

ACT: Architectural Carbon Modeling Tools

*@ MICRO 2024
Tutorial*



**CORNELL
TECH**

Leo Han
Udit Gupta

Computing incurs a growing environmental footprint

1.2-2.2 Billion tons of CO₂

- **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



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

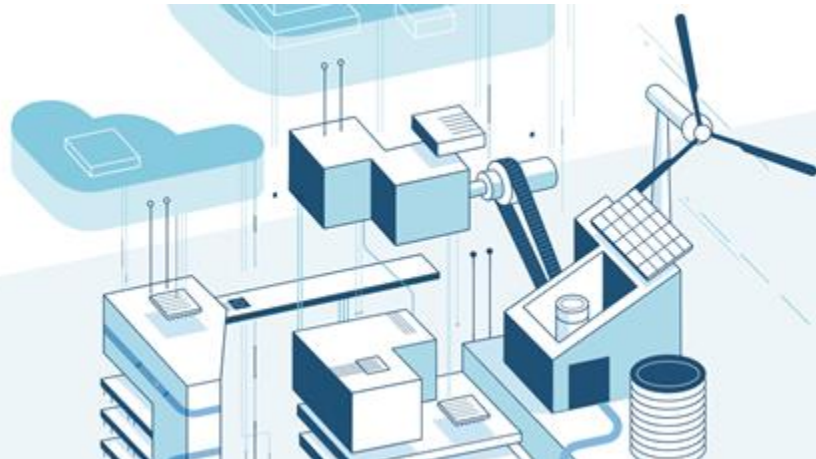
Transform

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.

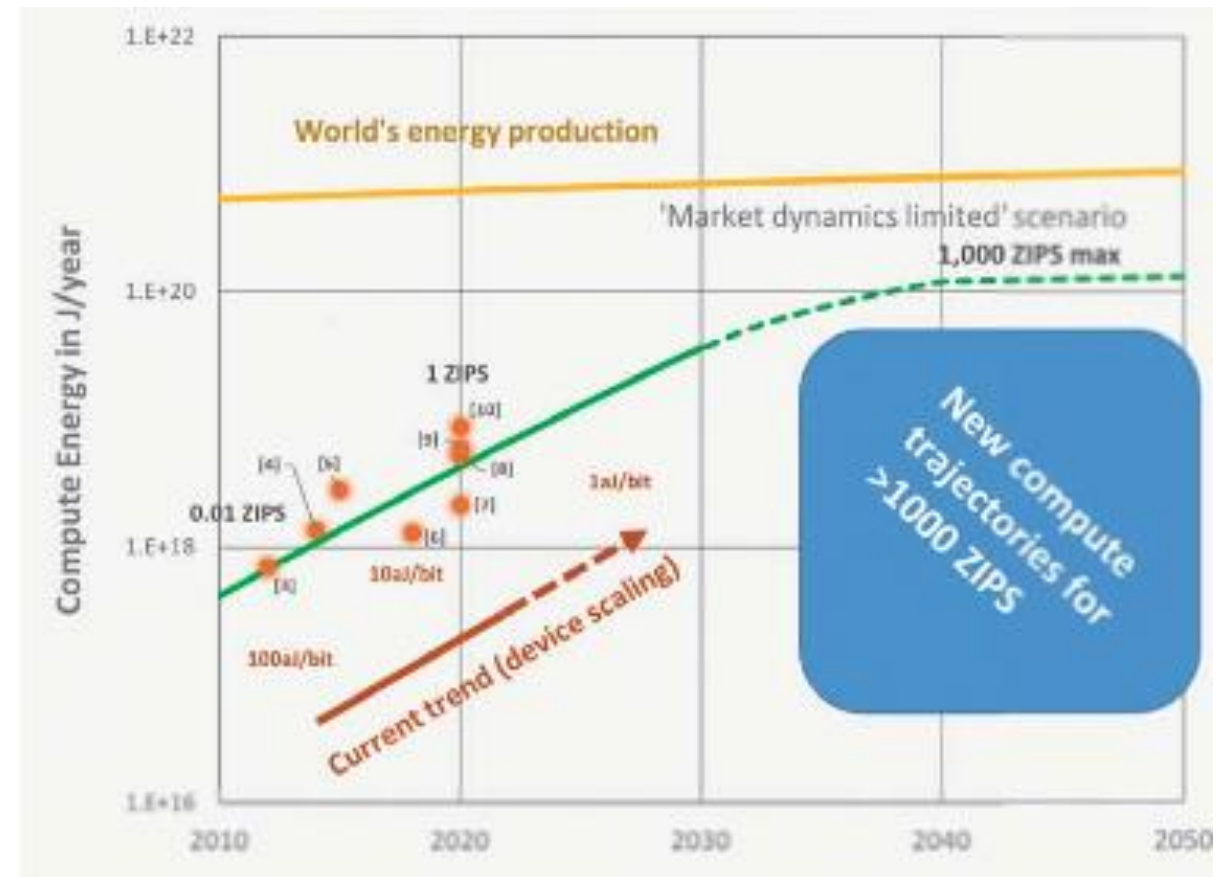
PRESS RELEASE

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



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NSF 22-060

Dear Colleague Letter: Design for Sustainability in Computing

March 15, 2022

Dear Colleagues:

