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Green IT for Higher Education

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Overview



- What do we mean by cyberinfrastructure and "green IT"?
- Inefficient truths and scary facts
- What can be done?
- What are we doing?
- Novel approaches
- Next generation internet (NGI)
- Zero carbon CI facilities
- Significant economic opportunities
- Closing remarks

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Cyberinfrastructure



- Coordinated aggregate of software, hardware and other technologies, *as well as human expertise*, required to support current and future discoveries (NSF OCI)
 - Data analysis and management
 - Laboratory automation (sample and data handling)
 - Visualization and modeling
 - Remote collaboration tools (interactive conferencing; remote sensing; remote access/control of instrumentation)
 - Learning and workforce development
 - Knowledge and skills needed to design, deploy, adopt and apply cyber-based systems change how we teach and how we learn to prepare a globally engaged workforce
 - Integrating research and education
 - Students gain practical experience and conduct original research

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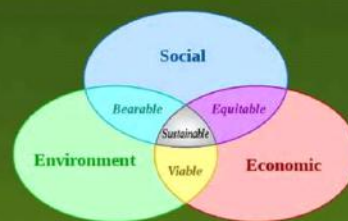
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Green Information Technology



- ***The study and practice of using computing resources efficiently***
- Similar goals to green chemistry: reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste
- The future of cyberinfrastructure is about building network and computational architectures and business models that help reduce CO₂ emissions



The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century. Report of the IUCN Renowned Thinkers Meeting, 29-31 January, 2006

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Inefficient truths about ICT*

* <http://www.globalactionplan.org.uk>; <http://www.gartner.com>



- It is estimated that the ICT industry alone produces CO₂ emissions that are equivalent to the carbon output of the entire aviation industry (~2% of global emissions)
- ICT is now 5th largest industry in terms of consumption of power
- ICT emissions growth is the fastest of any sector in society, increasing 6%/yr (aviation sector growth is 3%/yr)
- One small computer server can generate as much carbon dioxide as a SUV with a fuel efficiency of 15 miles per gallon
- Nearly 40% of servers at universities and businesses are underutilized by more than 50%

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Cyberinfrastructure scary facts*

* <http://www.nanoq.org/mtg-0802/levy.html>; <http://www.iht.com>; <http://www.gartner.com>



- Cyber-infrastructure is often the 2nd largest consumer of electricity after basic heat and power on university campuses
- Energy costs are now the 2nd highest cost of a Data Center or science facility
- By 2010, half of all Data Centers will have to relocate or outsource applications to another facility
- Personal computer ownership will quadruple to 4B devices by 2020
- Online entertainment (such as Second Life) uses as much power as the average Brazilian uses to live

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Personal carbon footprint*

* <http://www.independent.co.uk/environment/climate-change/>;
<http://jasonschaeffer.net>



- A measure of the amount of carbon dioxide a person, organization or state produces or for which they are responsible in a given time

- The average per capita carbon footprint world wide is 4000 kg/year
- The average per capita carbon footprint in industrial nations is 11,000 kg/year
- The average per capita carbon footprint in the United States is 19,000 kg/year
 - Hummer H3 = 10,000 kg/year



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What can be done?



- Carbon neutrality imposed by law or taxes
 - British Columbia was the first government to introduce a **carbon tax** in the Western Hemisphere, mandating all public sector institutions to be carbon neutral by 2010 (New Zealand has done the same)
- Carbon neutrality linked to funding agreements
 - Government funding in the United Kingdom will reward greenest universities and colleges based on their performance in reducing carbon emissions
 - Success in cutting emissions will be linked to funding agreements from 2011.
 - Energy efficiency and emission reduction will be key priorities in a forthcoming government plan to build a framework for the future of higher education over the next 10 to 15 years
 - Higher Education Funding Council for England (HEFCE) has set out a strategy for curbing emissions by 80% by 2050

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BOLD BUT...
These initiatives will have a big impact on research and higher education


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What can be done?

- Telecommute (telework) and adopt alternative work schedules
 - Advantages
 - Cost savings, increased productivity, organizational flexibility
 - Reduced traffic congestion, reduced total travel and consequential pollution, access for people with specific difficulties
 - Drawbacks
 - Personal motivation, "culture", the nature of the task

Day 1: Ethics



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What can be done? **iLinc™**

- **Green conferencing:**
Adopt web-based desktop technologies for online meetings and instruction
- E-learning
 - Dynamic and engaging
 - Easier for individuals to adapt to communication in an online environment
- Network communities
 - Collaboration between teams with expert involvement

Meetings that Save Money, Increase Revenue & Save the Planet



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What can be done?



- **Upgrade systems and recycle information technology and cyberinfrastructure-associated waste**
 - Technology trade-in and recycling and eco-delivery efforts optimize energy efficiency of routers, computers, databases and switches
 - E-waste recycling programs deal with megatons of obsolete personal computers, old cell phones and other waste electrical, electronic equipment, and electronic-associated waste piling up every year
 - High density, low power "green storage" media advance energy efficiency and conservation in all networked storage technologies and minimize the environmental impact of data storage operations
- **Employ server virtualization**
 - Allows multiple network and computational instances to exist on a common high energy efficiency network and computational substrate

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Remotely-enabled instruments



- Basic tools to do cutting edge research are becoming prohibitively expensive
- Growing number of science and engineering fields are becoming information and computation intensive
- IT progress (and cost reduction) makes it easier and more affordable to share research data, tools, and computing power
- Facilitates collaboration, consultation and distributed expertise
- Provides exceptional opportunities for education and training
- Good pedagogical reasons for effective deployment and support of remote collaborations include
 - *Illustrating and validating analytical concepts*
 - *Introducing students to professional practice*
 - *Developing instrumentation and collaborative skills*

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What is Cal State Fullerton doing?



