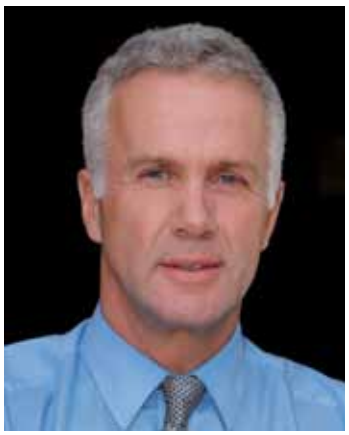
Changes in power systems – are they bad for nuclear?

With the advent of renewable power and the rise of small, flexible gas-powered units, the power grid is becoming much more complicated. Utilities will need to adapt to remain competitive in a market where the role of 'traditional' power stations remains unclear.



By Steve Kidd

Some 15 years ago, I read and reviewed a book titled Transforming Electricity – The Coming Generation of Change by Walt Patterson, a fellow at The Royal Institute of International Affairs (Chatham House) in London. Although a trained nuclear physicist in Canada, Patterson had turned against the industry and became one of its most credible opponents in the UK.

Although the book wasn't specifically about nuclear power, its main thesis was that the traditional model of electricity supply, with large centralised generating units supplying power through huge grid systems to distant customers, was on its way out. This was to be replaced by distributed generation, whereby power is supplied locally – indeed, each home could ultimately have its own generating unit, providing surplus power when available but also drawing from a local grid when demand is high. Such a switch in the electricity supply model would inevitably cause significant difficulties for nuclear power, as the larger generating units would not be required in a distributed system, and indeed the whole concept of supplying baseload power (upon which nuclear is essentially based) would go out of the window.

My review of the book was far from sympathetic, and centred on the view that switching to such distributed systems would be expensive and create security of supply issues. There was little evidence that customers wanted a small generating unit hidden away under their sink in the kitchen, rather than drawing from a national grid.

At the same time, however, I thought that wind power would never gain much traction in the developed world, which proves that one must always be cautious about predicting the future. Although my view remains that in 50 years' time, people will look back at on- and offshore wind turbines (by then long banished from mainstream power supply) as a rather ridiculous episode in world energy history, some of the changes in power supply which have come with them are more likely to stay with us. Within the developed world, we may not reach a fully distributed electricity supply system, but there are some fundamental changes taking place today.

Electricity demand

The old concerns about supply failing to meet demand for power have largely gone away and we suddenly have relative abundance. Although there are sometimes worries about the lights going out as old generating units, largely coal-fired, are shut down and have to be replaced by alternatives, the underlying position is much more secure.

On the demand side, electricity has become decoupled from economic growth in the developed world and previous forecasts of steadily rising demand have proved incorrect. To some extent this results from a change in industrial structure from heavy industry to services, but this only means that electricity demand shifts from Western Europe and North America to rapidly-developing countries such as China and India. These are therefore the countries that need additions of large generating units to meet demand, hence nuclear power still has excellent prospects here. There is a rapidly-rising baseload of power demand, which can ideally be met by large, environmentally-friendly generating units.

The demand movements in the developed world, however, go a lot further than a change in industrial structure. Energy saving has become very important, with newer household goods much more efficient than those of the past. People today have a far more devices running on electricity in their homes, but most don't use much power. For many people, ensuring that their smartphone remains charged up has become a prime concern, but the power from the grid consumed by this is relatively small and the phone manufacturers are pushing hard to reduce consumption so that batteries last longer. In Germany, for example, household consumption of electricity is now lower than it was back in 1990 and, globally, the previous assumption that demand will increase by an average of 2-3% per year is questionable.

It is now recognised that the cheapest and cleanest energy choice is not to waste it. Energy efficiency is akin to an additional fuel and investing in it can earn a substantial and even a quick return. The design of buildings is one area where a lot of energy can be saved on heating and cooling and efficiency of use is now an important factor. The stock of old buildings designed with little thought of energy saving is a drag on progress, but they can be slowly improved or replaced with new build.

Higher prices for power also have something to do with the push for greater efficiency. The need for substantial investment in new generating capacity has meant that electricity prices to customers have risen well ahead of general inflation (which is now at very low, or even negative, rates in many developed countries). The huge subsidies necessary to get renewable energy established have to be paid for, while in the UK the plan to build new nuclear power stations involves a high and guaranteed power price.

There are risks that higher electricity prices will lead to "energy poverty" for those at the bottom end of the income distribution, but higher prices provide a clear incentive to think of power as a valuable commodity. There was a tendency to think of electricity as a "free good" like water, with a risk that large quantities would be wasted, but today there is a greater recognition that there are real costs involved in getting adequate supplies to the customer.

Another increasingly important area is storage. This is needed for intermittent renewable energy sources to reach their full potential and important gains are now being made in battery technology. Most analysts believe that solar power offers the most potential amongst the renewables and linking solar panels with batteries for storage is becoming economically viable as the costs of solar panels come down. Cheap home-generated electricity can also be stored as thermal energy, while battery-powered cars act as a way of storing power.

