Metaverse: Could creating a virtual world build a more sustainable one? (PART 1)

ISAAC SARPONG: Isaac is the Partner in charge of Tax Services. He has over 26 years' experience in the provision of multi-faceted advice to both local and international clients in taxation, accountancy, audit & assurance, and corporate law, among others. Isaac is a Chartered Accountant, a Chartered Tax Practitioner and a Lawyer.

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This is a critical moment in the environmental and social sustainability of the metaverse. Business leaders can't be spectators.

In brief

- Compute-heavy metaverse commerce raises climate concerns. Yet, substitution, digital twins and immersive experiences could bring sustainability benefits.

- While environmental sustainability is critically important, so is social sustainability. We must create an accessible, inclusive and equitable metaverse.

- Business leaders must engage now to ensure the metaverse develops in a way that is sustainable for planet and people, before exponential growth occurs.

In this liminal moment for the metaverse, new dimensions of sustainability are opening both significant challenges to global climate objectives and new opportunities for achieving them.

Concerns about energy consumption and carbon emissions have come to the fore as compute-intensive transactions skyrocket. For example, there is a chasm between the energy use and carbon costs of the relative few who participate in cryptocurrency transactions and the rest of the world.

Yet, the metaverse also holds the promise of substantial carbon reductions through the substitution of physical goods by digital ones and replacing real-world presence with virtual interactions. Digital twins will help us optimize the physical world, from the planet to individual humans. The immersive nature of metaverse experiences could help us overcome our behavioral barriers to climate action.

As critical as environmental sustainability is, so is social sustainability. We can't lose sight of the need to build a metaverse that is accessible, inclusive and equitable. Now is the time to build sustainability into the front end of virtual worlds rather than try to retrofit them after exponential growth.

All stakeholders, but especially business, must remember we have agency to build the metaverse we want and need, and not just be a spectator as it develops. As businesses invest, develop new customer strategies, and transform to pursue the potential of the metaverse, better sustainability outcomes should be integral to the future vision and planning.

This article is part of our **Metaverse series**, in which we explore different dimensions of the metaverse. In this second article, we investigate how sustainability will be impacted by the introduction of new technologies within the metaverse and what this means for the future of our planet.

CHAPTER 1

The race to decarbonize metaverse data and commerce

Realizing the persistent virtual worlds and experiences promised by the metaverse will require a "superabundance of cloud-streamed data."1 Generating these data will require a lot more computing power, a thousand-fold increase by some estimates. So will growth in the compute-intensive blockchain transactions currently driving metaverse commerce. How these factors affect energy consumption, and, by extension, carbon emissions will depend in large part on data center efficiency and power sources.

Can data center decarbonization keep pace?

Over the past decade, efficiency gains have decoupled data center workloads from power consumption. From 2010 to 2020, internet traffic increased 16.9x and data centers 9.4x, yet power consumption grew only 1.1x. Excluding crypto currency mining, data centers represent about 1% of global electricity demand.

These efficiency gains were driven in large part by the shift to hyperscale data centers operated by large tech companies who have a strong interest in restraining energy costs and the capital to invest in continuous upgrades and optimal siting.

"The public cloud services providers design their hyperscale data centers from the ground up, everything from the siting, to the building construction, clean power source, server racks, cooling, software and processors, giving them incredible efficiency outcomes," says Amr Ahmed, EY Americas Infrastructure and Service Resiliency Leader.

Hyperscale infrastructure represented 45% of data center energy demand in 2021, up from 16% in 2015.

Most large tech companies also have a strong commitment to eliminating carbon emissions. Some already meet 100% of their electricity needs through renewable energy power purchase agreements and are moving to "24x7 renewables", where data center energy demand is met by location-specific renewables at all times.

However, several factors could challenge these impressive efficiency and decarbonization achievements. Data privacy and localization requirements could persuade some companies to keep or reinstate their own data centers. In addition, lifelike and compelling VR experiences demand low latency, which could push data processing to the edge of networks, closer to users.