- **Reducing power consumption and therefore our carbon footprint**
- **Desktop power management**
 - Puts desktop computers on standby after 15 minutes
- **Campus-wide data center consolidation**
 - Remove ad-hoc data centers and concentrate them in a central locations
- **Monitor replacement**
 - Remove all CRTs and replace with low power (energy star) monitors
- **Desktop replacement**
 - Redeploy older rollouts and replace inefficient desktop computers
- **Server virtualization**
 - Reduce the number of servers on campus; utilize virtualization technology

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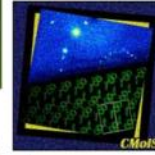
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What is Cal State Fullerton doing?



- Remotely enabling instruments (since 1997)
- CMoS
 - Keck/CSUPERB core facility for the 23-campus of the CSU
 - Research partner with SSRL
- STaRBURSTT-CDC
 - Nationwide consortium of PUIs and CCs
- PRISM
 - E-consortium of CSU core facilities serving system, partner institutions including CCs and

STaRBURSTT-CDC



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What is Cal State Fullerton doing?



- Reduction of printing
 - Academic Senate online portfolio project
 - Online publication instead of print
 - Eco-font deployment (less is more)
 - Office 2007 deployment with pdf generator
- Generating a publication on Green IT or IT Computing to assist individuals to achieve Green Computing



ecofont



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The Vision

ubiquitous

Hello!

research

e-learning

collaborate

Virtual Networked Organization

faculty

students

accessibility

Help

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Novel approaches



- Many companies like Cisco, Google, IBM, iLinc, etc will purchase carbon offsets if you use their technology to reduce CO₂
- [CANet - news] Google announces tools to determine if your ISP is blocking or throttling traffic
 - Google will provide researchers with 36 servers in 12 locations in the U.S. and Europe to help users attempt to diagnose common problems that might impair their broadband speed, as well as determine whether BitTorrent is being blocked or throttled by their ISPs
 - BitTorrent is a free, open source file-sharing application effective for distributing very large software and media files

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- Cut down on the amount of CO₂ we pump into the atmosphere by holding classes, meetings training sessions, as well as research collaborations, over the Internet instead of sending faculty, students and staff out in polluting automobiles (or planes)
- **iLinc™** donates \$100 toward renewable-energy sources and carbon-reduction programs for every company that saves ~450,000kg of CO₂ or more using its products

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Electronic publishing



- **UC libraries and Springer Science+Business Media**
 - Groundbreaking experimental agreement to support open access publishing by UC authors
- **Articles by UC-affiliated authors accepted for publication will be published using Springer Open Choice**
 - Full and immediate open access
 - Per-article charges have been factored into the overall license

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The falsehood of energy efficiency

- Most current approaches to reduce carbon footprint are focused on increased energy efficiency of equipment and processes
- This approach is doomed to failure because of Khazzoom-Brookes postulate (aka Jevons paradox)
 - Greater energy efficiency reduces overall cost and therefore promotes increased usage
- We need a “zero carbon” strategy, because increased usage will not change the emission equation
 - Anything times zero is zero
- Innovate (big bottom line) vs sustain
- Internet networks and broadband architecture are one answer

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Next generation internet (NGI)

- Any future internet network, project, program or application must have as its primary objective of a **zero carbon footprint**
- Zero carbon condition applies to
 - Remote instrumentation and laboratories
 - all optical, wireless and last mile networks
 - all routers, switches, and web servers
 - all applications, computers instrumentation
 - and all customer devices such as PCs, mobile phones, PDAs etc

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Zero carbon CI facilities



- Purchasing green power locally is expensive with significant transmission line losses
 - Demand for green power within cities expected to grow dramatically
- CI facilities **DON'T NEED TO BE LOCATED IN CITIES**
 - Cooling also a major problem in cities
- Most renewable energy sites are very remote and impractical to connect to an electrical grid
 - But can be easily reached by an optical network (CANARIE)
 - May also meet some of government's objectives of extending broadband to rural/remote areas

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Zero carbon CI facilities



- Many examples already
 - Green House Data, Cheyenne WY
 - **AISO, Romoland, CA (desert)**
 - Solar powered network, data farm and web hosting
 - AMD/IBM processors and virtualization
 - Iceland and Lithuania National strategies



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Upcoming events



- **Tech Day, CSUF**
 - February 26, 2009
 - "Green Computing"
 - Booths, prizes, and an *e-waste recycler on campus*
 - Recycle any personal e-waste items (no state owned, only personally owned)
- **Global Clean Technology Forum, UCLA**
 - March 4-7, 2009
 - Athgo International (<http://www.athgo.org>)
 - Provides young people with applied entrepreneurial education and training and a platform to develop and launch socially conscious initiatives
 - Students from over 100 countries will brainstorm for 4 days
- **Emerging Technologies Week, CSUF**
 - April 13-17, 2009
 - A series of five 60-minute workshops *showcasing key emerging technologies* that are transforming higher education

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Acknowledgements



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|------------------------------|---------------------------------------------------------------------------------------|
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| • Faculty Development Center | • SSRL |
| • Information Technology | • STaRBURSTT-CDC |
| • iLinc Communications | • PRISSM |
| • President Gordon | • Bill St. Arnaud (CANARIE) |
| • Vice President Smith | http://green-broadband.blogspot.com |

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Questions



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