

Designing ICT in the abundant present for a future of scarcity

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SICT 2022: Rethinking the Roles of Information and
Communication Technologies in the Anthropocene: Towards a
Post-Growth World?

Collaborators

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Neil Young

Sarah Lovell

Eli Blevis

Yue Pan

Marcel Pufal

Benoit Aubert

Kurt Squire

Barath Raghavan

Andre van der Hoek

Dan Stokols

Birgit Penzenstadler

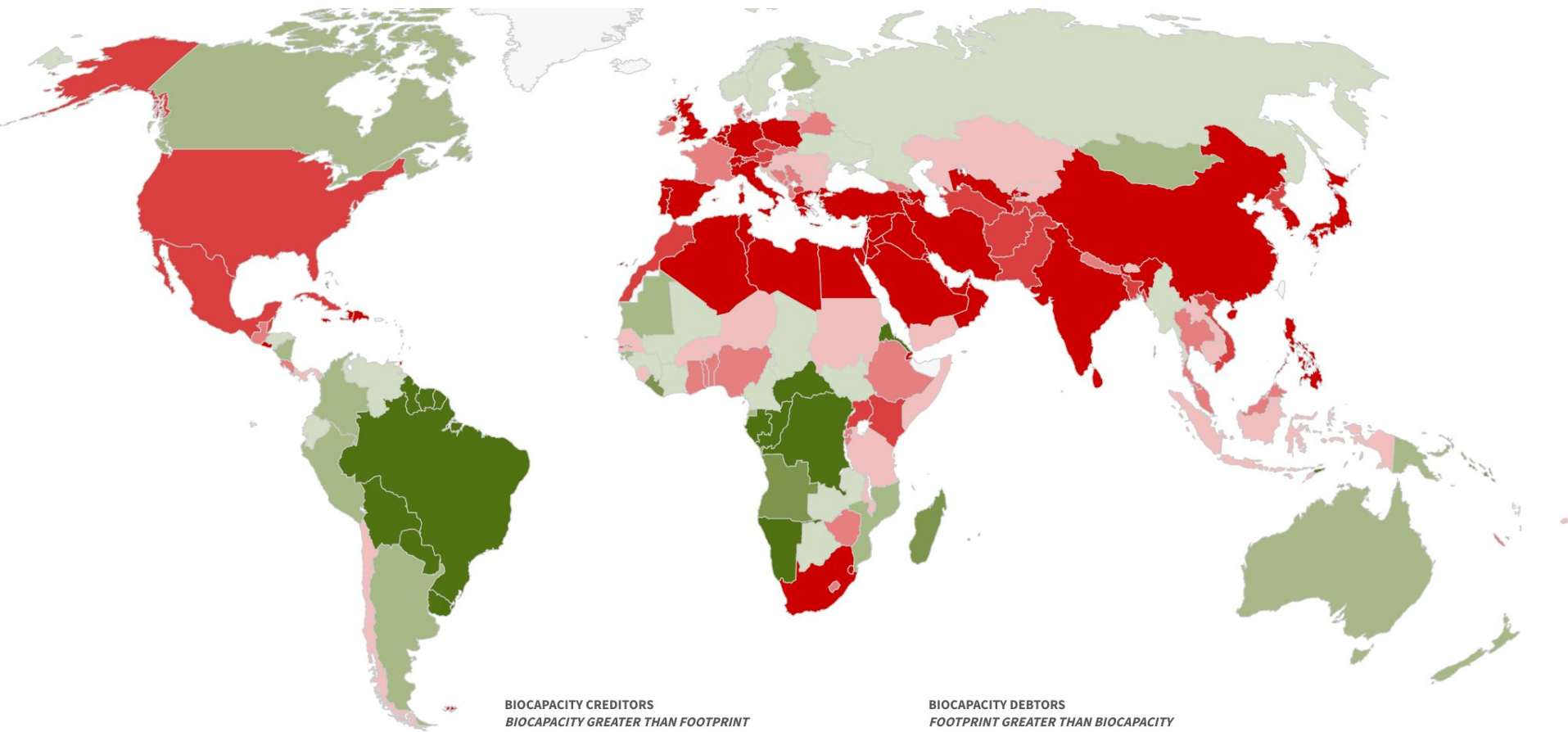
Hayden Freedman

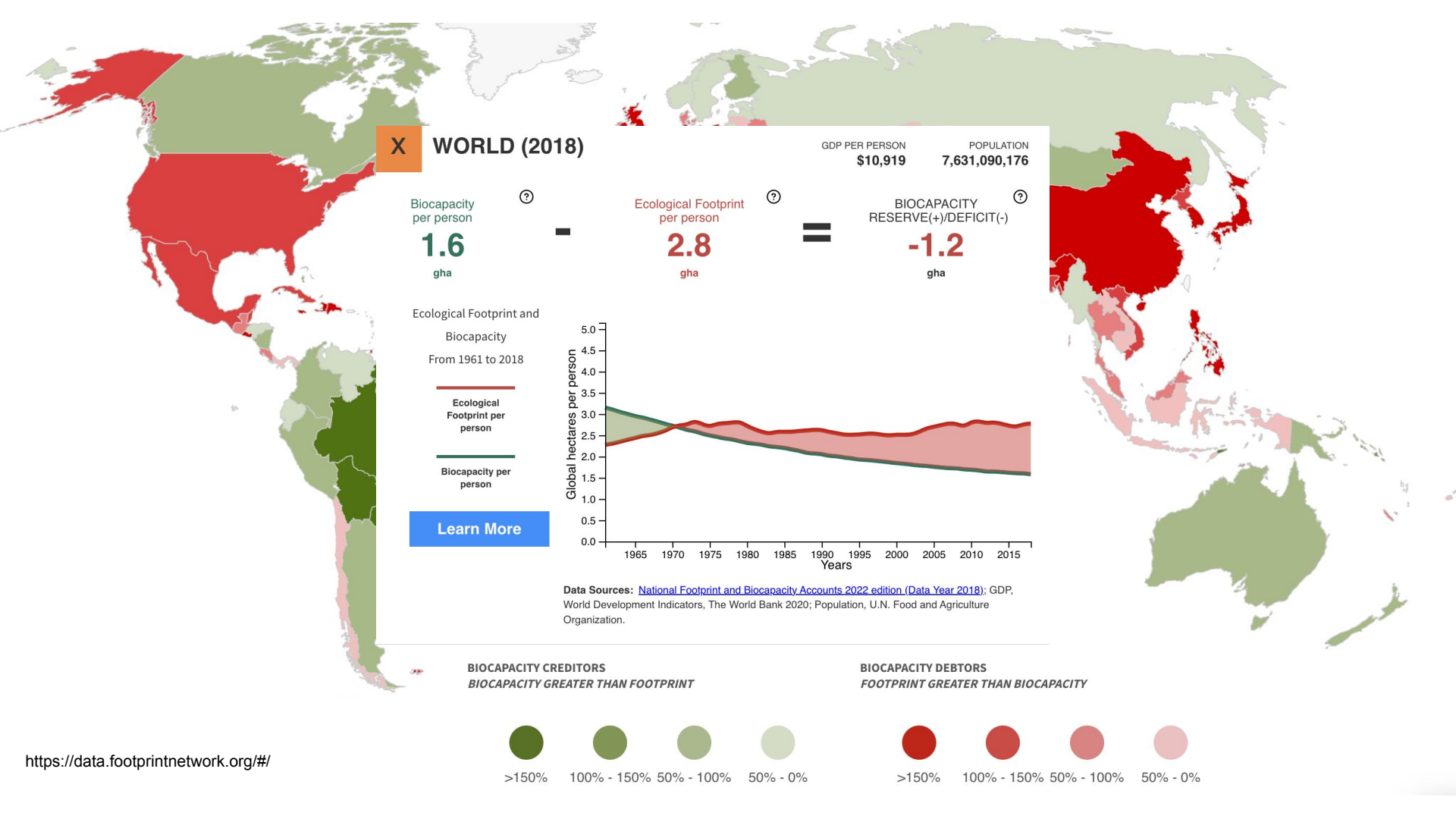
Rebecca Black

and many others

...for a future of scarcity

Biocapacity - Ecological footprint

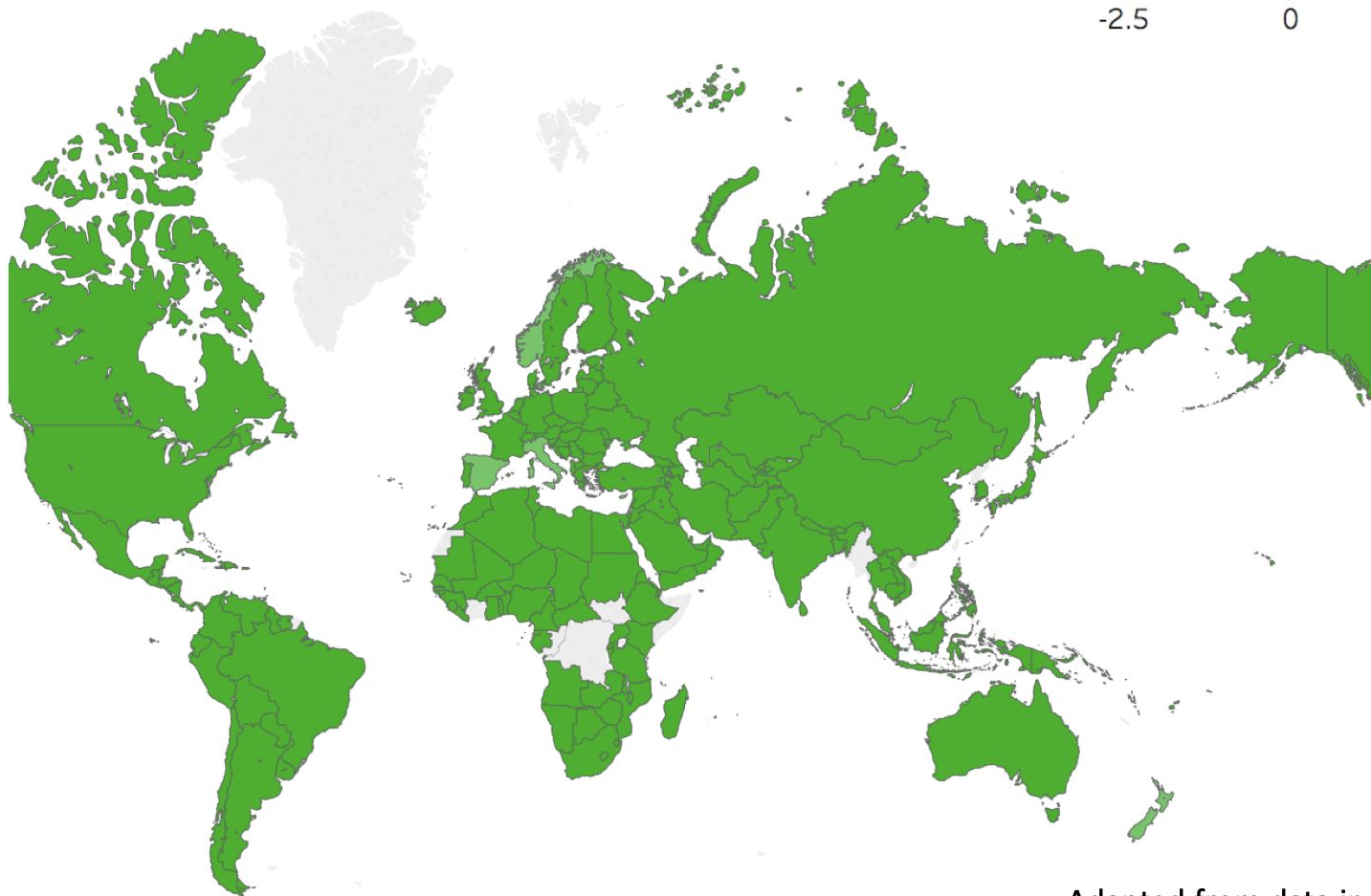
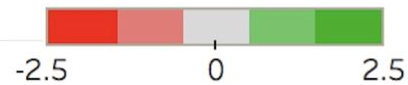




