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ENERGY & CLIMATE CHANGE

Rising living standards have resulted in a dramatic increase in demand for energy. Since the industrial revolution, total global commercial energy use has increased a hundredfold. Demand growth will continue in the future, but from different parts of the world. China has already overtaken the US as the world's biggest energy consumer, increasing demand at a relentless pace: only 10 years ago, its total energy consumption was just half that of the US. Most energy still comes from fossil fuels: oil, gas and coal. The pressure on oil supplies continues to increase, while greenhouse gas emissions climb. Meanwhile, rising global temperatures threaten to alter the planet's climate, with potentially damaging consequences for fragile ecosystems in many regions of the world.

Where's the heat?

/ Fossil fuels
Four-fifths of our energy comes from fossil fuels – a finite resource. Estimates of how long existing resources may last range from 40 to 120 years, depending on how quickly we can change the rate and composition of our energy consumption.

/ Alternative energy
Non-hydro renewable energy delivers around 3 per cent of the global electricity supply. Last year, China led the world in terms of wind turbine installation and solar panel manufacturing. Developing economically workable alternative energy is one of the world's big challenges.

/ Carbon emissions
Reducing emissions is widely considered to be critical. Consumers can now calculate their carbon footprint for many activities and are increasing pressure on companies to be carbon neutral.

/ Nuclear power
Nuclear power generates about 13 per cent of the world's electricity. Since Japan's Fukushima disaster, the debate about the industry's safety has reignited and some countries – Germany, for example – have turned away from nuclear power. The industry's future is uncertain.

/ Energy security
Natural disasters, political instability, conflict, terrorism, and restrictions over access can all threaten energy security. Many countries are heavily dependent on others for their energy supplies, as illustrated by Europe's plight when Russian gas supplies were halted.

x5

China accounts for most of the world's new nuclear capacity, forecast to grow fivefold by 2020

x100

Since the industrial revolution, total global commercial energy use has increased a hundredfold

/ Smart grids

Electricity infrastructure with embedded intelligence can ensure a more reliable, safe and efficient supply. One estimate sees smart grid spending growing by about 17 per cent a year to $46bn in 2015.

/ Transport

Energy and climate change concerns have focused interest on low-carbon transport: vehicles powered by electricity, biofuels or hydrogen. Greater energy efficiency increases the value of public transport and has intensified the road-versus-rail debate.

What's the context?

With the economic pressures many countries are facing, increasingly there is seen to be a trade-off between focusing on the environment and the economy. On this basis, companies that make "green" choices are seen as dragging down their profitability; being environmentally conscious means holding back economic growth. The conversation about energy and climate change is heavily balanced towards this zero-sum argument, casting big business as the bad guy who sacrifices the planet for the sake of short-term growth.

But for a number of companies, energy efficiency has become a "north star" for their innovation. "Smart grids," for example, are a central part of IBM's Smarter Planet strategy. IBM has convened a network of utility companies around the world, covering almost 150m customers. Together, they are developing ways to optimize the flow of energy across grids.

Another example is GE's "ecomagination" – an R&D initiative with a substantial focus on energy efficiency, exploring new technologies in hybrid vehicles, fuel cells, lighter and stronger durable materials, and more efficient lighting. Their newly released 40-watt Energy Smart LED bulb provides a 77 per cent energy saving, while lasting more than 25 times as long.

Rolls-Royce is a world-leading manufacturer of engines for aircraft and ships – a growing source of fuel consumption and carbon emissions. Ships are relatively unnoticed culprits in the CO_2 story, with emissions projected to rise to 1.4bn tonnes annually by 2030. Rolls-Royce has designed a ship engine that runs on liquefied natural gas, cutting CO_2 emissions by up to 30 per cent, compared to one that runs on diesel.

As usual, there is a flip side – the Jevons Paradox: as efficiency increases, prices fall and demand rises. In other words, the argument goes, new efficient technologies may actually push up energy use. There are no easy solutions, but many companies are taking up the challenge.

> I have a feeling that climate change may be an issue as severe as a war. It may be necessary to put democracy on hold for a while
>
> — James Lovelock, environmentalist

> [Climate change is] undoubtedly one of the chief concerns facing the world today
>
> — Bjorn Lomborg, former climate change skeptic

"When we talk about energy efficiency we mean the maximum output of energy for the minimum input."

Warren East, CEO of ARM, explains where we need to look for energy efficiencies

Efficiency of generation: *Solar panels, for example, are notoriously inefficient – single digit percentages of efficiency. The sun may be an infinite source of energy, but the space occupied by solar panels, the energy consumed in manufacturing them and in the infrastructure required to connect them to the grid, increase their inefficiency. If we can use technology to double their efficiency, say from 7 per cent to 14 per cent, it would mean we would have halved the cost of the space, the manufacturing and the infrastructure – and halved the environmental impact of that system.*

In traditional energy: *In a coal-fired or nuclear power station, the efficiency of the generation process is heavily influenced by the efficiency of the turbine. If we can double the efficiency by putting a smart system around it, then – again – we can halve the number of power stations that need to be built.*

Efficiency of transmission: *Transmission is often the forgotten part of the story. Typically, energy is generated remotely from where it is used. So it needs to be transmitted to where it will be used, but transmission is hugely inefficient – a lot of the energy simply falls out of the wires on the way. For each kilowatt of usage you need to generate three kilowatts.*

