

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

ADVANCED MATERIALS &
MANUFACTURING
TECHNOLOGIES OFFICE



Welcome to EES2 and Roadmap Working Group Meeting #8

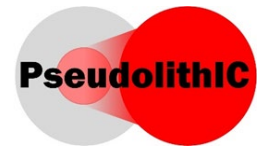
Tina Kaarsberg, PhD
EES2 Workshop Co-Chair

July 19, 2023



<https://microelectronics.slac.stanford.edu/amo-microelectronics>

WELCOME FERMILAB—Our 48th Pledger



July 17, 49th EES2 Pledge Signing with Fermilab Director Meringa

Dr. Meringa cited the amazing 75 year history of the transistor and chips whose efficiency doubling reached 100,000,000X. She said the mission of EES2 was perfectly aligned with Fermilab mission because they need extreme microelectronics efficiency to continue to do particle physics at ever more powerful accelerators with better and better detectors increasing data exponentially



Lia Meringa
with Top
Fermilab physicists
and engineers and
students and
me and Sadas
at signing

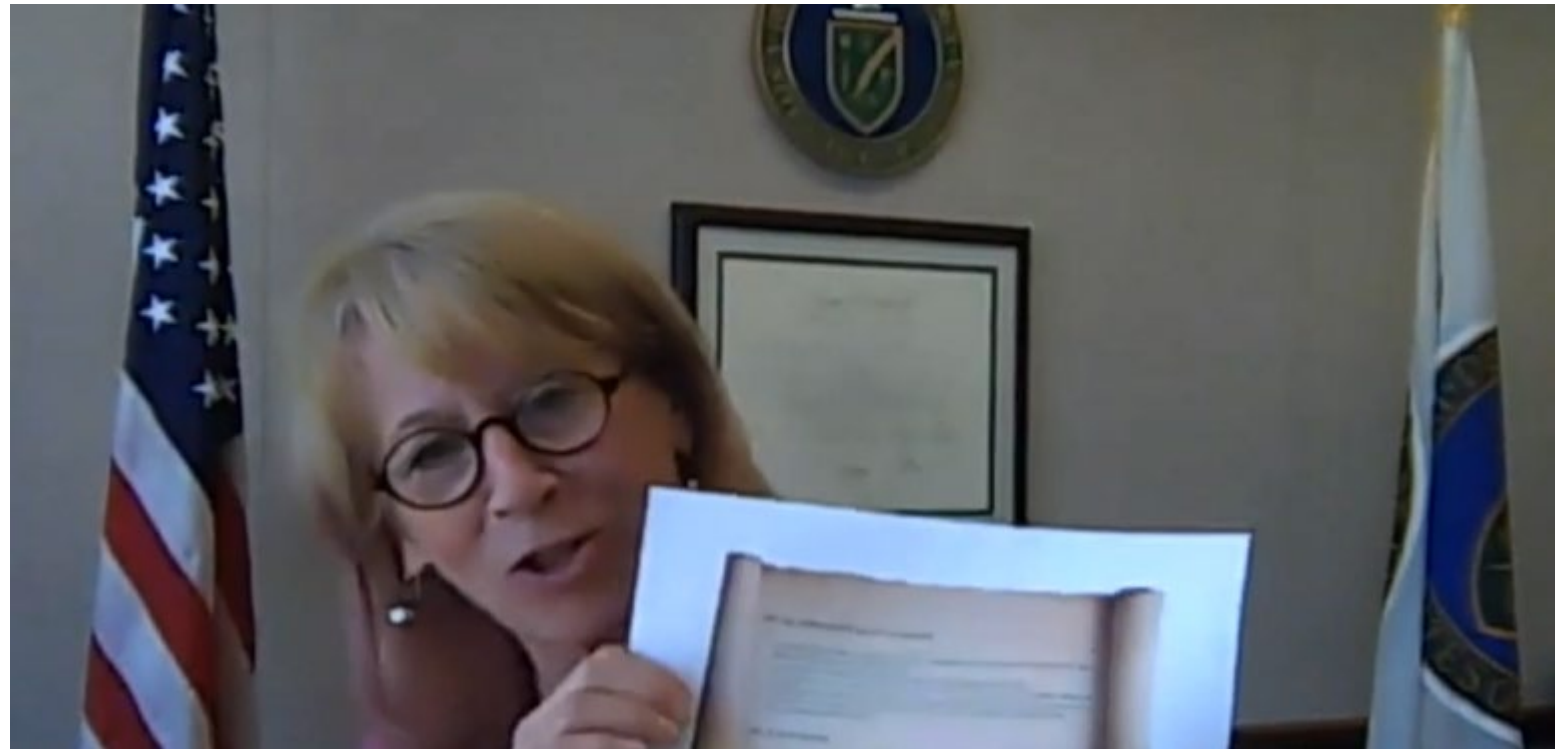
September 20, 2022 Inaugural EES2 Pledge Signing with S-4

