Electric Opportunities

Climate change represents an opportunity as much as a threat. By tackling the climate problem at its root we can also tackle critical problems of security, equity and sustainability. But to do this, we have to challenge deep-rooted assumptions on how we think of energy and electricity

By Walt Patterson

Wind farm in Cornwall, England. Photo: Corbis.

We've known for decades how to use energy better. We've never really tried. Now, however, all the factors are coming together, including climate, reliability and security. The key is electricity. Even if climate were not a problem we'd have to do something about electricity. World electricity is in turmoil, and the turmoil is getting worse. Keeping the lights on gets harder and harder. Two billion people – one-third of humanity – have no electricity at all. The International Energy Agency has estimated that by 2030 the investment needed for electricity will be ten trillion dollars. Yet moving to competitive commodity markets selling electricity by the unit has cost many of those in the electricity business their jobs, their shirts or their companies – tens of billions of dollars' worth of losses already. Future electricity investment, to say nothing of ten trillion dollars, could now be so risky it might not happen.

The main technologies of traditional electricity – large dams, coal-fired and nuclear power stations, and overhead transmission lines – are all in trouble, both financial and environmental. Yet electricity fogies try to stampede us into more of the same. If we are to keep the lights on, if the rest of humanity is to join us in the light, electricity has to change – in technology, finance and organization. Fortunately, electricity is already changing. With the right policies it could change much faster, helping to stabilize climate even as it improves security, equity and sustainability. The most advantageous electricity investments worldwide might not even need one thousand billion dollars every three years.

The essential step is to recognize that electricity is different. Despite prevailing assumptions to the contrary, electricity is not a fuel, nor is it a commodity. Electricity is a process, occurring simultaneously and instantaneously throughout an entire interconnected circuit. Unlike a fuel or other commodity, electricity cannot be stored. A fuel such as coal, oil or gas comes out of a hole in the ground at a particular place. If you want to use it anywhere else you must carry it there. Electricity, by contrast, you can generate anywhere, in an extraordinary variety of different ways, in quantities from immeasurably small to awesomely large, according to purpose. Within the past two decades the technical options available have expanded dramatically, offering a mouth-watering array of opportunities to deliver electricity services more reliably and sustainably.

We have yet to seize these opportunities. Instead, we still cling to an arrangement dating back more than a century. For reasons that made sense at the time, this arrangement became spectacularly successful – so much so that it spread all over the world, sometimes to places where it made no sense at all. It now makes less and less sense even where it was once successful. In this traditional arrangement, very large remotely-sited power stations use rotating machines to generate electricity in the form of synchronized alternating current, delivered to users over vast networks including long high-voltage transmission lines. This

made sense when the main generating technologies then available, water power and steam power, offered substantial economies of unit scale – when a better power station was always a bigger power station farther away, even though a steam-cycle station wasted two-thirds of the energy in the fuel. It made sense when loads were significant and close enough together to make the network efficient, and when the network improved reliability and power quality, in spite of the losses involved.

These criteria no longer apply. Economies of scale have long since been overtaken by diseconomies. Networks no longer prevent but often cause blackouts and other faults. In liberalized electricity markets, risks are borne not by captive customers but by shareholders and bankers, and they are hurting. But most of the world still relies on outdated electricity systems to keep the lights on. What is outdated is not just the physical power stations and networks, although many are forty or more years old and obsolete. What is outdated is the actual configuration of electricity systems, indeed the very concept of how electricity systems should function. Updating electricity could alleviate stubborn problems and yield major benefits.

The starting point is not merely that electricity as such cannot be stored. The difference is more fundamental. Unlike oil, or even natural gas, electricity simply does not exist without the infrastructure of assets that generate, deliver and use it, and through which it flows. Electricity is first and foremost a function of infrastructure. Understanding this is the key to the necessary changes. You can generate and use electricity without fuel, but not without infrastructure. The flow of electricity through the system infrastructure is easy to measure; but that does not make it the most appropriate basis for finances, transactions and business relations. Ownership, access to and use of system assets – generators, networks and loads – are much more important. Moreover, these factors are tightly constrained by the need to keep the entire system stable, instantaneously and continuously. The rights and obligations of the different asset-owners must be meticulously defined and observed, not only from moment to moment but over extended periods of time. The rights and obligations of asset-owners determine how to operate, maintain and modify the system.