GDP in 2099

2020

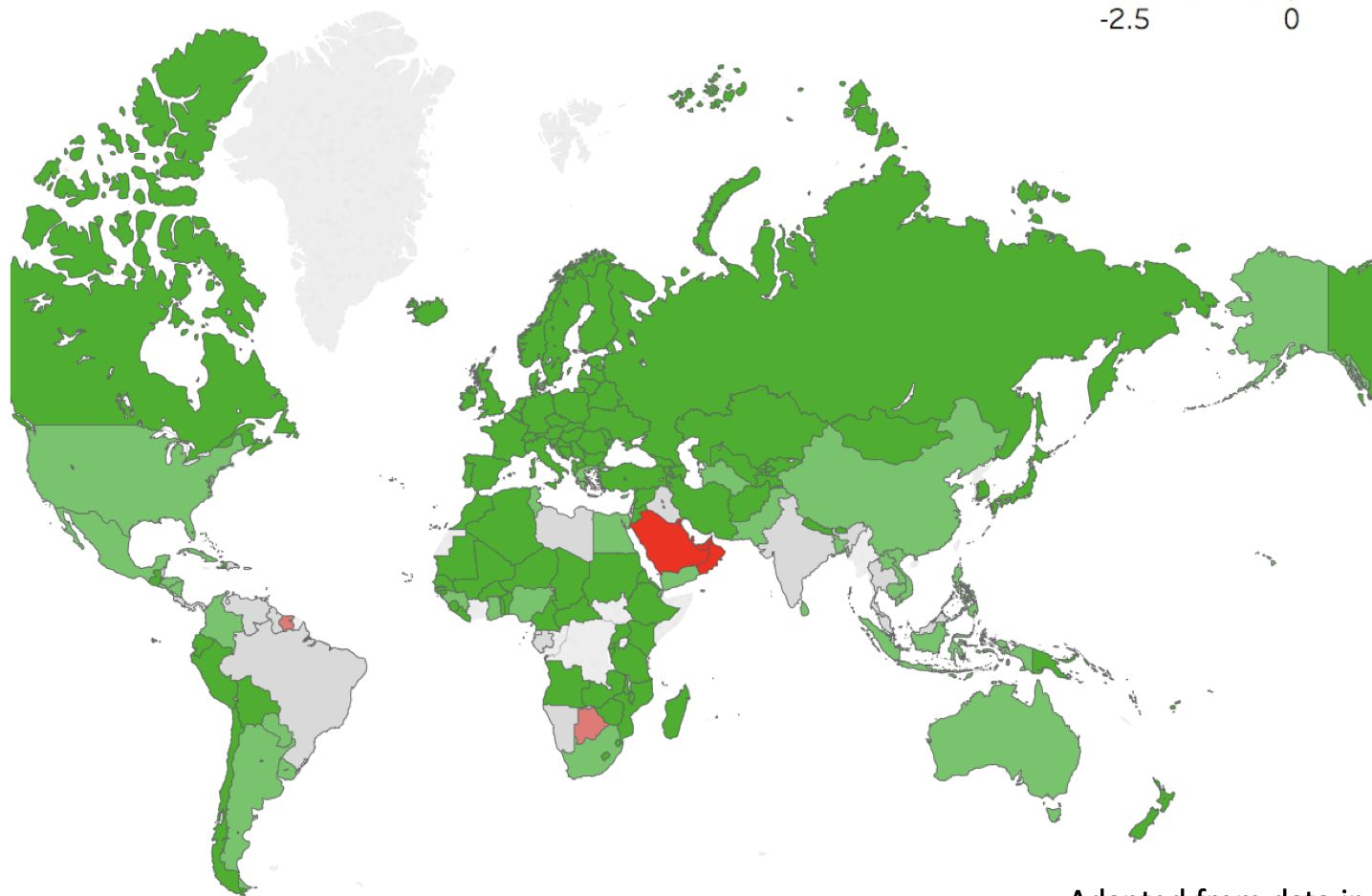
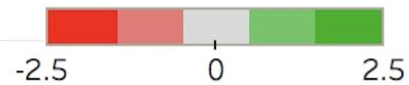
GDP Growth (annual %)



