### **Transcript for Climate Conscious AI Use: Wrestling with Environmental Impacts**

**ETUG Fall 2024 Workshop: Navigating Ethics and EdTech – November 1, 2024**

**Presenter: Emily Simpson**

ANDY SELLWOOD:

Well, welcome back, everyone. So Andy Selwood here. So I'd like to introduce our next speaker. So with great pleasure. We have Emily Simpson, who is an instructional associate in the Centre for Teaching Learning and Research. Emily is going to be talking about Climate Conscious AI Use: Wrestling with Environmental Impacts. So I'm going to hand things over to Emily.

EMILY SIMPSON:

Thanks, Andy. Hi, everybody. It's great to be gathered here with you this morning, and I'm looking forward to collaborating and talking about wrestling with environmental AI impacts. I don't know if this has been something that you've been feeling lately as it's been coming up more in the news, but this is a conversation time of collaboration.

So I want to start by respectfully honouring and acknowledging that I am joining you from the traditional and surrendered lands of the Musqueam Squamish, and Tsleil-Waututh Peoples who have stewarded this land since time in memorial and continue to live in relationship with and care for these lands today. And particularly as I've been thinking about this topic, I just think of all of the wisdom and knowledge of Indigenous world views on the central interconnectedness of land, water, sky, and all living beings, and the way they have cared for everything around them in looking forward to seven generations. As a parent, I've been thinking about this more and more, not just with generative AI, but climate change and all the impacts of the choices we make in the ways that we live.

As Andy said, I work in the Centre for Teaching, Learning, and Research, and in the last two years, I've been supporting instructors and departments with generative AI in teaching and learning. There was a point last year where I was just stunned at finding out that 20 to 50 prompts in ChatGPT or another comparable, large language model tool used up two cups of fresh water in cooling the data servers. The same shock that I saw colleagues experience when I shared that information. I began wondering what else I didn't know about the environmental costs of generative AI. I started searching for information and bringing up this question in sessions I was attending or educators who were leaders in generative AI. There was a lot of talk about how to minimize other kinds of risk, like privacy and bias. But not so much about environmental risk yet. But it's coming up more and more in research articles. I really want to thank Helena Prins from BCcampus and Lucas Wright from UBC Centre for Teaching and Learning for their feedback and encouragement on putting on this workshop together to go forward with it. I'm hoping in this session we can learn together, maybe wrestle with the tensions of these tools, share our wisdom, and think about how to shape a sustainable future and adopt responsible practices. Specifically today, we're going to spend a bit of time looking at both the positive and negative environmental implications of generative AI. We're going to explore a framework of guiding questions that might help you reflect on where you use AI, where you see its value. Then take that into starting a draft philosophy or framework that's personalized for you, that embodies and aligns with your environmental values. The final piece of that will be looking at some practical strategies to minimize the carbon and water use of generative AI, just environmental impacts. Today we will be collaborating with Padlet. There'll be three points where we'll share a Padlet to bring our thoughts together so we can share that out after the session and also in the chat. I want to acknowledge I did not create any of the slides or images in this presentation with generative AI. I did use Google Notebook LM to gather my sources and help me clarify my focus on the themes for today because I knew I would be reusing this workshop at least three more times.

Here we go. The first question on Padlet is, What do we know about generative AI's environmental costs so far? I'm going to put that link in the chat for folks who might not have a QR code picture taker on their phone. I'm just going to give a few minutes for folks to do that.

Some of the themes come up as energy usage, not much. Yeah, many giant tech companies can't meet their energy savings goal. The press to come to net zero emissions because of AI. Oh. Fantastic screenshot about how many queries are equivalent to doing laundry. I love that folks are posting articles and resources that are inspiring them about this. There's a great question about why fresh water is needed to cool servers, and I will get to that in the next section. Fantastic. There is a lot of collective knowledge here around the environmental cost. Yes, electronic waste. Okay. It's good that you all could absolutely do the next six slides of this presentation for me. I'll try not to get too much into the facts and figures at this point, see if we can all be on the same page.

