Our House Is On Fire: The Climate Emergency and Computing's Responsibility

Bran Knowles, Kelly Widdicks, Gordon Blair, Mike Berners-Lee, Adrian Friday

We are writing this as the world's leaders gather at the UN Climate Change Conference (COP26). In today's news, Boris Johnson is "upbeat", reporting that if this were a football match, the world is down only 5–2 or 5–3, as opposed to 5–1 only a few days earlier. As China's leaders (conspicuously absent) haggle over whether the target should be 2 degrees Celsius warming instead of 1.5 degrees, and nations engage in a pledge drive to reach an unfathomable 28 gigatonnes emissions reductions by 2030, it's easy to lose sight of what is really at stake here. We are talking about the risk of *catastrophic* climate change and whether we going to have a planet habitable for human life.

What is computing's pledge? Beyond being keen to innovate digital 'solutions', are we going to address our contribution to the climate emergency? Last week, ACM released its first TechBrief [1], which was designed to communicate to an audience of policy makers some of the key headlines regarding the climate impacts of computing. The brief was in part a response to proposed climate strategies that entail investment in digitalization based on unproven climate gains without acknowledgment of the carbon costs of such endeavors. The overall message of the piece is that computing is by no means immaterial [7], and given that computing's emissions are rising, we cannot assume that continuing to do what we have been doing is going to produce a sudden reduction in computing's footprint.

The brief draws in part from a much longer report [8] that elaborates at length the kinds of details that matter in this space. Estimates of computing's current and future carbon footprint vary, and there is (sometimes heated) disagreement about which figure to accept as 'fact'. For example, the percentage of global energy use by data centers ranges from about 1%-3%. But these estimates are exactly that: *estimates*. Anyone claiming to know precisely the carbon footprint of something as vast and as multiplex as the world's data centers, or networks, or devices should be met with skepticism. There is simply too much interpretative licence involved in setting the boundaries of the analysis, and too little formal and transparent accounting. We can quibble whether computing's global share of carbon emissions is closer to 1.8% or 2.8%—or possibly even higher (around 3.9%) if accounting for the full supply chain and complete life cycle of the technologies [8]—but in doing so we are avoiding reckoning with the hard truths about computing's responsibility.

We'll most likely never do better than a best guess at computing's carbon footprint, but given uncertainties it would be safer and more responsible to act on the assumption that higher estimates could be closer to the truth—especially since the pace of warming has exceeded our expectations at every point. But in big picture terms, the difference between 1.8% and 3.9% does not fundamentally change our mission: computing's emissions need to reduce urgently and drastically. How are we going to achieve this?

Through efficiency?

There is a natural logic to reducing emissions by using less energy for any given operation, and it would be highly convenient for computing to be able to claim environmental benefits for continuing to deliver efficiency improvements (our bread and butter). Unfortunately, however counterintuitive, the arc of computing does not bend toward lower emissions as underlying efficiency improves; quite the opposite. Computing's footprint has risen steadily despite becoming much more efficient in the transmission and storage of data over the last 50 years. Greater efficiency leads, almost always, to *growth* in overall carbon emissions, as efficiency gains are quickly swamped by the desire to do more; hence we see global emissions increasing decade after decade despite continual efficiency gains in every sector.

In spite of the above, computing technologies are considered critical to enabling key 'emissions reducing' efficiency improvements across the economy, and as a result, the entire computing sector basks in the green glow reflected off these ostensibly honorable pursuits [4]. The fact is, the vast majority of computing solutions are *additive* in terms of carbon. Of course some digital innovations specifically intend to increase efficiency of some process and/or reduce emissions, but most innovations are introduced in the service of generating profit and can claim no environmental benefit. Responsible individuals are 'doing their bit' to reduce their personal footprints by cycling to work, using electricity during off-peak hours, going vegan, etc.; meanwhile, computing is "repeatedly finding ways to use more chips in parallel" [5] without a care for environmental costs, and the footprints of cryptocurrencies soar past that of ever-larger nations. This exposes the lie behind

ACM ISBN 978-1-4503-2138-9.
DOI: 10.1145/1235

"micro consumerist bollocks" [9], and illustrates clearly why computing cannot be allowed to shirk its responsibility.

In the absence of some external constraint (such as a carbon price applied at the point of extraction), the efficiencies computing delivers are highly unlikely to materially reduce emissions, particularly not at the scale required. However, efficiencies delivered by computing technology could play a vital role in enabling continued functionality within a resource constrained future. The computing industry should be lobbying hard for the introduction of a carbon constraint! Far from stymieing innovation, it *requires* it, and guarantees that the efficiencies that computing can deliver will be more valuable than ever.

