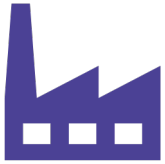
CHIPLETS & SUSTAINABILITY

SRILATHA (BOBBIE) MANNE, CAROLE-JEAN WU

Meta

Outline

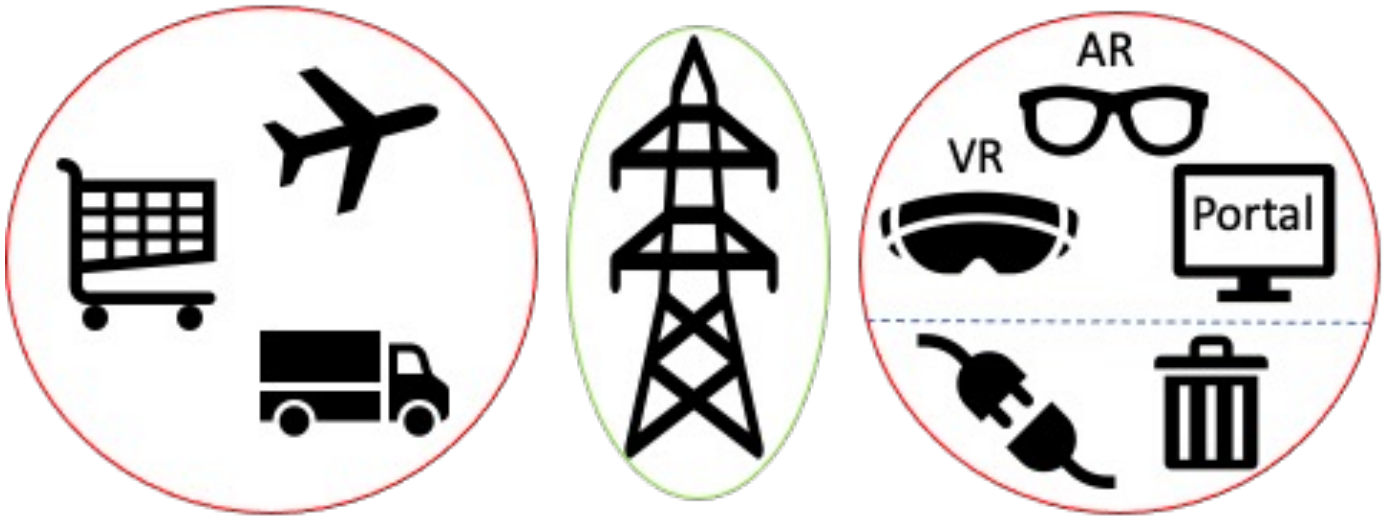


Sustainability and silicon

Intersection of chiplets and sustainability

Tools and modeling

Carbon Framing

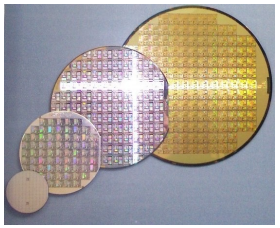


Value Chain Emissions
Upstream Scope 3

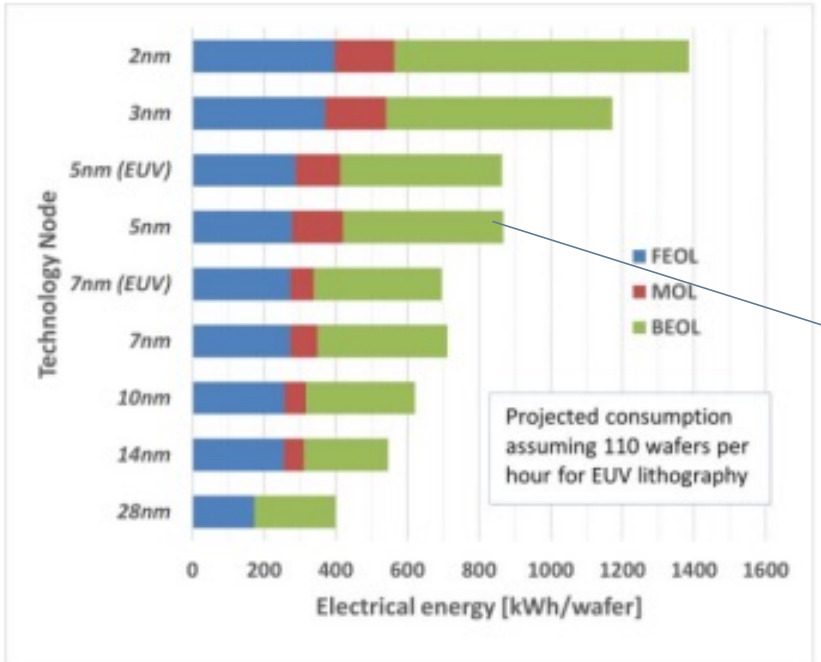
Electricity Use
Scope 2

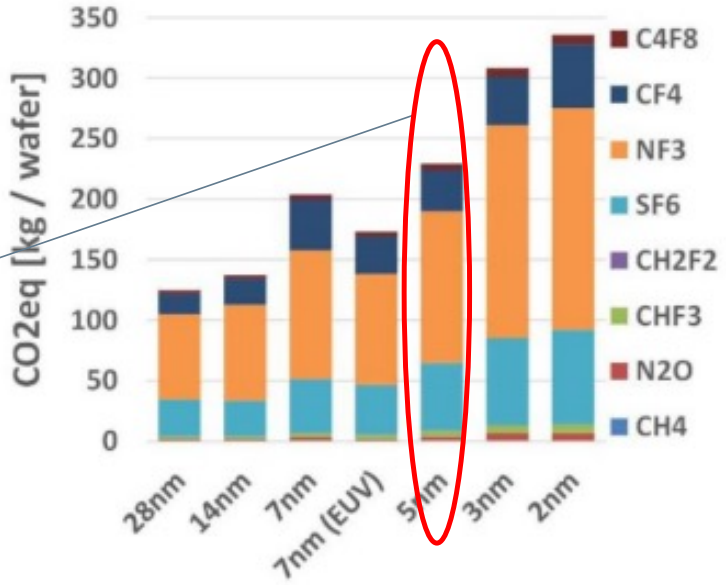
Use and Disposal
Downstream Scope 3

Framing – Process Scaling



~2500 Miles





https://www.imec-int.com/en/articles/environmental-footprint-logic-cmos-technologies

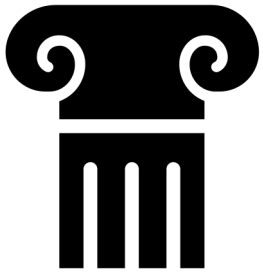
Carbon Breakdown

	4300 kg	6700 kg
	52 kg	10 kg

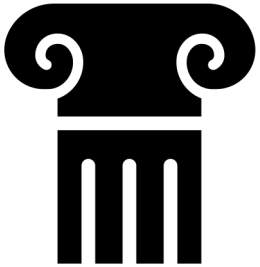
Server: Dell R740

Cell Phone: Iphone 13

https://www.delltechnologies.com/asset/en-us/products/servers/technical-support/Full_LCA_Dell_R740.pdf
https://www.apple.com/environment/pdf/products/iphone/iPhone_13_PER_Sept2021.pdf