I want to start on the flip side with the benefits first. Where is there excitement about the way AI could help with environmental challenges? The key feature is generative AI's ability to analyze vast amounts of data and identify patterns and insights that humans might miss or simply we don't have the resources. There's not enough humans to look at all the data in a quick enough time to respond. For example, at NOAA, the National Oceanic and Atmospheric Administration has partnered with Google in terms of AI to help improve climate water and Earth systems modelling for better predictions around climate change and severe weather events. There's excitement about the ability of these tools to be used to monitor deforestation, air quality, emissions, and to look at the success or unsuccess of climate mitigation approaches. It's also going to be used to help with forest fire events in terms of picking up smoke patterns on cameras. In terms of our everyday experience, flights not flights. The aviation sector is looking at generative AI to optimize flight paths, which could cut down on contrails, and sorry, reduce the emissions by up to 35%. It's good that I'm not in control of the slides here. One moment, please. There we go.

Also another place where there's excitement is around tracking biodiversity of animals. Better ability to analyze patterns, locations, distributions of animals. Another place where folks are excited about how AI could improve environmental challenges is just through using it as a way to improve the efficiency of any code and coding language in computer and software applications. There's a recent study that showed that can reduce application energy use by up to 50% through improving the coding. There is movement, I think, within the generative AI development world to look at ways to reduce its impact. Sasha Luconioni's research group has really been putting forward this idea of an AI energy star rating for AI models. They have done a lot of research about the individual carbon emissions of different types of AI tasks with different AI models to compare how really with model optimization, and size, you can significantly reduce the carbon emissions associated with it. There's lots of other optimization going on around being able to cap the power draw during training, ways that you could change hardware or when jobs are run or where the data servers are located, or what hardware is paired with the AI model, and even the algorithms used in training the model can all have significant impacts on reducing the power draw. And of course, we're also seeing that smaller AI models are now approaching the capabilities of larger ones. I should say in all of this, I'm not a computer person. I'm not a techie. So I welcome any corrections to information I may misstate. But for folks who don't know, the model size is based on both the amount of data that it's trained with and the more data you train with in order to recognize the patterns, the more compute power it takes to finish the training process, and as well as the amount of tokens you allow it to put in, or we can think of it like our prompt size. That also increases the amount of compute power required to run it. Those I think are the positives. I think we've seen the EU is pushing ahead, and the UN and UNESCO are also emphasizing. It's really essential we start having legislation that requires transparency around the environmental costs of particular generative models both in the training phase of the model and in the use phase of the model.

But the question on the other side is, are the promises and the rate at which these improvements in environmental impacts happening fast enough relative to the scale at which models in use are rolling out and accelerating and the push towards larger models to keep pushing that envelope of what these tools can do. You all in the Padlet really captured, I think the three of the key points of the environmental challenges are the energy and carbon footprint of these tools. These are run on data servers or data centres, and generative AI is not unique in this in terms of many of our daily activities require natural resources and produce carbon emissions, and we're always making choices about which resources to use to accomplish goals we believe are important. Bitcoin and cryptocurrency was a big push for the use of data centres before generative AI. But the thing that seems to be concerning now is the accelerated use of resources. As someone shared on the Padlet, many of these companies like Google and Microsoft are walking back their targets for net zero emissions now because there is so much demand on the energy grid that they are not decommissioning coal plants when they said they would, there's not a strategic use of where data centre is located. For example, if you were using a data server or data centre in somewhere that drew on hydro-electricity, the carbon emissions would be much lower than using a data centre that's, of course, oil fueled or coal fueled. Set from 2020 to 20. Apologies. 2020 to 2022, Microsoft emissions rose 30%. Most of that is believed to be due to the increasing demand from generative AI, and Google's emissions rose 50% since 2019. And it's predicted by 2026 that data centre energy use and carbon footprint will be equivalent to Japan's total electricity consumption of 1,000 terawatt hours, and that's a worst case scenario. Somebody asked about water for cooling. So this is from Dr. Shaolei Ren Group at University of California Riverside, and they really brought forward the water use of generative AI. And so there's two places where water is significantly demanded. One is in the cooling tower for the power plant that provides the power to the data centre. But the second one or the primary one is the onsite water cooling tower. Because these centres generate so much heat, many of them use water cooling. There are some that use air-base cooling, but water cooling for this. The International Energy Association, I think, noted that Google's Data centre water use increased 20% from 2021 to 2022, and Microsoft's increased 34% for the same period. There's competition for freshwater sources. As other folks mentioned, mineral mining and e-waste is a huge concern. Where these, all the components to build the chips that go into CPUs and GPUs and into the data centre. In all these countries where there are less restrictive environmental or labour regulation requirements, there's deforestation, soil contamination, toxic-waste disposal, groundwater pollution, air pollution. There's a call being raised about the widening disparity of impacts. So water is being drawn from places that are already water stressed. The mining for these materials is happening in places where the countries themselves aren't really reaping the benefits because there's foreign-owned companies. There's been articles about the municipality of Colón in Uruguay and Chile, around drought in those regions where data centres are being planned to be built and protests around how it's going to impact the actual local communities' access to water. This is being linked to, of course, this idea of uneven regional distribution of these costs. Risk is reflecting settler-colonialism and racial capitalism. Those are some of the challenges we're facing.

