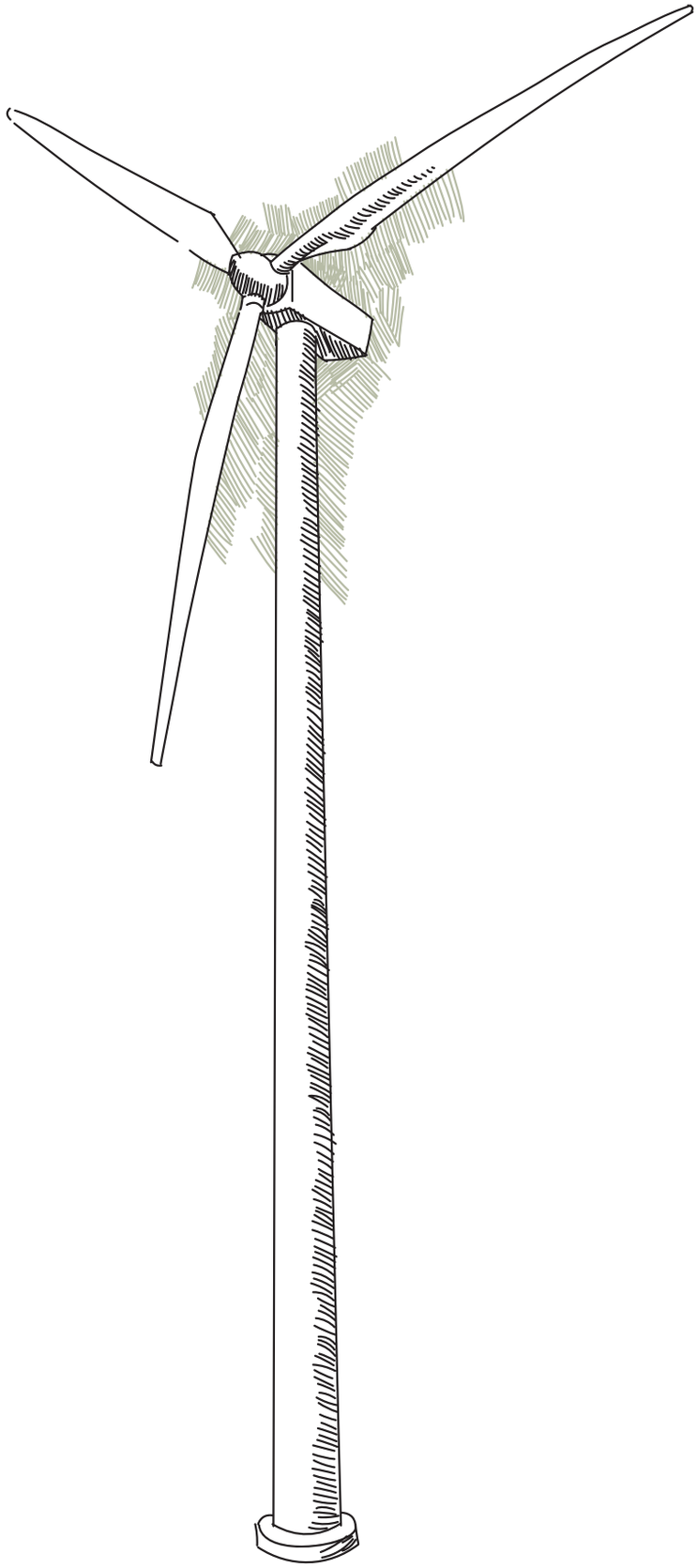
THE FUTURE OF ENERGY

What can we expect from the fast-paced energy industry over the next few decades? Dan Lewis, Chief Executive of Future Energy Strategies, looks into his crystal ball



Energy, the second biggest industry in the world after agriculture, is the one absolutely indispensable economic input to our everyday activity. None of us will get far for very long without electricity, fuel for the car or heating for the home – or indeed aviation fuel for the plane you're sitting on right now. No wonder then that this sector is always under huge consumer and political pressure, rarely far from the news and frenetically innovative and ambitious for the future. The awkward question is though – what changes can we realistically expect in the decades to come?

