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CLIMATE PROGRESS

Debunking the myth of the internet as energy hog, again: How information technology is good for climate

June 21, 2010

For some reason, the power used by computers is a source of endless fascination to the public. Most folks think that the power used by computers is a lot more than it actually is, and that it's growing at incredible rates. Neither one of these beliefs is true, but they reflect a stubborn sense that the economic importance of IT somehow must translate into a large amount of electricity use. That incorrect belief masks an important truth: **Information technology has beneficial environmental effects that vastly outweigh the direct environmental impact of the electricity that it consumes.**

That's the start of a guest post from Dr. [Jonathan Koomey](#), a project scientist at Lawrence Berkeley National Laboratory. Koomey has been a friend and colleague for more than a decade and a half — and we've spent a lot of time debunking mis-analysis in this area (see "[Ignore the media hype and keep Googling — The energy impact of web searches is very LOW](#)").

The overhyping of the internet's energy use goes back over a decade, pushed initially by two right-wing disinformers, Mark Mills and Peter Huber. I ended up writing a major [report](#) debunking this myth and then [testifying in front of the Senate Commerce committee](#) (i.e. John McCain) and the [House](#) on the subject. Koomey and others at LBNL did even more work debunking this nonsense (see links below).

Recently, someone sent me this *UK Guardian* story, "[The dark side of cloud computing: soaring carbon emissions](#)," which asserted:

According to Joseph Romm's 1999 seminal work, [The Internet Economy and Global Warming](#), direct sales to consumers and decentralized digital inventories of goods could lead to dramatic reductions in energy consumption and greenhouse gas emissions by 2010.

However, things turned out differently. Each day we generate more and more data — your digital footprint, so to speak, requires huge amounts of server space and energy. A part of that digital footprint may be described as digital waste — just think about all the data that you have created online that you no longer use.

Well, it's nice to have one's work called "seminal" — and that paper might well be the single most cited study I ever wrote (with Art Rosenfeld and Susan Hermann). But like many seminal papers, people cite it without actually reading it!

The 1999 paper never said that the Internet would lead to "dramatic reductions in energy consumption and greenhouse gas emissions by 2010." It said that the Internet would help significantly improve the efficiency of the overall economy, leading to a much faster rate of energy intensity decline than had been seen in the previous decade.

The Energy Information Administration initially scoffed at that prediction, but in fact, the EIA now [reports](#) that from 1986 to 1995, energy intensity (primary energy consumed per dollar of real GDP) dropped about 7.5%, whereas from 1996 to 2005 it dropped a whopping 20%! And it dropped another 8% from 2005 through 2009. Besides vindicating by prediction, it is one strongly suggestive piece of evidence that internet- and IT-driven growth is less energy intensive.

Focusing on the direct energy consumption of the digital economy simply makes little sense in trying to understand the overall impact of the Internet on the economy.

I asked Koomey if he wanted to respond to this piece. Besides his work at LBNL, he is a consulting professor at Stanford University and is one of the leading experts on the resource impacts of information technology and building efficiency technology. Here is what he wrote:

For some reason, the power used by computers is a source of endless fascination to the public. Most folks think that the power used by computers is a lot more than it actually is, and that it's growing at incredible rates. Neither one of these beliefs is true, but they reflect a stubborn sense that the economic importance of IT somehow must translate into a large amount of electricity use. That incorrect belief masks an important truth: Information technology has beneficial environmental effects that vastly outweigh the direct environmental impact of the electricity that it consumes.

Back in 1999, a cleverly written [article](#) was published in *Forbes* magazine, claiming that the Internet used 8% of all US electricity, that all computers (including the Internet) used 13% of US electricity, and that this total would grow to half of all electricity use in ten to twenty years. Most major

U.S. newspapers and business magazines, many respected institutions, and politicians of both political parties cited these assertions (the first one even came up in *Doonesbury* at about the same time). Alas, most people took leave of their critical faculties when evaluating them.

Joe Romm, Amory Lovins, and I spent a few person years of effort between us demonstrating in the scientific literature that these assertions were all false (for a compilation of that work, go [here](#)). The Internet, as defined by the *Forbes* authors, used less than 1% of US electricity in 2000, all computers used about 3%, and there is no way, short of repealing the laws of arithmetic, for the total to grow to half of all electricity use in one to two decades (see the Epilogue in [Koomey 2008](#) for a summary). Joe also showed that the high-level statistics on growth in energy, electricity, and carbon emissions in the Internet era all showed exactly the opposite of what the above claims would imply: the growth rates were significantly lower in the Internet era (1996 to 2000) than in the preceding four year period, even though GDP growth was *higher* in the latter period.

Unfortunately, variations of these myths persist to this day. In early 2009, the [normally reliable](#) *Sunday Times* of London reported that generating the electricity needed for a Google search emitted half as much carbon as did boiling a cup of tea, but this claim proved to be spurious (see [Mills and Koomey 2009](#)). As recently as April 12, 2010, *Energy Tribune* published an [op-ed](#) by Robert Bryce repeating the falsehoods in the *Forbes* article and confusing several important issues on this topic. And the ongoing concern over total electricity used by data centers continues to generate news coverage (for example, see [this article](#) in the Guardian), even though these facilities use only about 1% of world electricity use and their efficiency is improving rapidly over time.

In my view, the really important story is that while computers use electricity, they are not a huge contributor to total electricity consumption, and while it's a good idea to make computers energy efficient, it's even more important to focus on the capabilities information technology (IT) enables for the broader society. Computers use a few percent of all electricity, but they can help us to use the other 95+% of electricity (not to mention natural gas and oil) a whole lot more efficiently.