Department of Energy Announces Pledges from 21 Organizations to Increase the Energy Efficiency of Semiconductors and Bolster American Manufacturing:

<https://www.energy.gov/eere/articles/departments-energy-announces-pledges-21-organizations-increase-energy-efficiency>

**Undersecretary
For Science and
Innovation Geri
Richmond** is first
to sign

<https://vimeo.com/769659745/f054bc19d5>



Extreme Heat: Code RED for Humanity

Scorching temperatures will put roughly a quarter of the U.S. population under a heat advisory this week

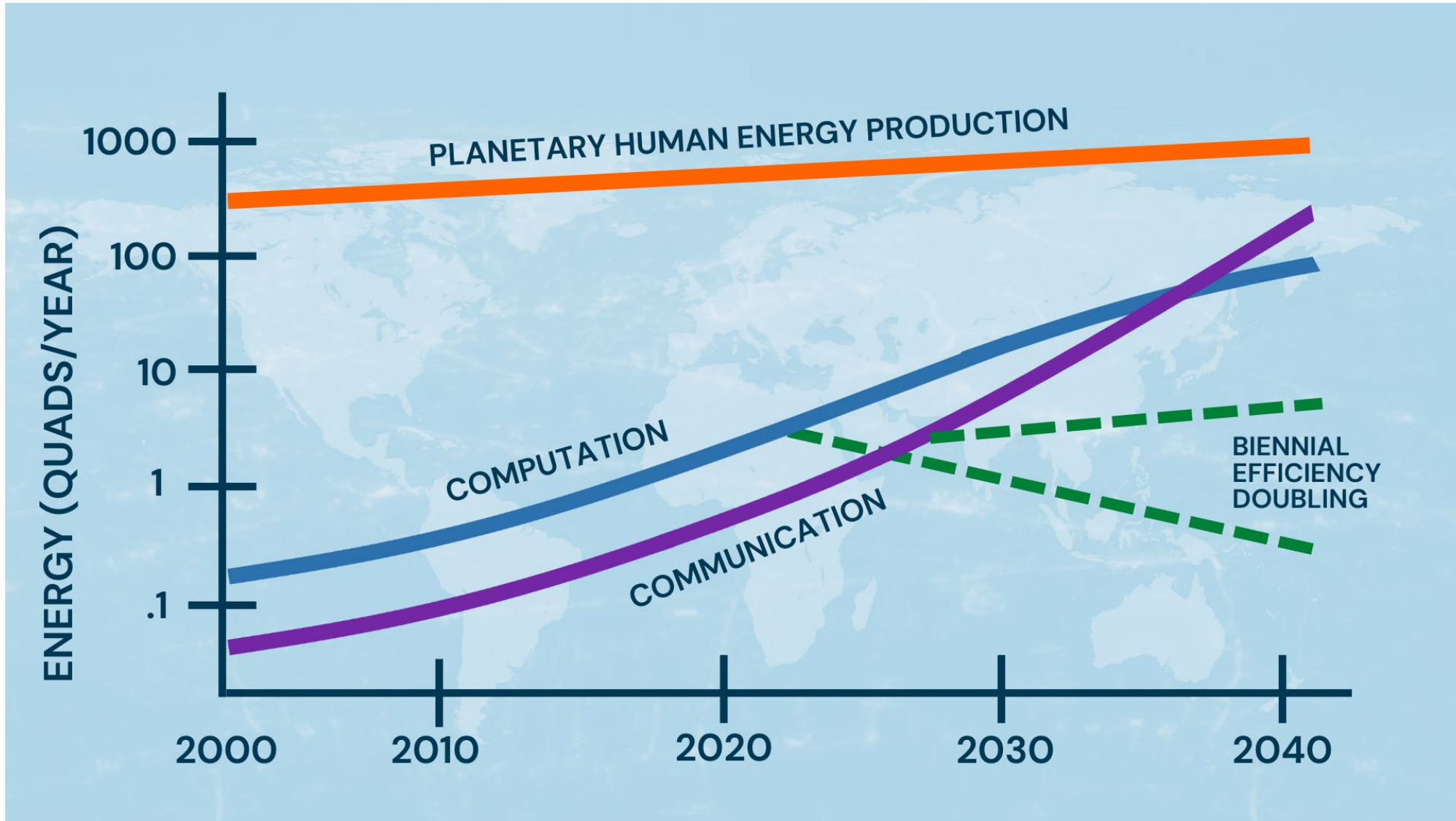


Tracking Dangerous Heat in the U.S.

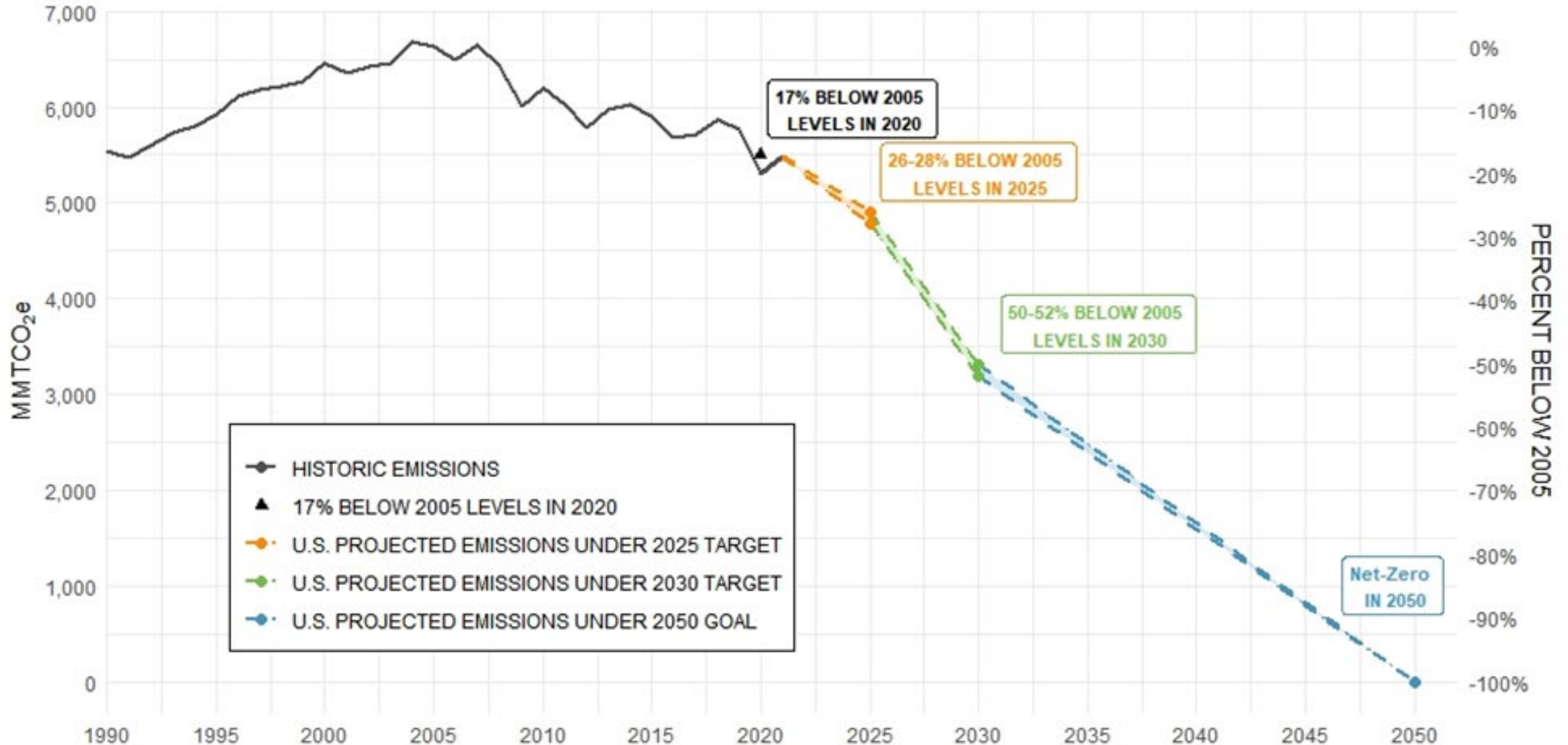
By [Matthew Bloch](#), [Lazaro Gamio](#), [Zach Levitt](#), [Eleanor Lutz](#), Bea Malsky and John-Michael Murphy

