will. And it reveals some of the problems that remain, in Austria and elsewhere. Officials in countries that are looking for ways to tackle misconduct should pay close attention.

Lesson one: act quickly and decisively. The agency was born out of a scandal that rocked Austrian science to its core. In 2008, the Austrian Agency for Health and Food Safety deemed a clinical trial of an experimental therapy for urinary incontinence to be illegal and invalid. The trial, led by Hannes Strasser at the Medical University of Innsbruck, was conducted without appropriate approvals, and did not adequately inform or protect patients. But the university initially failed to investigate.

At the time, an Editorial in *Nature* lamented the sorry state of Austrian science, which was riddled with rigid hierarchies that deterred many from raising complaints and concerns (*Nature* **454**, 917–918; 2008). The article called for the nation to speed up the creation of an independent body to investigate cases of academic fraud, which it had been planning and discussing for some time.

It did so. Since June 2009, the agency has handled 144 allegations of research fraud, and confirmed 40 cases. Of the rest, 12 are ongoing. In 31 cases, it was not possible to determine whether misconduct had occurred, and for a further 37 the allegations were not within the remit of the agency (for the most part, these revolved around labour disputes). The remaining 24 were either not followed up or were investigated by the university in question.

Lesson two: institutions have nothing to fear. The Vienna agency offered a confidential route for research scientists to report concerns, but required institutions to buy in to the agency by becoming members. Initially, many universities were reluctant to sign up, fearing their reputations could be ruined if they were found to be harbouring fraudsters. But the ministry of higher education linked membership to funding, which quickly persuaded them to change their minds. All of the country's 22 public universities have now signed up. Sanctions against researchers found to have committed misconduct are left to the universities. According to the agency, these include sackings and retractions.

Lesson three: one size cannot fit all. Any investigatory system must consider unique aspects of a country's research system. The Austrian agency, for example, uses scientists working outside the country to assess the complaints. This is crucial for protecting the process from undue influence from strong local networks and loyalties within the small nation's academic research community of fewer than 20,000 people.

"Research misconduct is moving higher up the political agenda."

Lesson four: wider legal reforms are necessary to properly address cases of fraud. Much behaviour that science frowns on is not explicitly against the law, and findings of misconduct and associated penalties can themselves be challenged in court. In 2012, the Austrian agency concluded that protein crystallographer Robert Schwarzenbacher had faked the structure of a birch-pollen allergen. Schwarzenbacher lost his job at the University of Salzburg, but later sued the institution for unfair dismissal. The case was settled out of court. In 2011, an employment tribunal ordered that Hannes Strasser be readmitted to a teaching post at the Medical University of Innsbruck. (He lost that post in 2014 when a final criminal-court ruling sentenced him to jail for aggravated libel related to the case.)

The legal status of scientific fraud is a thorny issue — and one hotly debated. But Sweden, following Denmark, is already working to define research misconduct in law so that there are clear lines in place. Laws against misconduct would also compel more institutions, such as those that are privately funded, to act transparently.

Research misconduct is moving higher up the political agenda. And for countries that are in the process of creating systems, revamping old ones or assessing their achievements, Austria offers a good example to follow. Institutions that continue to drag their feet on the problem should take careful note, too. ■

False fuels

Clever chemistry brings synthetic kerosene and petrol closer.

Necessity is the mother of invention, and a century ago, nations needed petroleum. They could run ships on coal, but burning solid lumps of fuel was impractical for cars and tanks, and unsuited to aircraft. Unlike other countries, Germany had no access to crude oil, so two chemists there — Franz Fischer and Hans Tropsch — invented a way to make synthetic petroleum from coal in 1925.

Their Fischer–Tropsch (FT) process could now help countries and companies that want to phase out fossil fuels: if coal can be turned into liquid fuels, then, theoretically, greener alternatives such as biomass could be as well. But so far, efforts to do this have been inefficient, and certainly not cheap enough to compete with oil.

A study in *Nature Catalysis* this week points to a possible way forward. Chemists in Japan and China have boosted the FT process, and improved on how it can be steered to produce different liquid fuels (J. Li *et al. Nature Catal.* http://doi.org/ctxv; 2018).

Although the FT process is good at converting gases — used directly, or produced from solids such as coal or even ground-up peanut shells — it's rather unfussy about what it churns out. Mostly, that's a blend of synthetic-petroleum products, from light gases such as methane through to heavy waxes (think Vaseline). The most useful stuff, such as petrol, diesel and aviation fuel (kerosene), falls somewhere in the middle, and must be separated and purified. That typically makes large-scale FT synthesis of those fuels a two-step process, which increases costs, complexity and pollution.

As a consequence, it's usually used commercially to make synthetic liquid fuels only where the feedstock is unusually cheap (China operates some facilities that process coal), or where there is no alternative (the South African company Sasol developed an FT process to liquefy coal when access to foreign oil was denied by sanctions in the apartheid era).

The latest study shows that this conversion can be made more selective. With small tweaks to the composition of the catalyst used — a well-known porous material, called a zeolite, mixed with cobalt nanoparticles — the team steered the chemical reaction to produce significant quantities of the desired liquid fuel. For example, the chemists could tune it to make 74% pure petrol (gasoline) or 72% pure jet fuel. Conventionally, it was difficult to produce anything more than 50% using FT synthesis, in a process usually based on iron or cobalt catalysts supported on silica or aluminium oxide. This is one of a string of recent results to show that barrier can be overcome.

There remains some way to go. Zeolite-based catalysts are notorious for their fast deactivation, and the paper reports the synthesis of the fuels in a reactor the size of a thimble, using just a single gram of catalyst. To make it economical, the process would need to be run stably for much longer and scaled up to much larger reactors using at least 100 tonnes of catalyst. Enthusiasm for synthetic fuels ebbs and flows with the market: they were popular a decade ago when oil prices were at record levels, but not so much now. There is no guarantee that the market demand for these fuels will drive the necessary investment.

Noritatsu Tsubaki, a chemist at the University of Toyama in Japan who led the project, says a major advantage of the process is that it could be used to make 'one-step' direct synthesis of kerosene and petrol from FT reactions for the first time — with yields high enough to avoid needing the separation step. Several airlines are already looking into FT chemistry as a source of fuel, and Tsubaki says his team plans to contact airlines and aircraft manufacturers with the findings. The necessity is clearly there, and now, so is a possible invention. ■