As an example of this latter point, consider downloading music versus buying it on a CD. A [study](#) that is now "in press" at the peer-reviewed *Journal of Industrial Ecology* showed that the worst case for downloads and the best case for physical CDs resulted in 40% lower emissions of greenhouse gases for downloads when you factor in all parts of the product lifecycle (Weber et al. 2009). When comparing the best case for downloads to the best case for physical CDs, the emissions reductions are 80%. Other studies have found similar results (see Turk et al. 2003, Sivaraman et al. 2007, Gard and Keoleian 2002, and Zurkirch and Reichart 2000). In

general, moving bits is environmentally preferable to moving atoms, and whether it's *dematerialization* (replacing materials with information) or *reduced transportation* (from not having to move materials or people, because of electronic data transfers or telepresence) IT is a game changer.

Another area where IT can help us is in *getting smarter and more capable*, so we can use our resources more efficiently. This could take the form of better sensors and controls in buildings and industry, like the [wireless sensor networks](#) that can be quickly and cheaply distributed in existing structures without wiring. Or it could involve more widespread use of software to make better energy-related decisions, such as Lawrence Berkeley National Laboratory's [Home Energy Saver](#) or the private sector tool called [Wattbot](#), both of which I've worked on over the years. Or it could involve [computer controls](#) in automobile engines, which reduce criteria pollutant emissions and improve fuel economy at the same time. Or it might mean [smart meters](#) that track electricity use minute by minute. Or it might involve the various companies that scan utility bills for big corporations and "roll up" those bills into analysis software that gives companies visibility into their actual energy costs (see, for example, [AdvantageIQ](#)). All of these examples and more are enabled by cheap, abundant, and powerful information technology

And there is good reason to believe that trends in information technology are going to make these positive developments even more pervasive and important. We're all familiar with Moore's law, which describes the rate of change in transistors per chip over time (doubling every year from the mid-1960s to the mid-1970s, and doubling every two years since the mid-1970s), with correspondingly rapid reductions in costs per transistor. However, few people are aware that there's a similarly regular trend on the electrical efficiency of computers that has persisted for two decades longer than Moore's law, and applies to all electronic information technology, not just microprocessors. The electrical efficiency of computation, defined as the number of computations we can do per kilowatt-hour consumed, has doubled roughly every year and a half since the mid 1940s (see [Koomey et al. 2009](#), below).

This trend has important implications for mobile computing technologies because these devices are constrained by battery storage. The power needed to perform a task requiring a fixed number of computations will fall by half every 1.5 years, enabling mobile devices performing such tasks to become smaller and less power consuming, and making many more mobile computing applications feasible. Alternatively, the performance of mobile devices could continue to double every 1.5 years while maintaining the same battery life (assuming battery capacity doesn't improve). Some applications (like laptop computers) will likely tend towards the latter scenario, while others (like mobile sensors) will take advantage of increased efficiency to become less power hungry and more ubiquitous.

IT is one technology that should give us hope about meeting an aggressive warming limit of [2 degrees C](#) (or [less](#)) from preindustrial times. Never before has society had to confront a challenge like this, but never before have we had such a powerful technology moving so rapidly in the right direction. And if we combine ubiquitous mobile computing with rapid advances in solar photovoltaic technologies (like in the [Big Belly trash compactor](#), for example), the possibilities for truly game changing societal innovation are breathtaking

Of course, this story is as much about personal and institutional change as it is about technology, and without a focus on the human and organizational evolution (as well as a stiff price on carbon) we'll continue on our currently unsustainable path. But one important piece of facing the climate challenge is falling rapidly into place: Information technology allows us to dematerialize, reduce transportation emissions, and get smarter faster. There's no time to waste in putting it to work.

So Google, Youtube, blog, and flickr as much as you want. If you are worried about your carbon footprint, buy 100% green power and do an efficient retrofit on your house to cover your emissions — and let the Internet keep saving people energy and resources.

Indeed, replacing material consumption and transportation with electricity is almost certainly a good thing from a climate perspective since it is considerably easier to generate carbon-free electricity than it is to have carbon free-transportation or carbon-free versions of books and newspapers and inventories and offices (see "[An introduction to the core climate solutions](#)").

Related Posts:

- [Energy efficiency is THE core climate solution, Part 1: The biggest low-carbon resource by far](#)
- [Part 2: The limitless resource](#)
- [Part 3: The only cheap power left](#)
- [Part 4: How does California do it so consistently and cost-effectively?](#)
- [Energy efficiency, Part 5: The highest documented rate of return of any federal program](#)

Further reading

The best overall summary of the Forbes electricity use controversy can be found in the Epilogue to the second edition of my book [Turning Numbers into Knowledge](#):

Koomey, Jonathan. 2008. *Turning Numbers into Knowledge: Mastering the Art of Problem Solving*. 2nd ed. Oakland, CA: Analytics Press.

<<http://www.analyticspress.com>> and <<http://www.numbersintoknowledge.com>>

The key supporting work analyzing the *Forbes* claims is well documented in the following three articles (the first is a short summary in a technical magazine, and the second two are in peer reviewed journals):

Koomey, Jonathan. 2003. "Sorry, Wrong Number: Separating Fact from Fiction in the Information Age." In *IEEE Spectrum*. June. pp. 11-12.

