

An Electric Planet?

Presentation by Walt Patterson

I'm not sure what I'm doing here. You lot know more about electricity than I'll ever know. But I do come at electricity from a somewhat different perspective. Comparing notes between us may be mutually useful and beneficial.

The output of ideas and analysis from your Electricity Policy Research Group is impressive, going on daunting. I can't claim more than a superficial acquaintance with it. But it covers a remarkable range of issues, in depth and detail, far more than I can begin to comprehend. What I bring to this discussion is rather a campaigning mindset, developed over some four decades of troublemaking. I start from the premise that we are doing things wrong, and could do better. I try to work out what exactly we are doing wrong and why, and how we could do better. Then I try to find a way to persuade other people that I'm not talking nonsense.

Some of you may know that I started out at the end of the 1960s as a general environmentalist, and edited the UK's first environmental magazine. In 1972 I joined the embryonic UK wing of Friends of the Earth. For a year I was their garbage specialist. Then, rather to my surprise, I became their first energy specialist, at a time when official UK energy policy saw the future as entirely nuclear. For nearly two decades I was probably the most visible critic of civil nuclear activities in the UK. While waging a running battle with the nuclear establishment I was also trying to work out what we ought to do instead. That included what people then called energy conservation and later efficiency, as well as better ways to use coal and some skeptical but hopeful interest in what people called renewable energy.

It also, of necessity, included electricity. In 1977 Friends of the Earth published a book of mine called *The Fissile Society*, whose subtitle was *Energy, Electricity and the Nuclear Option*. It sank without trace. But when I recently reread it I was startled to find that some of my most radical ideas about electricity date back at least that far, more than three decades. If you're interested, *The Fissile Society* is now available as a free download from my website archive Walt Patterson On Energy – waltpatterson.org. But electricity as such only became the focus of my work after the Thatcher government liberalized UK electricity in 1990. One consequence, much to the dismay of Mrs Thatcher, was the effective termination of the UK nuclear programme, when the City of London refused to buy it. I was overjoyed. By that time I was bored with the sound of my own voice, reiterating arguments that had hardly changed in nearly two decades. I was eager to move on.

In 1991, to my astonishment, I was invited to join the Energy and Environment Programme at Chatham House, the Royal Institute of International Affairs, just as electricity burst on the scene as

an international issue. The Chatham House fellowship also made me a colleague of my long-time friend Michael Grubb, through whose good offices I have the opportunity to talk with you today. By the mid-1990s all my earlier work had converged on electricity itself.

I've long been puzzled as to why no one has ever written a history of world electricity. It is a story at least as remarkable as Dan Yergin's Pulitzer-winning history of world oil, *The Prize*. For electricity, however, we are now in a history trap. World electricity is still based on a conceptual and technical model more than a century old. We are stuck with legacy assets, legacy institutions and – most importantly – legacy mindsets, that are out of date, obsolete and dangerous. Nearly one-third of our fellow humans still do not have electric light, and traditional electricity is not going to reach them. Those of us in the more fortunate parts of the world are going to have more and more trouble keeping the lights on. The way we use fuel, not least for electricity, may cause climate catastrophe. We have to do better.

I was in favour of liberalization of electricity, not least because it at last exposed the disastrous economics of nuclear power. But I was, and am, deeply uneasy about how the UK did it. Mrs Thatcher's liberalization did not really change the traditional model of electricity. It only superimposed a new layer on top of it, a seriously ill-fitting layer as it has turned out.

At Chatham House in 1995, picking up on ideas from colleagues such as Michael Grubb and Carl Weinberg, I undertook work on a book I called *Transforming Electricity*. Then I had a bad fall at home and fractured my pelvis, putting me out of action for nearly two years. The accident had an unexpected benefit. In early drafts of the book I'd been referring to developments that might take place. By the time I was able to finish the book, some of these developments were no longer hypothetical. They were already happening.

Since that time I've been trying to rethink electricity from its fundamentals. My efforts have been nothing like as detailed or as focused as yours, but they may nevertheless be complementary. My approach has been broad-brush, very long term and global. I take as an initial premise that if we were starting now to design an electricity system for human society, knowing what we now know, technically, financially, institutionally and environmentally, our resulting system would look dramatically different from the systems that are now keeping our lights on. That of course is the corollary problem. We rely completely on our out-of-date traditional legacy systems. We can't just scrap them and start over. The key issue when designing a future electricity system is how to get there from here. I'll say more about that shortly.

