Manifesto from Dagstuhl Perspectives Workshop 25122

Climate Change: What is Computing's Responsibility?

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Abstract

This Manifesto was produced from the Perspectives Workshop 25122 entitled "Climate Change: What is Computing's Responsibility?" held March 16–19, 2025 at Schloss Dagstuhl, Germany. The Workshop provided a forum for world-leading computer scientists and expert consultants on environmental policy and sustainable transition to engage in a critical and urgent conversation about computing's responsibilities in addressing climate change – or more aptly, climate crisis.[1]

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[1] We adopt the singular form over "climate crises" for readability, but note the inextricability of human induced climate change from the primary and secondary effects of this change on all kinds of local and global essential systems which are also in a state of crisis.

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The resulting Manifesto outlines commitments and directions for future action which, if adopted as a basis for more responsible computing practices, will help ensure that these technologies do not threaten the long-term habitability of the planet.

We preface our Manifesto with a recognition that humanity is on a path *that is not in agreement* with international global warming targets[2] [2] and explore how computing technologies are currently hastening the overshoot of these boundaries. We critically assess the vaunted potential for harnessing computing technologies for the mitigation of global warming, agreeing that, under current circumstances, computing is contributing to negative environmental impacts in other sectors. Computing primarily improves efficiency and reduces costs which leads to more consumption and more negative environmental impact. Relying solely on efficiency gains in computing has thus far proven to be insufficient to curb global greenhouse gas emissions. Therefore, computing's purpose within a strategy for tackling climate change must be reimagined.

Our recommendations cover changes that need to be urgently made to the design priorities of computing technologies, but also speak to the more systemic shift in mindset, with sustainability and human rights providing a necessary moral foundation for developing the kinds of computing technologies most needed by society. We also stress the importance of digital policy that accounts for both the direct material impacts of computing and the detrimental indirect impacts arising from computing-enabled efficiencies, and the role of computing professionals in informing policy making.

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Executive Summary

The increasing threat of climate crisis requires concrete efforts to minimise the negative impacts of computing practices today on current and future generations of life on Earth. While computing has enabled transformative progress, it is implicated in unsustainability, contributing to and accelerating the rapid overshoot of planetary boundaries [1, 59, 19, 62]. It is our responsibility to ensure that technological advances benefit human and non-human well-being and do not come at the cost of a just ecological foundation *for all life on Earth.*

Knowing that a multitude of planetary boundaries are already being crossed today [1, 59] and that digital technologies cause significant social impacts, this Manifesto focuses on impacts that exacerbate the ecological and climate crises. We are aware that social impacts are also important and in many cases, if conflicting, are typically valued higher. Ultimately, however, human well-being is contingent on being within a healthy environment and living within the limits of the planet that can sustain life.

[2] While we focus on climate change, we also note incompatibility with other planetary boundaries and UN sustainable development goals.

As a basis for our commitments, we recognise:

1. The need for a safe and just space for all life on the planet to thrive [58].
2. The urgent need to address environmental challenges, including the short time horizon for reducing greenhouse gas emissions.
3. The limited resources of the planet and the need to uphold planetary boundaries; and for those boundaries that have been surpassed, the need to move back within a safe region [59].
4. That, as with other resources, computational resources are not equitably distributed today. While some use excessive amounts of computational resources, others do not have enough.
5. The need to attend to environmental challenges while advancing universal human rights and well-being.
6. That computing is not immaterial and has both direct and indirect adverse impacts on the environment:
   a. Direct impacts occur through the energy used for, e.g., mineral extraction, the manufacturing, use and disposal of hardware that provides computation, storage, network access, and interactivity; but also include water consumption and ecological disruption at these stages.
   b. Indirect impacts arise from the transformative nature of computing, with effects across societal and economic sectors yielding both beneficial and detrimental environmental impacts.
7. That computing, under current circumstances, contributes to the negative environmental impacts of other sectors and is accelerating the exceeding of planetary boundaries. Humanity is on a path that is not in agreement with the 1.5-2°C of global warming target of the Paris Agreement [2], and computing is likely getting us there faster.
8. That the enablement narrative of direct impacts being outweighed by positive indirect impacts (sometimes called 'digital exceptionalism' [39]) is ignoring the detrimental indirect effects, cherry-picking for those domains or applications with a likely beneficial outcome, and thus likely not true.
9. The tendency for low-level interventions to induce rebound effects and confirm an unsustainable status-quo.
10. The need for changing high-level leverage points (for example societal structures and paradigms) even though it is difficult.
11. That limiting climate change is a systemic challenge. Advancing computing, and its uses, cognizant of environmental limits and impacts is the joint responsibility of governments, corporations, educational institutions and computing professionals worldwide.
12. The contested nature of sustainability [24] and prevalence of misunderstandings of the term, along with the principles of sustainability design outlined in the Karlskrona Manifesto [12].