Updated July 19, 2023, 6:33 AM ET

Updated SRC (from NIST MAPT) + EES2 Chart



US International Agreements on GHG Reductions



Energy Efficiency Scaling for 2 Decades (EES2)



ANNOUNCED JANUARY 12 2022:

Shift from R&D Roadmaps based on biennial length-based scaling (e.g., Moore's law) to ultra-energy-efficiency scaling and ensure all R&D includes some energy-efficiency focus

- Specifically, develop in partnership with U.S. and Allied Country Semiconductor Industry an RDD&D roadmap to ensure
 - **Doubling* of microelectronics' energy efficiency every two years or faster for the coming decades**
 - **In two decades, increase energy efficiency of next generation microelectronics by >1000X**

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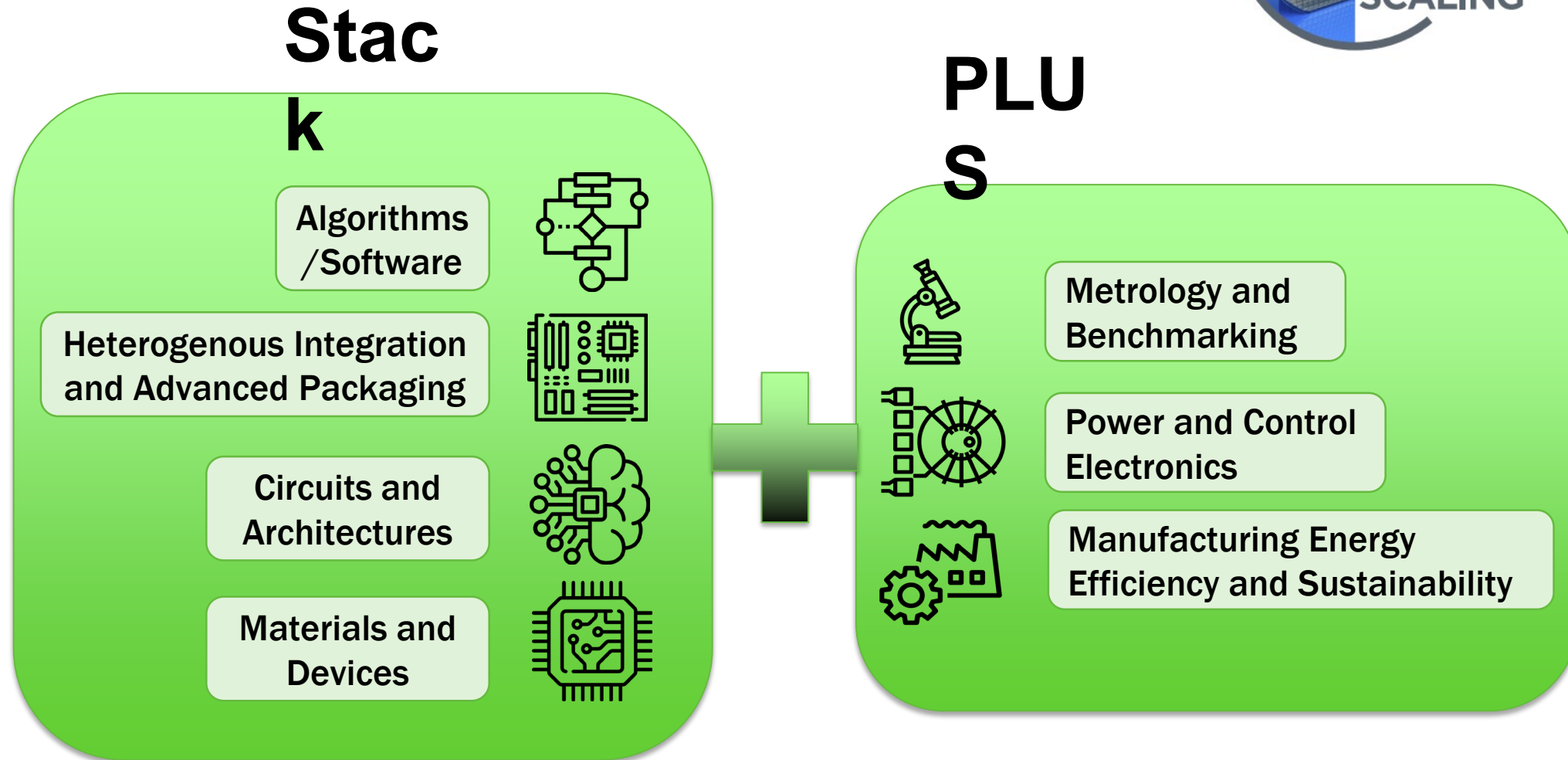
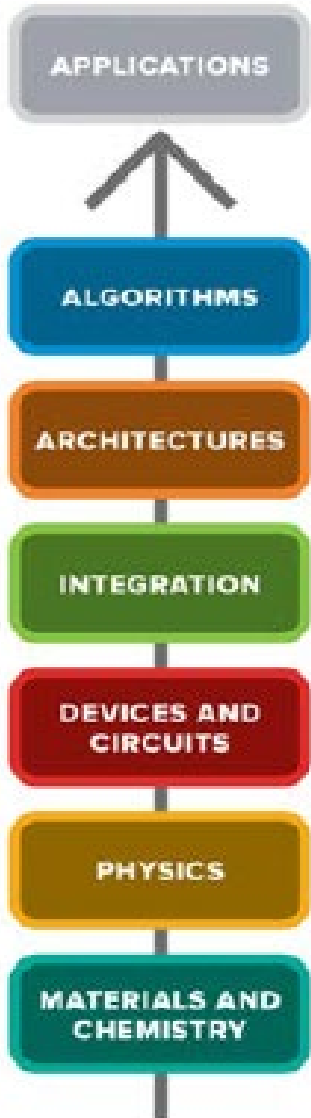
DOE Semiconductor “Deep Dive” for Whitehouse Supply Chain

