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# Upgrading electricity

The traditional electricity system is based on a common technical model 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 remotely-sited 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 require the same high quality of electricity. But we then use most of this high-quality electricity for undemanding applications 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.

It does not have to be like this. Innovative technologies and innovative system design now offer cleaner, more robust and more reliable electricity services. But legacy systems, legacy institutions and - especially - legacy mindsets make upgrading electricity a daunting challenge.

If we were starting from scratch today to create electricity systems, using what we now know about technologies, applications, finances, business models, resources, environment and society, the systems would look utterly different. Our main problem, however, is that we cannot start from scratch. Billions of people already rely on traditional electricity to keep their lights on. We cannot scrap it and start over. The transition from nineteenth to twenty-first century electricity must be gradual. But gradual does not and must not mean slow. The process of upgrading electricity must be coherent, focused and directed, toward a credible long-term vision of the future of electricity in our human society.

Smaller-scale generation can be cleaner and more efficient. It can be sited close to loads, even on the same site, reducing losses and vulnerability to disruption. Technologies such as gas engines, Stirling engines, microturbines and fuel cells can also offer cogeneration and even trigeneration, producing electricity, heat and cooling from the same amount of fuel. They can be heavily instrumented and remotely monitored, requiring no on-site staff or maintenance. The catalogue of innovative technologies also includes wind turbines of every size and kind, solar thermal power generation, solar photovoltaics, and a lengthening list of marine technologies. But innovation is not just about generation, about producing and delivering electricity. Upgrading electricity means changing the fundamental nature of the system, its role and function in society - not only how we make, use and pay for electricity, but how we think about it.

Ever since the introduction of the electricity meter in the mid-1880s we have thought of electricity as a commodity, that we sell and buy by the measured unit. The notion of electricity as a commodity was central to government plans when they began to liberalize electricity, some two decades ago, and created the so-called 'electricity market'. It is a bizarre and arbitrary construct. The reason they have not yet got it right is because electricity is not a commodity - it is a process. Selling electricity by the unit of measured flow is ultimately as sensible as selling by the unit the kinetic energy passing from the drive shaft of a car engine to its wheels. What matters is the *whole system* through which electricity is flowing. Electricity by itself is useless. It only exists in infrastructure. What is important about electricity is that we use it to *run stuff*. What matters is the *stuff we run*, the technology and the infrastructure that deliver the services we actually want. Upgrading electricity depends above all on upgrading this stuff - the lights, motors, chillers, electronics, and especially the buildings, that provide all these services.

In the grip of a global financial crisis the UK government, like many others, is trying desperately to inject fresh confidence and fresh funds into the economy. As Nick Stern and other commentators have pointed out, this is a dramatic opportunity to upgrade our energy systems and infrastructure. The UK government should stop telling the rest of us what to do and show us instead. The Sustainable Development Commission, the National Audit Office, and most recently the Environmental Audit Committee of the House of Commons have all pointed out that the UK government uses tens of thousands of buildings. Most are inadequate; many are appalling. To inject funds into the UK economy the government should immediately launch programmes to upgrade its own facilities to much higher standards - better insulation, better doors and windows, better lighting, better controls, better appliances and electronics, and - especially - complete local systems using on-site generation of electricity, heat and cooling.

Government upgrade programmes would persuade major energy players to create effective and profitable energy service companies to bid for and carry out the work. They would create skilled jobs everywhere. They would also offer a vivid example to the private sector. Bulk orders for upgrades would bring down the unit cost of innovative materials and technologies. Such programmes would dramatically accelerate the upgrade of electricity into the twenty-first century. Best of all, properly managed, government upgrade programmes would save all us taxpayers money.

Upgrading our energy systems could save the global financial system. It might even save the planet. Let's start with electricity, and let's start now.