Efficiency of usage: *Changing the design of an electric motor to include a smart electronic system – such as a smart microprocessor – has the potential to double the efficiency of that motor. And electric motors are huge consumers of energy.*

WARREN EAST
CEO, ARM

ARM is the world's largest designer of chips for smartphones. *Warren East*, CEO for the last 11 years and an engineer by training, tells Brunswick's Sarah West about looking beyond Moore's Law in the microprocessing industry. Progress is no longer so much about doubling processing power every two years, but more and more about delivering exponential improvements in energy efficiency. ARM's products are at the heart of that effort; microprocessing technology is essential for the development of things like "smart grids" to increase energy efficiency, which is a large part of most governments' plans to reduce greenhouse gas emissions by using less energy in homes and industry.

Energy efficiency is a huge concern in today's world: what is ARM to energy efficiency?
ARM microprocessors are in almost everyone's mobile phone. When we make our microprocessor twice as efficient, we're doubling the battery life of your mobile. That's been the driving force of ARM since the start. The original ARM microprocessor was designed for Acorn computers, with low-cost manufacturing in mind. A consequence of that was that it consumed less energy, making it ideal for mobile phones – and we've gone on improving the technology continually since then.

Would you say that energy efficiency has been the guiding star for innovation at ARM, since the beginning?
Absolutely, yes. That is why we've concentrated on mobile phones, because it's a very obvious area where energy efficiency is absolutely important. If you look at data consumed on the devices, we would say that over the next decade we're looking at an increase of between 30 and 100 times in the amount of data, but crucially we're only looking at a twofold improvement in the energy capacity of a battery. That means we have to be 15 to 50 times more efficient in the work we do. That's what we focus on.

Is it possible to keep improving the energy efficiency of microprocessors?
It's getting harder to deliver those improvements. The tremendous advancements in the past have been driven largely by Moore's Law, stating that computer power and the number of transistors on a chip approximately doubles every two years. But in the future, to achieve the same relative benefit, the actual design of the microprocessor is going to have to be a lot smarter.

Is that possible?
We continuously have to innovate. Last October we launched our "big.LITTLE" microprocessors – where you have the same level of computer performance that is enjoyed in a state-of-the-art smartphone, for 20 per cent of the energy consumed. So it is possible, but harder.

Given that your chips are already in almost all the mobile phones on the planet, what else could ARM technology be applied to?
An area we're focusing on now is getting ARM's technology into network infrastructure. Everyone gets excited about the new digital services available on their smartphones, tablets, computers and so on – and how they're going to connect to the internet and smart TVs. But the reality is that all these bits of equipment mean roughly a twentyfold increase in data traffic over the next five years or so, but increasing the energy consumed by these networks by a factor of 20 is clearly nonsense. So this connected, limitless digital world we're all anticipating just won't happen unless we change something fundamental in the infrastructure. At ARM we are working on energy-efficient technology that can help to answer this problem.

So that's another market opportunity for you?
Yes. It's not as exciting to most people as a mobile phone or a tablet, but it's just as important. The analogy I use is the road network. In the 1950s, road networks revolutionized the way we travel, and that infrastructure evolved over the years. But people love their cars, not the road – just as people love their iPads and not the networks it is connected to, although it's crucial.

It's easy to forget about the invisible technology we're all connected to ...
Absolutely. If you think about the digitally-connected world we all live in, there's a huge demand for servers: large computers that sit in the "cloud," serving up content and enabling operators to deliver services. Those things

are huge consumers of energy – and energy is consumed in cooling them as well. You hear about companies like Google locating their data services in Iceland to keep them somewhere cool: it's a big issue for them. We think that we can remove three-quarters of the energy consumed by servers, thereby reducing the amount of power needed by a factor of four – which is all good news.

Do you think ARM's biggest contribution to the energy challenge is yet to come?

Yes. In terms of overall energy use, mobile phones and computers don't use that much energy. We could make all the mobile phones in the world 10 times more efficient and it wouldn't make a whole lot of difference to mankind's contribution to climate change. It's a bit larger when you count the infrastructure and so on, but it's still relatively small compared with the world's larger-scale energy challenges. So the opportunity has to be in applying our technology more broadly.

Where would you look to make the biggest contribution?

Electric motors. These are huge consumers of energy in the world we live in, and therefore the benefit of changing the current generation of electric motors to smarter ones using microprocessor technology is obvious. I'm talking about motors like those used in your washing machine or winding up the window in your car, through to those powering elevators in skyscrapers. Motors account for around 50 per cent of our overall electrical energy use in the world. Of course, it doesn't have to be ARM technology, but if we can double the efficiency of the electric motor, then we will be making a very big, positive environmental impact.

So you're saying a product can have a positive impact for society at large and be good for business. But there's another debate at the moment about whether businesses are a positive or negative force in society. What's your view on that?

I think it's irrelevant. Normally, when people ask that question, they mean business is bad because some businesses exploit people to make others better off. We are talking about businesses making products that make life better and do some good for society. Remember that whenever anybody creates a product that makes life better for society, there is usually a business behind it.

Sarah West *is a Partner in Brunswick's London office. She advises on corporate brand positioning and reputation.*

SPACE TAKEN BY NEXT CONVERSATION