We commit to:

1. Reducing the environmental impacts of computing systems, comprising direct, indirect, and systemic impacts.
2. Contributing to achieving absolute reductions in global greenhouse gas emissions.
3. Achieving absolute reductions in global greenhouse gas emissions caused by computing by:
   a. Ensuring durability, longevity, repairability, and reusability of hardware.
   b. Ensuring adaptability, longevity and resilience of software [32].
   c. Advocating sufficiency in use of computational resources.

d. Aiming for Paris-compliant [2] reduction of around 7% p.a. of CO_2 emissions in the organisation and participation of Computer Science scientific and industry-oriented events (conferences, conventions, etc.).

4. Sharing information regarding potential and actual impacts of computing in a transparent, evidence-based, truthful, and holistic manner.
5. Promoting said information towards the media and general public.
6. Elevating sustainability to a first-class consideration for computing and computing facility design and implementation decisions.
7. Educating for climate-conscious computing with a sustainability mindset.
8. Leveraging computing to solve environmental challenges for climate solutions when relevant and advocating for policy/funding/innovation frameworks which ensure their effective uptake and usage while minimising rebound effects.
9. To this end, exploring, and where possible measuring, environmental and societal impacts; contributing to appropriate measurement methods and practices.
10. Seeking to effect positive change by locating and acting on leverage points that are beyond the conventional scope of computing.
11. Prioritising purposes that support sustainable development goals [50], well-being, and scientific truths.
12. Working to support the equitable and democratic redistribution of computing capabilities.
13. Advocating for national and international digital policy that focuses on climate and environmental sustainability.
14. Including all populations that are negatively affected by environmental impacts in these conversations.
15. All of the above while promoting and advancing human rights as defined by the Universal Declaration of Human Rights [7].

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1 Introduction

Global average temperatures are now about 1.1°C above pre-industrial levels, with most recent months consistently ranking among the hottest on record. At the same time, atmospheric CO_2 has surged past 420 ppm – the highest concentration in at least two million years – driving a relentless rise in greenhouse forcing. Under current national pledges, the world is headed for roughly 2.7°C of warming by 2100 (according to the Climate Action Tracker compiled by Germany-based nonprofits Climate Analytics and the NewClimate Institute[3]), far beyond the Paris Agreement's 1.5°C ambition and exposing a wide gap between commitments and what's needed. The IPCC warns that keeping warming under 1.5°C requires achieving net-zero CO_2 emissions by around 2050 and slashing methane and other short-lived pollutants – meaning "deep, rapid, and sustained" cuts this decade. Yet the latest UN global stocktake finds existing plans are woefully inadequate, hampered by financial shortfalls, uneven policy rollout, and slow deployment of renewables and efficiency measures. Without immediate, sweeping transformation across energy, land use, transport, and industry, irreversible impacts – accelerating sea-level rise, ecosystem collapse, and more frequent extreme weather – will become unavoidable, underscoring how narrow our window has become.

2 Positionality statement

This Manifesto was composed by computing professionals, researchers, educators, developers, and users from the Global North. We write from our limited perspective, recognising our comparative privilege in shaping possibilities and, with that, our outsized responsibility to shape these possibilities in accordance with sustainability and global justice.

We further recognise that many of the populations that are most negatively affected by environmental impacts of climate change are not included in the creation of this Manifesto (see "asymmetric vulnerability" [34]). We strongly recommend including *all* affected populations in these conversations – or, where direct participation is not possible, engaging methodologies that facilitate perspective taking [27]. This more inclusive approach is consistent with the commitment to social justice that this Manifesto underscores.

3 Computing and Climate Change

For an issue that has been publicly debated since the 1960s, concerns about computing's contribution to climate change (now crisis) have emerged surprisingly recently [40], with "Sustainable Human-Computer Interaction" [46, 14] and "Green IT" [49] entering the computing landscape around 2007. In the meantime, the total carbon footprint of computing has grown inexorably. At present, although the share of Information and Communication Technologies in global CO_2 emissions seems small at approximately 3% [33], collectively it exceeds that of many whole nations and is similar in magnitude to aviation, which is under significant pressure to reduce in line with internationally agreed climate targets. Moreover, mainly due to the rise of Generative AI, computing technologies are contributing to a rapid acceleration in global energy demand [37].