Working on electricity, I came gradually to realize that I was trying to design not just a satisfactory global electricity system, but a global energy system. I say 'design', but that's way too ambitious, if not indeed megalomaniac. What I'm attempting is what Einstein called a 'thought experiment': to imagine a coherent, consistent and plausible arrangement, corresponding to known realities, that delivers what human society expects and desires from energy. So far, at least, I'm finding that electricity may be the key to a sustainable global energy system, for reasons I'll try to explain.

Recall the campaigning mindset I bring to this discussion. One key motivation is the stubborn disconnect between what people call 'energy security' and climate security. Viewed from a conventional perspective, these two essential categories of security appear to be incompatible going on irreconcilable. To me, however, the reason this problem looks so intractable is at least in part because we are describing it wrong. What politicians and commentators call 'energy security' is

really fuel security – the concern that our supplies of fuel, especially imported fuel, may not be sufficiently reliable or affordable. That is to be sure an issue, but it is about fuel, not 'energy'. In any case this word 'energy' is also confusing and misleading. I trained as a nuclear physicist. To me energy is the unifying principle of science. Energy is how the universe works. Since the early 1970s, however, people have been saying 'energy' when they really mean fuel - oil or coal or natural gas - or even electricity. Fuels are not all the same. They are not interchangeable. You can't substitute one for another - not without changing the technology to use it. Electricity is not even a fuel; it's a process in technology. To me, using the word 'energy' with all these different meanings, smearing them all together, is confusing and misleading. I think we are managing energy wrong. As a result we are getting ourselves into deep and unnecessary trouble, with fuel security, with climate, and with global equity and stability.

Our troubles arise not from energy, but from the ways we use fuel. That ought to be our focus of concern. Let me say at once that I long since heaved a sigh of relief that I came to devote my career to energy, not transport. I have frankly no idea how we are going to cope with transport in the coming decades. Transport is not just an energy problem. Over more than a century we have organized human society under the influence – what feels increasingly like the pernicious influence – of cheap petroleum and the internal combustion engine. We have laid out our settlements and our activities in ways that make large-scale forms of artificial mobility not merely desirable but essential. The implications are scary; but I can offer no solution. All I can suggest is that we tackle the easier problems first, while we and our successors wrestle with transport.

To me electricity is much the easiest and most obvious place to start; indeed the transformation we need is already under way, and not before time. This how my book *Keeping The Lights On* describes traditional electricity:

It is based on large central-station generators, most of which operate either intermittently or at only partial load most of the time. The central-station generators that use fuel waste two-thirds of the fuel energy before it even leaves the power plant. The system necessitates long lines of network, in which line losses cost another significant fraction of the energy flowing. The configuration is inherently vulnerable to disruption, by mishap or malfeasance, over a wide area and almost instantaneously. It assumes that every load is essentially equivalent, requiring the same high quality of electricity. The system produces and delivers high-quality electricity as required by sensitive loads, much of which is then used for undemanding services such as heating and cooling. The generators are almost all thousands, more often millions of times larger than most of the loads on the system. Most of the loads are inherently intermittent or variable; but the system's large fuel-based generators are inherently inflexible.

The mismatch is so complete you'd think we planned it that way. Yet probably the single worst feature of this arrangement is that the rest of the system is selling electricity to the user by the measured unit. The more the user has to buy, the more revenue for the seller. The seller therefore wants the user to have inefficient lamps, inefficient motors and other inefficient user-technology. This perverse incentive to poor overall system performance has persisted ever since the invention of the electricity meter some 125 years ago.

We know that we can now do much, much better. With that in mind I've been trying for more than a decade to imagine an electricity system for the entire planet, knowing what we now know. If we have such a future system in mind, we're better able to judge whether our immediate policy and

contemporary decision-making for electricity is taking us in the right direction. That means, for instance, not building new long-lived facilities that do not meet the criteria for our future electricity system.

You all know what we now have available as components of a future system, including a growing catalogue of innovative generating and network technology. For me, however, the key is to take a whole-system approach, and to start not with electricity supply but with electricity use and user-technology. That emphatically includes buildings, the most important energy technology of all. The aim of the system should be the absolute converse of the traditional aim. From Edison onward electricity systems have striven to maximize the amount of electricity used. My future system would strive to minimize it, as a corollary of delivering all the reliable, affordable services we may desire. That means, of course, that we stop wasting electricity the way we do, with egregiously inefficient lamps, motors, heaters, chillers and other user-technology. It also means that we upgrade the performance of our built infrastructure, to deliver comfort and other services with a minimum of fuel-based electricity.

