

Towards a Material Ethics of Computing

Addressing the Uneven Environmental Stakes of Digital Infrastructures

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As concerns around climate change escalate, the need to address the environmental impacts of computing becomes more dire. While urgent action is needed, there is also opportunity to rectify longstanding inequities and injustices present in the relationship between computing and the environment. The aim of this one-day hybrid workshop is to gather researchers and practitioners and develop a material ethics of computing. We frame material ethics as a shared understanding of the relations between material and labor that shape digital infrastructures. Through presentations, discussions, and facilitated activities, we aim to build a research community to understand how computing facilitate sites of environmental damage and degradation, and also spaces for justice, change, and hope.

CCS CONCEPTS • Human-centered computing • Human computer interaction (HCI) • HCI theory, concepts, and models

Additional Keywords and Phrases: sustainability, ethics, materials, labor

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1 Background

The practice of computing, even in its most seemingly abstracted and ‘cloudy’ forms, rests on material infrastructures [4,6,27]. For instance, the training of large deep learning models rely on immense computing power that releases close to

the lifetime carbon emissions of five cars [28]; more than 380 undersea cables spanning 1.2 million kilometres carry our communications and internet infrastructure [27]; while over 53.6 million metric tonnes of e-waste was generated in 2019 alone [10]. Additionally, computing technologies as varied as satellite imagery, sensor networks, databases, and algorithms increasingly shape our imaginaries of the world around us, and our place within it. A material ethics is concerned with the ways that such technologies are part of how we come into relation with nature, how such relations unfold and evolve, and the manner in which they are sustained. Thus, the data standards, design choices, regimes of expertise, and other elements of information infrastructures used to map, model, and forecast environmental phenomena become issues of central concern, as well as potential leverage points, in wider efforts at justice and sustainability.

As global concerns around climate change escalate, there have been increasing calls within HCI to examine the field's relationship to environmental concerns [5,15,19]. Heeding this call, our workshop contributes to a material ethics of computing rooted in a shared set of grounding commitments and practices that centers the relations between the materials and labor that form and shape digital infrastructures. How do environments influence and press upon the way computing technologies are designed, produced, maintained, repaired, and circulated [3,9,14,18,24]? How do digital infrastructures affect our knowledge of environmental developments and dynamics [8,11]? Our workshop welcomes researchers and practitioners to collectively think through these questions around values, knowledge production, and political economy to understand the environmental impacts of HCI.

1.1 Related Work

In recent years, there is growing interest in ethics within the field of HCI as a way to examine and address concerns such as algorithmic bias, discrimination, and other resulting inequalities that arise through the proliferation of digital technologies [12,21,25]. In our workshop, we expand the discussion of HCI ethics to include questions on the material and environmental impacts of computing. Rather than a focus on normative ethics that can place the onus on individual behaviors, we see the possibility of ethics to foster and evolve collective imaginations and shared responsibilities [16]. More specifically, we will draw out existing threads of scholarship in HCI related to the materiality of computing and sustainability to understand how design and computing are not only both sites of environmental damage and inequities but also spaces for justice, change, and hope.

Our workshop framing also draws on recent scholarship in sustainable HCI and related areas that have shown how digital infrastructures are sites of social and environmental injustices. For example, researchers have examined how increased global demand for minerals used in electronics such as cobalt and lithium has exacerbated local conflicts and environmental degradation [1,26]. In the manufacturing of computing components, workers have historically faced exploitative work environments, while chemicals from manufacturing can create hazardous environments for local residents [17,22]. Similar injustices and unequal effects may be found in practices of e-waste and repair. Global e-waste often follows material flows from rich to poor countries, leading to an uneven distribution in e-waste processing [18]. The work involved in processing e-waste can also be hazardous to workers who disassemble and repurpose the electronics [23].