[3] `https://climateactiontracker.org/`

The increasing threat of the climate crisis requires concrete efforts to minimise the negative impacts of computing practices today on current and future generations of life on Earth.

3.1 Challenging optimistic rhetoric

While there are abundant examples of computing that benefits society, even “positive” applications can have attendant harms. Given their inherent accelerating properties (cf. amplification theories [64]), computing technologies are notorious for intensifying societal and economic trends. The year 2024 was the first to have an average temperature exceeding 1.5°C above pre-industrial levels [20], the preferred limit laid out in the historic Paris Agreement [2], and we are on a path to exceed the even riskier 2°C of global warming target [52]. Under business as usual, per amplification, computing is likely getting us past 2°C warming faster.

The improved efficiency that computing applications enable is typically viewed as naturally yielding reductions in energy use. In reality, efficiency can drive (and in our current paradigm, does drive) the amplification of social and environmental harms. The fact that greenhouse gas (GHG) emissions have been steadily rising over the decades that computing technologies have been delivering continuous efficiency improvements is evidence of the tendency for computing-enabled efficiency gains to generate increases in demand greater than the energy reductions derived from the efficiency (cf. Jevons’ Paradox [5]). All available evidence indicates that computing contributes to negative environmental impacts of other sectors by making it cheaper and easier to do more.

Artificial Intelligence is often touted as delivering other critical environmental benefits, such as energy optimisation, materials discovery, resource planning, forecasting and disaster mitigation, policy analysis and modeling, and more. Many of these benefits have yet to be demonstrated in practice; meanwhile, the negative environmental impacts of AI are already quite clear and are significantly greater than these proposed benefits. The vast majority of AI applications are not even purported to benefit the environment, and much of the consumption we would characterise as wasteful, excessive, and even harmful. The selective highlighting of climate mitigation applications of AI represents strategic – and dangerously misleading – obfuscation of the already alarming and still growing environmental impacts of these technologies.

This Manifesto resoundingly rejects “digital exceptionalism” [39], i.e. the justification for unchecked growth on the grounds that direct negative impacts of computing are outweighed by their positive indirect impacts. This argument ignores the detrimental indirect effects, cherry-picking for those domains or applications with a likely beneficial outcome, and thus is likely not true. As a corollary, this Manifesto rejects the premise that computing is worth developing at any cost because it will help solve the world’s problems. We assert that, with respect to solving increasingly pressing environmental problems, on the whole, computing as it is currently being developed is exacerbating rather than mitigating environmental and social harms.

3.2 Direct versus indirect impacts

Computing is not immaterial; it has numerous, multifaceted, and intertwined impacts on the environment. For this Manifesto, we adopt an established taxonomy that distinguishes between direct effects, beneficial indirect effects, and detrimental indirect ones [15].

Direct impacts occur through mineral extraction, the manufacturing, transportation, use and disposal of hardware that provides computation, storage, network access, and interactivity. These impacts include air/water pollution, GHG-emissions, water consumption, waste production, and mineral depletion – all of which are growing as computational-intensity increases and as new applications of computing are developed. These impacts arise through, e.g., fossil-fuel based energy powering of data centres, evaporative cooling, rare mineral extraction to create hardware, and largely illegal dumping and processing of electronic waste [57, 23, 31].

Self-reported GHG emissions from major tech companies are rising significantly due to the increasing development of deployment of generative AI such as large language models (LLMs) [8, 36, 47]. However, the true amount of energy used or emissions produced in the manufacture, use, and disposal of computing are unknown [18, 48]. There is an abundance of contradictory information regarding these direct impacts and, relatedly, a lack of transparency and disclosure from technology companies. It is not possible, for example, to understand the drivers of total energy consumption from the data that is voluntarily published; and recent investigations have claimed that the true emissions from data centres could even be 6–8 times higher than reports produced by the world's major tech companies [51]. Existing transparency requirements mandated by regulations such as in the EU AI Act [54] are focused on high-risk systems and impact incurred during model training. Inference reporting requirements [29] and supply chain disclosure are needed to develop more complete estimations of direct impacts and to understand opportunities for reductions, e.g. energy/emissions hotspots which can be more directly targeted. Transparent and standardised benchmarking is critical, and further work is needed to develop standards for measuring AI safety which includes energy requirements [65].

