

U.S. DEPARTMENT OF  
**ENERGY**

Office of  
ENERGY EFFICIENCY &  
RENEWABLE ENERGY

# Microelectronics' Energy Efficiency Scaling for 2 Decades (EES2) Pledge and WG Day 2 Closing

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**EES2 Workshop Co-Chair**



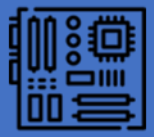




Advanced Materials and Manufacturing Technology Office (AMMTO)

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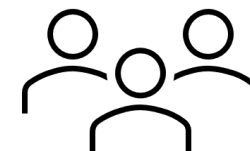
<https://microelectronics.slac.stanford.edu/amo-microelectronics>



# EES2 Working Group Homework for March

Working Group	Materials and Devices	Circuits and Architectures	Het Intg Adv Pkg	Metrology & Benchmark	Power & Control	Software Algorithms	Mfg Energy Efficiency
							
Co-chair Point for March 2023	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Working Group Highlight Month	March	April	May	August I	June	July	August II

....don't stop thinking about the workforce



# Next Steps: Go Back to Pledge as our Guide

## We the undersigned agree to cooperate

- To document and learn from the extraordinary record of microelectronics', including power electronics', energy efficiency such as increases greater than 1,000,000x in energy efficiency since the invention of the transistor nearly 75 years ago;
- To document and learn from microelectronics' past and forecasted future ability to enable all sectors of the economy to become more energy efficient and sustainable;
- To identify and publicize problems solved and opportunities offered by microelectronics' Energy Efficiency Scaling over 2 Decades (EES2);
- To participate in the **AMMTO-led EES2 2022-2023 R&D roadmapping effort**; and
- To explore formation of a partnership, an "EES2 Alliance" that enables the EES2 1000X efficiency increase goal by leading EES2 R&D Roadmapping after 2023 and by catalyzing the deployment of cost-effective technologies, including power electronics, needed to stay on the EES2 path of doubling microelectronics' energy efficiency every two years.

## We do this because

- Microelectronics' life-cycle energy use is rapidly becoming unsustainable as microelectronics demand begins to outpace continuing efficiency improvements due to burgeoning computing, communication, and electrification demands
- EES2 is a key organizing principle that aims to help meet new energy demands
- The EES2 is a technology leadership path that provides economic and other public benefits.

# We can DO This!

- We've been doing it for 30 generations
- In the short- and medium-term
  - We understand the difference between the best and the rest\*.
  - The best technologies are already on EES2 path\*.
- For the long term –getting from 100X to 1000x and beyond
  - Shankar's physics-based analyses (2021) showed potential for 1,000,000X efficiency improvement
  - Shankar's data analysis and projections (2022-2023) show potential for 1,000,000,000,000X





**Thank you**

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