As a result, some data centers could come to be sited in energy markets where procuring renewables is difficult, or where operating conditions (e.g., heat, humidity, grid intermittency) cause loss in efficiencies or require carbon-intensive back-up generation. Continuing to green power grids globally and create resilient distributed data center solutions will be essential. ∎
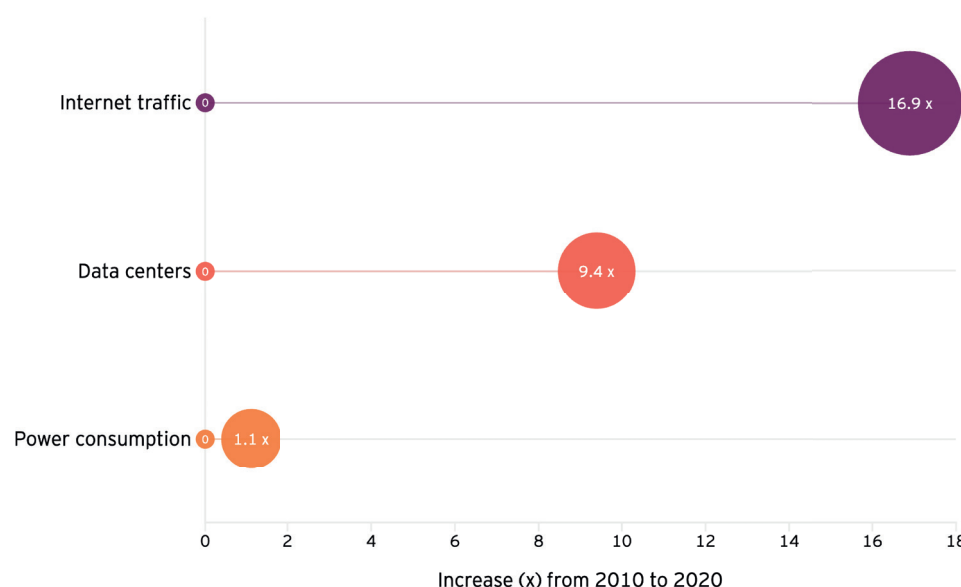
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Figure 1: Data center energy efficiency has kept pace with workloads and traffic

Internet traffic — 16.9 x
Data centers — 9.4 x
Power consumption — 1.1 x

Increase (x) from 2010 to 2020

Source: IEA, Data Centres and Data Transmission Networks, November 2021.

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Powering metaverse commerce

The conventions of commerce – creating, selling, owning, investing – being established around the metaverse are much more problematic from a climate perspective. Non-fungible tokens (NFTs) minted through blockchain-based processes and paid for with cryptocurrency, have become the predominant means for conveying ownership rights to assets such as digital art and virtual land.

Yet, an average Ethereum transaction consumes 60% more energy than 100,000 credit card transactions, while an average Bitcoin transaction consumes 14 times more energy (see Figure 2).

Only about 25% of the energy going into bitcoin mining is renewable. One analysis found that the average single NFT transaction produced 48 kg of CO2, the equivalent of burning 18 liters of diesel.

Figure 2: Crypto transactions are far more energy intensive than conventional ones: Average energy consumption per transaction