For futurists, confidently predicting energy trends is a well-trodden reputation graveyard. And many so-called impending energy revolutions – like hydrogen or fusion or solar – have evidently failed to materialise. But there are some megatrends that we can fairly safely assume collectively as a planet in the coming first half of the 21st century:

1) The world will want and use more energy and will find a way to do so

2) The role of electricity will grow massively in the developing world and transport and heating in the developed world

3) Innovation will accelerate and the underlying energy data will fuel a new software industry delivering greater efficiencies and lower, more predictable prices

4) Coal will be progressively replaced by natural gas and the combined share of renewables and nuclear will grow

5) OPEC's stranglehold over oil prices will at least greatly diminish and possibly be broken

6) In the long run, energy will get cheaper relatively to economic growth and become much less of a concern to our daily lives

For all that, in 2012, we're not there yet. Energy remains a highly fragmented industry – not just by sector, ownership, extraction, production, supply or distribution but also when stratified by country, region, climatic and geological potential and perhaps, most importantly in these straitened times, the availability and cost of finance and the underlying consumer willingness to foot the bill.

So bearing all of this in mind, which of today's energy technologies today have the most potential for the future and why?

Renewables

There are many types of renewable power but in the years to come, the three main ones to watch are wind, solar and hydro. In the last 10 years, the great poster child of the renewables industry has been the wind turbine. And whilst it has shown exceptional growth from 6.1 to 238 gigawatts of installed global capacity between 1996 and 2011 it is running into major growth constraints that can no longer be ignored. These are the difficulty of load-balancing on the grid larger amounts of its unpredictable power with unpredictable demand, a consumer backlash against its subsidies and visual impact and a maturing of the technological design that has not led to further falls in cost that could allow it to work without subsidy. As these bottlenecks tighten, watch out for some energy storage technologies becoming mainstream that make it easier to integrate existing and future wind power. We may also see design innovation that rejects horizontal axis wind turbines and embraces larger vertical axis wind turbines, with higher cut-out speeds and super-strong nano-engineered blades that won't break. Expect a growing role for software, too, which would ideally seamlessly match and control wind's supply and consumer demand thus overcoming the intermittency constraint. This will be further buttressed at international level with electricity interconnectors spanning national borders.

For solar power, specifically photovoltaics, what everyone is watching out for is the arrival of solar grid parity (SGP). SGP is reached when the installed price of solar falls so low that it is cheaper as a forward purchase of electricity spread out over the lifetime of the system than to buy the power in from your supplier. Thanks to a silicon supply glut and Chinese manufacturing, the cost of solar panels has fallen much faster than anyone anticipated. At the end of 2011, the world had 70 gigawatts in total of solar power installed. SGP may become a reality in some sunny, major parts of the world with high and insecure conventional grid prices by 2020, but it will not be revolutionary or disruptive. A technology that for now can only work in the day when it's not very cloudy will nonetheless start to regularly shave off a few percentage points of demand in the summer months in a few relatively wealthy countries that can afford it. This is because it has a low load factor of 10% of the stated capacity. The International Energy Agency however foresees a tripling of capacity to 230 gigawatts in 2017.

