ACT: Architectural Carbon Modeling Tools

@ MICRO 2022
Tutorial

Meta

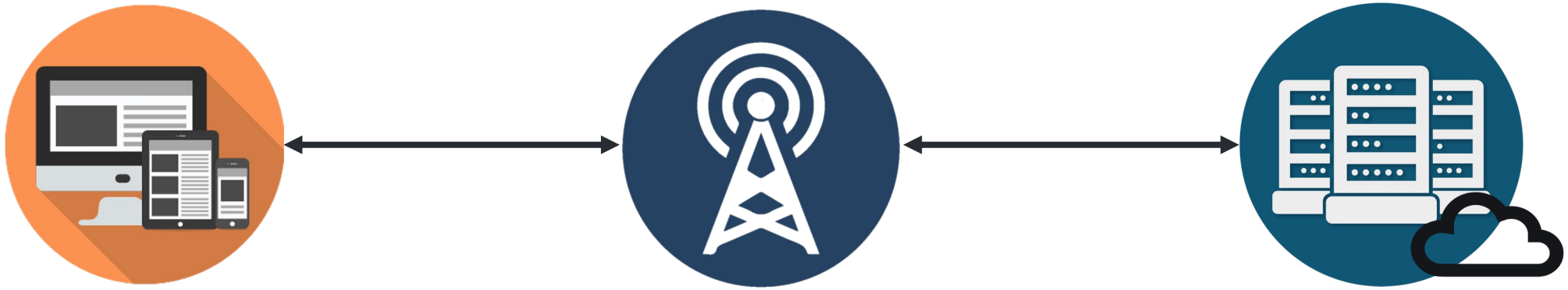
CORNELL TECH

Udit Gupta

Computing incurs a growing environmental footprint

1.2-2.2 Billion tons of CO_2

- **On par with** the aviation industry's footprint
- **2.1 - 3.9%** of worldwide emissions (Freitag'21)



Mobile Communication Data center

Computing's emissions are rising given its growing demand!

Big Tech. companies are pledging carbon neutrality

Google The Keyword Latest stories Product updates Company news

A MESSAGE FROM OUR CEO

Our third decade of climate action: Realizing a carbon-free future

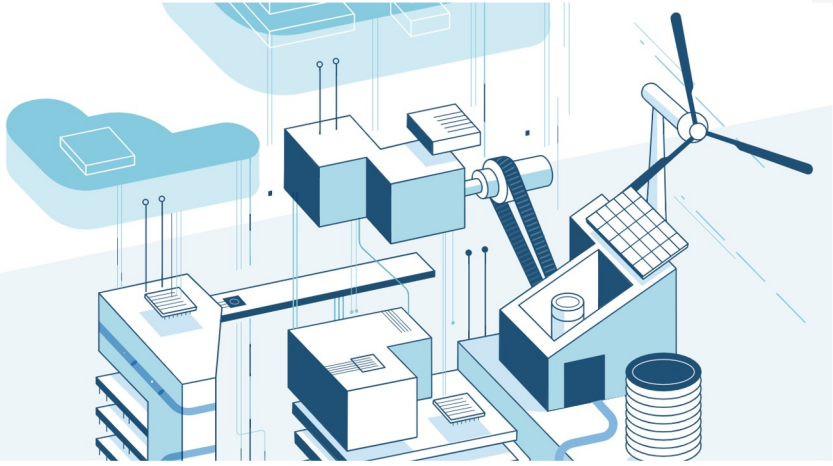
Microsoft | Official Microsoft Blog Microsoft On the Issues The AI Blog Transform

Microsoft will be carbon negative by 2030

Jan 16, 2020 | Brad Smith - President

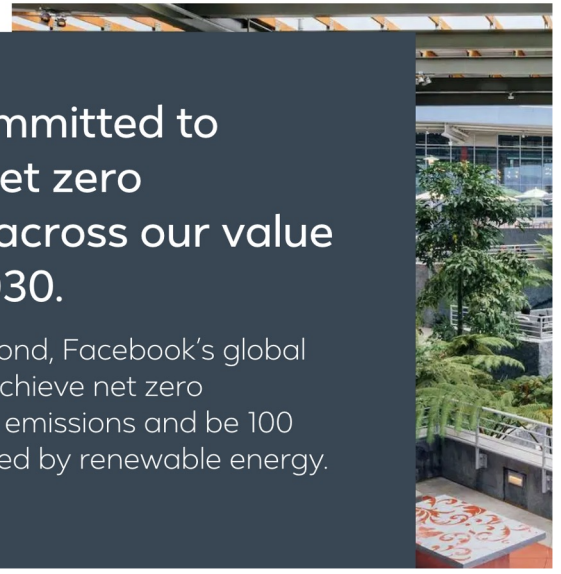
Sustainability in the Cloud

Amazon Web Services (AWS) is committed to running our business in the most environmentally friendly way possible and achieving 100% renewable energy usage for our global infrastructure.