Adapted from data in Burke et al. 2015

2060

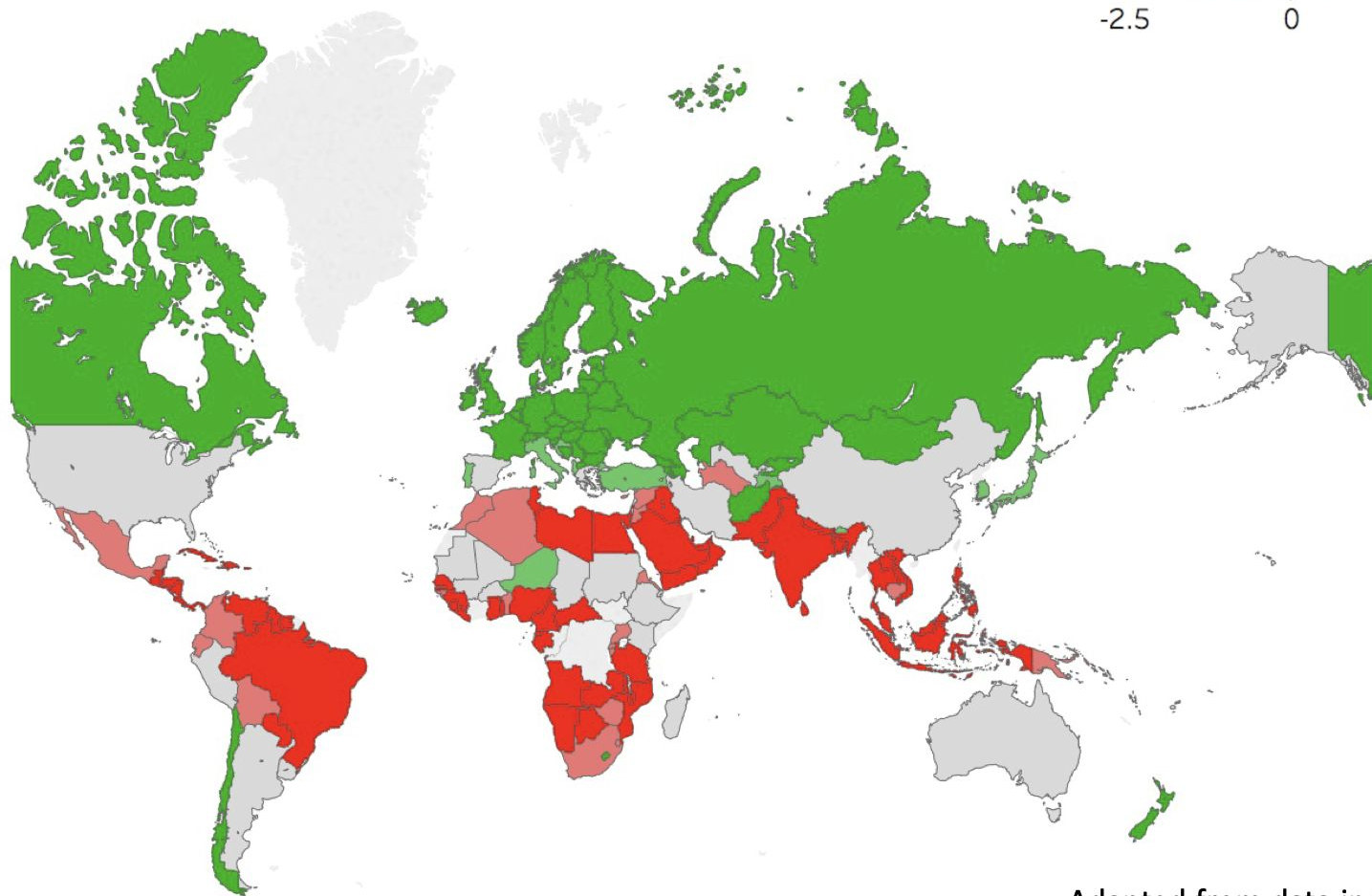
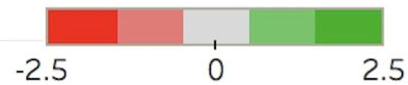
GDP Growth (annual %)