1 Bitcoin transaction

1 Ethereum transaction

100 000 credit card transactions
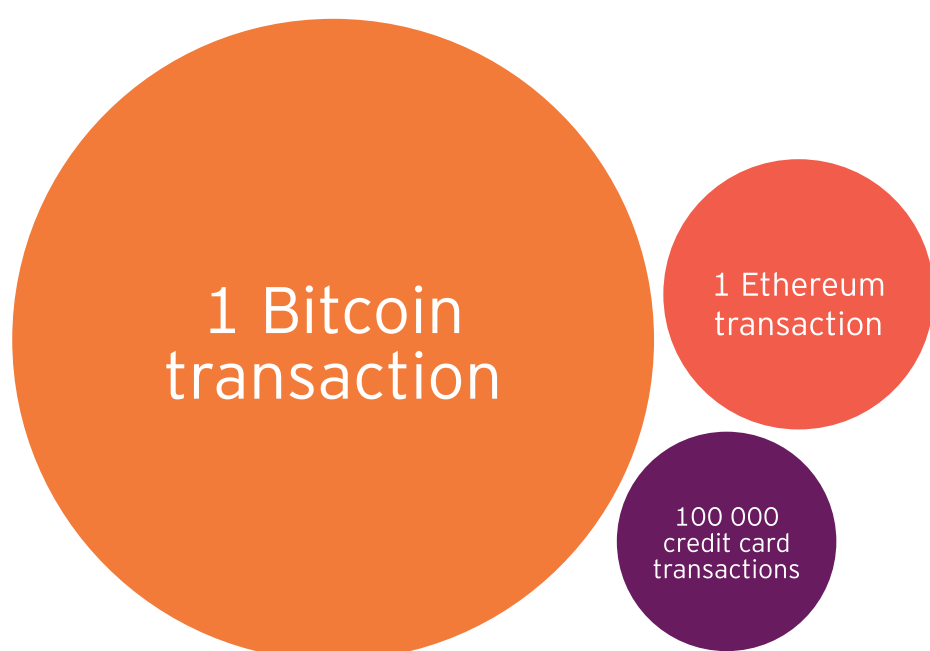
Bitcoin and Ethereum transactions are estimated to consume over 300 terawatt hours of electricity annually, more than global data center consumption.6 Where data centers serve billions of people globally – arguably everybody with a connected device – there are currently only about 300 million cryptocurrency users.7 An industry shift to proof of stake in transactions, which is less energy intensive than proof of work, could lower cryptocurrency power consumption.

This chasm between the distribution of costs and benefits underscores the need for urgent intervention by regulators, investors, consumers and other stakeholders to make metaverse commerce sustainable now before exponential growth makes it much more difficult.

CHAPTER 2

Substituting the physical with virtual

"The metaverse offers capabilities which are not bounded by the physical world and which could be a strong enabler of the things businesses are already trying to do," says Thomas Møller, EY-Parthenon EMEIA Digital Leader. "From testing, to assembly and dismantling, to new product and service development, virtualization could enable the faster creation of better customer outcomes and experiences, yet with less real-world resource consumption," Møller adds.

Substituting resource-intensive physical goods and real-world experiences with digital and virtual alternatives in the metaverse could drive substantial sustainability benefits. Digital twins of the physical world combining IoT, visualization and real-world data from a variety of sources will enable new levels of optimization – from the planet to the individual human.

Virtual consumption: fewer real resources

Digital products and virtual experiences in the metaverse will likely be significantly less resource-intensive and more carbon-efficient than comparable ones in the real world. As metaverse offerings become increasingly more compelling, consumers might shift the allocation of their limited budgets to more sustainable virtual options, yielding significant positive sustainability impacts.

Embodied in the global denim trade, for example, is 16.0 Mt CO2e and 4.7 billion m3 of water annually. If consumers opted to buy virtual denim for their avatars instead of real denim for their physical bodies, the carbon and water savings could be substantial. Already, 21% of consumers intend to buy fewer physical items in the future because they expect to do more things digitally, according to the EY Future Consumer Index.

If this kind of substitution reduced the physical denim trade by 10% it would reduce CO2 emissions by the equivalent of the annual emissions of nearly 350,000 American internal combustion automobiles, and water consumption by the equivalent of the annual average per capita footprint of over 400,000 Chinese consumers. Taken across the various categories of consumer spending, substitution effects could result in substantial carbon and resource efficiencies.

A lifelike virtualization of the experience of trying on clothes could also yield meaningful sustainability benefits. As online sales have increased globally so have returns. In the US, for example, 21% of online sales were returned in 2021. Customers often over-buy, "bracketing" sizes or colors.10 The returns result in a doubling of the transportation miles, packaging and stocking. Companies sometimes overproduce items in response to these false signals, leading to more waste. ∎

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"As with any form of immersive technology, the metaverse is likely to offer a range of promises the physical world can't."

David Markowitz
Co-author of ''Virtual reality and the psychology of climate change''

Meeting in the metaverse: a new way to travel

Recreational and business travel, both air and ground based, could also be displaced by metaverse experiences to a significant degree. Air travel accounted for 2.5% of global emissions prior to the onset of the pandemic, after which the sector's emissions were cut in half. The business world and consumers learned that videoconferencing, while not great, was good enough for many purposes, from team meetings to virtual happy hours.

Imagine then a convening in the metaverse, whether for work or play, with real personal presence and the ability collaborate, share and recreate in ways which wouldn't be possible in a ''live'' gathering – without the time, expense and complexity of conventional travel.

