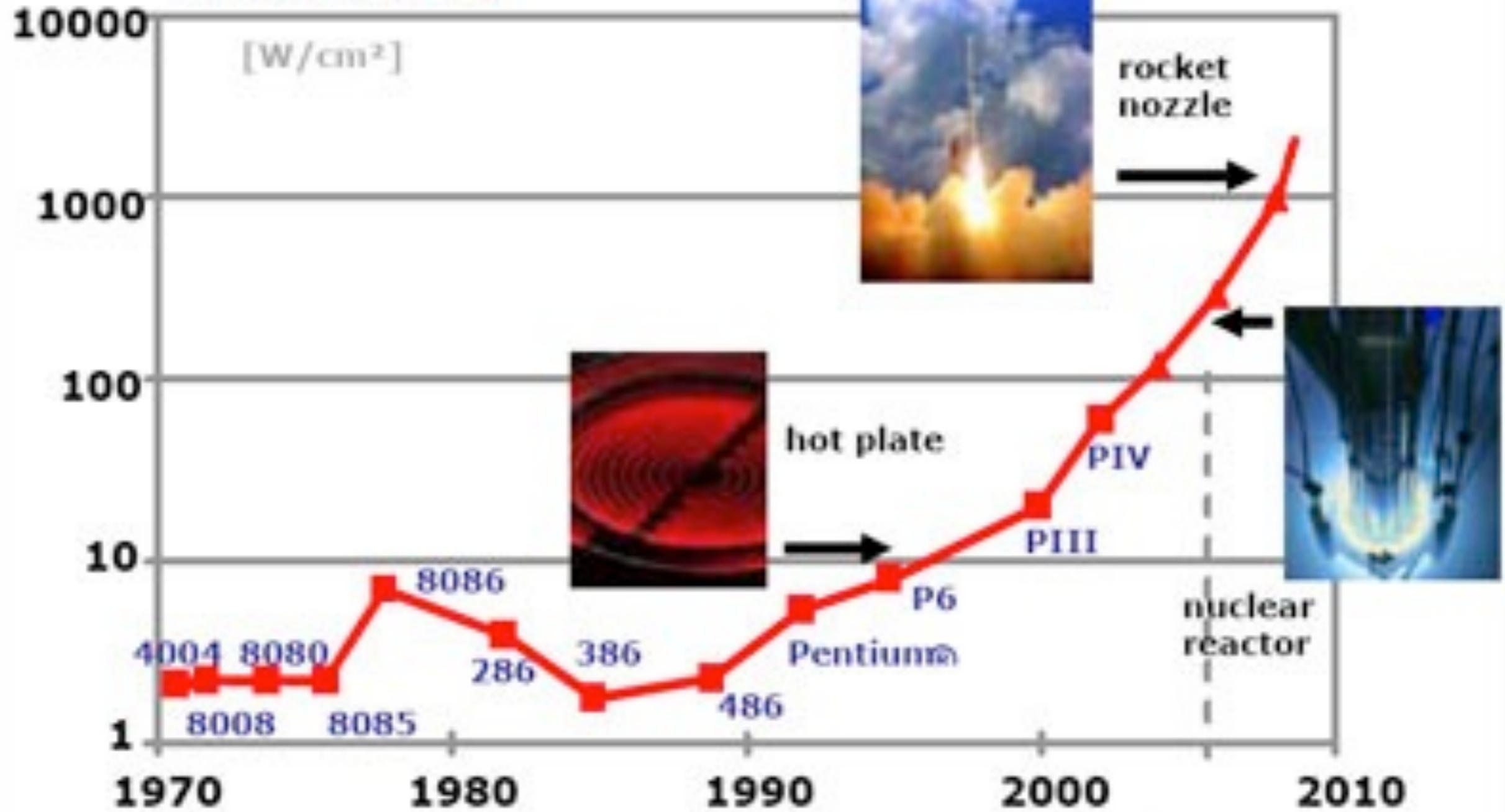
