to help balance out renewables. "[But] for all fossil fuels, CCS will have to be applied from around 2030 onwards in the power sector," says the commission. It correctly points out that the future of CCS depends on public acceptance and adequate carbon prices however, neither of which it can claim today. Yet nuclear faces challenges of its own, notably safety after the disaster at the Fukushima Daiichi nuclear power plant in Japan. The commission may yet need to analyse a scenario that includes both low nuclear and delayed CCS.

A low carbon price and an uncertain climate-policy framework for after 2020 threaten the tremendous investments needed for decarbonization. "It's policy that steers finance," Acke says. The ECF calculates that €1.8 trillion — or 0.5% of EU gross domestic product per year from 2010 to 2020 — needs to be invested in the power sector to finance its decarbonization to 2030. Most of that money will go to renewables. But, the commission emphasizes, substantial renewables do not necessarily mean high electricity prices, nor does decarbonization require much more investment than the power sector would in any case need.

Helping utilities finance the transition to a low-carbon economy is another key challenge for policymakers. "Governments need to be intervening in this space, because the dominant risk is a policy risk," points out Michael Jacobs, a visiting professor at two London universities and a member of the ECF's board. In its draft energy roadmap, the commission says institutional investors need to be brought in. To attract them, policymakers must further harmonize European energy policies, talk directly to financiers, and provide capital of their own to leverage private contributions, the ECF says[5].

At the end of the day, there are ways to minimize the scale of the challenge. Energy-efficiency improvements, demand response (managing demand in response to supply), pan-European coordination on renewables deployment, and development of electricity storage all offer ways of minimizing the investment required in new-generation and grid expansion. All eyes are now turned to the commission's energy 2050 roadmap and the proposals that flow from it. As Jacobs says: "If we fail, it won't happen in the rest of the world." ❐

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MARKET WATCH:

Duty down under

As Australia anticipates its carbon tax, Anna Petherick contends that of the world's dirtiest economies, this nation is leading the way in the design of policies to price emissions.

It has been a long time in the making and in the end it barely squeezed through the legislative process, but Australia's carbon tax has now passed in both houses of parliament. This is an event of global significance because Australia's per-person emissions are larger than those of the United States and twice those of Germany[1]. So the move begs an obvious question: if Australia can stomach the pain of carbon pricing, surely any rich country can?

There is some elegance to the scheme's blended design. As of July 2012, 500 of the country's filthiest firms will pay the national government Aus$23.5 (US$24) for every tonne of carbon that they emit. This arrangement will persist until 2015, with the tax rising by 2.5% in real terms each year. Then, market forces will set the price of carbon through the trading of emissions permits, under a cap-and-trade scheme.

Starting off with a tax will avoid the turbulent carbon prices that beset the initial stage of the European Union's (EU's) cap-and-trade system. That should help businesses to plan ahead (although any additional costs will irritate some). By switching to cap-and-trade in three years' time, the policy's emphasis will shift from stabilizing the price of carbon to more precisely promising emission reductions once firms are used to the idea[2].

And all Australians — except, maybe, the odd outback dweller who sidesteps participation in the market economy — will experience changes. The 500 filthy firms will be encouraged to carve cleaner futures because they can lower costs by cutting emissions. What additional outlay they are forced to spend on the new levy they will pass on, as price increases, to consumers — who until now have had no financial incentive to favour a product made in an ecofriendly way over an identical alternative that was manufactured in a mucky manner. But cleaner will soon mean cheaper, and as this price signal permeates the whole economy, Australians will become greener, merely by exercising hard-nosed, economic self-interest.

The real sophistication lies in the details of the policy's logic. Carbon taxes are inherently socially regressive — that is, they tend to impact poor people more than rich people because carbon-intensive products such as fuel make up a bigger proportion of poor folks' total spending. In Australia, the government is not the only body to have modelled this. A recent independent analysis[3] calculated that a Aus$23 tax will make electricity (which, in Australia, tends to come from burning coal) 10% more expensive, gas prices will rise by 5%, food by 0.5% and most other items will go up 0.3% in price. As a result, couples on low incomes with dependent children will spend an extra Aus$8.60 per week.

This amount will be more than compensated for by the government — not by a simple cheque in the post (as was a more prominent feature of an earlier draft of the law that died in Senate in 2009), but by raising the amount of income that Australians earn before they start paying income tax. "Which is what the economics textbooks tell you ought to happen, but this is the first scheme where it actually happens