This is already happening with metaverse-based concerts which would have sparked travel by thousands of people if held in the physical world. While in-person interactions will always be important, metaverse travel could displace many discretionary trips.

Digital twins: optimizing physical with virtual

The convergence of AI, AR/VR, and IoT and satellite-generated data in the metaverse promises to elevate digital twins. Virtual representations of real-world entities and processes, digital twins could help propel sustainability at the planetary level, from supply chains and manufacturing assets, to individuals:

‣ The European Space Agency is working toward a digital twin of the earth which will help visualize and forecast the impacts of human activity on the planet, simulating different scenarios to inform policy decision-makers. The project will start with key planetary subsystems, such as antarctica, oceans, forests and climate.

‣ Manufacturing and supply chain digital twins can drive optimization of material inputs, processes, energy, traceability and logistics. Combining digital twins with agile manufacturing applications, such as generative design and additive manufacturing, is already happening in many industries and can yield significant reductions in scrap and energy use.

‣ Digital patient twin technology integrates a wide range of data sources beyond the traditional medical record – from wearable sensors, to air pollution levels – to forecast the future health of individuals and enable better care and outcomes.

But perhaps the biggest sustainability opportunity – and imperative – for digital twins is in cities, where 70% of global carbon emissions occur. Building operations – heating, cooling, lighting, and the like – alone contribute 28% of global emissions. Global building floor area is expected to double by 2060, the equivalent of adding an entire New York City to world's building stock every month, for 40 years.

A whitepaper by EY teams (pdf) shows that digital twins can:

‣ Reduce a building's carbon emissions by 50%

‣ Improve operational and maintenance efficiency by 35%

‣ Increase human productivity by 20%

‣ Improve space utilization by 15%

"As the nexus of IoT, 3-D visualization, open data, and mobile data, urban digital twins are the only real-world metaverse here today," argues Michael Jansen, CEO of Cityzenith, which offers an urban digital twin platform. "Eliminating emissions in the built environment requires the integration of different types of tools to simulate if-then scenarios. Because urban digital twins are good at dealing with data variety, visualization at scale and multisystem simulation, they're perfect for this kind of challenge," he adds.

In the future, Jansen says we're likely to see urban systems of building digital twins connected to area or city-wide twins, giving city managers deep insights into the metabolism of the city and new opportunities for broad sustainability gains.

CHAPTER 3

Catalyzing climate action with immersive experiences

The biggest barrier to addressing climate change is not technological – it's behavioral. Evolution has conditioned us for success in the ''now'' through hyperbolic discounting, valuing small rewards and costs in the present substantially more than larger ones in the future. For long-term, seemingly gradual problems like climate change, human behavior is a recipe for disaster.

Tackling the psychological barrier to climate change

Our short-term bias is so ingrained we have a hard time perceiving climate change even when it is happening quickly. A study of two billion social media posts found we quickly normalize climate conditions which would be considered historically extreme. People base their idea of normal weather on what has occurred in only the past two to eight years, the study showed.

Fortunately, the immersive experiences which will form a central element of the metaverse have the ability to tap into other parts of our psyche to create new climate consciousness that could spur action. The VR environment provides users with three key dimensions of experience:

‣ **Presence:** users forget they are in a synthetic, mediated experience.

‣ **Immersion:** the technological quality of the medium enables presence.

‣ **Embodiment:** one can believably change perspective or character in the environment.

"As with any form of immersive technology, the metaverse is likely to offer a range of promises the physical world can't," says David Markowitz, Assistant Professor in the School of Journalism and Communication at the University of Oregon, and co-author of "Virtual reality and the psychology of climate change" with Jeremy Bailenson, founding director of Stanford University's Virtual Human Interaction Lab. ∎

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"For example, you could speed up time and offer an experience of what climate science projects the world will look like in 2050 or 2100. You can get people to care much more because their brains treat the experience as real, as opposed to the narratives published by climate activists for many years," says Markowitz.

Immersive experiences yield greater impact

A range of experiments related to VR and climate and other sustainability issues has shown that immersive experiences yield better learning outcomes, more personalized impact and greater emotional engagement with the issue.

