The world is ever turning on to electric

Demand for electricity will almost double in the next 25 years, reports **Bill Hedley**, with a shift from coal and oil to renewables, gas and nuclear

The Industrial Revolution was really the energy revolution. Steam replaced muscle and coal mining became the prime mover for the developed world. Energy markets emerged that came to dominate the global economy, and could change the status of nations almost overnight.

For most of this time, the energy markets have been relatively stable. The producers have been asset-intensive, planning and running large operations over long time scales, and the markets themselves have rewarded long-term investment.

Energy markets have also been largely compartmentalised; energy types have rarely directly competed with each other but rather have evolved their own economic, regulatory and structural models. Even large disruptions, such as the oil crisis and price spikes in the early 1970s, have not provoked significant moves for particular industries to change sectors – see how transport remains reliant on oil-derived fuels.

However, that is changing with increasing rapidity. Energy types are coming into direct conflict due to technological advances and environmental pressures; new batteries and power-management systems have made electric vehicles increasingly attractive compared with petrol or diesel ones, while decarbonisation and stricter emission standards provide another pressure in that direction. Similarly, electrical heating is getting a significant boost over oil and gas as better heat-pump technology increases its efficiency.

With the UK Government predicting 100pc of new car and van sales to be electric in 25 years' time, and Norway already at more than 33pc, the possibility of an electric planet is not too far-fetched.

Some sectors still seem immune – such as aviation, where hydrocarbons' unmatched energy density (how much energy is available per kilo) makes oil-based fuels the only economic choice. Even here the theoretical capabilities of the best battery chemistries promise direct competition, although substantial technical problems remain.

Expanding role
Nuclear power is likely to be an essential part of the energy mix for the foreseeable future

But it is looking certain that the global demand for electricity will all but double in the next 25 years. The International Energy Agency (IEA) forecasts that the global appetite for electricity will lift demand by more than 70pc by 2040, almost entirely due to economic growth in non-Western countries.

Renewables will overtake coal as the largest global source of electricity by the early 2030s, with the US Energy Information Administration predicting that coal's share worldwide will decline from 40pc in 2012 to 29pc in 2040. That is part of a broader shift from carbon energy. Over the same period, Western oil markets will contract to levels last seen in the 1960s, says the IEA, and by 2040 oil and coal collectively will relinquish 9pc of the global energy mix, with renewables growing by 5pc. Gas and nuclear will each grow by 2pc.

While renewables are growing at the expense of coal, they cannot easily match the ability of fossil fuels to respond to short-term changes in demand; renewables can be turned down or taken off-grid when demand is light but they have limited ability to sustain generation when wind is low or sunlight absent. Hydroelectric generation can have water-storage reserves for on-demand boosts, but these can only run for limited periods.

There are three technologies that can compensate for this. One is local electrical storage – large batteries that soak up excess generation and feed it back during excess consumption.

Another is superconducting power grids, capable of transferring energy efficiently over thousands of miles and letting winter markets take power transhemispherically from summer sources, or night markets take solar power from the daylight side of the planet. Neither technology is close to materially affecting the market in the near to medium term, with power-grid replacement being much further away still. The third non-carbon generation system is nuclear. Although older nuclear power plants were not capable of varying their output rapidly enough to balance loads – and that reputation continues to haunt the sector – current designs are intended to be manoeuvrable.

For example, the licensing regime of the European Utility Requirements for nuclear power stations sets operating limits at between 50pc and 100pc of output capacity, with a range of three to five percentage point changes a minute. Because nuclear fuel costs are a small fraction of operating expenses, unlike with carbon-based generation, and because manoeuvring creates higher maintenance costs, operators have preferred high constant loads. But as far as providing guaranteed baseline power and compensating for intermittent power sources, nuclear is likely to be an essential part of the power mix for the foreseeable future.

> Western oil markets will contract to levels last seen in the 1960s

"No matter what economic or environmental factors dominate, future energy policies will be a balanced mix of energy types," says Paul Atherley, chief executive of uranium miner Berkeley Energia, which is developing a new mine in north-west Spain. "Investors in energy markets should reflect that in a balanced portfolio."

While energy markets will be volatile in the short term and susceptible to geopolitical changes in policy and the shocks of major events, and some medium- and long-term trajectories are dependent on technologies not yet evolved and decisions not yet taken, the overall picture is clear. Provided people and physics do not change, the future is mixed and electric.