Indirect impacts arise from the transformative nature of computing, with effects across societal and economic sectors yielding both beneficial and detrimental impacts. Several mechanisms have been identified in Science and Technology Studies literature, notably how automation increases the resource intensity of everyday life through accumulation, acceleration, and stacking [41]. Typical bottom-up assessment methodologies for estimating indirect impacts are limited for a several reasons:

1. The ontologically uncertain set of mechanisms yielding indirect effects, and the epistemically uncertain assessment of those that are known.
2. The "chronic potentialitis" [21] of such assessments, which typically lie *in the future* and their occurrence is almost *never validated in hindsight*.
3. The plethora of different types of rebound effects [6, 60, 43, 22] that exist and can outweigh the positive indirect effects.
4. The difficulty in estimating the hypothetical baseline/counterfactual, often leading to its overstatement, which consequently also yields an overstated positive effect.
5. Possible time boundaries for indirect effects: when they become part of the socio-technical regime [35], should these effects no longer be considered additional?
6. The possibly difficult boundary between rebound effects and economic growth: are rebound effects merely one mechanism of economic growth, and if so, should they be counted as indirect effects of computing at all?

Top-down assessments, such as quantitative systems dynamics or input-output analyses, would address some of the first four limitations. As opposed to bottom-up assessments, they can set the system boundary arbitrarily wide and thus account for the subtle and hard-to-grasp mechanisms which end up being significant. For top-down assessments, however, causal links are hard to establish, so they miss some of the explanatory power of bottom-up analyses. A hybrid approach deploying both might thus be called for, combining the useful aspects and compensating for the limitations of each. Crucially, we emphasise the importance of establishing a systematic framework of methods and standards for quantitatively assessing the impacts of various computing technologies, especially computationally intensive and fast growing ones, such as those due to generative AI, blockchain, and cryptocurrency.

3.3 Reducing impacts

Halting climate change requires that we commit to reducing the environmental impacts of computing systems: reducing direct, indirect, and other systemic impacts. Specifically, we must achieve *absolute reductions* in global GHG emissions caused by computing. To be compliant with the Paris Agreement, GHG reductions of around 7% per annum in the organisation and participation of Computer Science scientific and industry-oriented events are also necessary. And while other sectors bear responsibility for reducing GHG emissions, as computing researchers, professionals, educators, and users, we are not exempt and must commit to enabling the absolute reductions in global GHG emissions in any way possible.

To gain a clear understanding of whether and to what extent the above commitments are being met, we must also commit to sharing information regarding potential and actual impacts of computing in a transparent, evidence based, truthful, and holistic manner. Any claims regarding the beneficial impacts of computing must be substantiated *with evidence*. To this end, more comprehensive reporting is needed to assess the individual and comparative impacts of different computing solutions which are promising to reduce emissions, as well as the technological readiness of such solutions. There are already good overviews of what approaches can be taken (particularly for direct impacts) [42, 44, 45, 38, 48, 26], but there is a critical research-to-deployment gap and a comparative underdevelopment of approaches for assessing indirect impacts.

4 Shifting the Paradigm

In keeping with the principles of sustainability design as outlined in the Karlskrona Manifesto [12], a serious commitment to reducing digital technologies' environmental and social harms requires fundamental changes to the design priorities underlying hardware and software development. In contrast to environmentally destructive planned obsolescence, an anti-obsolescence paradigm would entail ensuring durability, longevity, repairability (e.g. modularity), and reusability of hardware. Incorporation of biodegradable parts should also be explored [17] (though should not be seen as a replacement for recycling parts wherever possible). Software should be low-resource and low-energy by design [32]. Anticipating the systemic impacts of climate change, it is also important to avoid catastrophic failures from critical infrastructures by developing technologies that are robust enough to withstand environmental or political instability (cf. "collapse informatics" [63]), i.e. ensuring adaptability, longevity, and resilience of software [32].[4] At the same time, a commitment to reducing demand necessitates a transition to self-obviating technologies and to supporting the development of skills that can, over time, decrease our technological dependence.

[4] Often these design aims are realised through lower-complexity technologies, and/or specialisation to specific tasks/use cases (rather than general purpose).