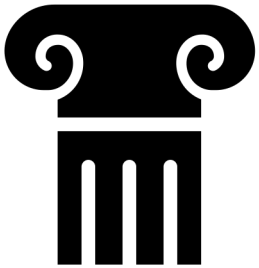


YIELD

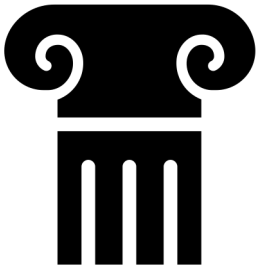


TECH NODE OPTIMIZATION

Chiplets Pillars

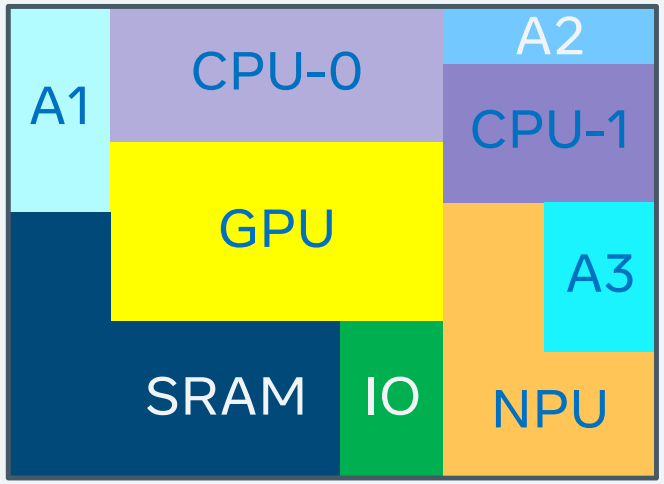


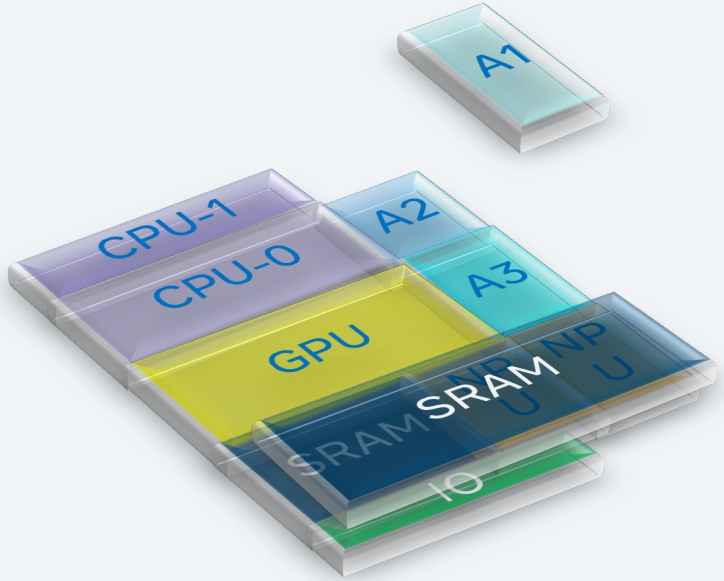
REUSE/TTM



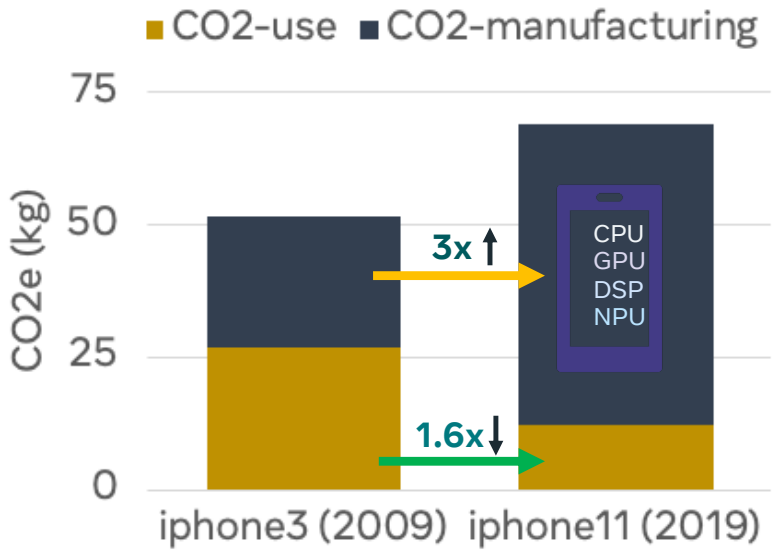
IP SOURCING

Optimizing for Sustainability

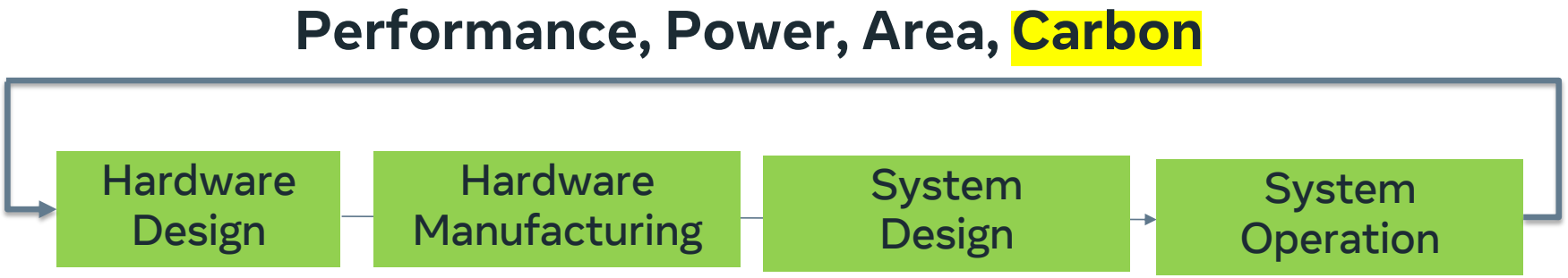




Carbon Characterization for iPhones



Component-Level Carbon Footprint Modeling Tool



$$CO_2^{total} = CO_2^{operational} + CO_2^{embodied}$$

- Platform Bill of Materials;
- Supplier Life Cycle Analysis;
- System Specification (CPU, Memory, Storage)