Koomey, Jonathan, Chris Calwell, Skip Laitner, Jane Thornton, Richard E. Brown, Joe Eto, Carrie Webber, and Cathy Cullicott. 2002. "Sorry, wrong number: The use and misuse of numerical facts in analysis and media reporting of energy issues." In *Annual Review of Energy and the Environment 2002*. Edited by R. H. Socolow, D. Anderson and J. Harte. Palo Alto, CA: Annual Reviews, Inc. (also LBNL-50499). pp. 119-158.

Koomey, Jonathan, Huimin Chong, Woonsien Loh, Bruce Nordman, and Michele Blazek. 2004. "Network electricity use associated with wireless personal digital assistants." *The ASCE Journal of Infrastructure Systems (also LBNL-54105)*. vol. 10, no. 3. September. pp. 131-137.

If you have a genuine interest in this history, please [email me](#) and I'll send you electronic copies.

The most recent summary of data center electricity use is the 2008 study I wrote for the peer reviewed journal *Environmental research letters*. I'm working on an update to this study now.

The 2008 study is this one:

Koomey, Jonathan. 2008. "Worldwide electricity used in data centers." *Environmental Research Letters*. vol. 3, no. 034008. September 23.
<<http://stacks.iop.org/1748-9326/3/034008>>

The Google search = 50% x a cup of tea claim showed up in an article in the *Guardian*, and it was subsequently debunked in the following blog posting:

Mills, Evan, and Jonathan Koomey. 2009. *Tempest in a tea-kettle*. Berkeley, CA: Lawrence Berkeley National Laboratory. February 2.
<<http://evanmills.lbl.gov/commentary/tempest.html>>

The paper comparing CDs to downloads is this one:

Weber, Christopher, Jonathan G. Koomey, and Scott Matthews. 2009. *The Energy and Climate Change Impacts of Different Music Delivery Methods*. Analytics Press (also in press at the *Journal of Industrial Ecology*). August 17.
<<http://www.intel.com/pressroom/kits/ecotech>>

And here's the paper on computing efficiency trends:

Koomey, Jonathan G., Stephen Berard, Marla Sanchez, and Henry Wong. 2009. *Assessing trends in the electrical efficiency of computation over time*. Oakland, CA:

Analytics Press. (also in press at the *IEEE Annals of the History of Computing*).

August 17. <<http://www.intel.com/pressroom/kits/ecotech>>

Finally, here are those other references analyzing dematerialization of physical goods:

V. Turk, V. Alakeson, M. Kuhndt, and M. Ritthoff, The environmental and social impacts of digital music – A case study with EMI, 2003.

D. Sivaraman, S. Pacca, K. Mueller, and J. Lin, “Comparative Energy, Environmental, and Economic Analysis of Traditional and Ecommerce DVD Rental Networks,” *Journal of Industrial Ecology*, vol. 11, 2007, pp. 77-91.

D.L. Gard and G.A. Keoleian, “Digital versus Print: Energy Performance in the Selection and Use of Scholarly Journals,” *Journal of Industrial Ecology*, vol. 6, 2002, pp. 115-132.

M. Zurkirch and I. Reichart, “Environmental Impacts of Telecommunication Services Two Life-Cycle Analysis Studies,” *Greener Management International*, vol. 32, 2000, pp. 70-88

This entry was posted by [Joe](#) on Monday, June 21st, 2010 at 12:28 pm and is filed under [Solutions](#). You can follow any responses to this entry through the [RSS 2.0](#) feed. Both comments and pings are currently closed.

43 Responses to “Debunking the myth of the internet as energy hog, again: How information technology is good for climate”

1. *Chris Rusbridge* says:

[June 21, 2010 at 12:47 pm](#)

Just one query: you write “others (like mobile sensors) will take advantage of increased efficiency to become less power hungry and more ubiquitous”. There is clearly an issue where increased numbers of devices reduce the benefits from decreased power per device. Have you analysed this to see its general effect?

2. *Jonathan Koomey* says:

[June 21, 2010 at 1:02 pm](#)

Chris (#1),

The increased numbers of devices is a real issue, but battery powered devices are vastly less energy intensive than the grid powered devices that they often displace. We also have technology improvements leading to displacement of older energy intensive technology with newer less energy intensive technology, which offsets the effects of the larger number of

devices to some degree. For example, laptop computers for the first time outsold desktop computers worldwide in 2009 according to IDC data, and laptops use a third to a fifth as much power as desktops. And the old cathode ray tube monitors use three times as much power as LCD screens, and LCDs have almost completely displaced CRTs.

To get the complete picture one would have to inventory all these devices and add up their power use. The last time people did this comprehensively was in 2000 (related to the debunking of the Forbes article) and it's getting to be time to do this again soon.

3. *Pierre* says:

[June 21, 2010 at 1:10 pm](#)

Thank you Joe and Jonathan. Excellent post. Within the climate & clean energy movement we need to maintain consistency on findings and messaging. I'm calling out Greenpeace's recent report, Make IT Green: Cloud Computing and It's Contribution to Climate Change to make my point(<http://www.greenpeace.org/international/en/publications/reports/make-it-green-cloud-computing/>) and encourage Greenpeace to reach out to you before publishing future reports on IT and energy/climate.

4. *Nigel Melville* says:

[June 21, 2010 at 1:34 pm](#)

"Of course, this story is as much about personal and institutional change as it is about technology, and without a focus on the human and organizational evolution (as well as a stiff price on carbon) we'll continue on our currently unsustainable path"

Institutional and organizational challenges are significant. IT groups do not have a stellar track record in rolling out organizational systems successfully. Not to mention employee mindsets (rebound effect comes to mind in the realm of electricity use). These and other non-technical factors will prove critical in effective application of IT for environmental sustainability in organizations – if the future is anything like the past.