4.1 Prioritising sustainability

The current, unsustainable trajectory is a consequence of prioritising computational scaling over improved efficiency, or environmental sustainability[5] [23]. The only remedy is elevating sustainability to a first-class consideration for computing and computing facility design and implementation decisions. This means considering carefully where and how computing is deployed in the world – specifically, advocating for sufficiency in use of computational resources [61] and prioritising purposes that support sustainable development goals, human rights and scientific truths over uses that may support excessive consumption or antisocial behaviour. Crucially, this also means working to reduce demand for computing through cultivation of a reflective mindset regarding the purpose of the applications and services that drive demand (see, e.g., [56]). In some cases, the implication will be to apply less computationally intensive solutions, or to not employ computing at all for a given problem [10].

While decarbonisation (i.e. through use of renewable energy) is essential for reducing emissions arising from human activities which cannot yet be feasibly eliminated, it does not give licence to continue to create new and higher demand for computing technology. Decarbonisation of computing without demand reduction is not in line with a serious commitment to achieving absolute reductions in GHG emissions caused by computing; nor is it in line with a commitment to contributing to achieving absolute reductions in global GHG emissions. Renewable energy is limited by mineral availability / extraction capability and manufacture (all of which have associated environmental and humanitarian costs, including incurred GHG emissions), so using renewable energy to meet ever-rising computing demands diminishes the renewable energy available for decarbonisation of other sectors.

4.2 Within Planetary boundaries

Computing technologies do cause significant and varied social impacts, as well as environmental ones. Delivering positive social impacts necessarily entails environmental costs of the manufacturing, use, and disposal of the associated computing, and there is an implicit need to strike a balance between realising social good and maintaining a habitable planet. Traditional measures of human well-being, such as Gross Domestic Product (GDP), do not sufficiently account for this delicate balancing, ignoring the physical/material basis for sustained well-being.

We borrow the principles of Doughnut Economics [58]. The "doughnut" represents the "safe and just space for humanity" (ibid), between undershoot of social needs and overshoot of ecological limits. Applied to computing, this means contributing to technological innovation that helps humans meet longstanding sustainable development goals while upholding planetary boundaries [59], including but not limited to the limit of 2°C of global warming.[6] And for those boundaries that have already been surpassed, it means working to move back within a safe region, but doing so cognizant of the harms of deprivation (see "just sustainability" [11]).

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5 The term "sustainability" is deeply political, deployed variously depending on philosophical orientation and ideology [24]. This Manifesto recognises the climate change challenge as systemic in nature (section 5), involving the work of resolving contradictions between design goals and the political regimes into which they are deployed [28].

6 Note that climate action is one of the sustainable development goals: "Goal 13: Take urgent action to combat climate change and its impacts" [50]. Our point is to underscore that sometimes these goals are in conflict.

4.3 Justice and human rights

We recognise that, as with other resources, computing is not equitably distributed today. While some use excessive amounts of computing resources, other do not have enough. We assert that working to support the equitable and democratic redistribution of computing capabilities is imperative. And, as a corollary, while environmental impacts of computing systems must be reduced overall, we acknowledge that when exploring possible trade-offs between direct and indirect impacts, in some cases a larger footprint might be needed to ensure decent living standards for all.

We recommend exploring, and where possible measuring, environmental and societal impacts, both, with social impacts included in reporting requirements. This would necessarily involve accounting for exploitative practices in supply chains, model training, and data labeling, as well as whether/how computing technologies help to advance human rights, well-being, and equality. We note that formal methods for assessing social impacts are conspicuously lacking. Too often, social benefits of computing technology are taken for granted, while detrimental social impacts are understood only after harm has materialised. This also necessitates a commitment to contributing to appropriate methods and measurement practices, both for environmental impacts and social impacts. It is crucial that pursuit of reductions of environmental harms of computing technologies is done in ways that advance human rights as defined by the Universal Declaration of Human Rights [7].

4.4 Cultivating a sustainability mindset

In circumstances of constraint (contrasting the current condition of unchecked growth in demand for computing), the efficiencies that computing naturally delivers could help drive GHG emissions reductions across the economy, thus enabling society to maintain a certain quality of life using less and less energy resources. But computing technologies can and do catalyse deeper changes to society. Hence, we echo others who have demanded that "Digitalisation must increasingly be put into the service of society and of a sustainable socio-ecological transformation" [9]. To this we add a commitment to help enable change by locating and acting on leverage points that are beyond the conventional scope of computing. And, to enable better, more sustainable, and more just decision making, it is essential that forecasting of environmental and social impacts are incorporated into all technological developments at an early stage. This should involve a thorough exploration of scenarios of use and potential indirect effects, e.g. considering what the consequences would be if a billion people used a given technology, or if a technology became critically entangled with another technology.