In one non-climate related VR experiment, participants embodied a person who was evicted from their home and experienced life and interactions as a homeless person on the streets of San Francisco. Those who had experienced this embodiment were more likely to advocate for the rights of the unhoused.

Similar embodiment experiences – perhaps as a climate migrant or someone impacted by an extreme weather event – could have the potential to drive meaningful climate action. "It's not too far a leap to suggest if you walk in someone else's shoes through embodiment you'll be more empathic to that person, but also to that group of people" says Markowitz.

Gamification, another core element of the developing metaverse, could also work together with immersive experiences to drive sustainable behaviors, according to Markowitz. In an analog, non-immersive experiment several years ago, the participants who played a pro-environmental game were more likely to take energy conversation actions afterwards. "If that's the baseline, imagine where we could possibly get with immersive experiences and gamification,

and the more consequential decisions people might make," says Markowitz.

The availability of these kinds of immersive experiences might also drive climate action among corporates, suggests Markowitz. Brands might come to prove their environmental bona fides by allowing consumers to immersively experience a product's sustainability journey and attributes.

The impact on consumers of an immersive experience demonstrating climate action would likely be far greater than published narratives, and companies without a substantive sustainability experience to share would be at a disadvantage. "It could reveal who the real actors are versus the ones who might just be going through the motions," says Markowitz.

CHAPTER 4

Don't forget the 'S' in metaverse ESG

This is a defining moment for the metaverse. Important actors are making commitments and investments. Systems are forming. Many new opportunities are opening, but some are closing.

In this moment, we must not focus only on how to build environmental sustainability into the metaverse. We must also ask how we can seize this opportunity to ensure that the new virtual worlds coalescing in the metaverse don't simply import the unsustainable social dimensions of the current world.

"There's opportunity to design the metaverse from the start for social inclusion and equity amongst many stakeholders, rather than letting it become the domain of the rich and those with access," says Steve Varley, EY Global Vice Chair – Sustainability. "We need to address

issues of accessibility, diversity, inclusion, and equity in the metaverse before they become ingrained," he warns.

How can we make the metaverse better than what we have now? There are no easy answers, and no one actor holds the solution. It will require intention, and broad and diverse collaborations between businesses, regulators, investors, academia, and civil society organizations.

For example, as companies create virtual worlds it will be important for them to collaborate with academia to understand how the systems in these worlds actually work, and their impacts on users.

> "We need to address issues of accessibility, diversity, inclusion, and equity in the metaverse before they become ingrained."
>
> **Steve Varley**
> EY Global Vice Chair – Sustainability

Another important needed collaboration is between technology companies and the diverse array of potential users to understand what they really need and want from the technology, so that it can be made accessible, affordable, and a means for equitable access to the metaverse.

Education is a domain where these strands of technology and stakeholder collaboration could come together to create inclusion and equity. "While the metaverse risks widening income gaps, it could become a means for closing them by making education easily accessible to people all over the world. Imagine the possibilities a metaverse university offering the power of immersive experiences and virtual collaboration to young people, no matter their income or location," says Varley.

Business must lead in shaping a sustainable metaverse

Ultimately, we shouldn't resign ourselves to simply observing the metaverse take shape. There are multiple possible futures for the metaverse, and we have both the agency and solutions to create a future designed for environmental sustainability

in the physical world and human flourishing in the virtual ones.

The metaverse opens new dimensions of sustainability, and now is the time for business to lead in this critical moment, leveraging its innovation, convening power and investment. It begins with working together with stakeholders to develop a vision of the metaverse we want and need, and designing a future-back strategy for achieving it.

Summary

The metaverse opens new dimensions of sustainability, both challenges and opportunities. Compute-intense transactions raise concerns about energy consumption and carbon emissions. Yet, the metaverse also promises carbon reductions by substituting physical goods and experiences with virtual ones, optimizing with digital twins, and overcoming behavioral barriers to climate action with immersive experiences. Social sustainability is equally important, and we must ensure the metaverse is accessible, inclusive, and equitable for all. To succeed, business must lead. ∎

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> If the biggest barrier to addressing climate change is behavioral, immersive experiences can amplify emotional engagement with the issue and subsequently drive meaningful action.