Existing work in sustainable approaches to computing has attempted to ameliorate such environmental consequences by reducing these energy and material needs, such as curtailing our internet runtimes and streaming services, or developing technologies to quantify and develop new metrics and consumption habits [2,20,30]. However, reduction is only one angle to approach this issue, and to pursue equitable and justice-driven outcomes. Our workshop aims to thus move away from reduction as a sole entry point for sustainability and instead focus on tactics that center equitable redistribution of power. One direction for redistribution includes an attention toward how computing supply chains are sites for mobilization, collective action, and community organizing [13]. As an example, recent organizing among tech workers in “Amazon Employees for Climate Justice” fought to hold the company accountable for carbon reduction efforts and took steps to reduce fossil fuel emissions [29]. The tech worker coalition also advocated for fair working conditions for warehouse and delivery workers on the other end of Amazon's supply chain as the COVID-19 pandemic began to break out, evidencing that climate issues are inseparable from political and economic oppression and exploitation. Such coalition work represents efforts that far exceed carbon reduction; it is a formation of new and lively political work at the intersections of labor, tech, and the environment.

These dynamics between politics, technology, and environment urge scholarly and practical attention. If computing bears a consequential, practical and (we believe) ethical relation to the material world, how can we as HCI researchers, designers, and practitioners address and research material concerns and their relationships with data, justice, power, and labor? More broadly, how do we go beyond earlier discussions and efforts at sustainability to address the full range and possibility of computing's 'care-ful' relations with the material world, at levels ranging from global supply chains to highly local values and interactions? Hence, a material and environmental ethics of computing focuses **on both the extractive consequences of computing as well as the social, political, and moral possibilities for collective and/or transnational organizing, solidarities, dependencies, collectivities, and interconnections between workers and manufacturing and production sites.**

1.2 Topics of Interest

For our workshop, we welcome participants who are interested, but are not limited, in the following topics:

- New sites of value, labor dynamics, and exploitation at resource frontiers to support digital infrastructures, e.g. Internet cables, data centers, etc.
- Lifecycles and afterlives of computing which includes sourcing, extraction, maintenance, repair, waste, and toxicity;
- Environmental and social justice efforts that are not simply focused on reduction of consumption but also on building supply chain solidarities;
- Diversifying ways of representing material and energy production / consumption beyond measurement and representation e.g. data visualization for communicating climate uncertainty;
- The disparate impact and visions of digital technology in energy transitions (e.g. net zero carbon emissions policy, philanthropic funding of development projects in poverty and sustainability, geoengineering projects);
- How different epistemic regimes, design choices, and data standards encoded in computing technologies used to analyze environmental challenges such as pollution or climate change shape our understanding of these problems and delimit the realm of possible responses.

1.3 Workshop Goals

In this workshop, our primary goal is to bring together researchers and practitioners from academia, industry, and activist circles to contribute to what a material ethics of computing might entail. Within this broader goal, we aim to: (1) Share, discuss, and map how participants' research connect and align with each other as a way to understand the landscape of a material ethics of computing (2) Identify a shared set of keywords and terminology, and (3) Cultivate a research community around the material ethics of computing for future collaborations and projects.

2 Organizers

Jen Liu is a PhD student in the Information Science department at Cornell University. Her work studies the ecological, social, and political implications of computing technologies and infrastructures. She employs ethnographic and design methods to understand these challenges and build alternatives for livable and equitable futures. Her current work examines the impact of climate change on network infrastructures in the American South.

Cindy Lin is a postdoctoral fellow at the Atkinson Center for Sustainability and Department of Information Science at Cornell University. Her current research focuses on the genealogies of ground truth in artificial intelligence (AI) systems deployed within the environmental sciences. She is currently working on a book project that examines ground truth within the history of machine learning as a shifting political and scientific category.

Anne Pasek is the Canada Research Chair in Media, Culture, and the Environment at Trent University. She studies how carbon becomes communicable to different communities, to different social and material effects. She is a PI on an Internet Society-funded project examining the carbon intensity of ICT subsea cables and the convener of the Low-

Carbon Methods Group, a collective of scholars examining how climate change stands to alter not just what we study, but how we do so.

Robert Soden is an Assistant Professor in Computer Science and the School of the Environment at the University of Toronto. His work draws on the arts, social sciences, and humanities to evaluate and improve the design of the ICTs we used to understand and respond to environmental challenges like disasters and climate change.

Lace Padilla is an Assistant Professor at the University of California Merced. Her program focuses on how people make uncertain decisions with forecast visualizations to improve data transparency and uncertainty literacy. She works collaboratively with domain experts to empirically test current uncertainty communication approaches and develop new techniques in contexts such as wildfire risk reduction (PI, NSF award #[2122174](#)), pandemic forecasting (co-PI, NSF award #[2028374](#)), energy grid resiliency (sub-contract, DOE award), and hurricane forecasting.