Adapted from data in Burke et al. 2015

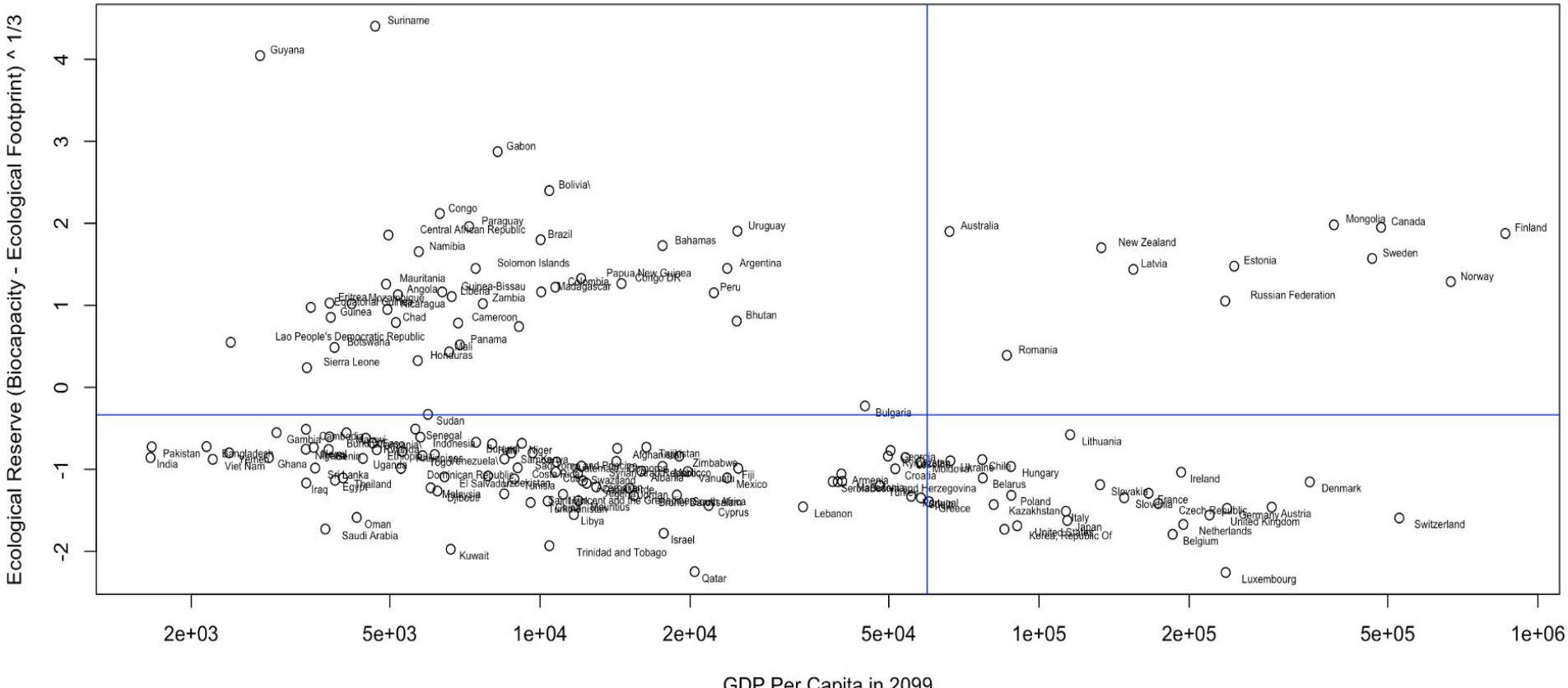
2099

GDP Growth (annual %)



Adapted from data in Burke et al. 2015

Ecological reserve vs. GDP per capita



Hundreds of millions of people displaced by 2050

World Bank: 216 million by 2050

<https://www.worldbank.org/en/news/press-release/2021/09/13/climate-change-could-force-216-million-people-to-migrate-within-their-own-countries-by-2050>

IEP: 1.2 billion by 2050

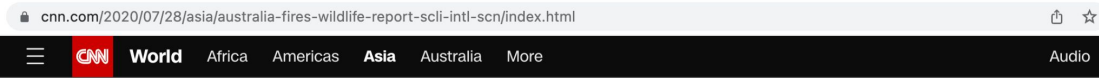
<https://www.economicsandpeace.org/wp-content/uploads/2020/09/Ecological-Threat-Register-Press-Release-27.08-FINAL.pdf>

UN International Organization for Migration: 1.5 billion in next 30 years.

<https://www.theguardian.com/news/2022/aug/18/century-climate-crisis-migration-why-we-need-plan-great-upheaval>

A lot of uncertainty

And that's just the human impact...



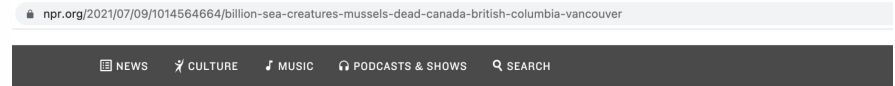
Nearly three billion animals killed or displaced by Australia's fires

By Jack Guy, CNN

Updated 8:32 AM ET, Tue July 28, 2020



An animal rescuer carries a kangaroo burned in a bushfire.



ENVIRONMENT

Heat Wave Killed An Estimated 1 Billion Sea Creatures, And Scientists Fear Even Worse

July 9, 2021 · 4:40 PM ET

DEEPA SHIVARAM



Prof. Tom Murphy: The energy trap

We need to spend energy to fix these problems. New infrastructures, invest in R&D, etc. However, as the problems grow more severe, human civilizations will be less and less able to sacrifice in the short term to address long-term problems.

Tom Murphy: “The construction of that shiny new infrastructure requires not just money, but...energy. And that’s the very commodity in short supply. Will we really be willing to sacrifice additional energy in the short term—effectively steepening the decline—for a long-term energy plan? It’s a trap!”

<https://dothemath.ucsd.edu/2011/10/the-energy-trap/>

What to do?

This is the slide where I wish I had a nice clickbait-like “do this one thing and it’ll all be better” answer.

But I don’t.

So that’s why I have a significant concern that we will be entering a future of scarcity.

...in the abundant present...

Energy Use

20 million barrels of petroleum per day in US

<https://www.eia.gov/tools/faqs/faq.php?id=33&t=6>

330 million people in US

0.06 barrels/person/day

Barrel of petroleum has the equivalent of 10,000 hours of human manual labor in it. <http://theoildrum.com/node/4315>

600 hours of manual labor embodied in the oil each US resident uses each day.

US civilization's energy use, from oil alone, is like having 25 human-strength robots doing labor 24-hours-a-day on each person's behalf.