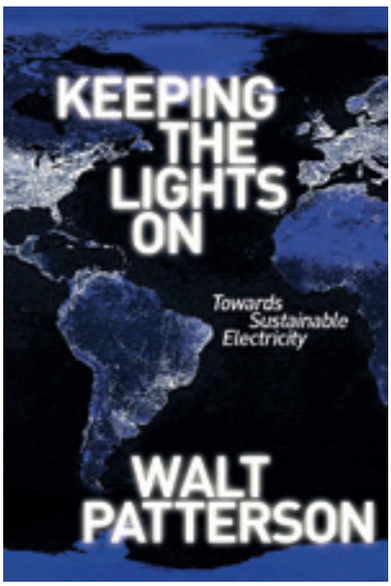
Treating electric current as though it were a commodity fuel is profoundly misleading. Even on a traditional monopoly-franchise system, the decreed price of a kilowatt-hour of electricity flowing through some circuit at some instant depends ultimately on a regulator. On a system liberalized as though electricity were a commodity, this is yet more so, because of the essential role of the network. The price per unit is an arbitrary and inadequate surrogate for a complex and evolving nexus of business relations. Focusing entirely on the price of an ephemeral unit of electricity is asking for trouble. The trouble is duly arriving – bankruptcies, bailouts and blackouts. Instead of fighting a losing battle to defend outdated assumptions, we should seize the opportunities now burgeoning. We should regard electricity as a process occurring in infrastructure, and focus on the infrastructure, not the electric current. We should develop policy explicitly to alter the electricity infrastructure – generation, network and loads, but especially loads, and in particular buildings – to increase the reliability of the services the infrastructure delivers, to improve its performance and to broaden its benefits.

This is where innovative opportunities burgeon. We can now use a widening array of small-scale generating technologies, including microcogeneration of several kinds, wind power, microhydro and photovoltaics, to power local systems to deliver electricity and heat. A local system is much easier to optimize. Those with the requisite expertise, especially energy service companies, can get the entire system right.

If governments want to seize these electric opportunities, policy levers are ready to hand. Begin by ignoring the so-called “cost of generation” by different technologies. These numerical constructs tend to be plucked out of the air and stated baldly to fractions of a penny, with no qualification as to the accounting or financial framework, tax treatment, subsidies however defined, risks and who bears them, system context, network effects or

Walt Patterson is an associate fellow of Chatham House in London, a visiting fellow at the University of Sussex and a member of the editorial board of European Energy Review. His latest book is Keeping The Lights On: Towards Sustainable Electricity (Chatham House/Earthscan 2007). Walt Patterson On Energy, www.waltpatterson.org, is an online archive of more than 35 years of his work on energy and environment.

other essential details. The "cost of generation" thus stated is essentially a "hooray" or "boo" number, used tendentiously to compare one generating technology with another, almost always with an agenda favouring one over another. For policy purposes such purported "costs" are essentially meaningless. Today they are routinely cited to indicate that traditional large-scale remote fossil-fired generation is "cheaper" than smaller-scale renewable or cogeneration closer to loads. The comparison is specious.



Consider, for example, one of the most potent policy levers government can use – taxation. If electricity is treated as a commodity fuel, governments think taxation only applies to the unit price, and to batch transactions in measured amounts. But if electricity is treated as an infrastructure issue, effective tax policy should focus not on flows of electric current, but on the tax treatment of assets in electricity infrastructure – all assets, explicitly including loads and the buildings that contain them. If a policy objective is to upgrade the electric infrastructure, to improve performance and reliability of services and reduce unwanted side-effects, asset taxation should reflect this objective. It should recognize that electrical appliances and even passive infrastructure such as buildings are part of the system that delivers comfort, illumination, refrigeration, information and all the manifold electricity services so many of us take for granted.

We've known for decades that upgrading this end-use technology is the most effective way to deliver better services more reliably at lower cost and with lower impact. But most electricity users don't know or care enough to do anything about it. Worse still, companies whose business is selling units of electricity want us to use more, not less. Until recently, tax policies with this objective have been fragmentary, tentative and ad hoc. Now, however, innovative electricity offers more cogent reasons and more attractive opportunities to integrate and optimize entire local systems, including both generation and loads, especially buildings. Users do not want reliable "electricity"; they want reliable electricity services. With local generation, under local control, driving local loads, the responsibility for keeping the lights on can be similarly local and coherent. Moreover this responsibility can be the focus of well-defined contracts between those using the comfort and illumination, say, and those providing them. Explicit fiscal policies, notably on asset taxation, combined with enlightened regulatory policies, can give specialist companies with the requisite expertise, including the major gas and electricity companies, a sound economic incentive to do so as effectively and economically as possible.

As a key policy lever, start with government procurement. Throughout the European Union, governments themselves, national, regional and local, have vast estates of buildings that are their own responsibility – everything from schools to prisons. In the UK, the quality and energy performance of these buildings is mostly substandard, often appalling. Governments can launch programmes to upgrade their own buildings to much higher standards. Such programmes would be valuable pump-priming for energy service companies. They would bring down the unit cost of innovative technologies. They would create skilled jobs all over the EU. They would dramatically reduce greenhouse gas emissions. They would reduce or indeed eliminate so-called "fuel poverty". They would be a spectacular international public relations coup for the EU.

Begin by changing the mind-set. Take electricity as the starting point. Regard electricity not as a commodity but as a process delivering services. Improving the process in turn starts with improving the energy service infrastructure itself. If we can set this in train for electricity worldwide, we may begin to recognize that all energy services, even including transport, are not commodities but processes. The challenge is always to optimize the entire process – an inherently positive undertaking for human society. Let's get started. ■