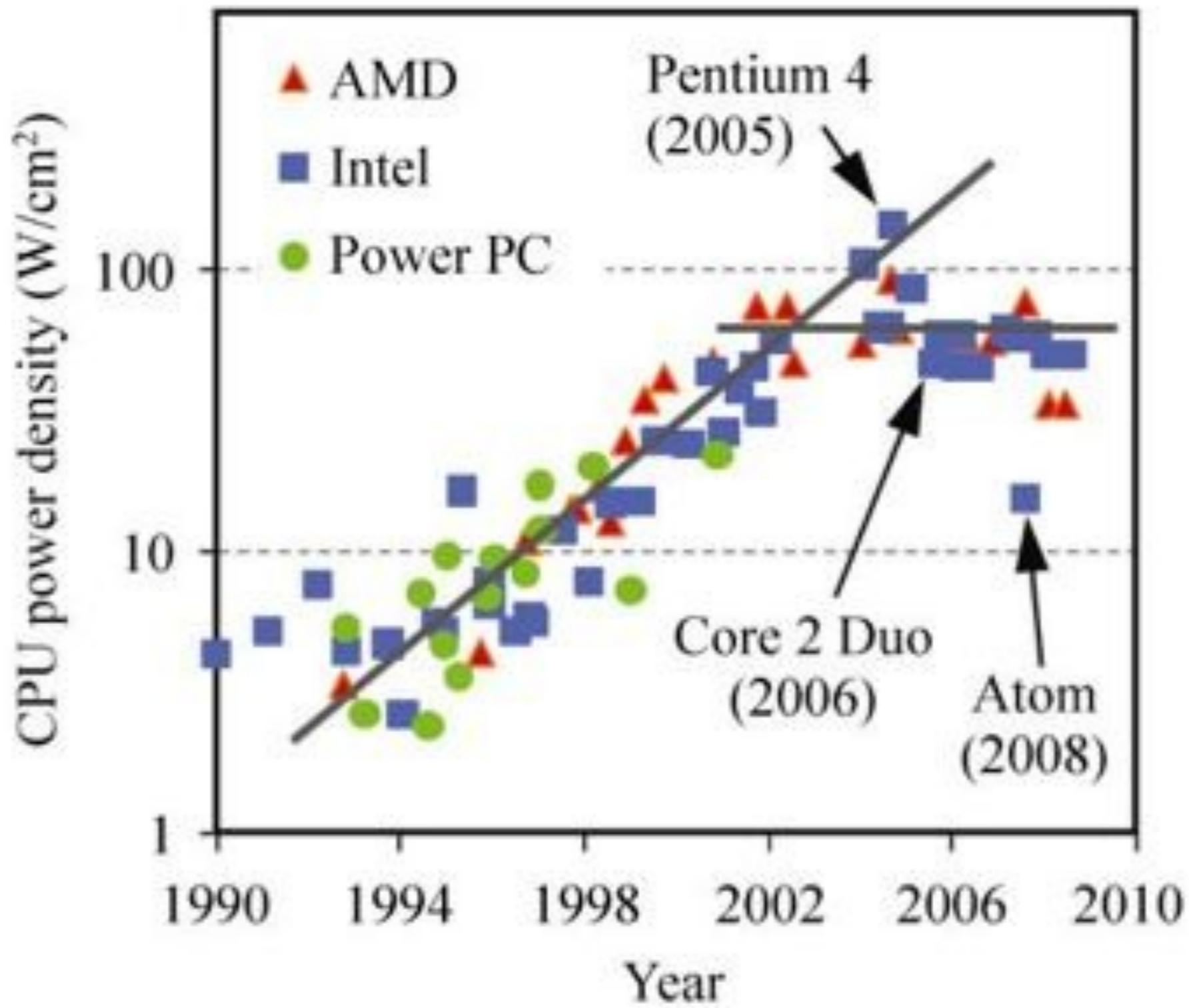


