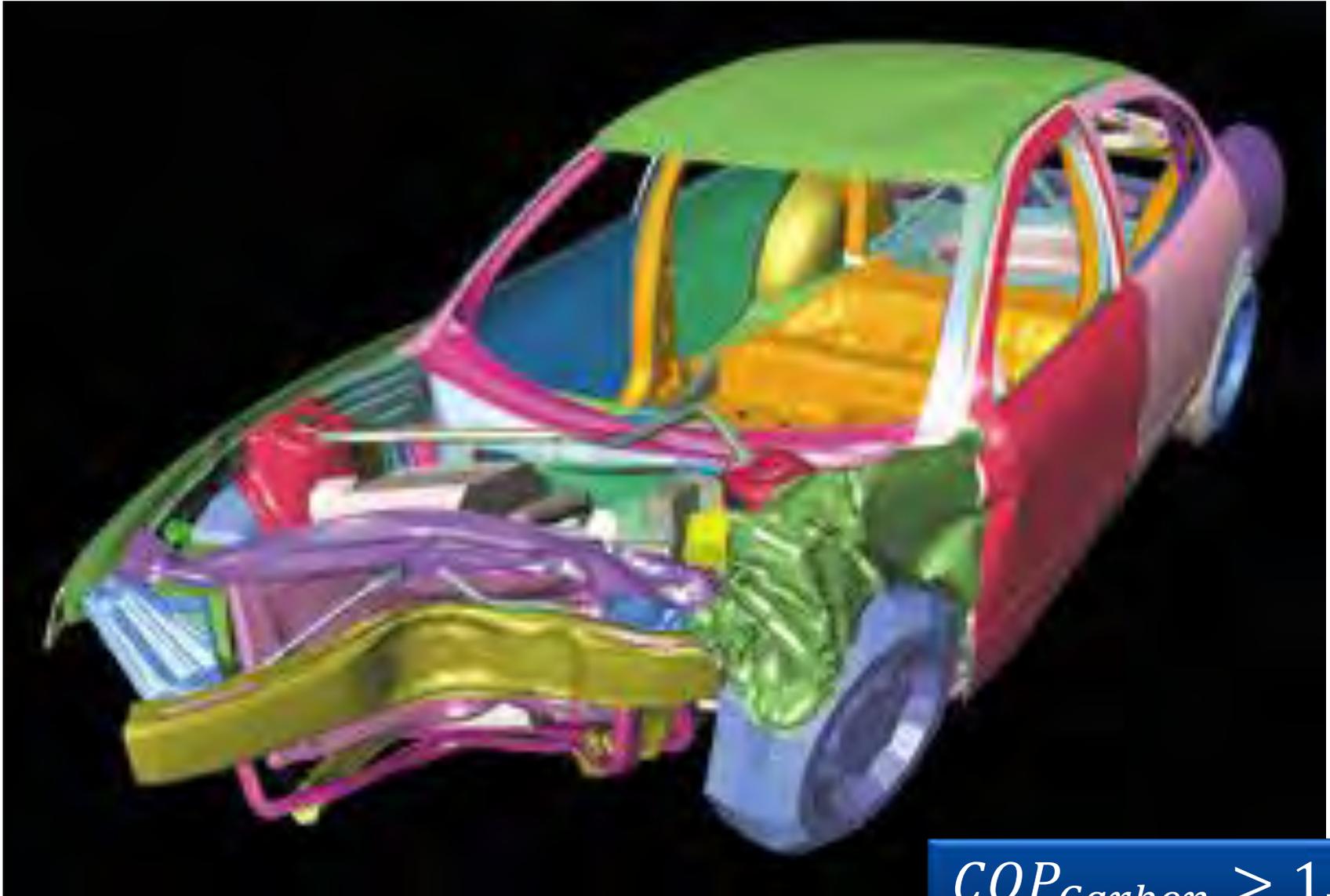
206,683

Uploaded by moetocool on Dec 9, 2008

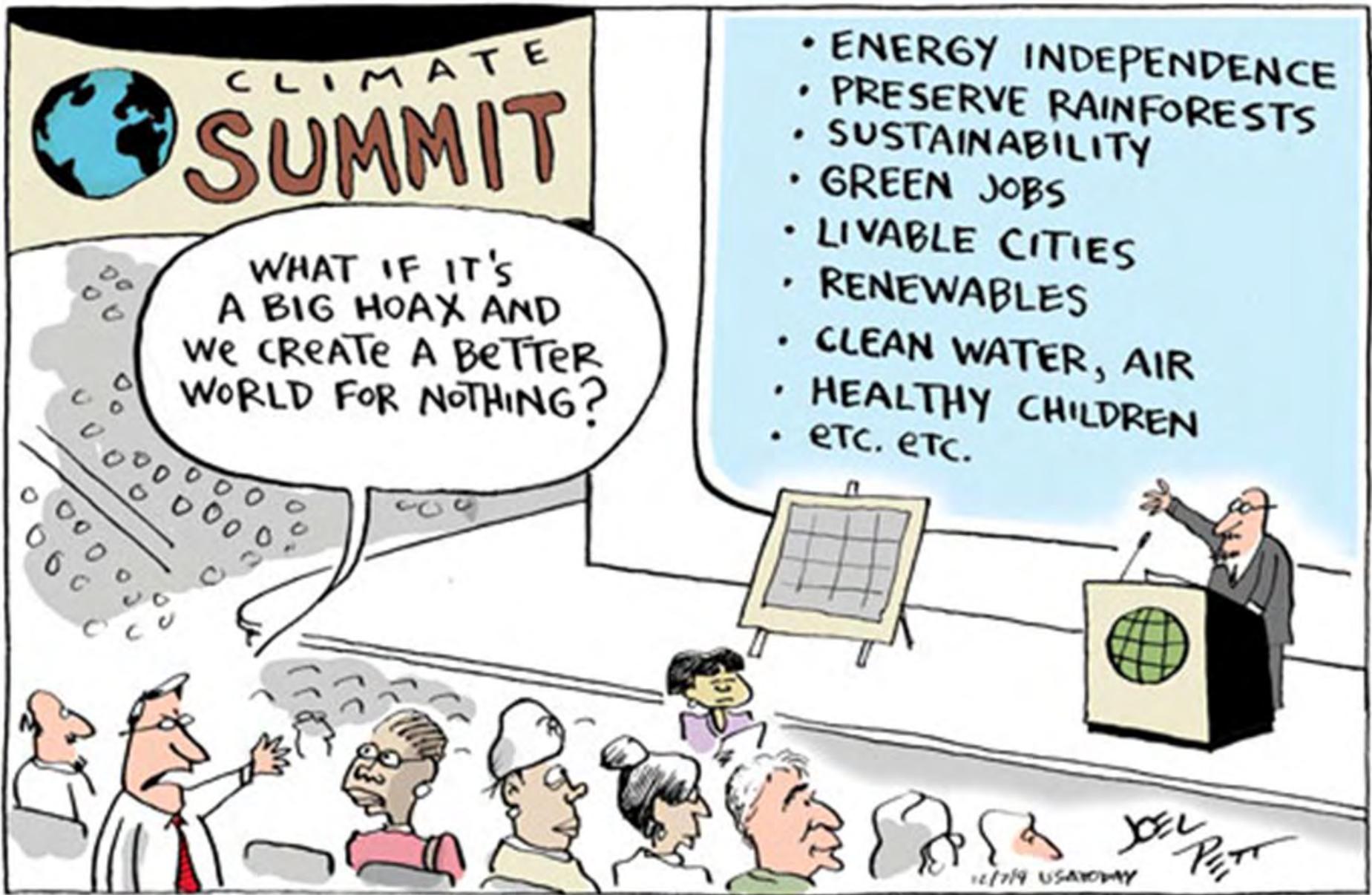
<http://www.youtube.com/thenayefsoufan>

532 likes, 25 dislikes

$$COP_{Carbon} = 0$$



$COP_{Carbon} > 1.0$



Source: Joel Pett, USA Today, Dec 7, 2009

Agenda

Start	Stop	Presenter	Topic
09:00	09:15	M. Patterson	Opening remarks
09:15	09:30	N. Bates	Energy Efficient HPC Working Group Overview
09:30	10:15	S. Matsuoka	System Architecture and Energy Efficiency
10:15	11:00	A. Yoder	Energy Efficiency Strategies for Storage in HPC Environments
11:00	11:15		Break
11:15	12:00	A. Bailey	LLNL's Power Management System
12:00	12:45	W. Tschudi	Energy Efficiency Tools and Resources
12:45	01:45		Lunch
01:45	02:30	M. Patterson	Liquid Cooling Guidelines
02:30	03:15	G. I. Meijer	Hot-water Cooling of Energy-Hungry Data Centers
03:15	03:30		Break
03:30	04:15	M. Patterson	Metrics Overview and Update
04:15	05:00	N. Dube	Sustainability: the Path to a Net-Zero Datacenter (Energy, Carbon, Water)
05:00	05:15	N. Bates	Closure

Energy Efficient HPC Working Group

EE HPC WG

- 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.

<http://eehpcwg.lbl.gov>



Energy Efficient HPC Working Group

Membership: The Energy Efficient High Performance Computing Working Group is open to all interested parties. Please [contact](#) us if you would like to join.

EE HPC WG Website
<http://eehpcwg.lbl.gov>

Email
energyefficientHPCWG@gmail.com

Energy Efficient HPC Linked-in Group
