

## Start With Electricity

What do you mean by 'energy'? Many of you here today probably use the word dozens of times a day, speaking and writing. Do you know what you mean by it? Do you even think about it? Do you mean oil? coal? natural gas? Do you mean electricity? Do you mean all of them together? They are not the same. They are not interchangeable. Smearing them all together and calling them all 'energy' is at least misleading. Those most likely to be misled are you and your colleagues, especially those of you whose business is 'energy', whatever you may think that means.

I know what I mean by 'energy'. By training I'm a physicist. I'm also a pedant. I am fussy about language. Whenever I hear so-called experts talk about 'energy production' or 'energy consumption', my teeth ache. Have these experts never heard of the first law of thermodynamics, the law of conservation of energy? Energy is never created, nor destroyed. That's what makes it such a potent physical concept. We don't have to conserve energy. Nature already does that. Since the early 1970s, however, we have used 'energy' as a handy label for any and all fuels, plus electricity. That's not just wrong - it's dangerous. It has given us a seriously distorted picture of what we do with energy, how we do it, how we think about it and how we pay for it.

When we smear together all fuels plus electricity, and call the result 'energy', we are smearing together many different, distinct problems, with different attributes and timescales, different scope, and different options. It makes us think these problems are all the same, all equally difficult and all amenable to similar solutions. They are not. We need to stop saying 'energy' when we really mean a particular fuel, or electricity.

Moreover, we persist in thinking of energy issues as though they were commodity issues. We are preoccupied with short-term batch transactions in oil, gas, coal and electricity. What we call 'energy policy' is nothing of the kind. It used to be called 'fuel and power policy'. That's what it still is. Today's so-called 'energy policy', and all the commodity thinking that goes with it, including the so-called 'energy market', regards end-use energy technologies, what we can call energy service technologies, as an afterthought. That has to change, and change quickly.

When you buy a lamp, a motor, a computer, do you buy it because you want to use electricity? Of course not. You buy it because you want the service the technology delivers. Let me repeat that. The **technology** delivers the services - the comfort, the illumination, the motive power, the mobility, the refrigeration, the information, communication and entertainment.

At any given moment, when you already have the physical assets, the energy service technology, you also want to ensure whatever supply of fuel or electricity your existing technology may also require to deliver the service. Over a timescale of years, however, to say nothing of decades, what matters is not 'energy security', which these days just means 'fuel security'. What matters is 'security of energy **services**' - that is, keeping the lights on.

If the timescale is in years and decades, you have a choice. Should you try to ensure a supply of the requisite fuel or electricity to run your existing energy-service technologies? or should you instead

use the time and the investment to upgrade the energy-service technologies themselves? We can improve dramatically the energy performance of our buildings, fittings, appliances, process plant, vehicles and other energy-service technologies. At least since the 1970s we've known how to get better, more reliable services while needing less fuel or electricity. But we have not bothered. It's time we did.

Energy service technologies, especially buildings, should be the explicit focus of what will at last become real *energy* policy. Except in the very short term, energy issues are not commodity issues. They are about *investment*. Energy issues are *infrastructure* issues. Moreover, despite what you may hear from people in what they call the energy industry, the most important infrastructure is not the pipelines and power lines that deliver fuels and electricity. The most important infrastructure is the physical assets, the technologies that deliver the energy services we actually want.

Energy, therefore, is not a single issue but a range of very different issues. Some are truly daunting. Over the past century we have organized human society under the influence of cheap petroleum and the internal combustion engine. How we are to cope with future mobility and transport on this finite planet I frankly have no idea. On the other hand, I am now convinced that we can improve dramatically and quite rapidly the performance of the electricity systems on which modern industrial society now depends. My book *Keeping The Lights On: Towards Sustainable Electricity* explores the possibilities.

Think about it. The traditional electricity system that we all take for granted worldwide is based on criteria from the 1890s, a common technical model whose essentials are now more than a century old. It arose because of the economies of scale associated with water power and steam power, the only two options then available to drive electricity generators. Traditional electricity is still based on large central-station generators. Most of them operate either intermittently or at only partial load most of the time. Those that use fuel waste two-thirds of the fuel energy before it even leaves the plant. The system has to have long lines of network. Line losses waste another significant fraction of the energy flowing. The system is inherently vulnerable to disruption, by mishap or by malice, over a wide area and almost instantaneously. We see the resulting blackouts all too often.

The arrangement assumes that every load is essentially equivalent - that all loads require the same high quality of electricity. But we then use most of this high-quality electricity for undemanding services such as heating and cooling. The generators are almost all at least a hundred times, and more often ten or a hundred thousand times, larger than most of the loads on the system. Most of the loads, such as lamps, motors and computers, are inherently intermittent or variable; but the system's large fuel-based generators are inherently inflexible. The mismatch is already so complete you'd think we planned it that way.

But electricity is different. A fuel such as oil or natural gas comes from a hole in the ground. If you want to use it somewhere else you have to carry it there. Electricity you can generate anywhere, in any quantity from minute to vast. In particular, if you want to, you can generate electricity close to where you want to use it, and in the quantities you want to use. We already do this some of the time - think of a flashlight or iPod. But we can now also do this on a larger scale, for a whole building or group of buildings, a neighbourhood or a village. The shopping list of innovative small-scale, clean generating technologies is already long, and expanding rapidly. We can now design and implement integrated local systems, using high-performance end-use technologies to make optimum use of local electricity, to deliver comfort, illumination, motive power, refrigeration, information and entertainment. Such local systems can be more reliable and cleaner than traditional electricity.

But what about the cost? The so-called 'cost of electricity', comparing different technologies, is usually plucked out of the air and stated baldly to fractions of a cent. But these purported comparative costs omit almost everything that matters. They say nothing about the accounting or financial framework, the tax treatment, the subsidies however you define them, the risks and who bears them, the system effects, the network effects and other essential details that influence costs and who pays them. For policy purposes these alleged 'costs' are meaningless. They should have no influence whatever on policy. Policy determines costs - not the other way round. That's worth repeating, with emphasis: ***policy determines costs***. Sensible electricity policy will make the most reliable, cleanest options the cheapest.

Governments make policy, and governments use energy, especially electricity. The opportunity is obvious. Governments should stop telling the rest of us what to do, and show us instead. Governments should launch programmes to upgrade ***their own facilities, their own energy service infrastructure***, to much higher standards - better insulation, better doors and windows, better lighting, better motors and controls, better appliances and electronics, probably even complete local systems using on-site generation of electricity, heat and cooling. Such government programmes would be valuable pump-priming for the energy service companies that would bid for and carry out the work, and a vivid example to the private sector. Government investment programmes would bring down the unit cost of innovative technologies. They would create skilled jobs everywhere. And of course, properly managed, such programmes would save all us taxpayers money. Imagine what such an approach could accomplish worldwide.

Let us, therefore, solve the easy energy problems first, while we continue to grapple with the daunting ones. Let's start with electricity, and let's start now.

(c) Walt Patterson 2008