Daniela Rosner is an Associate Professor in Human Centered Design & Engineering (HCDE) at the University of Washington and co-director of the Tactile and Tactical Design (TAT) Lab. Her work investigates the social, political, and material circumstances of technology development and use. Rosner's writing has appeared in *Public Culture*, *New Media & Society*, *Design Issues*, and other journals, conference proceedings, and edited volumes. She is the author of *Critical Fabulations: Reworking the Methods and Margins of Design* (MIT Press). Rosner serves as a co-Editor-in-Chief of *Interactions* magazine, a bimonthly publication of ACM SIGCHI.

Steven Jackson is an Associate Professor of Information Science and Science and Technology Studies at Cornell University. His work combines ethnographic, legal and theoretical traditions grounded in pragmatism and critical theory with an overall interest in how people build and maintain order, value and meaning in and with the worlds around them. He has written extensively on problems of infrastructure, maintenance, repair, and hope.

3 Website

A web page will be created for the workshop. This website will initially include workshop information, in addition to details for participation. After participants to the workshop have been accepted, it will host workshop papers and related materials.

4 Pre-Workshop plan

4.1 Key Dates

The key dates for the workshop is as follows:

- Call for Participation released: December 16, 2021
- Participant submissions due: February 24, 2022
- Notify participants of acceptance: March 12, 2022
- Workshop date: Saturday, April 30, 2022 or Sunday, May 1, 2022

4.2 Workshop Recruitment

The proposed workshop will be promoted through our website that we will register upon our workshop acceptance. We will use this website to circulate our call for participants via CHI mailing lists, in addition to relevant mailing lists in adjacent fields. We will also distribute our workshop call through personal contacts and social media. Using these methods, we hope to attract a range of scholars, activists, and artists who have interests in the intersections between digital computing and environmental sustainability.

4.3 Workshop Application

Workshop participants will have the option to submit a 2 - 4 page position paper in ACM submission format, or submit a multimodal piece with a biography (200 words maximum) and description (300 words maximum) of the piece (e.g.

drawing with caption, a combination of poetry or video work with written text, or even soundscape recording with written elaboration). The submission will respond to a series of prompts which include:

- How does your current or pre-existing work attend to material ethics of computing?
- How does your current or pre-existing work extend or challenge our current framing of material ethics of computing?
- What are sites of exploitation, redistribution, and justice in your research site or work?
- What inventive or speculative approaches have you taken to reimagining computing landscapes?
- What forms of collective imagination might a material ethics of computing make possible?
- What legacies of creativity, speculation, and computing practice inform your approach to material ethics?

Applicants will also notify us of whether they plan to attend the event in-person or virtually. This selection will allow us to plan for our hybrid workshop accordingly. Applications will be submitted to an email account (TBD) that will be part of our call for proposal and website. Upon acceptance, we will include and share participants' papers and pieces on our website.

5 Workshop Structure

5.1 Workshop Setup

Our workshop will be a one-day hybrid event. The estimated number of workshop participants is 15-20 people (not including the organizers) and we will aim to have a balanced distribution of participants participating virtually and in-person. For participants who will be attending virtually, we will organize a virtual meeting space using Zoom or a similar platform. For participants who will be attending in-person, we will use the room provided for us on-site at the CHI conference. In our on-site room, we will have a dedicated laptop, monitor, omni USB microphone, and speakers to interact with our virtual participants. We will also have additional laptops and tablets available on site for smaller hybrid group activities. Additionally, we will have a wi-fi extender and mobile hotspot to ensure Internet connectivity throughout our event. We will also distribute and share workshop materials to our conference participants by making them available on our website.

Our workshop organizers will also be participating in both virtual and on-site contexts. We will designate 1-2 workshop organizers as a point person for the virtual portion. This role will oversee any technical and logistic concerns and will communicate accordingly with on-site organizers. We will set up a backend communication channel for workshop organizers to communicate throughout the workshop. We will also designate 1-2 workshop organizers to document portions of the workshop. This role will include taking notes, photos, videos, and recordings of workshop activities. We will ask for consent from participants prior to any documentation.

5.2 Activities and Timing

Our workshop will take place on one day over the course of six hours (see [Table 1](#) for preliminary schedule). The main activities of our workshop are research presentations, a mapping exercise, a keyword activity, and working group formations. Breaks, in addition to lunch, are interspersed throughout the activities.