Power density





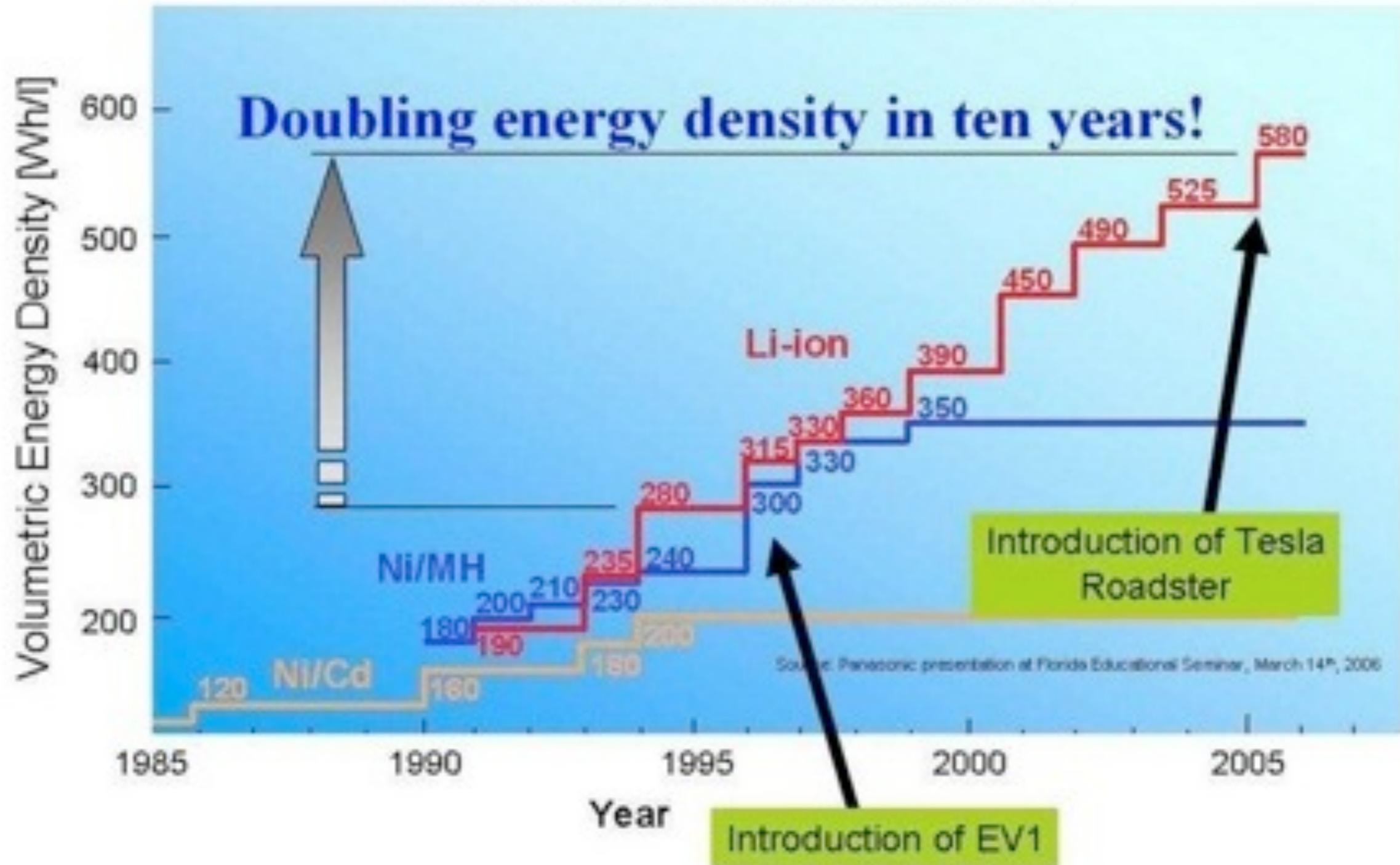
How do you measure/estimate power?