FACEBOOK Sustainability

Innovation for our world Collaboration for good



We are committed to reaching net zero emissions across our value chain in 2030.

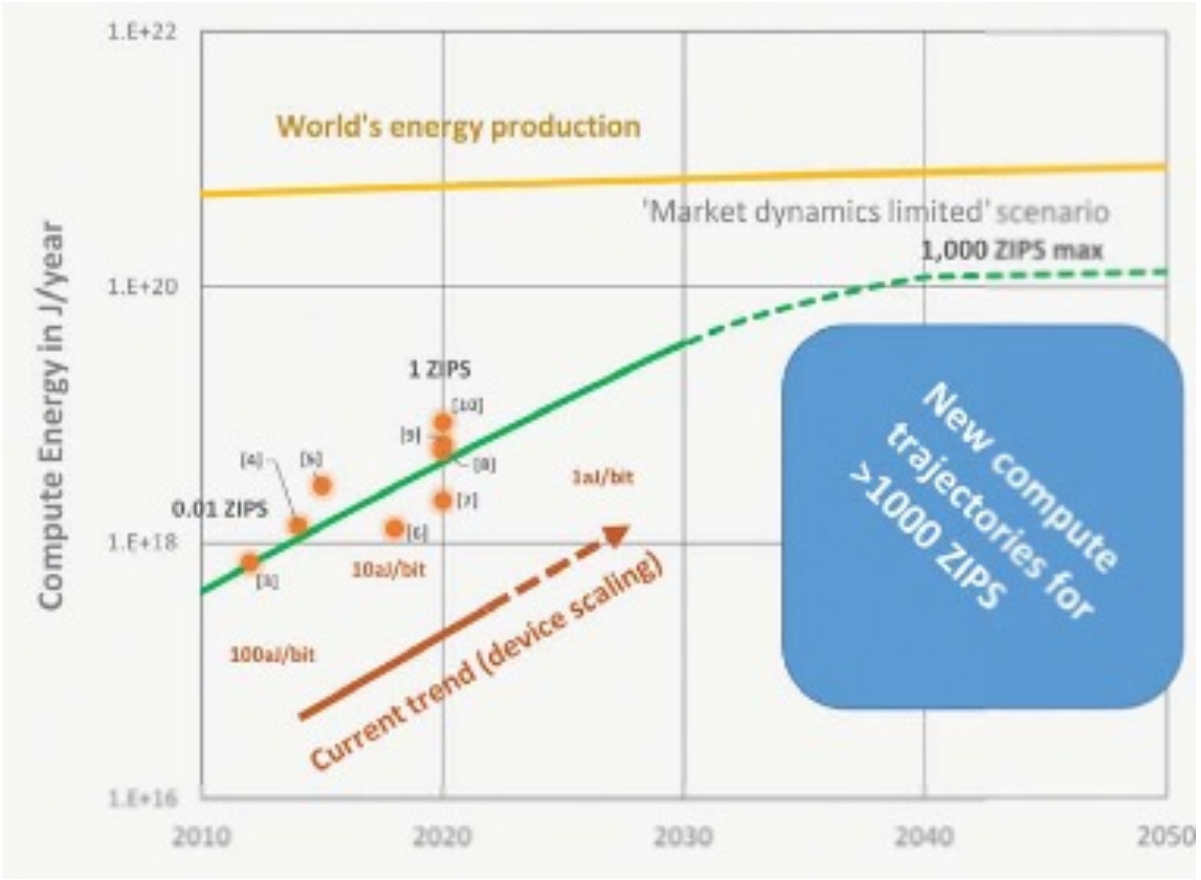
In 2020 and beyond, Facebook's global operations will achieve net zero greenhouse gas emissions and be 100 percent supported by renewable energy.

PRESS RELEASE
July 21, 2020

Apple commits to be 100 percent carbon neutral for its supply chain and products by 2030

SRC decadal plan calls attention to ICT rising energy footprint

Ever-rising energy demand for computing vs. global energy production is creating new risk, and new computing paradigms offer opportunities to dramatically improve energy efficiency.



NSF Dear Colleague Letter on Sustainable Computing

https://www.nsf.gov/pubs/2022/nsf22060/nsf22060.jsp

ACT Tutorial Motivation and Goals

Provide the necessary background and tools to enable researchers to incorporate sustainable as a first order design target

- Provide a brief *overview* of the *sustainability implications* of modern systems,
- Detail the ACT *methodology*,
- Demonstrate *how to use* ACT,
- Demonstrate *how to extend* ACT

The journey is only beginning!