The workshop will begin with introductions and brief research presentations by participants to introduce their interests in relation to our workshop topic. We will then start a mapping exercise where the goal is to see how our projects are interconnected. The goals of this activity are to deepen our understanding of each other's research interests and begin to develop a shared collectivist vision for material ethics. The design of this exercise draws from Joseph Dumit's implosion writing exercise that aims to "teach and learn about the embeddedness of objects, facts, actions, and people in the world and the world in them" [7]. The workshop group will be split into smaller groups, where each group includes members who are participating virtually or in-person. We will then use a collaborative application such as Google Jamboard or Miro to visualize the connections between our projects and research interests. We will then reconvene as the full group to share our visualizations.

The workshop will then transition to a keyword activity. The goal of this activity is to identify and define shared vocabulary to build a glossary around material ethics. As a full group, we will first brainstorm potential keywords. Then, working in smaller groups that consist of virtual and in-person attendees, we will work towards defining these terms. These terms will be placed in a shared document such as Google Docs or Etherpad that will be shared with the entire workshop group.

At the end of the workshop, participants will re-group to reflect on their workshop experience. During this reflection time, we will also create working groups, these groups will be aligned around emerging themes over the course of the workshop. The goal of these working groups is to create spaces for researchers and practitioners who have overlapping research interests to convene post-workshop. Potential activities for these working groups include reading and writing groups, in addition to collaborations for research grants and projects.

Table 1: Tentative Workshop schedule

Time	Activity
9:00 a.m. – 10:00 a.m.	Introductions and brief research presentations
10:00 a.m. – 10:15 a.m.	Break and setup for mapping activity
10:15 a.m. – 11:30 a.m.	Mapping activity
11:30 a.m. – 11:45 a.m.	Break and setup for keywords activity
11:45 a.m. – 12:30 p.m.	Keywords activity
12:30 p.m. – 1:30 p.m.	Lunch
1:30 p.m. – 2:15 p.m.	Continue keyword activity
2:15 p.m. – 3:00 p.m.	Wrap up and reflections

6 Post-workshop Plan

Following our workshop, we will share documentation of our workshop activities with our participants in the form of a zine that will be available in both digital and print format. This zine will include the visualizations that were created to map out and connect participants’ research interests, in addition to a glossary with shared vocabulary. Based on participant consent, we will also make this zine and additional documentation available via our website. We also plan to co-edit a special journal issue in TOCHI where we will invite workshop participants to publish their work. Our longer term goal for this workshop is to build a community and network of scholars, especially students and junior scholars, to connect with others who are interested in our research areas. We aim to begin building this network through the formation of our working groups during our workshop.

6 Call for Participation

“Towards a Material Ethics of Computing: Addressing the Uneven Environmental Stakes of Digital Infrastructures” is a one-day hybrid workshop aimed at contributing to and developing a shared material ethics for HCI. Material ethics is envisioned as a set of commitments and practices that centers the relations between material and labor that form and shape digital infrastructures. As the environmental impacts of ICT loom large, it is all the more important to consider the intersections between workers and environments across all stages of tech’s supply chains and aftermaths. We therefore ask: How do environments influence and constrain the way computing technologies are designed, produced, maintained, repaired, and circulated? And how do digital infrastructures affect our knowledge of environmental and labor developments and dynamics? Our workshop welcomes researchers and practitioners, both within and beyond HCI, to collectively think through these questions and other questions around values, knowledge, and political economy to understand the environmental impacts of HCI.

Workshop participants will have the option to submit a 2 - 4 page position paper in ACM submission format, or submit a multimodal piece with an approximately 200-word biography and 300-word description of the piece (e.g. drawing with caption, a combination of poetry or video work with written text, or even soundscape recording with written elaboration). The submission will respond to or address one or more of the following prompts:

- How does your current or pre-existing work attend to material ethics of computing?
- How does your current or pre-existing work extend or challenge our current framing of material ethics of computing?
- What are sites of exploitation, redistribution, and justice in your research site or work?
- What inventive or speculative approaches have you taken to reimagining computing landscapes?
- What forms of collective imagination might a material ethics of computing make possible?
- What legacies of creativity, speculation, and computing practice inform your approach to material ethics?

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