5. *Robert* says:

[June 21, 2010 at 1:54 pm](#)

I view the internet (and communications / IT generally) as one of the great enablers of our global economy, one that has shaped it more than any other factor in the last 20 years or so. But surely the big picture is that it has increased emissions? It has speeded up the pace with which container ships full of cheap Chinese and Indian goods can find their way to western markets. It has enabled information services such as call centres to be moved to India, thus boosting the economies of previously very low carbon parts of the world.

Global CO2 emission trends have accelerated significantly as globalisation has taken hold. Just look at the graphs.

<http://www.esrl.noaa.gov/gmd/ccgg/trends/>

Like education, IT has the potential for either good or harm, depending on how it is used. In my view unfettered and undirected capitalism will tend to increase emissions.

6. *pete best* says:

[June 21, 2010 at 2:44 pm](#)

This does seem to be a little bit off to me due to the fact that ICT and all related technologies are being bought in ever more numbers and by ever more people. Cloud computing means more storage so even if energy efficiency is improving in ICT when you add in the related TV and mobile technology, MP3 and video players etc and it all adds up to an overall increase in energy usage even if it's only on a par with the aircraft industry.

What about the PS3/XBOX 360 which are serious energy consumers when on and running along with the gaming PC which have up to 1 KW power supply units for serious gamers who require lots of modern graphics hardware that is a serious energy user. The XBOX and PS3 do 200 Watts and they sell like hot cakes.

Cloud computing makes matters worse as digital photography is now the most popular activity for a PC and yet it's more technology.

Come on Romm, clock it all up – all ICT and home electronics, it's getting wasteful.

[JR: Nice story. If only the data backed up what you were saying. Before broadband, there really was no conceivable way that I could work at home.

Not driving to work and not taking up an office save a heckuva lot of energy. I have no doubt whatsoever that there is lots of waste. Always has been, always will be (until the Ponzi scheme collapses). Can't pin that on the Internet, though.

But do your own study.]

7. *Steve H* says:

[June 21, 2010 at 3:00 pm](#)

@pete best-

Most computers, while having the capability of drawing large loads, actually use relatively little. When I've studied this issue for clients, the average draw is about 50W. The most intensive computers drew less than 100W averaged over the work-day. The one to three percent number cited sounds very similar to my findings, even in a tech-heavy commercial setting.

Now printers, that's where you go to find wasted energy. I've nearly stopped

printing once I started using MS OneNote.

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8. [Susan Kraemer](#) says:
[June 21, 2010 at 3:05 pm](#)

Another point is: Data servers are potential power stations: they can make megawatts. Combined heat&power (CHP) can be generated by the heat given off by data servers. The more computing we do, the more of our virtual lives are stored on “the cloud”, the more potential energy we can generate from computing.

Some examples:

<http://cleantechnica.com/2010/03/14/data-center-under-helsinki-to-warm-residents-above/>

<http://cleantechnica.com/2009/12/17/waste-heat-from-data-center-to-warm-a-conservatory/>

<http://www.scientificamerican.com/article.cfm?id=300-million-year-old-limestone-cave-2009-12>

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9. [Reid Lifset](#) says:
[June 21, 2010 at 3:08 pm](#)

There is an article that you have left out on digital music — a follow-up in part to study by Turk and colleagues:

Hogg, N. and T. Jackson. 2009. Digital Media and Dematerialization. Journal of Industrial Ecology 13(1): 127-146.

<http://dx.doi.org/doi:10.1111/j.1530-9290.2008.00079.x>

Also, there is an entire special issue of the Journal of Industrial Ecology that specifically addresses the environmental impact of e-commerce and the internet. See <http://www3.interscience.wiley.com/journal/120133161/issue>.

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10. [Susan Kraemer](#) says:
[June 21, 2010 at 3:15 pm](#)

District heating is a great way to recycle data center heat. Any urban environment, school, university or hospital can do it. In Finland and Scandinavia generally where they have used CHP since the '50s and had district heating systems are more common in cities, this is a big move: using data centers to make that heating.

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11. [Jonathan Koomey](#) says:
[June 21, 2010 at 3:17 pm](#)

@pete best-

This is the same kind of thinking that led people to believe those erroneous statistics about Internet electricity use in the first place. The data showed in

2000 that all office equipment, including PCs, servers, printers, fax machines, etc used 3% of US electricity. While that has probably grown since 2000, it hasn't grown nearly as fast as the number of devices have, and the total is still only in the single digits. As Joe points out, you really can't make your argument credibly without doing a comprehensive study, and nobody has done that recently.

And if you measure your PS3 with a Kill-A-Watt meter (about \$25 on Amazon) you'll find that it uses less than 100 watts (if you have a Slim version it uses less). The rated power of electronic equipment (ie what's on the nameplate) is typically 2 to 4 times higher than actual power use.

12. [rustneversleeps](#) says:
[June 21, 2010 at 3:45 pm](#)

Related directly to this topic, the [Carbon Disclosure Project](#) last week released a report "[The Telepresence Revolution](#)": *A study exploring the environmental benefits and financial savings from using telepresence technology as a substitute for physical travel.*

Excerpt from the press release: "Other conclusions of the study determined a business with \$1 billion or more in annual revenue implementing four telepresence rooms could:

1. Achieve a financial return on investment in as little as 15 months;
2. Save nearly 900 business trips in the first year of using telepresence; and
3. Reduce emissions by 2,271 metric tons over five years—the greenhouse gas equivalent of removing 434 passenger vehicles from the road for one year."

