

Sustainable C*omputing

REGISTER

Monthly newsletter of the IEEE Computer Society Special Technical Community on Sustainable Computing
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From the Chair's Desk

June was a busy month for our STC. The key highlight was our membership growth; our STC has now reached 237 members! It is great to see the efforts of the membership and conferences chairs paying off. My co-chair and I were also busy, with Ishfaq attending the IGCC conference that he chairs the steering committee of, and myself coordinating the GreenMetrics workshop and ACM SIGMETRICS/Performance conference that I was program co-chair of. In all three of these venues, our STC was highlighted to the audience, through presentation and/or posters.

In the upcoming months, we intend to increase the visibility of our STC among the numerous conferences and workshops in the sustainable computing domain. The purpose of this is both to attract more members to our STC, as well as to keep our pulse on the community, and learn about new and interesting research that we can share with our members.

As always, if you have suggestions on how to improve our STC, please feel free to contact myself (martin.arlitt@hp.com) or any of the officers.

- Martin Arlitt

Call for Pick of the Month Nominations

Each issue of the Sustainable Computing Register features a Pick of the Month, a research publication or industry project that has significantly advanced the field of sustainable computing. The goal is to increase awareness within our community about high-impact, transformative research.

Selection Process:

1. Members can submit worthy papers and industry projects by emailing me.
2. Submissions endorsed by 2 STC-SC officers will advance to public vote on Facebook.
3. By visiting our Facebook page, all members can vote for their favorite paper. At the end of each month, the paper with the most votes will become a Pick of the Month (provided the authors agree to be interviewed). Papers nominated but not selected for more than four (4) months will be removed.

Requirements for nominees:

- The paper must have been published in a peer-reviewed, research forum.
- The paper must be related to sustainable computing, e.g., energy efficiency, renewable-powered computing, smart grid, life cycle of ICT, smart buildings, etc.
- The paper must have been published in the last 2 years.
- Industry projects must have shown significant practical impact or intellectual contribution.

Resource and Energy Management



by Danilo Ardagna, Politecnico di Milano
How clean is your cloud? A Summary of the Greenpeace Report (Part 1)

In April 2011, Greenpeace published a report on the energy mix used by data centers of the largest cloud computing providers, entitled "How clean is your cloud?" The report stirred a lot of debate. Most of the providers surveyed received low grades. For example, Apple got three Ds and one F and Amazon fared even worse. The table below summarizes the report. You can obtain a full copy of the report here:

<http://www.greenpeace.org/international/Global/international/publications/climate/2012/iCoal/HowCleanisYourCloud.pdf>.

Company	Clean Energy Index	Coal	Transparency	Infrastructure Siting	Energy Efficiency	Renewables and Advocacy
Akamai	NA	NA	A	B	C	D
Amazon	13%	33%	F	F	D	F
Apple	15%	55%	D	F	D	D
Dell	56%	20%	C	C	C	D
Facebook	36%	39%	D	B	B	C
Google	39%	28%	B	C	B	A
HP	19%	49%	C	D	B	C
IBM	12%	49%	C	D	C	D
Microsoft	13%	39%	C	D	C	C
Oracle	7%	48%	D	D	C	D
Rackspace	23%	31%	C	C	C	C
Salesforce	4%	33%	B	C	C	C
Twitter	21%	35%	F	D	F	D
Yahoo!	56%	20%	C	B	B	B

Important points and expectations for Cloud Providers include (quoted directly from the report):

- “Despite significant improvements in efficiency, the exponential growth in cloud computing far outstrips the energy savings that can be obtained improving IT energy efficiency. Companies must look not only at how efficiently they are consuming electricity, but also the sources of electricity that they are choosing.”
- “The International Energy Agency (IEA) warned in fall 2011 that unless a decisive shift is made to clean energy investment and away from high-carbon sources of energy like coal, in the next five years (by 2017), the Earth will be locked into a disastrous cycle of unavoidable global warming. Electronic devices and the rapidly growing cloud that supports our demand for greater online access are clearly a significant force in driving global energy demand.”