One thing I wanted to mention is that there have been a lot of articles on energy use when we look at environmental impacts around the training phase of these models. But what's coming out, I'll not say now, but in the last two years, is that the energy used for the training phase of the model is actually the smallest proportion. It might be, depending on the study and the model, 20 to 40% of the total energy use. But the inference phase or what I think of is all of us as users using these tools. That's what accounts for anywhere from 60 to 80%. Now, there are numbers that are giant kilowatt hours, but I find that hard to translate to my meaningful life. I have appreciated people who have translated this information into our daily impacts, and I'm definitely going back to that idea of 132 queries is a load of laundry.

But training in a large AI model, again, this is, I would say an average, depends on the model and where the data server is located and what its power source is. But training a large AI model can admit as much carbon as five cars over their lifetimes. This was based on GPT-3, GPT-4, and the next iteration GPT-5 are all larger models. But there are certain efficiencies that are happening as that's going as well. This is equivalent to the energy use of 1,450 US average households. Sorry, is my audio back. Okay. And this energy used for training a large AI model, it was estimated to have evaporated 700,000 litres of clean fresh water. And that would be equivalent to 3,139 Canadians daily use of water.

Now the inference phase or use phase. I think folks have probably come across these stats maybe a little more often to help us think about what it's like for us on the use. A ChatGPT text request takes 2.9 watt hours. This is somewhere 5–10 times the energy of a simple web search where AI is not integrated into the browser or 3.5 minutes of watching Netflix. If ChatGPT were part of 9 billion web searches a day, this would be the same as 1.5 million European residents' energy use. Think about that. We know there's 100 million active ChatGPT users roughly a day, and that's not counting every other generative AI large language model. The energy to generate a single image is equivalent to almost a full cell phone charge. Yeah. So great comments in the chat about disproportionate impacts. To that question, Dr. Shaolei Ren Group, tried to do an estimate on how many interactions you could have with a large language model to be equal to the use of 500 mls of water. Again, this depends on where is the data centre located? Is it a water stressed area? If you look at places like Arizona, you could have 15 inferences or 15 chats and you would use 500 mls of water. Mexico and India, 21 to 25 chats. You go to somewhere like Wyoming, Virginia. There you can get 43, 40 chats. That's where this idea of how much water will it take for a single use?

Okay. I'm going to pause there and invite you to return to the Padlet and think about what stood out for you and what was shared of those positive and negative environmental implications of generative AI or just how you're feeling. I'll put that link in the chat again. Thanks, folks.

I'm seeing a lot of echoes of concern, worry, thinking about the way when we think about individual small amounts of uses, it can be hard to scale that up to the whole world. Yeah, I think that is the point developers in generative AI have made is that it feels like there is an AI arms race right now to keep pushing the biggest, the fastest, the most complex models, and the regulation isn't able to keep up yet. Great emissions data from either open AI or Google. Again, I'm not a professional researcher, but my understanding is they were much more transparent about emissions in maybe two or three years ago, and there's been less transparency with the newer versions of the model. I think some folks are trying to estimate based on their overall reported emissions and then trying to calculate back to where they think how much might be coming from generative AI. Thanks. Need for more transparency, knowledge sharing and policy development from institutions using the technology. Fantastic. Okay. Thank you for sharing your thoughts there and good to know we are not alone in what we're feeling.

My whole personal tension and just feelings of despair about this really made me feel like, what choice do I have? What can I do, if anything, here? I feel a little that because of the nature of my role, I do have to use this tool to some extent. But I really wanted to clarify for now why and how I will use the tool. I want to thank Helena Prins again for pointing me to Brett DeWall's ethical framework for AI generation. He had this wonderful framework of six guiding questions that he used in considering the creation of generative AI images. And I ended up with three questions. In this part, I'm going to ask folks to give some feedback on how these questions land for them. If they feel they're helpful or there are things that might be missing. But the big three areas that I now use to guide my work is one is the purpose. Why am I using generative AI? The second is reusability. How reusable is what I'm creating? And the third is impact. Who will gain through my use of generative AI and what are the costs and who bears them?