13. [John Mashey](#) says:
[June 21, 2010 at 3:53 pm](#)

Great article, Jonathan [maybe we'll cross paths some day, I come down the hill to Stanford often, attend Precourt events, etc.]

1) It is fairly ironic that others whack the computer industry, which actually has been working *very hard* for the last decade or so on energy use. I've been involved for 20 years with the Hot Chips conference at Stanford every August, and we have lots of low-power talks. Last time I was PC co-chair, we spent half the tutorial time 9all afternoon)on [low-power](#) issues.

The ironic thing is that people (sometimes aligned with industries that don't seem to care at all about efficiency) attack IT, which actually has a demonstrated track record for taking this quite seriously. It's like Hummer drivers pointing at the horrible inefficiencies of Priuses.

2) I've helped several wireless sensor network companies get funded and have been advisors to them. [Jonathan would likley know Kris Psiter & Dust Networks, and maybe offshoot Streetline Networks.]

The potential for overall energy savings is large. The WSN folks are *really* fanatic about low-power, and such networks manage to be *off* most of the time, i.e., they wake up in coordinated waves, take their measurements, and pass them along. I know of one application that expects to get 5-10 years lifetime from 2 AA batteries..

3) As for economic issues, I recommend the work of Robert Ayres and Benjamin Warr, who've long studied the relationships between energy use (or rather work = energy*efficiency and GDP.

See p.20 of [Accounting for Growth](#), in which the GDP/work has improved over the last few decades, above a model that had worked well for a century, for which they conjecture IT as a cause.

There's more in their [book](#) (get your library to get it, it's \$\$, but good).

Note: Ayres was originally a physicist, so has tended actually think economics has something to do with energy use in the real world.

14. *prokaryote* says:

[June 21, 2010 at 3:58 pm](#)

Jonathan Koomey, 2# "And the old cathode ray tube monitors use three times as much power as LCD screens, and LCDs have almost completely displaced CRTs. "

And it doesn't stop there 😊

Energy efficiency: An LED TV consumes the least power among all HDTVs with a substantial energy savings of up to 40 percent compared with a conventional lamp-based LCD model. The other major benefits of using light-emitting diodes include an extended panel lifespan, low heat emission and better eco-friendliness. The latter is due to the mercury-free design of these energy-efficient bulbs.

http://asia.cnet.com/buyingguides/home_av/0,39066264,61985379-3,00.htm

15. *prokaryote* says:

[June 21, 2010 at 4:13 pm](#)

"As an example of this latter point, consider downloading music versus buying it on a CD. A study that is now "in press" at the peer-reviewed Journal of Industrial Ecology showed that the worst case for downloads and the best case for physical CDs resulted in 40% lower emissions of greenhouse gases for downloads when you factor in all parts of the product lifecycle (Weber et al. 2009). When comparing the best case for downloads to the best case for physical CDs, the emissions reductions are 80%. Other studies have found similar results (see Turk et al. 2003, Sivaraman et al. 2007, Gard and Keoleian 2002, and Zurkirch and Reichart 2000). In general, moving bits is environmentally preferable to moving atoms, and whether it's dematerialization

(replacing materials with information) or reduced transportation (from not having to move materials or people, because of electronic data transfers or telepresence) IT is a game changer.”

Yes. And this is also the most efficient way to distribute knowledge.

Sidenote – US Government Told Piracy Losses Are Exaggerated

<http://torrentfreak.com/us-government-told-piracy-losses-are-exaggerated-100616/>

16. *pete best* says:

[June 21, 2010 at 4:25 pm](#)

I am sure Joe that as a knowledge worker you save a lot of miles via ICT but its not like that for the majority I would assume. What about all of the energy making all them PS3s/XBOX 360/Plasma,LCD,LED TC's etc with every bigger screen, PCs, laptops, yada yada etc? Its energy expensive and if we all worked at home then great, but we dont, we all drive cars too regardless of IT.

The more hosts the internet has registered the more servers we deploy and even if each generation of servers and technology save on energy we just deploy more.

The general problem is growth, if everyone switched to a hybrid car today in the USA within 7 years all would return to what we consume now.

[JR: *That is what I call missing the entire point of the post and various links.*]

17. *pete best* says:

[June 21, 2010 at 4:40 pm](#)

<http://www.hardcoreware.net/reviews/review-356-2.htm>

When gaming on PC/XBOX/PS3 its 175-220 Watts. These consoles are often rigged upto flat screen TVs which also have higher power usage than CRT TVs did.

<http://www.which.co.uk/advice/lcd-vs-plasma-tvs/lcd-vs-led-vs-plasma-tv/index.jsp>

Power consumption is even higher on larger models.

18. *prokaryote* says:

[June 21, 2010 at 5:12 pm](#)

Pete best, your link from which.co.uk seems pretty out of date to me and cherry picked – plus they use 2009 models and 40”.

“LED 40 inch 121 watts 90-152 watts” (just 2 models tested)

In 2010, current generation LED displays can have significant power

consumption advantages. For example, the non-LED version of the 24" Benq G2420HBD consumer display has a 49W consumption compared to the 24W of the LED version of the same display (G2420HBDL).

http://en.wikipedia.org/wiki/Backlight#LED_backlights

LED TV Sales Estimated to be 75% of Market by 2014

With more people looking to save money on their electricity bills, combined with global concerns regarding carbon emissions, LED is the most appealing technology currently available. Thanks to superior image quality and improved power efficiency, due to LED backlighting, LED TVs are proving to be very popular among consumers, who see the potential energy savings and reducing emissions.