2012 GreenMetrics Trip Report

by Martin Arlitt, HP Labs and University of Calgary



2012 marked the fourth anniversary of the GreenMetrics workshop. This year, the workshop expanded from a half day to a full day to accommodate a new track on SmartGrid. The SmartGrid track was co-chaired by Adam Wierman (CalTech) and Nidhi Hegde (Technicolor), while the original IT track was co-chaired by Niklas Carlsson (Linköping University) and myself. The program, including links to the papers and the slides of the invited speakers, is available at <http://www.sigmetrics.org/greenmetrics/program.shtml>.

The IT track opened with a keynote presentation entitled "Challenges in Multi-Modal Transport Planning". This talk was given by Dr. Jochen Mundinger, CEO of routeRank Ltd. routeRank is a travel search engine that considers the various options to get a person from point A to point B. Unlike typical search engines that require users to enter airport codes as the end points, routeRank permits more relevant endpoints (e.g., your home) to be entered as the end points. It then considers all of the options (e.g., car, train, air, and combinations thereof) to get the user between point A and point B. While routeRank does provide a free search service for the general public to use, its main focus is on developing customized instances for businesses. The customization permits company-specific policies to be integrated into the searches. The search results can consider (for example) the carbon footprint of different trip alternatives, giving preference to certain airlines, or selecting options that permit the user to work while in transit (e.g., on a train with WiFi). The keynote gave live demos of both the free version and a customized business version. Jochen also explained some of the challenges of building the service, described how they addressed some of them, and discussed which remained to be solved.

The IT track concluded with three paper presentations. The first was "Measuring Energy Consumption for Short Code Paths using RAPL". This was selected as the best student paper. The paper reports on the authors' experience in using the "Running Average Power Limit" (RAPL) energy sensors available in recent Intel CPUs. They look specifically at the energy costs associated with decoding video, and discuss what obstacles they encountered in the process. The second paper, "Empirical Evaluation of Power Saving Policies for Data Centers" used Amazon's EC2 platform to support a Wikipedia-like application, which they then used to experimentally evaluate different power saving policies. The final paper in the session was entitled "Evaluating the Need for Complexity in Energy-Aware Management for Cloud Platforms". The general concern raised by the paper is that the increasing complexity of energy management policies can have negative consequences on other important properties, such as application availability. The paper considers several benchmarks (the Voldemort key-value store benchmark, and a Hadoop benchmark) to illustrate the issues that exist.

The Smart Grid track consisted of four invited talks and three paper presentations. The first invited talk, "Stochastic Analysis of Real and Virtual Storage in the Smart Grid", actually contained two presentations. First, Jean-Yves Le Boudec of EPFL presented "A Stochastic Model of Demand Response". It describes a model of demand response for systems with volatile demand and supply. It uses the model to examine potential problems with grids, such as instability arising from volatile demand and supply. Then, Nicolas Gast of EPFL presented "Coping with Wind Volatility". This work too uses a model to explore questions like "What is the optimal storage size?",

GreenMetrics Trip Report continued from page 4

and "What scheduling policies should be used with small storage?". This work leveraged data from a UK archive. Next, Steven Low from CalTech presented "Branch Flow Model". It too is motivated by the operational challenges for a grid that obtains a non-trivial amount of electricity from volatile or intermittent sources like wind and PV. The third invited talk was entitled "Evaluation of the Impacts of Geographically-Correlated Failures on Power Grids", presented by Gil Zussman of Columbia University. The presentation includes a nice satellite image from the night of August 14, 2003, when a cascading power failure on the east coast of the US blacked out a large part of the US. Concerns over large solar flares or EMP attacks on the grid were examples of other motivations for this work. The presentation went into some detail on a failure in the San Diego area, in Sept. 2011.

The final invited talk was given by Catherine Rosenberg from the University of Waterloo. The topic was "Real-Time Distributed Congestion Control for Electric Vehicle Charging". The presentation provides an introduction to the existing grid, and some of the challenges in operating it. The main topic of the presentation is how to leverage techniques used for congestion control in the Internet for controlling the charging of EV vehicles in real time. The first paper in this session was "On the Impact of Storage in Residential Power Distribution Systems". It uses a probabilistic sizing technique from computer network research to size storage and transformers in an electric distribution network. They use measurements from a testbed of 20 homes to demonstrate how their technique could be used by a distribution company to avoid upgrades while maintaining desired reliability levels.