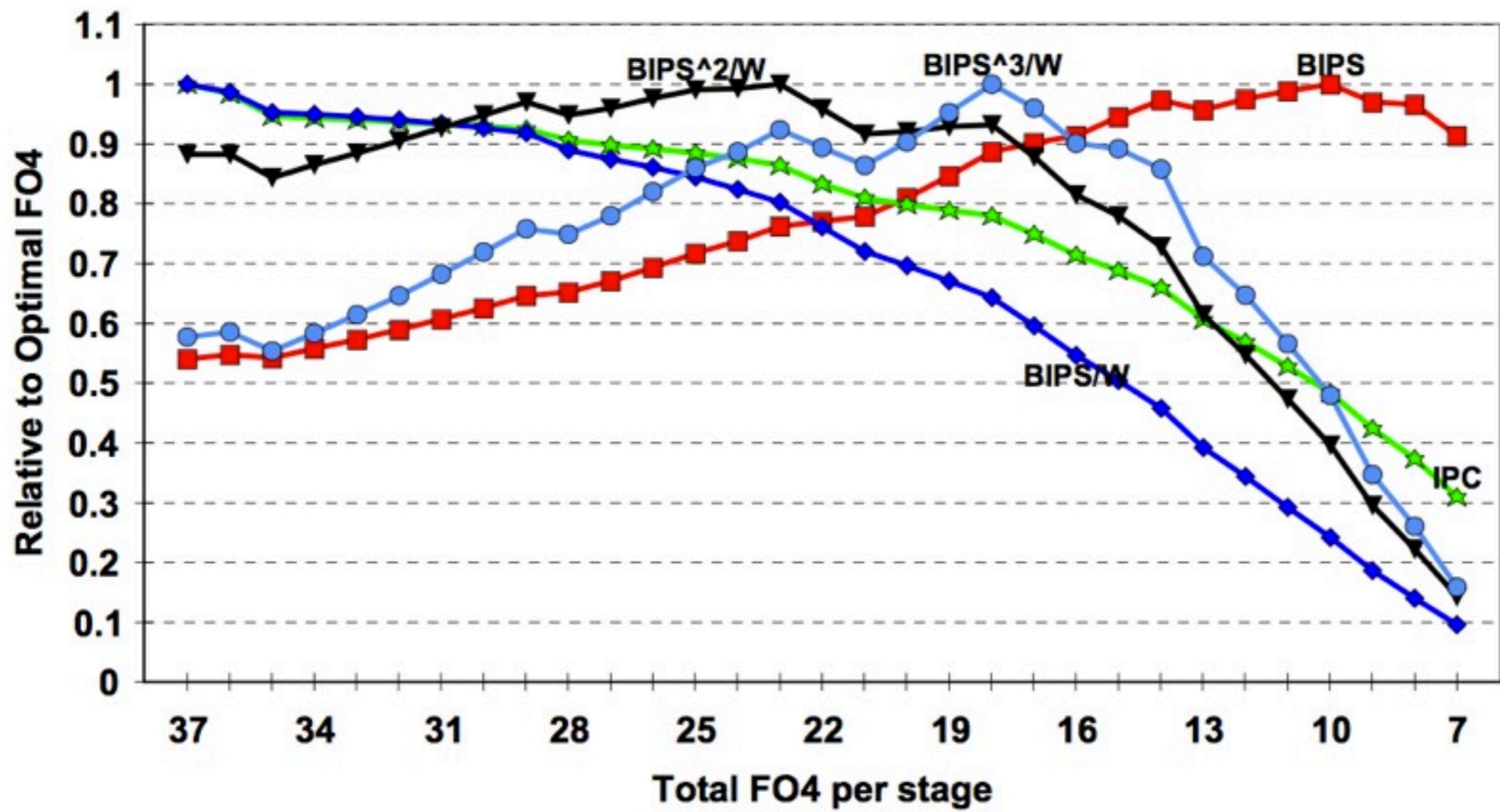
- Power measured in Watts
- Power = static + dynamic + clock
 - = leakage + Activity X freq X Capacitance X Volt² + freq X Clock_Cap X Volt²
- Power = Sum(Components X sizes X activity)

- Roughly: V pport F
- Roughly: F pport BIPS
- Thus: BIPS³ pport P

Battery Energy Density Trend

Lithium Ion vs. Ni-MH vs. Ni-Cd





Why 18-20?

- Deeper pipelines => more power (latches, forwarding networks, etc)
- Deeper pipelines => more performance
- Constants: memory system performance, width, decode, voltage, design of ALUs,

Where does the power go?

- GPU: 5-60W in a desktop
- CPU: (10-50W) decode: 15%, clock 20-30%, caches 20%, Integer Ex: 10%,
- Display: 25-35% of a laptop
- Disks: 2-10W
- DRAM

Now what?

- Multicore
- Clock-gating, power-gating
- “The Cloud”
- Power-gate devices
- DVFS
- Specialization
 - Approximation
-