In fact, LED TVs are proving so popular that research firm iSuppli announced supply shortages for the screens, although this is expected to ease off next year, as more manufacturing facilities open. So if you're looking to upgrade to an LED TV, you may want to buy sooner rather than later to avoid stock shortages or inflated prices due to the current shortage.

<http://www.unbeatable.co.uk/news/LED-TV-Sales-Estimated-to-be-75-of-Market-by-2014/284480.html>

19. *Pierre Delforge* says:

[June 21, 2010 at 6:18 pm](#)

As an engineer working on energy efficiency in the electronics sector at NRDC, I agree that information technology has great potential to increase energy efficiency and help transition towards a low-carbon economy. However this should not eclipse the fact that I.T. also uses a significant and fast growing amount of energy. I believe we need to do both: leverage I.T.'s power to transform the way we live and work, AND increase efficiency of computers and the internet.

As Joe and Jonathan point out, energy efficiency of computers has been increasing steadily over the past decades and we can expect this trend to continue. But this does not happen by itself, it requires a sustained effort by all stakeholders such as:

- Industry, to invest in energy efficiency research and development, and to provide leadership in steering the market to adopt the more energy efficient equipment available
- Governments to set voluntary and mandatory standards to accelerate market transformation
- Consumers to purchase the most energy efficient models available
- Advocates to provide independent analysis, expertise and leadership to facilitate the discussion between stakeholders and ensure progress
- All of these stakeholders, to develop and maintain standards and test protocols to allow energy efficiency to be compared between competing products and used as a basis for consumer choice and business specification.

Without these efforts, past experience shows that market forces and technology

trends by themselves are not sufficient to capture energy efficiency opportunities in information technology at the pace required to meet IPCC climate change targets: this is due to well known market failures, such as lack of awareness by consumers and electricity prices not including externalities. One of the best-known examples of how standards can turn around energy efficiency where market forces fail to do so is that of refrigerators in California, see the infamous refrigerator energy graph in my colleague Noah Long's blog post at http://switchboard.nrdc.org/blogs/nlong/energy_efficiency_moving_ahead.html, and David Goldstein's new book Invisible Energy on the role of standards to advance energy efficiency <http://www.baytreepublish.com/invisible-energy-fr.html>.

While computers have already become much more energy efficient over the past decade, they still present considerable untapped opportunities to further reduce their energy consumption, from more efficient power supplies, processors and disks to smarter operating systems, application software and communications protocols.

A large part of the electricity that goes into each computer is still wasted as heat. The majority of servers in data centers runs at less than 10 percent utilization, while still using more than 50% of maximum power. We cannot ignore this opportunity to contribute to the reduction of greenhouse gas emissions.

The good news is that energy efficiency standards provide cost effective ways of reducing IT energy use without impacting its growth or performance. So this is not about using less IT, but about using more efficient IT to make our economy more efficient.

-
20. *James Harper* says:
[June 21, 2010 at 6:33 pm](#)

I have to wonder the energy impact of DRM technologies. Those restriction-check cycles take energy.

-
21. *Dave Julain* says:
[June 21, 2010 at 7:57 pm](#)

What about the embodied energy (ie the energy required to manufacture) of digital devices. Commercial reality means these devices become obsolete quickly, resulting in toxic e waste issues and increased carbon foot print through the production cycle. Sure using computers is energy cheap, its their manufacture and disposal that is the problem. Creating fully upgradeable machines with minimal throw away components is the solution, though not, under our economic system, commercially viable. We need to change the economics to reward durability and upgradeability, not throughput.

22. *John Mashey* says:[June 21, 2010 at 8:38 pm](#)

re: #21

Reliability and long life is good ...

but it's not that easy...

having spent 17 years, including years of work designing microprocessors, workstations, supercomputers. I was the guy who pushed that to the limit in the SGI Origin 3000/Altix systems, whose basic approach managed to last ~10 years ... but it was really hard.

When you say "fully upgradeable machines" ... well, we all tried that, and we could sometimes get 2-3 generations before the interconnects and bandwidths just didn't work any more.

This doesn't work 8at all* in many segments of the computer space, like: how do you make a reasonable iPhone that works this way?

Moore's Law and the corresponding effect in disk drive density make this much harder than you might think.

23. *prokaryote* says:[June 21, 2010 at 8:46 pm](#)

You need memristor technology.

From the labs: IT's future today – Processors: Breaking Moore's Law

<http://news.idg.no/cw/art.cfm?id=5C0396AB-1A64-67EA-E49F964B22C8E4C6>

HP works on memristor-based processors

http://www.eetindia.co.in/ART_8800608988_1800001_NT_a04530ee.HTM

24. *Neven* says:[June 22, 2010 at 1:59 am](#)

In my humble opinion there are a few problems with the happy-IT-story:

-Energy costs of production. Many years ago [about 80%](#) of the total energy used in a life cycle of a computer went into production and distribution.

Computers have since then been become more efficient (or at least provide more performance per Watt) so even more of that total energy is going into production and distribution. If you really want to save energy and be efficient, you have to start producing less.

-Planned obsolescence. Firms like HP and Dell have to make profits, huge profits, their stakeholders demand it. John Mashey's experience may be different, but the fact is that it's possible to build computers that last much longer than they do, especially if they are built to be upgraded. Whole computers get dumped, by individuals and businesses, and sent 'back' to Asia, on a very regular basis (3-5 years). Do you buy a new car when your tyres have lost their profile?

-Perceived obsolescence. When is it enough? Is BluRay good enough? Are

LCD screens (the production of which emits huge amounts of GHGs BTW) with resolutions that the human eye can't appreciate anymore good enough? Why does Moore's Law have to be that the amount of processors on a chip doubles every two years and not every 10-20 years?