Environmental impacts of computing technologies extend well beyond their energy consumption and require a holistic focus on broader sustainability. Negative impacts of greenhouse gas emissions, depletion of rare earth elements, and e-waste are exacerbated by the proliferation of computing throughout society and treatment of computing systems as disposable commodities with planned obsolescence. Furthermore, environmental concerns range from the better-known carbon footprint from energy consumption (e.g., cloud) to equally important concerns of embodied carbon^[1], generation of methane, carcinogens, volatile organic compounds, and eutrophication, among others. Widespread use of compute intensive techniques (e.g., blockchain and artificial intelligence), handling and moving massive amounts of data, the rollout of next generation wireless/edge networks, and growth of smart devices amplifies the environmental concerns of this proliferation of computing. A new sustainable way of thinking about computing, across the full lifecycle -- including manufacturing, operation, and disposal -- is necessary to meet the needs of the present without compromising the wellbeing of future generations.

<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

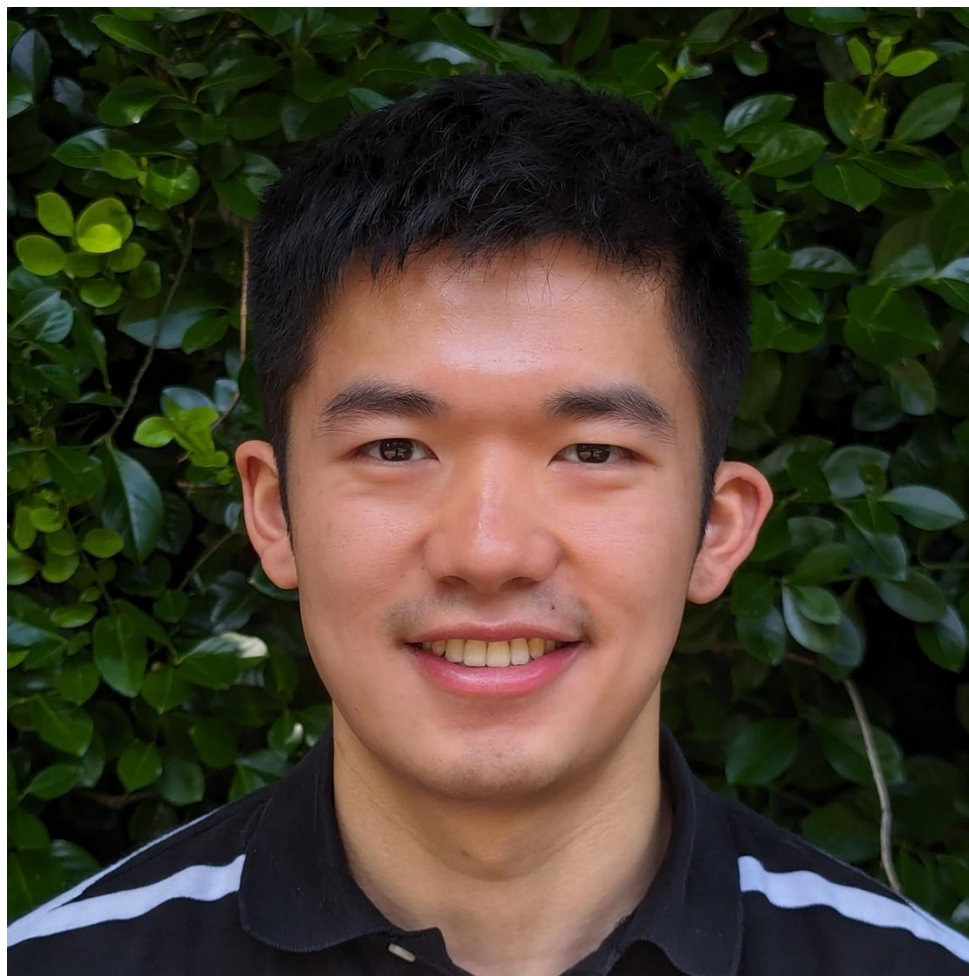
The journey is only beginning!

Topic	Speaker
Designing Cloud Servers for Lower Carbon	Jaylen Wang (Carnegie Melon University)
Extending ACT to evaluate H1 and FPGA for Sustainable Computing	Chetan Choppal (Arizona State University)
Carbon-Efficient Optimization for Computing Systems	Mariam Elgamal (Harvard University)
Silicon-Photonics for Sustainable AI	Farbin Fayza (Boston University)
Energy-/Carbon- Aware Evaluation of 3D IC Architectures with DCIM	Hyung Joon Byun (Cornell Tech)

Thanks to our speakers!



Special shout out to Leo!



Sign up!



ACT Tutorial Feedback and Updates Signup

Thank you for joining us for the ACT Tutorial! We value your feedback and would love to stay connected. Please share your thoughts, contact details, and let us know which updates on our sustainability efforts you'd like to receive.

alugupta@gmail.com [Switch account](#)



* Indicates required question

Email *

☐ Record alugupta@gmail.com as the email to be included with my response

Name *

Your answer

Affiliation *

Your answer