The next paper was "Electric Grid Balancing through Low-Cost Workload Migration". This position paper examines how data center workload migration could help with demand response. The paper includes a real world grid balancing problem from the US Pacific Northwest. The final paper in the workshop was "Survivability Analysis of Power Distribution in Smart Grids with Active and Reactive Power Modeling". The paper presents a model to study power distribution in smart grids during the period of time between a failure and recovery.

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- "While many brands are taking steps to manage and reduce pollution by increasing efficiency in their data center operations, only a few companies have demonstrated a significant commitment to meeting their growing electricity needs from renewable sources. This disconnect highlights the tremendous urgency in ensuring that these long-lasting investments in building the infrastructure to deliver the cloud are directed toward renewable sources of energy, and do not lock us in to our addiction to coal and other dirty sources of energy."
- "In order to achieve the reductions necessary to keep the sector's emissions in check and maintain safe levels of global greenhouse gases, renewable energy needs to become the priority for IT companies as they rapidly expand their data center infrastructure. A few companies, such as Yahoo and Google, have taken meaningful steps to steer their infrastructure investments toward cleaner energy, but the sector as a whole remains focused on rapid growth, with greater efficiency as a pathway to enable this continued growth. The replacement of dirty sources of electricity with clean renewable sources is still the crucial missing link in the sector's sustainability efforts."

A number of recent studies have sought to portray the cloud as "green" or "lower carbon," particularly in comparison to a non-cloud delivery of IT services. This was Amazon argument to the report. Other companies, notably Microsoft, provided no comment.

Networks & Distributed Systems

by Guillaume Jourjon, NICTA



What about this carbon tax (Aus)?

On the first of July, the Australian government put a price on carbon for a selection of large companies across the country. The idea was to initiate an Emissions Trading Scheme (ETS) similar to what is supposedly in place in Europe. Overall, I think having a carbon tax makes a lot of sense and it is clearly easier to implement than a trading scheme where the market will try to regulate itself without any clear metrics and a lot of people playing poker. A lot of articles and opinions have been published in newspaper in Australia about this new tax. Australia is a large producer of coal and mineral and the electricity is mainly coming from coal and gas. In this post, my modest contribution will be to analyze what would be the impact of the carbon and what consumers would expect to see *if* it were applied to the Internet as a whole. The computations presented hereafter are based on the article “The Energy and Emery of the Internet.”

Estimates by the government and independent bodies show that on average, the electricity bill of the consumer will rise by about 9% due to the carbon price. However, due to costs involved with maintenance and technology upgrades, energy companies are projected to raise prices by up to 18%. We can consider this raise in energy prices as a worst case scenario. Internet companies are large energy consumers and often receive discounts and lower rates. To be pragmatic, we will use the following figures to estimate carbon emission as a function of energy source.



Image by Ian Fieggen. Distributed by Wikimedia Commons.

- Coal: 1 MW emits 290 g of carbon,
- Natural gas (combined cycle) = 1 MW emits 120 g

Therefore, to reach a tonne of carbon, an industry needs to consume 3.4GW if it uses only coal. Based on these computations, we can have a idea of how much carbon and therefore how much tax the Internet company will have to pay. In their paper, the authors give the figure of a maximum consumption for the Energy of Internet of about 142.92 GW which gives 42 tonnes of carbon every second (i.e. AU\$ 966 in tax). I am discarding the Emery in this analysis on purpose.

Obviously in my computation, I took the very worst case scenario but it gives a good overview of how carbon will be produce if we are using only coal.

As a conclusion, this carbon tax as implemented at the moment would cost for the entire world nearly AU\$1k per second. I think it will be interesting to see how the different service providers will forward this new cost to the user. In particular, the different computations show that most of the operational costs of the Internet are coming from the different servers and cloud systems. I am wondering if the ISP in particular will increase, e.g., the cost of the contracts or limit the different quotas.

STC Updates

By Giuliano Casale, Imperial College



Membership: 237

Report from Secretary/Treasurer (Giuliano Casale):

- Collected officers' activity reports and prepared monthly STC report.