-Jevons Paradox. Ever notice how many people have gone from one desktop at home, to a desktop and a laptop at home, and a nettop for watching dvds on the train, and a mobile phone with 1 million functions, and an iPod... A lot of people own 3 computers nowadays. I know almost all of my friends do.

There's nothing wrong with IT in principle, the problem is the context: a society where unending, unlimited growth is the driver of everything, from economy to culture to psychology. As long as that doesn't change, nothing will ever get any better and we can all forget about a switching to a sustainably operating society. Or IT.

25. *Realist* says:

[June 22, 2010 at 2:02 am](#)

What about the server farms being created by Google, Youtube, Facebook etc. who are expanding to meet user needs? Do these not consume enough electricity to power a village?

26. *website* says:

[June 22, 2010 at 3:32 am](#)

Sure using computers is energy cheap, its their manufacture and disposal that is the problem. Creating fully upgradeable machines with minimal throw away components is the solution, though not, under our economic system, commercially viable. We need to change the economics to reward durability and upgradeability, not throughput.

27. *Acronym List* says:

[June 22, 2010 at 3:33 am](#)

Creating fully upgradeable machines with minimal throw away components is the solution, though not, under our economic system, commercially viable. We need to change the economics to reward durability and upgradeability, not throughput.

28. *talkpc* says:

[June 22, 2010 at 3:33 am](#)

well, we all tried that, and we could sometimes get 2-3 generations before the interconnects and bandwidths just didn't work any more.

29. *pete best* says:

[June 22, 2010 at 4:15 am](#)

Re #18, why dont those models exists in the wild any more. Nobody owns them

then.

30. *prokaryote* says:

[June 22, 2010 at 4:24 am](#)

Not sure what model you mean, but here is a UK site – featuring the LED model from the wiki quote. So they do not cite the energy consumption, for whatever reason.

<http://www.overclockers.co.uk/productlist.php?groupid=17&catid=510>

31. *prokaryote* says:

[June 22, 2010 at 5:01 am](#)

Pete, i have a post in moderation, but what is your point? LED's are more efficient in compare with conventional LCD's, when it comes to energy efficiency.

And about your argument with the PS/3 your correct to point this out.

Wow. If you're trying to 'go green' and you have a Playstation 3, you may want to consider switching to a Wii. An Australian consumer group found that the Sony Playstation 3 consumes five times more energy than a medium sized refrigerator – 10 times as much as the Wii.

<http://earthfirst.com/playstation-3-is-a-huge-energy-hog/>

32. *Jonathan Koomey* says:

[June 22, 2010 at 2:03 pm](#)

For those who are concerned about the energy to manufacture the devices, it's typically a modest fraction of the total for computers powered by the grid. For mobile devices it's a more important part of life cycle impacts, but the benefits from moving bits not atoms becomes really important. I calculated the ratio of the mass of one sheet of paper to the mass of the electrons needed to transfer a 1 megabyte PDF of that document over the internet, and came out with a factor of 300,000. This means that the energy needed to transmit the bits will be much smaller than that needed to move the sheet of paper. For the CDs vs downloads case, after you account for all the various indirect effects, the best case for both physical CDs vs the best case for downloads results in 80% fewer greenhouse gas emissions, which amounts to a factor of 5 reduction in emissions.

@Neven is far too pessimistic. You can have huge growth in information use with very little growth in material consumption, and the resource impacts of that growth is vastly less than the goods and services it displaces. So people can have more fulfilling lives and accomplish their goals more effectively while using fewer resources per dollar of GDP generated or GHGs emitted. Recall also that there is limited time to spend on activities, and that using IT services displaces other services. Nobody has really done a comprehensive look at this, but the "lightness" of IT services and information makes it likely that the resource impacts of using

IT will on balance be positive.

Of course, everything needs to be counted, so what I write above is not a license to ignore the manufacturing impacts—I just don't think they are likely to be that important in the longer term.

33. *Tony Fish* says:

[June 22, 2010 at 2:19 pm](#)

Loving this topic – couple of issues that I think are worth addressing.

1. Energy use for old data – how about a focus on what we are wasting here
2. more devices. more batteries, more chips – more dangerous components and less re-use, recycle. how about the energy put in to create the device and then break it down.

Blogged about Greenpeace response here.

<http://blog.mydigitalfootprint.com/greenpeace-and-the-cloud>

34. *pete best* says:

[June 22, 2010 at 2:32 pm](#)

Re #31, yes sorry, I dont mean to be in your face so I apologise for that. However its not just the Internet and its technology but all related electronics for audio and video and ICT means. Its not coming down for reasons of the flat screen. More efficient technolgy but not across much larger screens (features). Never expect technology to save you energy unless its in changes to your work and leisure related lifestyle.

35. *prokaryote* says:

[June 22, 2010 at 2:43 pm](#)

“Never expect technology to save you energy unless its in changes to your work and leisure related lifestyle.”

On the bottom line what counts is how energy is generated in the first place. Say you own a PS/3 (energy hog) but you power your home entirely with solar or wind. And this is why electric transport only makes sense with clean energy.

36. *prokaryote* says:

[June 22, 2010 at 2:53 pm](#)

Mobile virtual goods generated \$168M in revenue in last year

<http://mobile.venturebeat.com/2010/06/22/mobile-virtual-goods-generated-168m-in-revenue-in-last-year/>

37. *pete best* says:

[June 22, 2010 at 4:16 pm](#)

r #35, sure you can do it that way but as yet its not all that easy to so and

afford. Maybe one day yes for all of us but that's the entire issue is it not? We need solutions for millions of people, families and homes. Getting there to mitigate ACC is a major problem not yet realised.