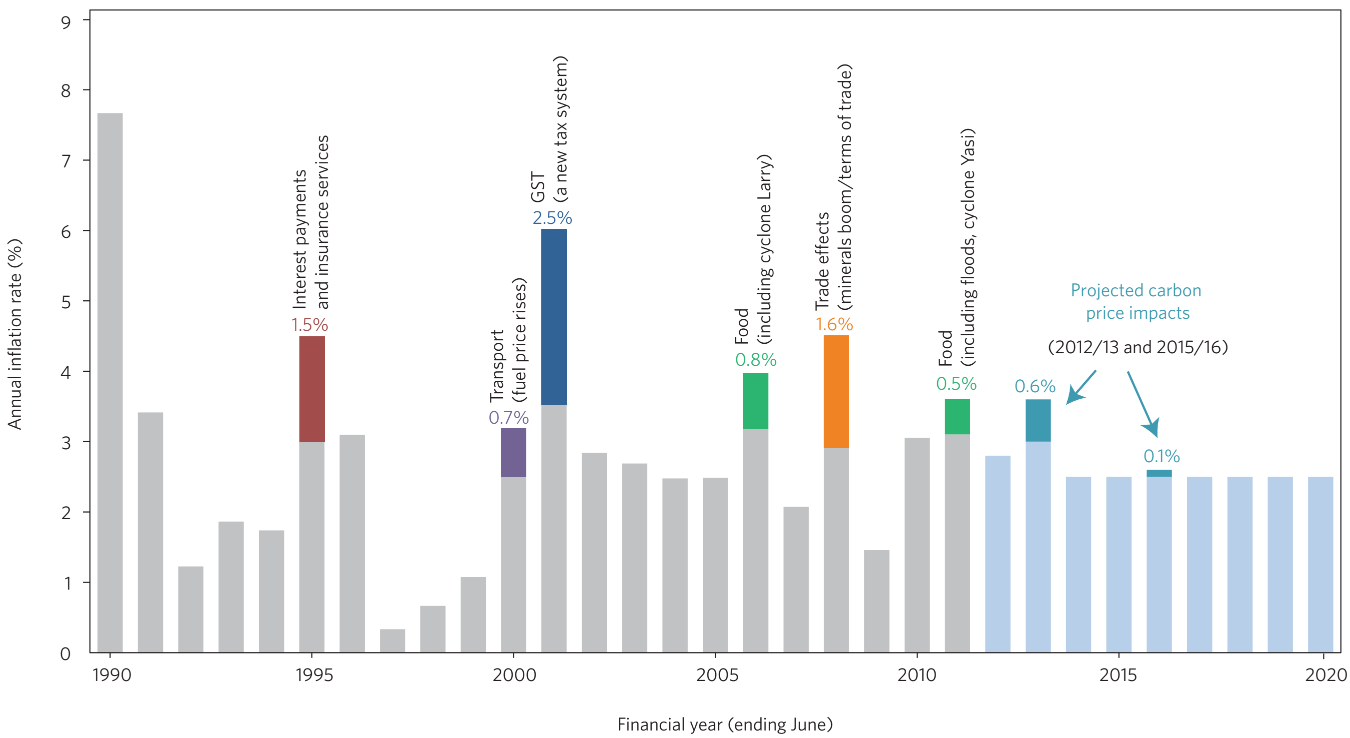

Figure 1 | The expected inflationary impact of the new carbon tax on the Australian economy, in the context of other perturbations in recent history. The graph picks out five contributors to inflation since 1990, indicated by red, purple, dark blue, green and orange bars. Pale grey bars indicate observed figures and pale blue bars indicate projected figures. Reproduced with permission from ref. 3, © 2011 CSIRO/AECOM.

to any significant extent," says Frank Jotzo, deputy director of the Australian National University Climate Change Institute. If the consumer price index rises by 0.7% (as is forecast), then the carbon tax reduces real wages by the same proportion, so compensating people with a cash transfer reduces their incentive to work. "But with this system," Jotzo explains, "the price rises are mitigated by giving people more money in their after-tax pay packet, which improves incentives for them to offer their services in the workplace." In all, more than half of the government's revenues from the new tax will be spent on compensating households, says Kathryn Smith, a consultant now with London-based Vivid Economics, who helped in the design of this part of the policy.

Moreover, the scheme has learned from the EU's teething problems. When permit trading begins, many will be auctioned from the outset rather than given away for free (as they were during the first two phases of the EU Emissions Trading System). There will also be no expiry date. This means that permits will be bankable, and thus firms should not be tempted to dump them on to the market *en masse* when they are due to expire, which in the EU has contributed to the price plummeting. Further protection from market volatility will come in the form of a price collar (an upper and lower limit to the cost of permits) for the first three years of trading. Australia's plan is more ambitious than the EU's: it covers more sectors of the economy (for example, emissions from waste) and a larger proportion of emissions.

All that forethought does not mean that the experts lack reasonable concerns. The opposition party has said it will repeal the policy if it wins the next election. Probably the toughest decision with any pollution tax is at what level it should be set. The policy's architects will be crossing their fingers that the price of carbon does not leap or crash when emissions trading starts in 2015. Some commentators[4] have raised concerns that, with insufficient investment in clean technologies, coal-supplied base-load generators might shut down before enough low-emissions capacity is built to replace them. Jotzo worries about how the flavour of emission-reductions credits that Australian companies will end up buying might influence the carbon price. "The EU has made it clear that it doesn't want to buy credits from new Clean Development Mechanism projects outside of least developed countries," he explains. "That leaves a whole range of countries — the whole of the Asian region — that Australia will be left to deal with, and the permit price could drop to low levels because of that."

However obvious a negative externality — be it cigarettes or carbon dioxide — politicians rarely have an easy job of convincing voters that paying yet more tax can mould behaviour in a way that is good for society as a whole. In the face of clamorous opposition from industrial lobby groups, Australia has now done this. Curiously, the scheme it has designed should hike consumer prices less than the trade and exchange-rate impacts of the 2007–2008 mining boom did (Fig. 1). That should give its coalmen pause for thought. Its policy isn't faultless, but at this point it is an example to the world. ❐

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