What is holding back the growth of solar power?

Solar sector needs better power storage, grid infrastructure and government support to meet bullish growth predictions

Solar's share of global electricity is predicted to rise from roughly 1.5% today to as much as 20% by 2027. Photograph: Peter Macdiarmid/Getty Images

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ixty years ago, the price of solar panels was astronomical. At a cost of $1,910 (£1,350) per watt in today's money, the only practical use for them was in space on the US Vanguard 1 satellite, which launched in 1958.

But slowly and then precipitously the price of building a solar cell came down. Today it is less than $0.80 (£0.55) per watt. The subsequent proliferation of panels (especially in Europe, China, US and India) has tracked along the dizzying curve that eventually lead to the market domination of the car, the mobile phone and electricity itself.

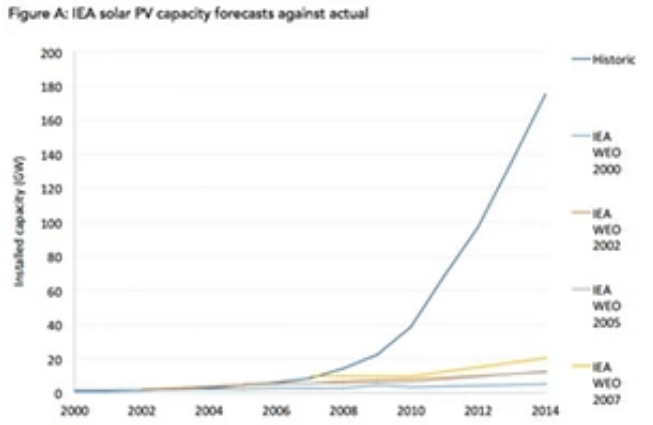
So could solar follow these inventions and achieve their level of ubiquity? "History tells us that sudden, disruptive and largely unpredictable technology shifts do occur," said a Deloitte report (pdf) on solar in 2015.

In a study released recently in the journal Research Policy, Oxford University researchers found, in the short term, that solar's upward swing was unstoppable. The researchers said falling manufacturing costs, which have dropped by 10% a year since the 1980s, would grow solar's share of global electricity from roughly 1.5% today, to as much as 20% by 2027.

Not everyone is as optimistic. The International Energy Agency's (IEA) most ambitious scenario for renewables puts the amount of electricity produced from solar photovoltaic cells at 16% of global

production by 2050.

However, the IEA has consistently under-estimated solar. In 2000, it predicted the world's solar capacity would quadruple over the course of the next 15 years. In reality, it took just five. The IEA then upgraded their 2015 forecast from 5 GW to 14 GW. This time it took just three years to get there.



The International Energy Agency's predictions for solar PV growth versus historical data. Photograph: Carbon Tracker

Beyond photovoltaic (PV) cells, concentrating solar power, in which the sun is used to heat water or oil and drive a traditional turbine, is also on the rise. It remains very much the little cousin, with around 1GW added around the world per year (compared with 50GW for PV). Dolf Gielen, director of the International Renewable Energy Agency's (Irena) Innovation and Technology Centre in Bonn, Germany said he expected strong growth in desert areas, such as Morocco and South Africa, where this source of power was particularly effective.

In developing countries, solar is the technology of the moment. Indian prime minister Narendra Modi has thrown his hefty political weight, and some money, into the development of an international solar alliance. China, already the world's largest solar producer, has added almost as much solar capacity in the first quarter of this year as the total solar capacity of France. It's penchant for vast large scale farms tipped the global balance (once about 50/50) away from rooftop installations.

Even in the poorest countries, solar's flexibility is making it desirable. In Bangladesh, more than 3.5m solar home systems have been installed in rural villages. Across the world, 1.3 billion people live without electricity. Often because the power grid does not extend to their home. As their economies develop, solar power will flood into these countries as the cheapest, most independent way for people to power their lives. The future of the sun looks bright.

What's holding solar back?

Yan Qin, a senior modelling analyst at Thompson Reuters Point Carbon, told the Guardian a few dips still lie ahead for the solar. The main is grid infrastructure, which was built to carry fairly consistent levels of generation and will struggle to cope with the variability of solar and wind energy.

National grids are adapting, but the infrastructure investments are huge and the work slow. In

Europe, a plan to build a massive solar farm in the Sahara desert that would provide 15% of Europe's power by 2050, collapsed because the costs involved in transmission of solar power have not fallen as fast as the costs to build panels. Gielen said this variability was a limit to growth.

"You have a very strong seasonality in solar production. That is a problem at higher latitudes. If you would connect all the countries around the world then always somewhere the sun would shine and problem solved. But we are still quite far from that situation," he said.

Like other renewables that rely on weather, solar is held back by its "capacity factor", essentially how often it is producing electricity. A coal power station runs at 70-80% capacity. In northern Europe, solar panel capacity factor is just 15%. This reduces its competitiveness significantly.

So instead of the continued exponential growth that is modelled by the Oxford team, Qin predicts "moderate growth in solar could continue as seen in recent years, but the growth will flatten out, turning into an S curve". This is backed by price forecasts of the UK government Climate Change Committee and the US Energy Information Agency. Qin said the industry would require government subsidies for at least another 15 years in order to compete against established fossil fuels technologies, such as coal and gas. A further challenge to solar will be chronically low prices of fossil fuels, which could push back its ability to compete.

Combining solar with other available renewable technologies – hydro, wind, tidal and geothermal – could help tackle problems including consistency of supply. Photograph: Jean-Paul Pelissier/Reuters

This is despite claims from the solar industry (pdf) in the UK (where subsidies were recently slashed

by 65%) that it will be able to go subsidy free by the early 2020s – a forecast Qin describes as "bullish". Gielen believes solar will eventually be one of the cheapest forms of energy. Although just how cheap depends partly on government policies and the institution of global or regional carbon pricing – which will deflate the competition from fossil fuels.

The best solutions

Gielen says solar could supply 10% of the world's electricity by 2050 as technological solutions are developed to cope with its shortcomings. Batteries that store excess power for night time or cloudy days remain expensive, although costs are coming down. Tesla, among others, claim they will soon be able to provide affordable storage to private rooftop solar and large utilities alike.

But a better solution, said Gielen, and one which was already proliferating across the world, was to combine solar with other available renewable technologies – hydro, wind, tidal and geothermal. These all provide either consistent power or vary on different rhythms to the sun. Costa Rica for example, uses a powerful mix of all these technologies so that it rarely turns on its diesel generation plants these days. Some countries – the UK in particular – are choosing to add nuclear to this mix, although the heavy price tag and public unease makes it a tough sell.

Despite the sun flooding the earth with enough light every hour to fulfil our energy needs for a year, solar power will not solve our clean energy conundrum on its own.