38. [Neven](#) says:
[June 22, 2010 at 8:22 pm](#)

For those who are concerned about the energy to manufacture the devices, it's typically a modest fraction of the total for computers powered by the grid.

Jonathan, do you have a source for this? I have developed extreme low power computers in things like wooden casings for a few years. My experience is that it's extremely difficult to find LCA's for computers. The market as a whole is lacking extremely in transparency.

You can have huge growth in information use with very little growth in material consumption, and the resource impacts of that growth is vastly less than the goods and services it displaces.

How is the switch from dvd to bluray reducing resource impacts? How is the acquisition of that extra nettop reducing resource impacts? How is that huge LCD screen that doesn't fit in most apartments reducing resource impacts? How are those computers on sale in supermarkets, chock full of functionality a) no one needs, such as discretionary video cards and b) is going to be obsolete in a few years if some component doesn't get fried first, reducing resource impacts?

Don't get me wrong, I love my computer and I think the Internet has some great things to offer, things that are quintessential if humankind wants to overcome the crisis cocktail. But there are some serious issues with the IT industry (perceived and planned obsolescence, Jevons paradox) and to deny this amounts to greenwash, IMO. We could also discuss the huge amounts of wasted energy and resources on things like massive entertainment and porn and spam.

All of this is not the fault of the IT industry but of the general context it is functioning in. By writing pseudo-positive reports you are pulling up a smoke screen that is hiding the root problem, and that is that you cannot have a sustainable IT industry or a sustainable society if the heart of this industry and society is the economic concept of unending economic growth (which is conflicting with the physical laws that we are currently bumping up against).

This concept is brainwashing our children as we speak, through our culture, and thus through our education systems and the example we set as parents and grandparents. And through our Internet. As long as we don't tackle this problem, first of all by making it the number 1 subject of debate instead of fata morganas like renewable energy or efficient IT, all of the improvements are pseudo-improvements.

It's like saying: look, this topkillhatstovepipe is sucking away 50% of the

oil! Isn't that great?

39. [Neven](#) says:

[June 22, 2010 at 8:35 pm](#)

To go back to the title, you cannot say: How information technology is good for climate. It would be more accurate to say: How information technology is less bad for climate.

[JR: I can and did say. Read the links!]

Furthermore – last point -, information technology would have much more potential if that cultural context, that has been thoroughly conditioned by the concept of unending economic growth, would change. Only then would we start seeing the real benefits of IT. Devices that last much longer, and no more 'progress' at break neck speed. We don't need progress at break neck speed, we are where we want to be. Now it's time to stop growing and start consolidating.

40. [Jonathan Koomey](#) says:

[June 23, 2010 at 2:30 pm](#)

@Neven,

Apple has a nice summary page on environmental impacts:

<http://www.apple.com/environment/>

Their aggregate numbers show 53% of the impact is the use phase of the equipment.

I haven't dug into those numbers, but Apple mostly sells laptops and mobile phones nowadays.

For normal desktops I'd expect that number to be higher.

In my opinion, you are worrying about second order effects. The big effect is in moving bits, not atoms, and the exact details of the systems that deliver the bits are of less consequence. As I said in my post, by all means make computers as efficient as they can be, but let's keep our perspective and focus on the big effects of IT on the broader society.

I don't oppose focusing on the issues of how we define well being. Asking questions about when enough is enough is a very good idea, but my post is about IT, not that broader issue.

There is a lot of recent literature on "sufficiency", and I suggest you look into it for more on your quest to stop unending growth.

41. [prokaryote](#) says:

[June 23, 2010 at 4:53 pm](#)

Energy Star Available for Data Centers

The Environmental Protection Agency (EPA) recently announced that stand-

alone data centers and buildings that house large data centers can now earn the Energy Star label.

Data centers use a significant amount of energy, accounting for 1.5% of total U.S. electricity consumption at a cost of US\$4.5 billion annually, an amount that is expected to almost double over the next five years.

Improving the energy efficiency of U.S. data centers by just 10% would save more than 6 billion kilowatt-hours each year, enough to power more than 350,000 homes and save more than US\$450 million annually.

<http://www.energyboom.com/policy/energy-star-available-data-centers>

42. *Prokaryote* says:

[June 25, 2010 at 4:47 pm](#)

World first for quantum memory storage

An ANU-led team has developed the most efficient quantum memory for light in the world, taking us closer to a future of super-fast computers and communication secured by the laws of physics.

The team at the ANU Research School of Physics and Engineering used a technique they pioneered to stop and control light from a laser, manipulating electrons in a crystal cooled to a chilly -270 degrees Celcius. The unprecedented efficiency and accuracy of the system allows the delicate quantum nature of the light to be stored, manipulated, and recalled.

“Light entering the crystal is slowed all the way to a stop, where it remains until we let it go again,” explains lead researcher Morgan Hedges. “When we do let it go, we get out essentially everything that went in as a three-dimensional hologram, accurate right down to the last photon.

“Because of the inherent uncertainty in quantum mechanics, some of the information in this light will be lost the moment it is measured, making it a read-once hologram. Quantum mechanics guarantees this information can only be read once, making it perfect for secure communication.”

<http://news.anu.edu.au/?p=2216>

43. *Prokaryote* says:

[June 28, 2010 at 7:25 am](#)

Related to Moore's Law

Researchers analyze the future of transistor-less magnonic logic circuits

<http://www.physorg.com/news196926602.html>