Through renewables?

One of the many frustrating things about this crisis is that we have known for decades what we need to do to solve it: we need to leave fossil fuels in the ground and ensure the immediate development and deployment of clean energy. From a technical perspective, it looks challenging but possible to replace today's energy supply. Yet this will not happen overnight, and there are significant embodied carbon costs in manufacturing these technologies, as well as other devastating environmental and humanitarian impacts of extracting the necessary (and dwindling) raw materials.

Thus, a renewable energy infrastructure gives us some respite to meet climate targets while continuing to use energy, but it doesn't grant us freedom to meet ever-increasing energy demand. Using this limited renewable energy supply to fuel computing's unchecked growth reduces other sectors' ability to decarbonize [8]. A serious and proportional response to the climate emergency would, therefore, involve constraining energy demand and mitigating drivers of infrastructure growth, and as a result, also consuming less energy. In real terms for computing, this means manufacturing fewer devices, storing and processing less data, generally managing with less compute power; and in terms of technical ambitions, scaling back the Internet of Things, resisting the temptation to throw AI and blockchain at every problem, and breaking free of the cycle of ever increasing demand for computation [3].

Through offsets?

Major tech companies like to boast of being "carbon neutral" – Google, for example, claiming to have eliminated in 2007 its entire carbon legacy. This is a nice soundbite, designed to mislead the public into thinking Google has achieved zero emissions every year since 2007. To the contrary, they have 'offset' the approximately 20 million tonnes they have emitted since then by paying toward capturing escaping natural gas [6]. Critiques of the true impact of offsets aside, when the goal is to reverse an as-yet undented curve of relentless exponential growth in carbon emissions, we need to be planting trees, capturing natural gas, and employing all possible techniques to sequester carbon *while drastically reducing emissions*. Offsetting is better than nothing, but not nearly as good as not emitting in the first place.

We must also call out other forms of "buying indulgences out of environmental guilt" [5]. When Amazon's Jeff Bezos pledges $2 billion to the cause at COP26, instead of viewing this as a charitable act, we should see it for what it is: repayment on a debt owed to humanity. And we might reasonably ask, as nations scramble to put together budgets to fund large scale infrastructure upgrades, when he plans to make the rest of that repayment. Let us be clear: the digital economy has produced obscene wealth for a handful of individuals by externalizing associated environmental costs and systematically devaluing the labor that produces those profits. We should demand that this wealth be reinvested in this planet and all its inhabitants.

No targets, no accounting, no plan

Without an external constraint on carbon (that, again, would be favorable to the computing sector), we need to start taking digital technology's role in the climate crisis seriously. Unregulated and voluntary climate pledges have been, and will continue to be, made by individual organizations in the computing sector. But those (seemingly few) pledges are often not ambitious enough to deal with the scale of the problem we are facing. Even more concerning is that pledges can be set and flaunted, without organizations being held to account to those targets. Are we willing, as a sector, to introduce our own science-based climate targets? For too long, digital technology has been able to expand without a consideration of its consequences—a freedom not granted to other sectors. For example, any new internet service can be developed and introduced with scant consideration of the societal and environmental implications, yet planning for the construction of new infrastructure (such as buildings) has oversight, and requires explicit permission. The computing sector is markedly overdue in accounting for its actions.

The end of digital exceptionalism

If we put aside exact percentages and look at trends, we see computing's carbon footprint growing at a rate unimaginable in other sectors [4]. In fact, climate change is seized upon as a positive use case for ever more digital solutions and an ever-increasing carbon footprint. We might call this 'digital exceptionalism'—the idea that all excesses of computing are justified because of the technology's unique capacity to increase productivity and generate profit. There are fantastic examples of computing's positive impacts, and these are often cited when rationalizing computing's privileged position in society; but the generation of profit *in itself* is not a guarantor of social good, particularly when economic growth comes at the cost of planetary overshoot [10].

We seem to need reminding that computing is not exempt from having to drastically reduce emissions. Instead of assuming computing can innovate the path to a greater future, the bravest and most heroic action the computing sector could take is to show restraint and leadership, "us[ing] our knowledge and skills to advance the profession and make a positive impact" (as per ACM's mission [2]) by putting the planet above profit. It's past time for action, and the ACM community has a duty to help drive this transformation.

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