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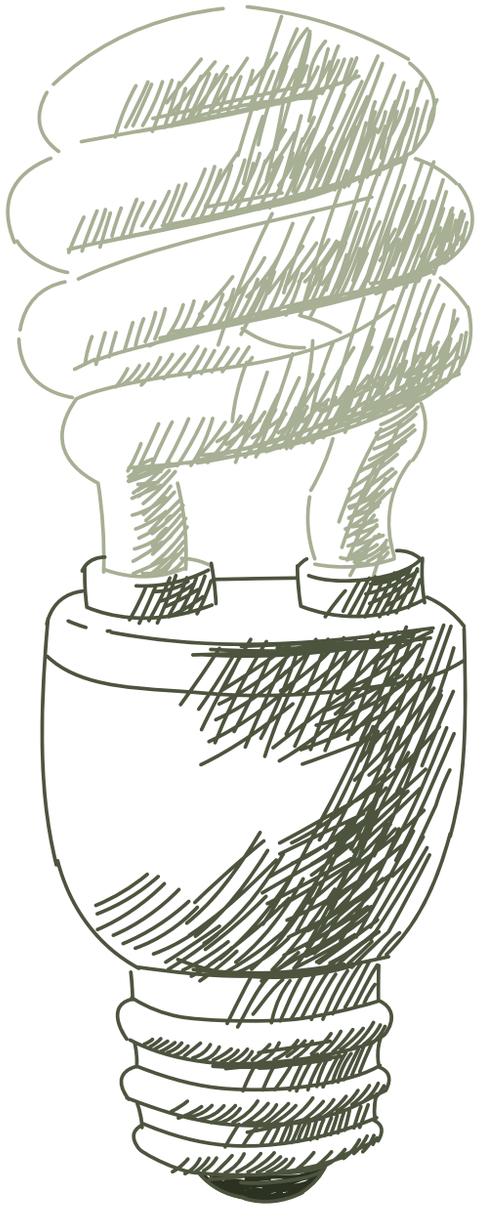
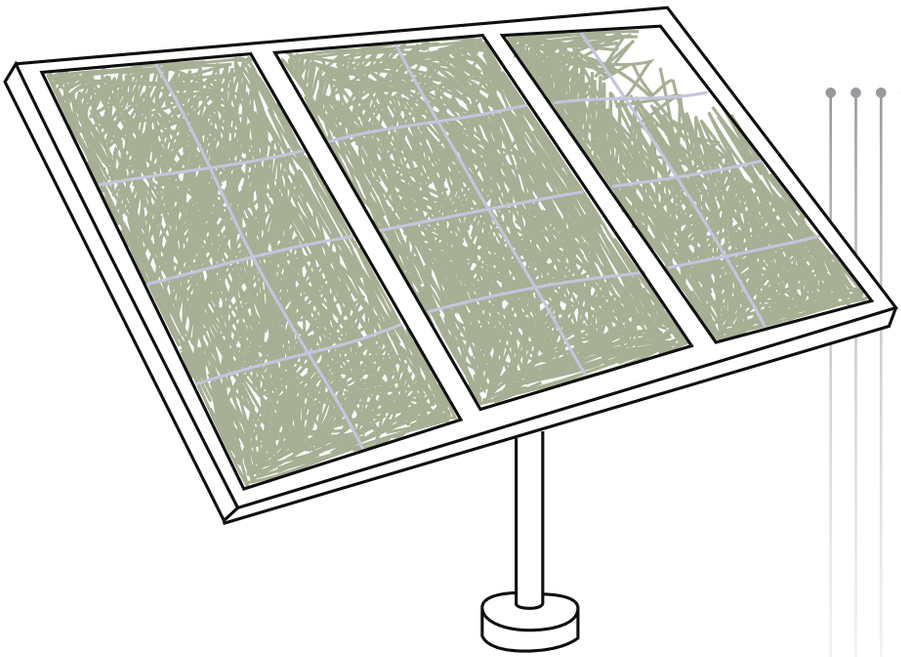
Hydropower – capturing the kinetic energy from falling water – is still by far the largest renewable contributor to power, with 740 gigawatts in installed capacity and working at a much higher load factor (approx 40%) than both solar and wind. And according to the Hydropower World Atlas and Industry Guide, there is still enormous potential for growth, particularly in Africa, South and Central America, China and, somewhat nearer to home, Norway. Ultimately, hydropower depends on the rain falling enough to fill up the dams of valleys or rivers that can release the power. It is expensive and takes a long time to build but once constructed, with refurbishment, they can last almost for ever. Europe's first hydroelectric plant at Rheinfelden in Germany built in 1898 has just been upgraded. The main benefit of hydropower is that it is a predictable baseload power supplier and when fully amortised, is the cheapest power in the world. That's why Iceland has a substantial swathe of energy intensive industry like aluminium smelting, because its hydroelectricity is so cheap. However, the problems that won't go away depending on which country you are in are the long payback periods, getting planning permission and environmental opposition.