AI Image generation

Midjourney: variant of “climate change”



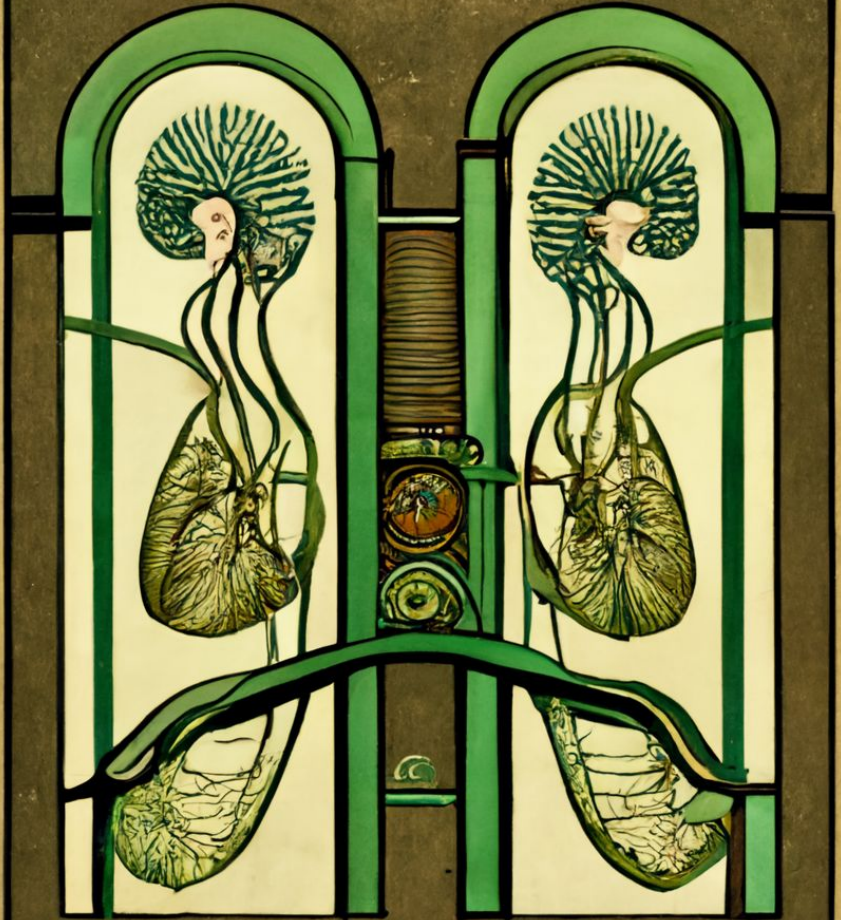
AI Image generation

Midjourney: variant of “detailed ecological life support system”



AI Image generation

Midjourney: variant of “closed ecological life support system in art nouveau style”



AI Image generation

Midjourney: variant of “minimalist Zaha hadid design of a sacred place of the future with plants and city lights and curves” (Inspired by the work of Sara Faraon)



AI Image generation

Midjourney: variant of “Rethinking the Roles of Information and Communication Technologies in the Anthropocene: Towards a Post-Growth World, photorealistic”



AI Image Generation: Environmental Costs

Midjourney CEO: “there has never been a service before where a regular person is using this much compute.”

https://www.theregister.com/2022/08/01/david_holz_midjourney/

I’m simultaneously fascinated by the potential of these systems, and ashamed to be fascinated by them because of the harm implicit in them (even though they apparently use “green energy compute providers”).

$I=P*A*T$ (Commoner et al. 1970)

If I were seeking to destroy the global ecosystem as efficiently as possible (which I'm not), I would maximize affluence...

...create a media ecosystem where every element of my experience---visuals, audio, filtering---would be tailored by enormous banks of AI-based computation.

But similar technologies could also form the basis for adaptive educational systems, optimized production pipelines, etc.

Simultaneously desirable and terrifying.

Designing ICT...

Greening Through IT (2010)

Environmental issues occur on larger scales of time and space than humans evolved to handle.

IT is the set of tools we use to bridge those gaps in scale.

Therefore, IT is well positioned to address environmental issues.

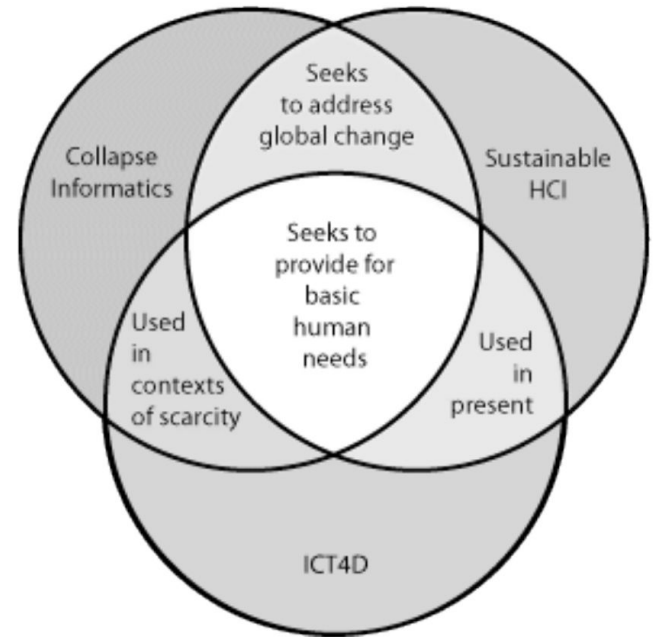


But what should the IT do?

Past Projects

Past Projects: Collapse Informatics

“the study, design, and development of sociotechnical systems in the abundant present for use in a future of scarcity.”



B. Tomlinson, M. S. Silberman, D. Patterson, Y. Pan, E. Blevis. 2012. “Collapse Informatics: Augmenting the Sustainability & ICT4D Discourse in HCI.” in ACM Conference on Human Factors in Computing Systems (CHI 2012).

B. Tomlinson, E. Blevis, B. Nardi, D. Patterson, M. S. Silberman, Y. Pan. 2013. “Collapse Informatics and Practice: Theory, Method, and Design.” In: ACM Transactions on Computer-Human Interaction (TOCHI).