The most expensive electricity in any power system is that consumed at peak time, when more costly generating units have to come on stream. So instead of cranking them up, customers can be incentivised to curtail their power demand. The Internet has made it possible to produce, store and manage data more efficiently and this can now be applied to electricity. Sensors can now collect vast amounts of data about energy use and computing power and algorithms can offer incentives to customers to curb consumption at peak times and increase it when demand is low. Flattening out the load curve is possible using smart meters to provide economic signals, but it is unknown at present how rapidly the plans for this can be rolled out. The alternative is individual smart devices programmed to maximise their efficiency. The key is to achieve a lot of small individual power savings from many customers at one time, which cumulatively make a real difference.

Supply situation

On the supply side, a simple fact is that it is not difficult to make electricity and with the advent of renewable technologies there are a huge number of options available. With the better management of demand, it has been argued that we are moving into a world of abundant energy. Unconventional gas has had an enormous impact on the power business in North America while in Europe it is renewable energy that has dominated. Transmission costs for electricity are also now plunging, thanks to solid-state technology, which makes efficient direct current (DC) safer and more flexible. Power grids that were previously isolated can now be connected. Indeed, investing in power grids is now as important as building new generating capacity, and is vital for getting renewable power to the market and for connecting national power markets in Europe.

The result of these changes is that the old model of the electricity industry is breaking down – rapidly so, in some countries. Sending high voltage power over long distances to passive customers, meeting the peaks and troughs in demand, was a stable and profitable business while it lasted. But with the advent of renewable power and small, flexible gas-powered units, we have entered a new world where demand can be tweaked to match supply, not the other way around. The power grid is therefore becoming much more complicated. It is rather akin to what happened in computing, as there is a parallel with the switch from mainframes and terminals to cloud storage and the Internet. The traditional power stations and grids will still play a role but increasingly this may be as a backup.

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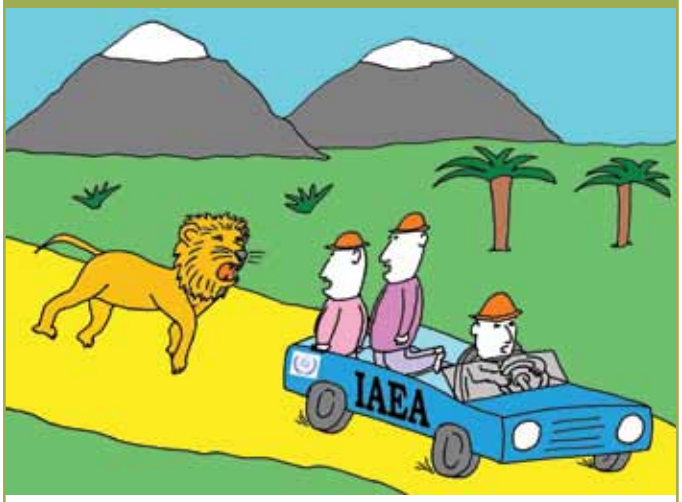
For the established power utilities, the business model has to change. The threat to them is similar to that the telephone companies faced from mobile phones in the 1990s or newspapers do today from the arrival of social media. In Germany, the traditional power utilities have been effectively destroyed by having to write off their very profitable investments in nuclear power and by the huge investment by competitors in renewable power. In other countries, such as the UK, the traditional model may survive rather longer, but with companies earning relatively low profits from administered power prices. The changes in the power markets are essentially unstoppable and will eventually spread to all of the developed country power markets in one way or another.

The Unit **Alexey Kovynev**



I did tell you that this country is not suitable for a nuclear power plant!

Where does this leave nuclear power?

In the developed world, nuclear power has huge problems. There is huge competition from alternative forms of generation. Although it can be argued that some of this is over-subsidised and causing higher power prices than necessary, it seems that the trend is irreversible. Investing in huge generating assets will be very difficult, especially as the big, financially secure power utilities may gradually disappear. On the other hand, despite the push for integrated European power markets, there will still be a diversity of choices made at national levels, and for particular reasons countries such as the UK, the Czech Republic, Finland and Poland may invest in further large nuclear units.

In Africa and the other poorer counties, nuclear's prospects look even worse. Rather as they have done with phone technology, these countries will probably jump one stage in development. As with landlines, it will be centralised power supply which will be jumped over, as they will move straight to a distributed model (likely to be driven by solar power). If the 1.6 billion people in the world currently without a regular power supply are to get it, it almost certainly won't be through nuclear. The industry can dream and the International Atomic Energy Agency (IAEA) can send missions to assess the suitability of these countries for nuclear power, but believing in it simply flies in the face of more significant trends in the power sector.

It is therefore only in a relatively small number of bigger developing countries that nuclear has much chance. With huge concentrations of power demand in urban areas and rapidly-growing industrial and commercial demand for power, China and India are the obvious key drivers for nuclear in future. Nuclear's unique selling proposition is that it can provide a lot of relatively cheap power in one place and time (and for a very limited fuel input). Not that it provides "clean power". There are lots of ways in which the world can improve the environment from making better energy choices and nuclear can make only a limited contribution to this. Promoting nuclear in markets where it is out of kilter with wider trends in the power market is wasteful and resources need to be concentrated where it can make a difference. ■

Steve Kidd is an independent nuclear consultant and economist with East Cliff Consulting. The first half of his career was spent as an industrial economist within British industry, followed by nearly 18 years in senior positions at the World Nuclear Association and its predecessor organisation, the Uranium Institute.