Nuclear

Post-Fukushima, nuclear power generated by splitting the atom may have had a very big public relations setback for a disaster that could have been much worse. But setting aside Japan and other countries like Germany that have since recoiled from this power source, worldwide, nuclear power continues apace as a recent report from the UK's Institute of Directors made clear. Globally today nuclear power amounts to 372 gigawatts. Future expansion is being led principally by China with 25 gigawatts under construction and plans for a further 180 gigawatts.

In the years to come, small modular





reactors will emerge as a cost-effective alternative for smaller nations. After these, perhaps by 2030, we may see the first thorium-based reactor and after that, just maybe, a fusion reactor.

Thorium as a nuclear fuel has great potential as it is four times as abundant as uranium, produces a fraction of the waste and cannot be made into weapons-grade material. Fusion, the reverse of nuclear power because power is derived by fusing nuclei, may have been the future for a long time. Yet in recent years, much progress has been made in the ability to create extreme heat and contain the resultant plasma. Should the construction and tests of ITER (International Thermonuclear Experimental Reactor) near Cadarache in France run according to plan, the intention is to build a subsequent 2,000 megawatt plant by 2033 called DEMO.

Fossil fuels

Impressive as the combined growth of renewables and nuclear has been and will be, we are still a long way from replacing the traditional fossil fuels of coal, gas and oil that still make up the bulk of our energy requirements.

Gas in particular has become very much more abundant and in North America much cheaper since the advent of shale gas and the hydraulic fracturing and horizontal drilling that could exploit it. Until 2009, natural gas in America cost much the same as in Britain. Since then, global gas reserves have doubled, and it has become 3-4 times cheaper than in Britain at just under $3 per million British Thermal Units (BTUs).

Beyond shale gas, Australia will bring onstream a lot of coal bed methane which it will export. That's why the biggest trend in natural gas is its growing fungibility. Unlike oil, gas is priced at very different levels all over the world. But the emergence of more pipelines and the international Liquified Natural Gas tanker trade means that we are heading to a global convergence downwards of prices which will be closer to America's than our own.

And because gas is much cleaner than coal at the point of combustion, it seems likely that worldwide, environmental regulation will drive the replacement of coal by gas as the lowest cost way of reducing carbon dioxide emissions.

When ExxonMobil's CEO proclaims that natural gas will overtake coal use by 2025, you have to take notice. The surprise for many will be that it can, to some extent, replace oil and has been doing so. Compressed natural gas vehicles are no more technically challenging than petrol or diesel and only slightly more expensive. The challenge is to produce a national refuelling network so until then, only mass transit or HGVs that can refuel in one place will drive this trend. Equally, electric cars, already far behind the 16 million CNG vehicles on the world's roads, are effectively run more and more by a natural-gas-powered electrical grid. And let's not rule out that 10 years from now, hybrid vehicles – including start/stop technology – may well be normal vehicles coming off the assembly line which would reduce demand for oil-based fuel still further.

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Consumer and financial impact

It would be a great mistake to overlook the role of the consumer and financial markets in the future of energy. One cannot assume that consumers who vote will keep choosing politicians who want more expensive energy like offshore wind or electric cars if they do not see the benefits accrued to themselves. Shale gas would not have succeeded if it didn't make the cost of electricity and heating dramatically lower and spur a US industrial and manufacturing renaissance.

Ultimately, the same will be true for renewables as the subsidies start to diminish. And nuclear, at least in the West, has an extremely high financing hurdle in the cost of capital, perhaps 12-15%, which government would have to subsidise for it to happen.

And then there's the utility companies themselves. Governments enacting policy is one thing but many utilities in the West simply do not have the balance-sheet strength to carry out the kind of investment that would see a full renewable and nuclear transformation over the next 10 or even 20 years.

You can't overlook that these companies are ultimately beholden to their investors. And the truth is that most renewable and nuclear investments only make sense as a hedge if you believe that oil and gas prices will rise fast and far into the future. But they leave you dangerously out of the money if – as has been happening – fossil fuel prices start to move downwards.

Nevertheless, financial and consumer woes notwithstanding, we can ignore the energy doomsayers. We have just entered a new golden age of accelerated energy innovation. We don't quite know what it will look like. But I can confidently predict we will all lead cleaner, richer and safer lives for it.

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