Getting energy right

By WALT PATTERSON

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When anyone asked me why my favourite school subject was science, I had a ready reply. 'In science tests, you know when you've got the right answer.' I was contrasting science with, say, English or history, when your mark depended so much on what the teacher thought of your effort. Looking back, I'm embarrassed to realise that I had not the faintest idea of how science really works – that in good science your answer is always – always – provisional.

Decades later, I now know that science is a key aspect of our shared external reality, as we attempt to understand and agree a satisfactory way to describe it. This shared external reality appears to have a continuity and a coherence. The science that we humans pursue as a collective activity, using observation, reason, numbers and logic, helps us to create a *story* for ourselves – a story about how the world works and where we fit into it, a story we can share, develop, amend, improve and anticipate, as we await what happens next.

Consider electricity. Those of us in the rich part of the world take electricity for granted. We also, most of us, still take for granted the traditional electricity story, which is now more than a century old. It goes like this: very large power plants a long way off generate electricity, and send it out to users over vast networks of wires. If you use electricity – and in the rich parts of the world we all do – you assume that someone else will keep your lights on. All you do is throw the light-switch and pay the electricity bill. It's a good story, as long as it works – and for most of the past century it worked fine, at least for us lucky ones.

Unfortunately, however, some two billion of us – a third of humanity – still don't have electric light; and traditional electricity is not going to reach them, ever. Indeed, as populations increase, traditional electricity may even be losing ground. Meanwhile, in rich countries, as old dirty power stations reach the end of their lives and 50-year-old wires under city streets deteriorate, even those of us lucky enough to live here are having more and more trouble keeping the lights on. The old traditional electricity story no longer works, not well enough for this twenty-first century.

Fortunately, an exciting new electricity story is now emerging, very different from the old one. You've probably heard bits of it already – about 'smart grids', micropower, making your own house a power plant and so on. I've been immersed in this new story for almost 20 years. I've already written two books about it, and I'm working on a third. The first book was called *Transforming Electricity*, and the second *Keeping The Lights On*. They're not for specialists; they're written for general readers, for people who use electricity without thinking about it. For me, however, thinking about electricity has convinced me not only that the traditional electricity story no longer suffices, but that we need to revise our whole story about energy in human society.

Start with this word 'energy'. What do you think it means? Does it mean oil? Coal? Natural gas? Does it mean electricity? They are not the same. They are not interchangeable. But calling them all 'energy' makes too many people, especially politicians, think they *are* the same – that one can substitute for another. We talk about 'energy supply', when we really mean 'oil supply' – not the same as 'gas supply' or 'electricity supply'. The very way we talk about energy, the story we tell ourselves, is fundamentally wrong. As a result we are managing energy wrong.

Why do we need these supplies? That is the key detail we so often ignore. We need fuels and electricity to *run stuff*. What matters is the *stuff* – lamps, motors, electronics, appliances, industrial plant, vehicles and especially buildings. This stuff, this user-technology, provides what we want – comfort, illumination, motive power, refrigeration, mobility, information and communication. The *technology* is what matters. Oil by itself is almost useless. Natural gas by itself is downright dangerous. Electricity as we use it does not even exist by itself. It's a process in technology. Fuels are only useful *because of technology*. Moreover, the better the technology the less fuel it needs to deliver the services. You'll hear that called 'energy efficiency'. I call it 'energy performance'.

Governments have been telling us for decades that we have to reduce our use of energy. I am a physicist, and a pedant; and I'm telling you that governments are wrong. I know what the word 'energy' really means. It's the unifying principle of the entire universe, as our science understands it. We can use as much *energy* as we want. That's how the universe works. But we have to reduce our use of *fuel*. The distinction is not just pedantic. It is crucial. Using fuel is why we worry about what politicians call 'energy security', but ought to call 'fuel security'. Using fuel is the main reason why we are upsetting the climate. That's why electricity is the key

to a sustainable energy future. Electricity will help us to reduce our use of fuel.

Fuel is a substance. Coal, oil or natural gas comes out of a hole in the ground at a particular place. If you want to use it somewhere else you have to carry it there, often now over many thousands of kilometres. Electricity is not a substance. It is a process. If you have the right technology you can generate electricity anywhere, in any quantity from minute to vast. In particular you can generate it close to where you want to use it, in a versatile variety of ways.

Human society uses two different kinds of electricity. One we generate using the stored energy in fuel, such as coal, oil, natural gas or uranium. The other we generate using technology to convert natural energy flows into electricity. This electricity, including hydro, wind, photovoltaic, solar thermal, wave, tidal and geothermal, *does not use fuel*. It is produced and delivered not by combustion or any other reaction but by the functioning of physical assets, what we call 'infrastructure'. Most people call this kind of electricity 'renewable', a term I dislike because it's meaningless. I call this electricity 'infrastructure electricity'. Once the turbines or panels or other installations are in place and functioning, whenever the natural energy flow is available the infrastructure converts it into electricity, for us to use however we wish.

Do you see how this story might develop? To me the implication is obvious. Using fuel the way we do threatens the security of our energy services and the climate of the only planet we have. Of all the ways we use fuel, generating electricity is the easiest to change. To get better, more reliable, more universally available and sustainable electricity services, we should be intending, and planning, to move as rapidly as possible away from fuel-based electricity to infrastructure electricity, for every feasible application, all over the world.

My current project for Chatham House and the University of Sussex Energy Group is called 'Managing Energy: for climate and security'. Changing the way we manage energy will change the way the world works. My old friend Amory Lovins gives a striking example of the possibilities. It goes like this: we know three ways to make limestone into building material. We can cut the limestone into blocks; we can roast the limestone using fuel in a furnace at 1,200 celsius to make cement; or we can *feed the limestone to a chicken*. Weight for weight, eggshell is one of the strongest materials we know. But we don't know how the chicken does it. What's more, the chicken does it not at a high temperature but at a chicken's body temperature, close to our own. As we change the way we manage energy, I'd like to think we can move beyond the brute force of extreme high temperatures, especially combustion temperatures from fuel, to make human energy systems and processes converge toward those we see in living nature.

I'm trying to take radical ideas such as this and develop them into an alternative vision of energy in society, a coherent, persuasive story I can tell. But that's only the first step. The vision I'm looking for will be pointless if it exists only in my own imagination. It will be worthwhile only if it also resonates in other imaginations, including yours – only if it becomes a part of our shared reality, our common story about our world.

Looking at our world in 2010 we can see all too many problems. Getting energy right will not solve them all. But if we don't get energy right the other problems may become insoluble. We can and must change the way the world works. We can start immediately, by changing the way we think about it. It will be challenging, exciting and exhausting: but if we do it right it will also be *fun*. Let's do it. ■

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Nesjavellir Geothermal Power Station in Iceland: the station produces approximately 120MW of electrical power and delivers around 1,800 litres of hot water per second, servicing the hot water needs of the Greater Reykjavik Area