I tried to expand on each of these a bit. I ask myself, is this a necessary task, or is it for fun? I will confess before I knew much more about the environment, I was doing a lot of vacation itineraries. Are speed and resources a critical factor? Am I trying to create or do something I couldn't on my own? Has someone already done this? Is there something out there already I could reuse? Is it the right tool for my task? I love that somebody asked about, could I turn off Google search? No. But what I could do was say, Well, all I need is a web search. I don't need generative AI to make me a summary, so I downloaded a new web browser that doesn't have generative AI integrated into it. The final question I ask myself is, is this lined with my pedagogy and ethics? How are these purpose questions landing for folks? I'll just invite you to share in the chat. Are there other questions that you ask yourself about the purpose for using generative AI before you decide to use it? I want to leave that thought there.

The second question I've been asking myself about reusability is, is this for a one-time use? Am I just writing an email? I don't actually use it for email, but am I just writing an email or maybe I'm making a presentation that goes to one small group meeting? Or is it going to be a multi-use thing? Is it something I can reuse over and over again? Am I saving or storing generated content? Depending on the tool that I'm using, for example, if I were using ChatGPT without logging in, there is no saved version of my chats, Thinking about and I also notice anytime I generated an image, I never had the associated details with where I had generated or when it was. Just thinking about how you could reuse that content. Then I labelling AI generated material? If I'm sharing something out, I can't label it as Creative Commons because that license can only belong to something created by a human is my understanding. But if I label it as AI generated and say, yes, please take this and use it. The fourth question I've been asking because I'm working with instructors thinking about how they want to build AI literacy for students is, if student use is being planned, will their generated content be reused?

The third question I've asked is who benefits from using Gen AI and what and who does it cost? This one is a little fuzzier for me, but these are the questions I've been trying to use. Will it increase accessibility? Is there a way I'm significantly increasing accessibility for students? Will it solve a significant problem? Maybe my need to think of a catchy title for my LinkedIn post maybe is not as important as say a hospital who's using it to analyze medical images to reduce the risk of sepsis deaths. Will it solve a significant problem? Is a company benefiting off the data I put in? Is the data going into training? Am I giving up intellectual property rights? Am I willing to use two cups of clean water to do this? Who's two cups of clean water am I using? This is the new one I'm trying to ask myself. If I had to pay for each prompt, would I use it as much as I am? Those are three questions. Again, I'll just ask, take a moment. How are these questions landing with you? Are there any questions that you would add? Who benefits the most? Thanks, Pablo. That's a great one to add. Excellent.

The next part we're going to go into is taking some of what we've been learning so far, what you've already brought in terms of your experience and knowledge, and put it into action in creating your own draft philosophy or framework or set of guiding questions that you want to use to bring your use of AI into alignment with your environmental values. And we're going to do that on Padlet and I'm just going to give you an example.

This is how I've done my personal philosophy for now, and it's for now because this is an evolving field, so I don't know which direction it's going to go, when things might be significantly improved in terms of reducing the carbon emissions from these tools. I don't know what my job is going to require in two years. I will also say this is much harder to follow when I'm under-resourced. I'm not going to be perfect at it, but it's something that I'm trying to aspire to. For my personal life, my philosophy is not to use it except when I need to help my children learn AI literacy. For work life, I'm very clear I will not use it for image generation, image captioning, or writing emails. But where I think I may consider using it is when I'm supporting major curriculum development with limited resources. When I need to develop a first draft of a major report or social media post for a wide audience. If I'm collating research or documents, the quality assurance in terms of entry to practice competencies with massive amounts of curriculum documents. There maybe I can see it might be worth it. I will reuse as much generated content as possible. I have already switched to default web browsers on my phone and my work computer that don't have embedded generative AI. Some examples for now are Duck Duck Go, FireFox, and I will try to keep raising conversations about the environmental impacts of those tools.

Now, I am going to invite you to start your personal philosophy on Padlet. Think about what use aligns with your values and/or feel worth the cost. What uses do not feel aligned with your values? We all have to make different decisions about this. This reflects your needs, the values that you're bringing, where you have choice and where you don't have choice. Now I will put the link to the Padlet in the chat again, and we're just going to take 5 minutes. I'm also going to attempt to share some soothing inspirational music during this time.