- <https://www.energy.gov/sites/default/files/2022-02/Semiconductor%20Supply%20Chain%20Report%20-%20Final.pdf>
- February 24, 2022, pp 8-9 on “biennial energy efficiency doubling goal.

SEMICONDUCTOR SUPPLY CHAIN DEEP DIVE ASSESSMENT

generations of semiconductor investments. This goal for successive generations of semiconductors-- to double energy efficiency of semiconductor use every two years or faster for the next 20 years also could help reestablish U.S. leadership in semiconductor manufacturing and would support Biden-Harris Administration electrification and decarbonization goals. Several recent studies have documented that ten generational doubling or a 1000x improvement in energy efficiency is technically achievable (Semiconductor Research Corporation, 2021); (Shankar, 2021). If aggressive effort and significant investment in the RDD&CA for more energy efficient semiconductors is not undertaken soon, however, it could affect the United States’ ability to reduce carbon emissions as rapidly, economically, and efficiently as possible.

“Stack” → EES2 Roadmap’s Working Groups



EES2 Analysis by Prof. Sadas Shankar

April 2021: Invited Plenary Speaker at Workshop #2 on absolute physical limits of microelectronics energy efficiency

Aug. 2021 Invited Plenary Speaker at Workshop #3 on energy efficiency potential of nature-inspired computing

Spring 2022: Enlisted to support EES2 RD&D Roadmapping

Fall 2022: Expanded effort to support EES2 RD&D Roadmapping (+hiring a postdoc)

July 2023: Classical vs. Quantum vs. Neuronal Computing: Key Energy Efficiency Differences



MARCH 22, 2023

SLAC's Sadasivan Shankar on Energy-Efficient Computing

How can we design computing systems that use less energy while still accomplishing everything we want them to do?

[Read the Full Story →](#)