- Cross-stack carbon accounting and reporting
  - How do we enable cloud providers to track carbon?
  - How do we track environmental footprint on mobile app and edge devices?
  - Unify top-down (systems and platforms) and bottom-up (devices and architecture) modeling methodologies

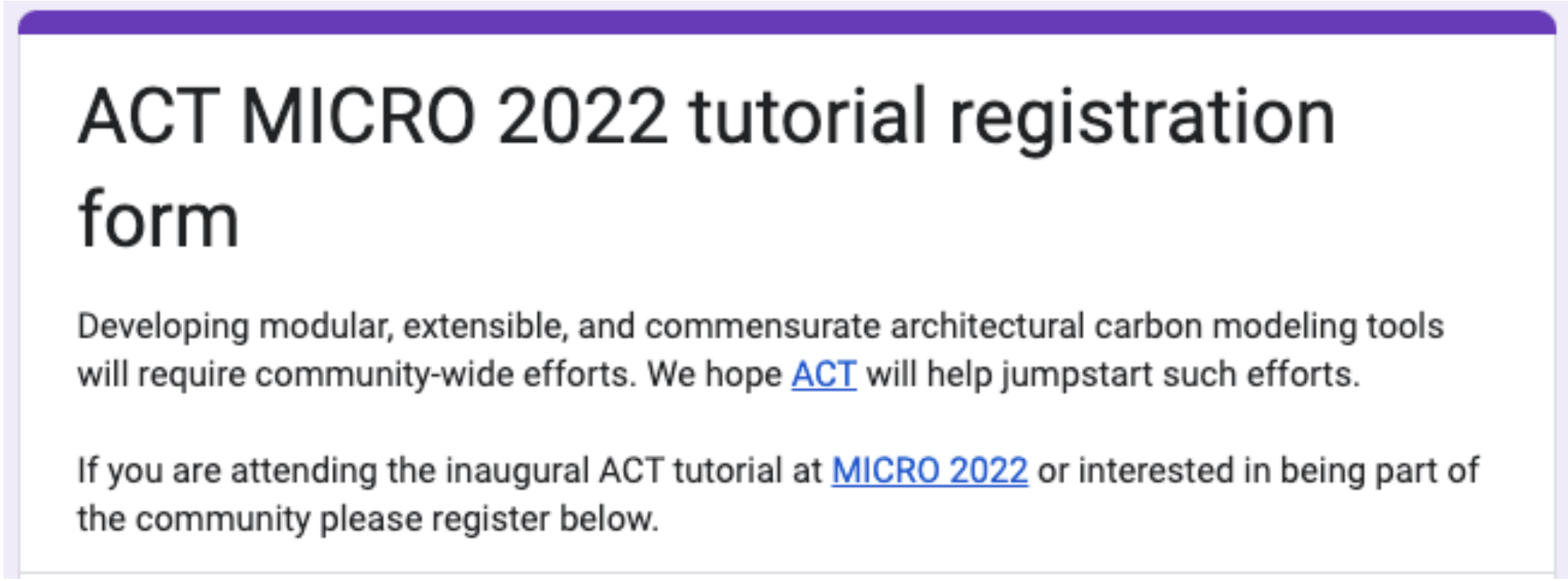
- Emerging technologies
  - What is the impact of emerging device technologies (e.g., eNVM's, optical computing)?
  - What is the impact of chiplet-based technologies?

The journey is only beginning!

- Extend ACT to include non-IC components for end-to-end system carbon accounting (e.g., batteries, PCB's, passive components)
- Apply ACT to find exciting new tradeoffs (applications and algorithms, run-time scheduling and mapping, systems and architecture, circuits and devices) between performance, power, and carbon!
- Validate ACT across a breadth of product-environmental reports and LCA methodologies (cost-based EIO, database-based LCA's)
- And so much more!

Sing up on our Google form!

https://forms.gle/hEAju2suaeEnisRQA



ACT MICRO 2022 tutorial registration form

Developing modular, extensible, and commensurate architectural carbon modeling tools will require community-wide efforts. We hope ACT will help jumpstart such efforts.

If you are attending the inaugural ACT tutorial at MICRO 2022 or interested in being part of the community please register below.

Our other organizers

Gu-Yeon Wei (Harvard) is a Professor of Electrical Engineering at Harvard University. His research interests span a variety of topics such as integrated voltage regulators, flexible voltage stacking, power electronics, low-power computing architectures and circuits, auto-parallelizing compilers, and more.

David Brooks (Harvard) is a Professor of Computer Science at Harvard University. His research focuses on the interaction between the architecture and software of computer systems and underlying hardware implementation challenges, including power, reliability, and variability issues across embedded and high-performance computing systems.

Carole-Jean Wu (FAIR) is a Research Scientist at Meta AI. Her research focus lies in the domain of computer system architecture with particular emphasis on energy- and memory-efficient systems. Her research has pivoted into designing systems for machine learning execution at-scale. In general, she is interested in tackling system challenges to enable efficient, responsible AI execution.

Thank you for attending

Reach out if you want to collaborate on the intersection of computing and sustainability!

Joining Cornell Tech (NYC) as
Assistant Professor in ECE
summer 2023

Visiting researcher at Meta AI

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