Past Projects: Computing within Limits

Integrating the collapse informatics perspective with others from KTH, USC, and elsewhere.

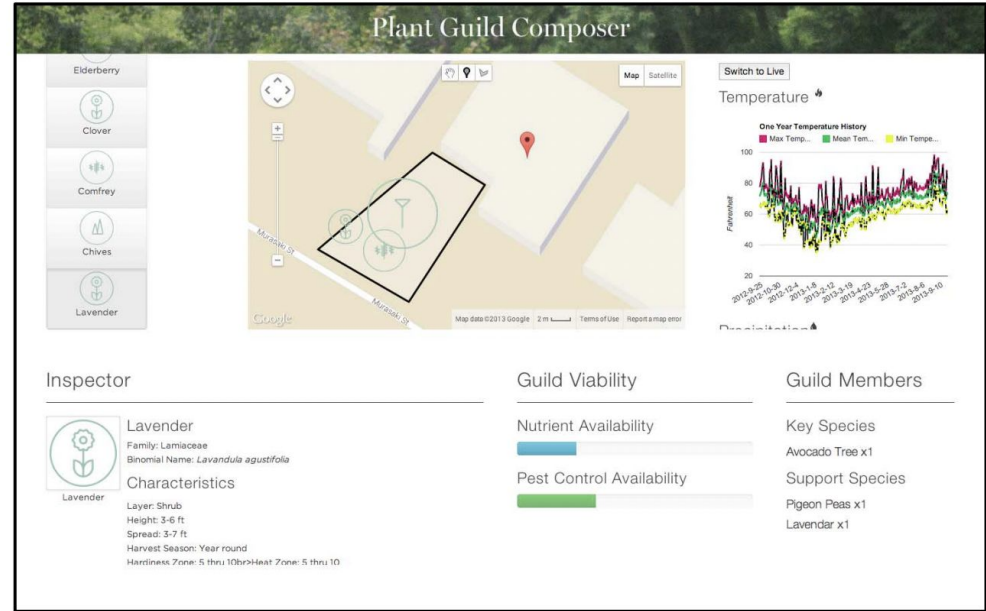
Summarized the perspective developed over several years of the ACM LIMITS workshop.

B. Nardi, B. Tomlinson, D. Patterson, J. Chen, D. Pargman, B. Raghavan and B. Penzenstadler. 2018. “Computing within Limits.” Communications of the ACM, October 2018, Vol. 61 No. 10, Pages 86-93.

(I believe you just heard about this topic in greater detail from Daniel Pargman.)

Past Projects: Computational Agroecology/Plant Guilds

Use technology
to develop capacity
for local food production



B. Raghavan, B. Nardi, S. Lovell, J. Norton, B. Tomlinson, D. Patterson. 2016. "Computational Agroecology: Sustainable Food Ecosystem Design." ACM Conference on Human Factors in Computing Systems (CHI 2016) Extended Abstracts (alt.chi).

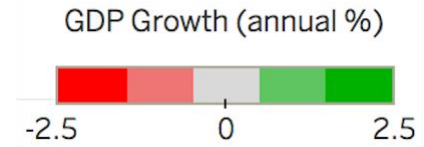
J. Norton, S. Nayebaziz, S. Burke, B. J. Pan, B. Tomlinson. 2014. "Plant Guild Composer: An Interactive Online System to Support Back Yard Food Production." ACM Conference on Human Factors in Computing Systems (CHI 2014) Extended Abstracts (Interactivity).

Past Projects: Self-Obviating Systems

“A system in which the successful operation of the system in the short term renders it superfluous in the long term“

B. Tomlinson, J. Norton, E. P. S. Baumer, M. Pufal, B. Raghavan. 2015. “Self-Obviating Systems and their Application to Sustainability.” iConference. Newport Beach, CA.

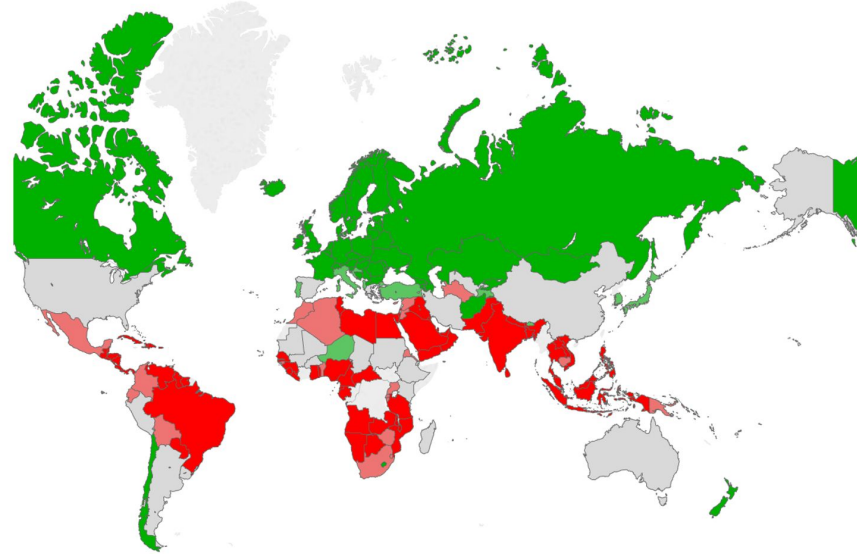
Past Projects: Information Systems in a Future of Decreased and Redistributed Global Growth



