



# What does China's Five-Year plan mean for energy?

Electric Cadillacs, robotic submersibles that ride into the dark pits of the hadal zone and a mad rush to double its nuclear capacity – Hollywood couldn't write it. But that's what makes the second largest economy in the world so exciting. [Ledetta Asfa-Wossen](#) reports.

China's air pollution kills around 4,000 people every day. Part of the problem is that 64% of its energy still comes from coal, despite it being the largest investor in renewables. However, its attempts to move away from coal carry some weight.

## At the coalface

In 2015, China's coal consumption declined by an estimated 3.7%, according to the Chinese Government. Energy consumption per unit of GDP also fell by 18.2% between 2011–2015.

The 13<sup>th</sup> Five-Year Plan seeks to lower this even further by 15% by 2020. It also lists reducing energy use, curbing air pollution, improving soil and groundwater and the development of wind, solar and nuclear as top priorities.

The Chinese Government claims it will target pollution black spots, such as smog in Beijing and fertiliser pollution in Lake Tai, near Shanghai. Another addition is China's target to reduce volatile organic compounds, which are emitted not only from fossil fuels, but paints, solvents, and many other industrial processes.

By 2020, R&D investment will account for 2.5% of gross domestic product, compared with 2.05% in 2014, and much of this will go towards cleaner technologies. The plan conveniently ties in with a General Motor's five-year growth plan that aims to launch 10 low-carbon vehicles in China, from the likes of Cadillac, Chevrolet and Buick.

## Nuclear ambition

China's plans become more earnest, specifically for nuclear energy. By 2020, it aims to have 58GWe of generating capacity in operation, up from the current capacity of almost 27GWe. In addition, a further 30GWe of nuclear capacity will be under construction by 2020.

## Deep-sea technology

China's ambitions do not stop there. In fact, it will be undertaking one of its most prestigious investments yet, exploring the depths of the hadal zone – the deepest part of the ocean.

It is hoped that its cutting-edge submersibles will be able to reach the very bottom of the ocean (11,000 metres) to examine its role in the carbon cycle as well as microbes that can digest organic matter.

But what does this masterplan mean for science? Over to the experts.



**Tim Harper**, Advanced materials investment consultant and entrepreneur.



**Prof Martin Freer**, Head of Nuclear Physics, Director of the Birmingham Energy Institute and the Birmingham Centre for Nuclear Education and Research at the University of Birmingham.



**Clive Rowland**, CEO at the University of Manchester Innovation Group.

## What can the UK learn from China's latest plan?

**TH:** China's leadership has long realised that there is a link between spending on scientific research and economic performance, and has been building research capacity for two decades.

But as we see with UK initiatives such as the National Graphene Institute, realising that economic potential takes more than simply spending lots of money on new buildings and filling them with equipment. Too often we see governments focusing more on the technology than the applications, which is good for curiosity-driven research but bad for transitional outcomes.

Unlike the UK, China still has a robust manufacturing sector driving the demand for new technologies that creates competition. The long term industrial policy and the supply side reforms in the Made in China 2025 initiative are driving the country to become self sufficient in key technologies and materials, such as carbon fibre and rare

earths, and has driven the rapid adoption of electric vehicles and photovoltaics. The One Belt, One Road initiative is also driving oceanography research as China seeks to become a maritime power.

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With projects such as the new ¥1.4 trillion 10-year water initiative, China is a giant test bed for a lot of material-based technologies related to emissions reductions and water treatment, which will help stimulate both research and adoption.

More interestingly, technology adoption is far more rapid in China, which provides a major opportunity for UK-based materials researchers to develop in the UK, deploy in China and then sell globally.

**MF:** The 1,000 Talent Plan – devised to attract high profile and successful researchers back to China – has reaped dividends, and this has been matched by current and planned investment into research infrastructure.

For many years, Chinese research was seen as second rate and, in many cases, it was. However, progress over the past decade has been truly impressive and China now stands on the edge of being the major global research powerhouse.

The Chinese national leadership, unlike the UK, does not have its origins in lawyers and accountants but in scientists and engineers. This produces a different mentality – rather than looking for the challenges and problems, China looks for the opportunity.

**CR:** Chinese plans are something that we can look to as a model for building a serious industrial strategy in the UK, beyond the broad goal of re-balancing the economy.

Of course, such an approach requires political and macro-economic stability. Given the potential instability of the debt-financed Chinese investment programme and the concentration of political power in China, it remains to be seen whether the intentions laid out by the plan will see the light of day.

## China continues to invest in science but still lags behind on conversion of academic research. Why do you think this is?

**CR:** The motivation for patenting in China is not clear – it is likely that staff are incentivised to make applications rather than their institutions filing a statement of intent to commercialise their inventions.

The last Chinese plan set a particular target number for patents. Quality is likely to be a casualty of such a directed approach. This has been known to happen in other countries trying to establish a culture and status for patenting in their academic communities, which leads to an explosion in numbers but not necessarily marketplace activity as a result of the filings, nor any improvement in economic performance.

To take graphene and other 2D materials as an example, Chinese academic institutions represent a substantial amount of all patent applications – 12 of the world's top 20 applicants are Chinese academic institutions. But the UK Intellectual Property Office's 2015 analysis shows that Chinese institutions do not have the collaborative relationships that US and South Korean institutes seem to have. Nor does China appear to have the expertise to facilitate technology transfer.

## What do you think of China's ambitious plans for nuclear?

**MF:** China is investing in nuclear power on an unprecedented scale in order to achieve decarbonisation of electricity. This is being achieved through the construction of more than 100 nuclear power plants and in the first wave through the construction of French and US designs.

China has a substantial track record in terms of building its own plants, dating back to the 1980s, and is currently perfecting its own design for the overseas market. China General Nuclear plans to bring the HPR design to the UK, for example.

China has invested in the whole fuel cycle, from uranium mining to reprocessing. It is highly likely that China will have a world-leading role in the production of nuclear power plants, producing and selling fuel and reprocessing. The scale of ambition, like everything in China, is enormous.

Ultimately, China has aligned its scale of research and engineering with its scale of investment, and that's what sets the pace for change.

In the UK, and the energy sector in particular, the scale of investment does not always match the scale of the challenge.