Report from Conferences Chair (Diwakar Krishnamurthy):

- Sought collaborations with a number of conferences/workshops related to sustainability to be held in July-August (ICGREEN 2012, VHPC 2012, LADIS 2012, PODC 2012, Green Networking & SmartGrid 2012, ISLPED 2012, HPCS 2012, SCALSOL 2012, GreenTech 2012)

Report from Academic Chair (Niklas Carlsson):

- Working with the industry chair on a short-feature and proposal of a student award.

Report from Membership Chairs (Anirban Mahanti and Sergey Blagodurov):

- Launched extensive membership recruitment drive. Contacted researchers active in the research community, resulting in approximately 30% replies and an increase in group membership.
- Developed a script that counts unique members across FB, LinkedIn, and web list

Report from Communications Chair (Abhishek Chandra):

- Continued to identify conferences, workshops and journals relevant to sustainable computing.
- Prepared a spreadsheet with information about upcoming call for papers and call for participation, for inclusion in the monthly newsletter and website.

Report from Policies and Procedures Chair (Stephen Dawson):

- Documenting implemented STC-SC processes and gathering requirements for future processes.

Report from Industry Chair (Canturk Isci):

- Worked with Academic Chair on the industry/academy group pictures and the student awards
- Worked with Newsletter Editor on finalizing the industry highlights section

Report from Information Officers (Danilo Ardagna, Guillaume Jourjon):

- Contributed material for newsletter and blogs.
- Guillaume preparing a new post on the blog about the potential consequence of the introduction of the Carbon tax in Australia

Report from the Newsletter Editor (Christopher Stewart):

- Investigating pathways to publicity
- Recruiting new contributors

Upcoming Events

By Abhishek Chandra, University of Minnesota



The following venues are all requesting submissions on subtopics related to sustainable computing or IT for sustainability.

Conference, Workshop & Symposium Call For Papers

Short Name	Main Topic	Location	Dates	Abstracts Due	Papers Due	Notification
ASPLOS 2013	Architectural Support for PL and OS	Houston, TX	Mar. 16-20, 2013	Jul. 16, 2012	Jul. 23, 2012	Nov. 9, 2012
INFOCOM 2013	Computer Communication	Turin, Italy	Apr. 14-19, 2013	Jul. 20, 2012	Jul. 27, 2012	Nov. 19, 2012
GreenTech	Eco-Technology and Green Computing	Bali, Indonesia	Dec. 8-9, 2012		Aug. 1, 2012	Oct. 25, 2012
NSDI '13	Network Systems	Lombard, IL	Apr. 3-5, 2013	Sep. 12, 2012	Sep. 19, 2012	Dec. 10, 2012
FAST'13	File and Storage Systems	San Jose, CA	Feb. 12-15, 2013	Sep. 18, 2012	Sep. 24, 2012	Dec. 6, 2012

Journal and Special Issue Call For Papers

Journal
Sustainable Computing

Conference, Workshop & Symposium Call for Participation

Short Name	Main Topic	Location	Dates
GreenTech 2012	Conference on Eco-Technology and Green Computing	Chennai, India	Aug. 10-11, 2012
SustKDD	Data Mining for Sustainability	Beijing, China	Aug. 12, 2012
SIGCOMM 2012	Computer Communication	Helsinki, Finland	Aug. 13-17, 2012
ICT-GLOW'12	ICT against Global Warming	Vienna, Austria	Sep. 3-7, 2012
EnA-HPC 2012	Energy-aware HPC	Hamburg, Germany	Sep. 12-14, 2012
GreenCom	Green Communications	Online	Sep. 25-28, 2012
SustainIT	Sustainable Internet	Pisa, Italy	Oct. 4-5, 2012
HotPower'12	Power-Aware Computing and Systems	Hollywood, CA	Oct. 7, 2012
OSDI'12	Computer Systems	Hollywood, CA	Oct. 8-10, 2012
SOCC'12	Cloud Computing	San Jose, CA	Oct. 14-17, 2012

Visit <http://stc-sustainable-computing.ieee.net/venues> for more information.

To advertise a relevant venue, email Abhishek Chandra at chandra@cs.umn.edu.

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The journal for sustainable computing research

Sustainable computing research spans computer science, electrical engineering, sustainability science, and many other engineering disciplines. SUSCOM publishes research findings related to energy-aware and thermal-aware management of computing resources, as well as research on the ecological and societal impacts of computing.

Now accepting submissions.

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