2020



2099



Results: ICT Goods Exports

2014

1. China (\$580B)
2. US (\$150B)
3. South Korea (\$120B)
4. Germany (\$67B)
5. Mexico (\$63B)
6. Netherlands (\$62B)
7. Malaysia (\$60B)
8. Japan (\$59B)
9. Thailand (\$36B)
10. Vietnam (\$36B)

2099

1. China (\$4.4T)
2. South Korea (\$730B)
3. Germany (\$500B)
4. Netherlands (\$350B)
5. US (\$340B)
6. Czech Republic (\$280B)
7. Japan (\$200B)
8. Mexico (\$190B)
9. Poland (\$180B)
10. Slovakia (\$180B)

Results: ICT Service Exports

2014

1. US (\$160B)
2. UK (\$130B)
3. Germany (\$110B)
4. France (\$110B)
5. India (\$100B)
6. Ireland (\$90B)
7. China (\$89B)
8. Belgium (\$57B)
9. Netherlands (\$54B)
10. Japan (\$41B)

2099

1. Russian Federation (\$900B)
2. UK (\$890B)
3. Germany (\$860B)
4. China (\$670B)
5. France (\$590B)
6. Canada (\$570B)
7. Ireland (\$530B)
8. Sweden (\$460B)
9. US (\$380B)
10. Finland (\$360B)

Current Projects

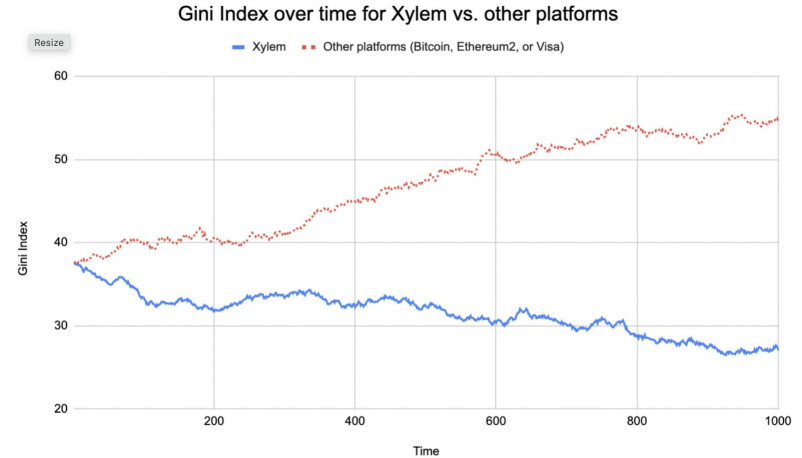
Current Projects: Xylem - Sustainable and Equitable Currency Platform

Proof of Work is an environmental disaster.

Proof of Stake worsens wealth inequality.

We are designing an alternative that has lower environmental impact per transaction than Bitcoin, Ethereum, Ethereum2, or Visa, and that would provide a mechanism for distributing potentially billions of dollars in transaction fees to 90% of the world's population.

(Patterson and Tomlinson, in preparation)



Current Projects: Knowledge Graphs for Sustainability

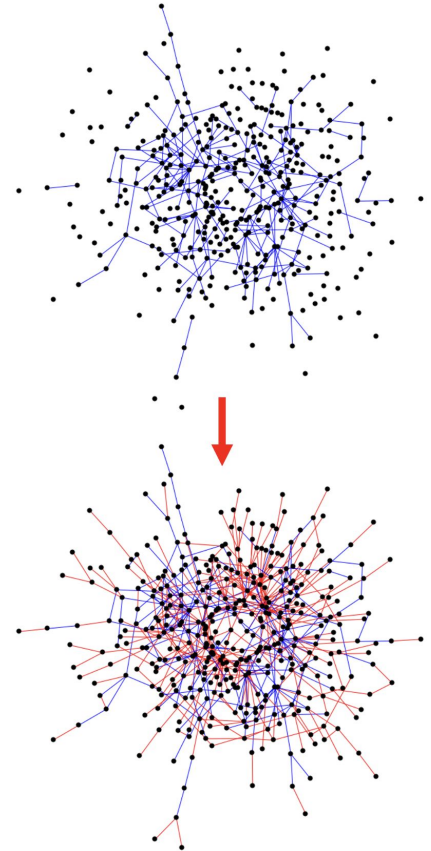
Knowledge graphs could form underpinnings for future intelligent systems.

Sustainability topics are poorly represented in Wikidata (the largest open knowledge graph).

We are developing technologies and sociotechnical systems to improve representation of sustainability in Wikidata and other knowledge graphs.

We are using those improved knowledge graphs as the basis for new approaches to sustainability education.

(Freedman, van der Hoek, and Tomlinson, 2022)



Half-Baked Scheme: Knowledge graphs + AI content for education



Summary & Conclusion

Summary & Conclusion

The world is likely to be heading toward scarcity, for many people and non-human species.

We currently have access to free time and free resources with unparalleled power.

ICT has enormous costs, but it also has the potential to transform how we live in the world.

We need dramatic civilization-scale changes in the coming years.

You are socially positioned to lead these changes.

An Exhortation

Pursue your work boldly. Present new world visions. Work together. Look out for those who can't look out for themselves (in particular, non-humans). Find joy in your work (you'll do it better).

The right idea, presented in the right way, could reach a billion people by tomorrow and restructure the world.

The Hiroshi Ishii story: Look for impact 200 years in the future.

Thank you!

My collaborators (especially Daniel Pargman for his feedback on the slides)

Lennart Oldenburg and the rest of the organizers

NSF IIS-0644415, CCF-1442749, EHR-2121572

And all of you for your attention!



Please ask questions!