Well, I appreciate folks just reflecting on where they're at with that. And I note some people are making the choice simply not to use the tool. Some people are noting it may take them time to figure this out. Some people note they really value giving credit to human-generated creativity out there. Yeah and acknowledging it is the intention of figuring out when to use it. Of course, this is not to say this tool is the only technology we use that has environmental costs. I don't want to completely discount the fact that all of our cloud storage and other activities aren't adding to this. Maybe it's focusing on helping other colleagues and students understand it. I love, yes, the reuse, recycle, reduce phrase. I did think about that one a lot when I was putting this together. Yeah, that's a great question about what does harm look like in this context. I love the way people are connecting this, not just as an individual reflection, but also thinking collectively, where are the spaces for conversation? What institutionally can we do? Great. Thank you.

Okay, I'm just going to move into the final part, which is what are some other ideas about practical strategies to reduce the... I'm sorry if the music didn't end up working out during that time. This section is really mostly drawn from Tilburg University. They have a great page on five practical techniques to lower your AI environmental footprint.

Now, I'm not as computery as them, so I've tried to translate these into something I can understand. The first idea, which we've talked about already, is use your whole toolbox. Somebody gave the analogy of I don't need a Ferrari every time I need to go like 5 minutes to the grocery store. Choosing one of the frontier models like ChatGPT or Copilot or Cloud that can do so much, when I just need to do something simple is a way that I can save energy. For example, internet search instead of an AI tool. The other way that we can do this is to choose the right AI model for the task. This is something I'm starting to learn a little bit more out of, but you can choose a smaller model. Like Ollama or most of the major frontier models also have smaller models that's less resource intensive for simpler queries. By not walking into ChatGPT, you would be using the GPT-3.5 model, which is less energy intensive than the GPT-4 model. Through sites like Poe, you can access multiple models when you decide to input your prompt or query. That may be a way to help minimize the energy costs of the tasks that you're doing. Of course, as everybody has already said, I could just choose not to use the tool. But here I'm assuming there is some need to use the tool, some demand may be external to yourself where we can't get around it.

As somebody mentioned in the chat, yes, recycle and reduce is a great one. Recycling, Creative Commons, open education, Yeah, open textbooks. Oh, I love that idea, Todd, I'm going to add that pay for your own carbon offsets. One thing I've noted is I was really frustrated with Adobe Firefly because I knew people were generating all these amazing AI images, but there was no way to search through them and try and reuse something somebody has generated. But I know, for example, on sites like Free Pick, you can filter the gallery to show AI-generated images. On the one hand, I feel that's positive, that I'm reusing something that's already generated. On the other hand, I don't know if it's going to tell the company in general that more people are preferring AI generated images, so they will produce more. I haven't found the sweet spot there yet. Reusing previously AI-generated outputs, of course. Then reducing. Again, when we're thinking in the context of a classroom, instead of having maybe all the students do a prompt on a generative AI tool, you could have them do it as a single group, or you could demonstrate to minimize computation requests. Most of the workshops I do on generative AI now, I'm pretty much just pulling up a past conversation with the tool rather than doing a whole new request to the server that then requires computational energy to process.

3. Limit the output length. If we can be very precise in our original prompt and limit the output, this reduces the computational effort and energy. This was a great example from Tilburg University. Sometimes, I don't know if you're like me, a child of the 90s AOL chat and you just type stuff in without really putting much thought into the origin. Much thought into intentionally crafting it. That's what I'm trying to say. I could say, "Explain climate change." But then most likely I'm going to have to go back and refine that and have more requests that take more computation energy to do this. Versus if I originally put "For a policy briefing, summarize in 100 words," and this is the key part to limit output length, "of the primary causes of climate change emphasizing human activities." That addition here or something like "Focus on the main idea or keep it short and simple," will limit the size of the output that the tool gives you, and that can reduce computational energy. The fourth strategy they suggest is called batch prompting, where you group multiple questions or tasks into a single request, and they should have some logic or flow or be related, so the tool doesn't get confused. This, of course, is also the idea of by reducing them or a request to the server, reduce the amount of energy required. This is just an example format that I will leave here for later.

And I love that somebody brought this up in the chat, running a local model on your device. Yes, will take less computational energy. This is in part because it has to be smaller if your device can run it and it won't be connected to the internet. It won't use cloud storage or communication, so it will consume less energy. This is a great recent blog post from Leon Furze about three ways educators can run local AI and why you should bother. There's some other advantages around privacy as well in that. Then this is institutionally, I've been thinking about what we could do as an institution, and I don't know for those who are involved in advocacy and procurement, when you're part of purchasing a tool, really communicating those values of sustainability and transparency about what the cost of those products are going to be. Another thing is choosing the right model. Again, depending on what we're doing, we may not need the Ferrari per se. We might get by with a nice four-door sedan and be really clear about how the costs are outweighed by the need and benefits of using the AI tool. I just wanted to pause there and do a little more crowdsourcing in the chat about any practical tips about how if we have to use these tools, we might reduce environmental impact. Okay. I do want to highlight Todd's idea of paying for your own carbon offset. That's a great idea.