Think about that phrase, 'fuel-based electricity'. All over the world, we use essentially two kinds of electricity. One we generate from fuel - mainly coal, oil, natural gas and uranium. The other we generate from natural ambient energy flows, including sunlight, wind and water. Most people call this electricity 'renewable', a term I dislike because it's meaningless. I call it 'infrastructure electricity'. You invest in a physical asset, a piece of infrastructure, such as a wind or water turbine or a solar array. It then converts the local ambient energy into usable electricity.

The long-term implications of infrastructure electricity are profound. Ever since the invention of the electricity meter, and its interaction with fuel-based electricity and large-scale dam-based hydroelectricity, we have treated electricity as a commodity, selling and buying it by the measured unit in short-term transactions, as the basis of electricity finance and electricity business - what we can call economics of flow. For infrastructure electricity, however, we need to use economics of stock - investment finances, and business relationships based on longer-term contracts, not on a meter. What matters is not a commodity but an array of physical assets - who owns them and who uses them, on what basis, with payments for availability of and access to services, just as you use and pay for your house.

Needless to say such a fundamental change in thinking is not going to happen quickly or easily. But it has an equally fundamental corollary. If, over coming decades, we move in this direction, changing the way we think about electricity, and making decisions accordingly, we may find that we are not just decarbonizing electricity, but using electricity to decarbonize the entire human energy system of the planet. What we are now calling a 'low-carbon' economy, if we get serious about moving toward it, will really be a 'low-fuel' economy. That means in turn that in due course, possibly many decades hence, much of what we now do with fuel we shall do with infrastructure electricity, running high-performance user-technology.

I did, however, say at the outset that this was going to be broad-brush and very long-term. I concede immediately that I don't expect to be around to see us get very far along in this process. The obstacles are all too obvious and obtrusive. The traditional mindset, the way we think about electricity and energy in society, is built into our institutions and social organization, our decisions and governance, individually and collectively. Governments, regulators and corporate planners see their roles in energy in particular ways. So do energy users. That will not be easy to change. We may

encounter physical constraints of resource availability, not for commodity fuels but for infrastructure materials, including rare metals and other minerals of critical importance for high-performance technology and controls. The change I'm suggesting, from traditional to innovative energy, away from fuels and toward infrastructure electricity, will create global constituencies of winners and losers; and the losers will not go quietly. Somehow I can't see the oil companies, the coal companies, or indeed the OPEC countries, taking kindly to a low-fuel future. Oddly enough, however, the natural gas companies might prove to be more amenable, precisely because in the interim decades gas could become the dominant fuel, the 'transition fuel' we've heard about for so long.

Which brings us, inevitably, to the main question. If this broad-brush long-term vision is attractive, as I hope it is, how do we get there from here? We have to start by recognizing the possibility of thinking differently about electricity and energy. Those of us in academia, with comparative freedom for intellectual innovation, without the constraints or responsibilities of government or corporate decision-making, are probably best-placed to take a lead here, to initiate the essential changes in concepts and language to shift the discourse of energy policy into this new direction.

To me, however, the next step is the crucial one. Governments are also energy users - major energy users. In their role as energy users, they themselves can change not only the discourse but the practice. As clients and contractors they can change the ground-rules for the business of energy. They can launch - and publicize, not just at the outset but on a continuing basis, as public education - major long-term strategic programmes to upgrade their own buildings, fittings and other user-technology, and to add innovative decentralized supply technologies for their own sites, including heat pumps, gas-fired microcogen and infrastructure electricity generation. The contracts entailed would prime the pumps for the new breed of energy service company we need. Such programmes would create skilled jobs all over the country, bring down the unit cost of innovative materials and technologies, and provide vivid practical examples to the private sector. Best of all, if properly organized and managed, they would save us taxpayers money. In the aftermath of the global financial mess, we've heard repeatedly about 'green stimuli' and a 'green economy'. The opportunity is obvious. Governments should stop telling the rest of us what to do, and start showing us.

When Madie Armstrong asked me for a title for the seminar today, I suggested that we call it 'An Electric Planet?' I insisted that the title include the question mark, because the concept is, to put it mildly, speculative. But the more I think about it the more I like it. I'm sure you'll let me know what you think.

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