ARPA-E COOLERCHIPS
Efficient Cooling for kW+ chipsets
-US leadership in high power chipsets cooling technology

Dr. Peter de Bock, Program Director ARPA-E
Dr. Jungho Kim, Program Director ARPA-E
Dr. Brent Ridley, Tech2Market Advisor ARPA-E

https://arpa-e.energy.gov/technologies/programs/coolerchips

AI computing is leading power and cooling energy need

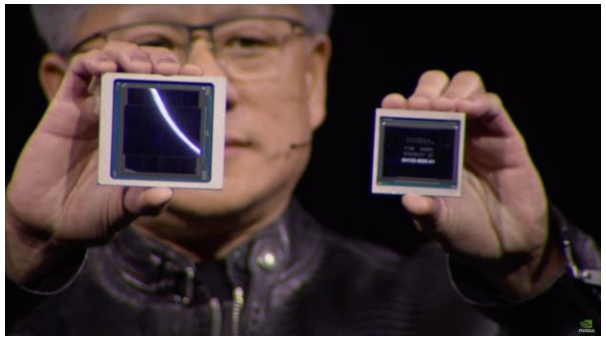
Insatiable demand for computing

ChatGPT/AI and solving large problems increasing global data center and high-density chipset demand

The rise of powerful >1kW chipsets

eUAV is currently the limit of lithography as a result; chip are getting bigger and use more power

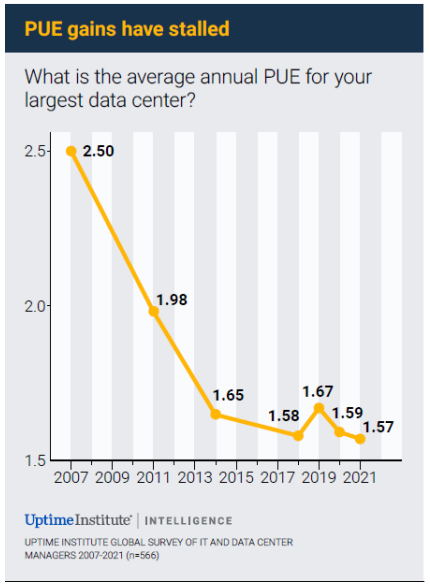
Consequence: More performance? More transistors..
Larger silicon, more power - >1000W per chip



Nvidia co-founder and CEO Jensen Huang held up the new Blackwell GPU chip, left, to compare to its predecessor, H100, "Hopper."

Cooling Energy & water need will rise sharply – Innovation Needed

Rack power >100kW requires reliable cooling systems that can minimize Thermal Resistance chip-facility supply



***Third fan law**: The power required to run a fan is proportional to the cube of the fan's rotational speed.*
→ increasing flow rate is <u>not</u> the answer

arpa·e
CHANGING WHAT'S POSSIBLE

ARPA-E COOLERCHIPS

https://arpa-e.energy.gov/technologies/programs/coolerchips

DOE Advanced Research Projects Agency – Energy (ARPA-E) : US Leadership in *transformational* Energy Technologies – moonshot high risk/high reward programs

COOLERCHIPS™

U.S. Department of Energy Announces $40 Million for More Efficient Cooling for Data Centers

15 Projects Will Develop High Performance Cooling Systems to Create More Energy Efficient Data Centers that Reduce Carbon Emissions and Mitigate Climate Change

05/09/2023

*"Climate change, including severe weather events, threatens the functionality of data centers that are critical to connecting computing and network infrastructure that power our everyday lives," said **U.S. Secretary of Energy Jennifer M. Granholm.** "DOE is funding projects that will ensure the continued operation of these facilities while reducing the associated carbon emissions to beat climate change and reach our clean energy future."*

arpa·e CHANGING WHAT'S POSSIBLE

https://arpa-e.energy.gov/technologies/programs/coolerchips

Let's make the most efficient use of our infrastructure

$42M program transformational Data Center Cooling Technologies

COOLERCHIPS Targeting Cooling 5.0*- *solutions for 2028+*

- Target to reduce cooling Energy by ~90%
- Design and verify new system is as reliable as air-cooling – 99.982% uptime
- In a Grid constrained future; Without innovation we will spend >40% of our limited Energy on Cooling. COOLERCHIPS targets >95% of energy used for computing.

US jobs and exports in cooling infrastructure technology

Track A: Secondary Cooling loop (10 awards)

Track B: Modular data Center (3 awards)

Track C: Cooling, Energy, Reliability Tools (1 award)

Track D: Facilities and Standards (1 award)

*) see DE-FOA-0002851 for full specifications and detailed targets