http://www.linkedin.com/groups?gid=2494186&trk=myg_ugrp_ovr

Hope to hear from you soon!
Dale Sartor & Natalie Bates, Co-leads, EE HPC WG

EE HPC WG History and Organization

- Conceived at the Super Computer 2008 conference in Austin and formed in '09. Currently ~200 members
- Three sub-groups
 - Infrastructure Team
 - co-led by Bill Tschudi, LBNL and Dave Martinez, SNL
 - Energy Re-use Metric, Liquid Cooling Guidelines, Dashboards
 - System Team
 - co-led by Erich Strohmaier and John Shalf, LBNL
 - System Metrics, System Power Management
 - Conferences Team
 - co-led by Anna Maria Bailey and Marriann Silveira, LLNL
 - SC, ISC, GovEnergy, IGCC
- Monthly Best Practices Webinars
- Bi-monthly General Membership Meetings

EE HPC WG Recent Highlights

- Publish Guidelines for Liquid Cooling Temperature
 - SC11 Paper and ASHRAE Whitepaper
- Collaborate with Top500, Green500, The Green Grid on standardizing energy compute metric(s)
 - Paper on power measurement methodology for HPL workload
- Promote and provide training for DCPro Suite
- Monthly best practices webinar
 - Every 2nd Tuesday at 10AM PT
- Plans: Dashboards, Shifting IT Load, Power Management



Other EE HPC WG Technical Sessions

- **Birds of Feather: "Setting Trends for Energy Efficiency"**
 - Tuesday, 12:15-1:15PM TC 101
- **Birds of Feather: "'Hot' for Warm Water Cooling"**
 - Tuesday, 5:30-7:00PM WSCC 613/614
- **State of the Practice: "'Hot' for Warm Water Cooling"**
 - Wednesday, 4:00-4:30PM TC 202