ACT: Designing Sustainable Computer Systems with an Architectural Carbon Modeling Tool. U. Gupta, M. Elgamal, G. Hills, G.-Y. Wei, H.-S. Lee, D. Brooks, C.-J. Wu. To Appear in ISCA-2022

Component-Level Carbon Footprint Modeling Tool

$$CO_2^{total} = CO_2^{operational} + \frac{Time_{application}}{Lifetime_{hardware}} CO_2^{embodied}$$

*carbon intensity * energy use*

SW design & performance
HW design & power
Fab characteristics
Environmental factors

$$\sum_{i=1}^{N} CO_2^{embodied}\, package(i)$$

+

$$\sum_{i=1}^{SoC,DRAM,SSD,HDD} CO_2^{embodied}\,(i)$$

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Component-Level Carbon Footprint Modeling Tool

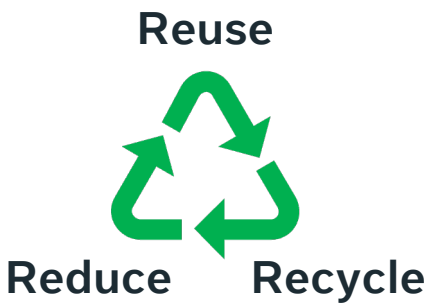
$$\sum_{i=1}^{N} CO_2{}^{embodied}\, package(i) \; + \; \sum_{i=1}^{SoC,DRAM,SSD,HDD} CO_2{}^{embodied}\,(i)$$

$$CO_2{}^{embodied}(SoC) = f(\,yield, (Carbon\ Intensity * Energy_{\,Manufacturing\ \text{per area}} + GHG_{manufacturing\ per\ area}\,) * Area\,)$$

$$CO_2{}^{embodied}(DRAM, SSD, HDD) = CO_{2\ manufacturing\ per\ GB}\,(DRAM, SSD, HDD) * capacity\,(DRAM, SSD, HDD)$$

ACT: Designing Sustainable Computer Systems with an Architectural Carbon Modeling Tool. U. Gupta, M. Elgamal, G. Hills, G.-Y. Wei, H.-S. Lee, D. Brooks, C.-J. Wu. To Appear in ISCA-2022

Carbon as the First Design Principle

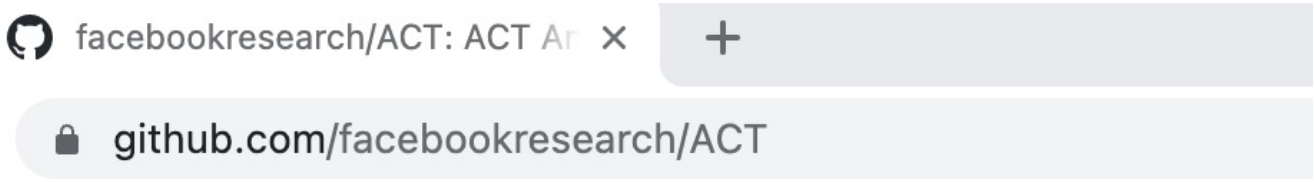


- Balance between general purpose, accelerators, and in-between for different application uses
- Fault-tolerance through HW-SW co-design
- Modular system design to leverage unique failure characteristics
- Design for 2nd life, for environmental sustainability, for circularity

Session 9A: Datacenteres and Sustainability --- Wednesday June 22 10:30-10:50AM

ACT: Designing Sustainable Computer Systems With An Architectural Carbon Modeling Tool

Udit Gupta; Mariam Elgamal, Gage Hills; Gu-Yeon Wei; Hsien-Hsin S. Lee; David Brooks; Carole-Jean Wu



Call to Action

USING THE RIGHT TECHNOLOGY NODE

LATE BINDING CUSTOMIZATION (LIMIT DARK SILICON)

REUSE TO REDUCE DESIGN OVERHEAD

ACCELERATORS FOR PERFORMANCE AND POWER SAVINGS

CHIPLETS & SUSTAINABILITY

SRILATHA (BOBBIE) MANNE, CAROLE-JEAN WU

Meta