How long will the local device last? I'm not computery enough to know if the local device will shorten the lifespan. I think it's like running any application on your device. If I run Zoom on my device, does it shorten the lifespan? I think, Todd, you ask an excellent question. How does a more specific prompt require less computational energy? In my mind, and I can't say for sure, it could still be complex, but it's that idea around minimizing the output length that should reduce computational energy, but also the avoiding repeated calls to the data centre to do the computation to answer the prompt. But I would love to hear from wiser folks about this.

So I guess at this time, I will just open up to general questions, comments.

 ANDY:

Thanks so much Emily. I'm just looking for questions as well. We did have something in the Q&A. Luke was asking about why not using AI for image captioning. What's the justification for maybe not using it image captioning?

EMILY:

Yeah. If you look at Sasha Luccioni's article about power hungry AI, it's in my references for this slide, but the energy required for image analysis is the second most energy intensive task you can ask a generative AI tool to do after image generation.

ANDY

Okay. Great. And then Meredith was asking, if we can focus on user choices like trying to fight climate change by changing light bulbs, are there ways we can put more pressure on upstream companies and regulation, so it's not dependent on us as users.

EMILY:

Yeah, I mean, I would say through what politics, like pushing our governments to move faster on regulation. That could be one way. Other folks have ideas around how we could do that. I think our institutional choices around when we choose to partner with these companies and use their tools.

ANDY:

And I guess in terms of educating instructors, do you have any sort of ideas around sort of getting the word out to instructors at different colleges and universities?

EMILY:

Yeah, that's a great question. I mean, I know that for myself, now anytime we do a workshop, this is something we just give the two facts about how many prompts can you do for two cups of clean water and image generation with the cell phone, and that seems to be pretty impactful. But I think a version of this workshop might be interesting to take out. I know after Lucas and I have had a couple conversations about this, I noticed he started including one of those facts like that in his workshops, but I mean, I think it's having the conversations, coming from, coming from a space like this and saying, Whoa, I'm feeling maybe really anxious about what the environmental costs are and what, if anything, we could do, having the space to have that attention, where I think a lot of us feel like we have to use these tools for our jobs. Or it's inevitable. Are there spaces to resist? Are there places to say, as a community, what can we do? I also think the more attention, possibly that we give to true consultations and dialogue with host nations and Indigenous partners to look for their leadership in terms of AI can also be a space.

ANDY:

Yeah, I'm just looking at the chat. There's some articles there about, I guess, increasing overall public awareness of this. I think it's growing, and I love that folks are referencing the whole, yes Google and Microsoft have both invested in small scale nuclear reactors now because the energy grid cannot meet the data centre's current demands. Yeah. Very clear.

ANDY:

Yeah, and I guess this is part of this kind of industry kind of 4.0 that's kind of often talked about, not just a AI, but cloud storage. I was looking into some other aspects of this kind of, as it's called this kind of industry 4.0, you know, trying to find more energy sources that are better for the environment. You know, and maybe, you know, nuclear energy seems to be the most kind of efficient.

EMILY:

Yeah. Again, I think there are possibilities to optimize like they said, if all the servers could work together to actually send work to where it's in an area that draws power from hydro-electricity or is staggered so that it's run at night or in winter months. I think there are ways that can reduce. I just, I don't know. It feels like invest, invest, invest in the capitalism of it without the regulation right now is one of the risks. I do want to acknowledge Todd's point, this is not alone in calculating our energy consumption on the Earth. For me, personally, Yes, I have a personal vehicle, but we use our bikes most of the day. So I kind of feel like I'm looking at this collectively as part of all of the ways that I approach energy use. And maybe for me, maybe I will choose Netflix over AI writing my email if I have to in the long run, but those kinds of questions like that. But I definitely welcome, you know, future thoughts and conversations around this and ideas about what we can do as institutions.

Please feel free to reach out to me, and I will leave all of these resources, and maybe we can collect together some of the other resources folks have shared in the chat.

ANDY: Thanks so much, Emily.