5 Additional Leverage Points

We recognise that limiting climate change is a systemic challenge. The climate crisis reflects the fundamental incompatibility of business-as-usual with the long-term life-sustaining health of our planet. Attending to this crisis requires changing high-level leverage points (e.g., societal structures and paradigms), even though it is difficult. Equally, computing professionals are not solely responsible for advancing computing, and its uses, cognizant of environmental limits and impacts. Governments, corporations, and educational institutions also bear responsibility, requiring unprecedented collaboration to effect the changes needed.

5.1 Influencing technology policy

Some form of regulation is needed to force a change to business-as-usual that will put us on a sustainable path. Individuals crafting regulation require good data to be able to make good decisions; but they also need to understand wider systemic effects such as rebound and the futility of efficiency-led solutions which call for ever more computing. Computing experts have an important role to play in informing and educating decision makers. Good science and solid numbers are needed to defeat discourses of delay [53]; hence, we reiterate the importance of exploring, and where possible measuring, environmental and societal impacts, and contributing to appropriate measurement methods and practices.

We also note that, as essential as it is to commit to leveraging computing to solve environmental challenges for climate solutions when relevant, it is also critical to counter techno-solutionism [16, 3], i.e. by advocating for policy/funding/innovation frameworks which ensure effective uptake and usage of computing solutions while minimising rebound effects. We contend that advocating for national and international digital policy that focuses on climate and environmental sustainability should be understood as a basic professional responsibility of those working in the field of computing.

5.2 Corporate truth and accountability

Historically, corporate reporting of impacts is prone to accounting that glorifies efforts that have the appearance of yielding environmental benefits (e.g. carbon offsetting) while minimising detrimental indirect effects. While on the one hand, this is a consequence of the immaturity of assessment methodologies and lack of standardisation required for meaningful accountability (as discussed above), it also highlights the dangers of transparency without the corresponding commitment to responsibility, honesty, and integrity from global businesses (cf. [25]). Much work is needed to develop robust accountability frameworks that prevent companies from bypassing their ethical responsibilities through strategic public relations efforts, and ultimately, from prioritising profits over ethical considerations.

We also note that the media today presents many outdated, contradicting, and false claims, making priority-setting and thoughtful policymaking difficult [53, 13]; and further, that social media has accelerated the spread of mis/disinformation. While there is no easy remedy to this problem, the more rounded assessment of environmental and societal impacts we advocate in this Manifesto would help reveal the interconnectedness of these issues. We stress, as well, the need to explore solutions for combatting mis/disinformation, including disincentivising (or, minimally, ceasing incentivising) its propagation through monetisation of engagement, and ending the domination of social media discourse by a small number of highly influential technology companies.

5.3 Revolutionising computing education

Shifting towards climate-conscious computing begins with cultivating a sustainability mindset through reforms to computing education. Accreditation requirements and curriculum development should reflect the changing skill set needed for professionals in a society undergoing socio-ecological transformation. Students should be taught to think about the consequences of the technology they will build and whether the technology is justifiable within a sustainability framework, developing broader skills in systems thinking [30] and in engaging with social theory [55]. The implications for computing education are profound, and will require a more significant and coordinated effort to design, implement, and evaluate curriculum [55].

Likewise, we note the importance of building these same skills in those who have been working as computing professionals under the old paradigm. Professional computing bodies, such as ACM and IEEE, will need to play a role in advocating for new professional responsibilities entailed by our changing circumstances.

6 Conclusion

This Manifesto has highlighted the dual role of computing in climate change – that computing can, and is currently, driving a range of environmental harms, but that it can be a key driver for the positive change needed if it is more purposely steered towards enabling sustainable socio-ecological transformation. Modern science depends heavily on computing, and we will need more computing in the coming years to understand how to adapt to a changing climate. Growth in computing for environmental benefit requires, however, corresponding degrowth in computing that does not provide meaningful environmental or social benefit (e.g. addressing our most pressing sustainable development goals).

Our recommendations cover changes that need to be made to the design priorities of computing technologies, but also speak to the more systemic changes needed and their implications for computing. Among these, we emphasise that a radical shift in mindset, with sustainability and human rights providing the moral foundation for developing the kinds of computing technologies most needed by society, is imperative. We also stress the importance of digital policy that accounts for both the direct material impacts of computing and the detrimental indirect impacts arising from computing-enabled efficiencies, and the role of computing professionals in informing policy making.

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