So you mentioned energy efficiency, power, and this being a big issue.

And of course, this is a huge issue when we have a smartphone.

Because we want to get performance, but we

don't want our battery to last only three hours.

So this is a bit of a conundrum for designers

like how do we make fast designs, yet make them energy efficient?

So you've done a lot of work in this area.

Can you talk about the techniques the designers use

to get energy efficiency as well high performance?

Sure.

But I think one point to make before I say

that is about the difference between energy performance and power,

because often these get confused.

So energy is really how much work it takes to do some task.

So, for example, how much work does it take to process a video frame.

Whereas, power is the rate change of energy.

So what's the rate at which I'm consuming energy?

And it's really easy to make low power processors.

You just make them really slow, but often we want both.

We want high energy efficiency-- so low energy-- and also high performance.

And that's the real challenge.

For a long time computer architecture was really a game of trade-offs

where you would increase the performance,

but you would add complexity, which meant you

were doing more work and more energy.

So it was this constant tension where, yes, I

am going to get more performance, but it's going to use more energy.

But in the last decade that's no longer good enough,

because now we need to understand how we can increase performance

at the same energy and try to stay with it under some type of power constraint.

And so when we think about energy and power,

we also need to think about what the constraints are.

So they constrain very different parts of our system.

So energy barely constrains things like your electricity bill

or the size of your battery.

Whereas, power constrains things like heat.

So how hot does your cell phone get?

And once we have an understanding of the difference between energy and power,

then we can think more about ways to tackle them.