

Such assessments are aided by a growing understanding of Earth's climate and humanity's effects on it. Scientists are increasingly confident that they know roughly what shares of the greenhouse gases in the atmosphere were emitted by individual countries, and even by the biggest corporate polluters. The Carbon Majors Database, compiled by Richard Heede, a geographer, tallies historical emissions by fossil-fuel firms and other heavy carbon emitters such as cement-makers. He finds that just 90 belched out 63% of all greenhouse gases between 1751 and 2010. Campaigners seek to argue that these deep-pocketed firms, and not their customers, are ultimately responsible for the emissions, just as cigarette-makers were held liable for their products whereas retailers who sold them on to consumers were not.

Splitting the bill

Mr Heede's calculations, which most scientists accept, mean that responsibility for past and future warming can be apportioned—at least in principle. Mr Lliuya's claim of €17,000 (\$19,800) against RWE corresponds to 0.5% of the cost of protecting his town against the glacial melt. That 0.5% is the utility's estimated share of cumulative global greenhouse-gas emissions, chiefly from all the coal it has mined. Likewise San Francisco, Oakland and three other Californian counties have sued dozens of carbon majors, including BP, Chevron, ExxonMobil and Royal Dutch Shell, for damages proportional to their share.

Scientists are also becoming more willing to blame carbon emissions, not just for global warming, but for specific natural disasters such as heatwaves, floods and superstorms. But so far no plaintiff has been awarded damages on the basis of such attribution arguments. After a legal battle that lasted from 2005 to 2012, an American federal court threw out a case brought by residents of Mississippi against 34 big carbon emitters for damages suffered as a result of Hurricane Katrina, which they argued had been made more devastating by climate change. The court decided that the plaintiffs lacked "standing", in other words

that they could not prove that they had suffered an injury, that the injury could be traced back to the defendant, and that the court could redress it (for instance by ordering damages to be paid).

But "attribution research" has made strides in the 14 years since Myles Allen of Oxford University introduced the notion of "climate liability" for calamities. The first *Bulletin of the American Meteorological Society* devoted to attribution studies, in 2012, contained just six papers. Last year's edition contained 26, and many more were turned down for lack of space.

Researchers are even beginning to combine individual emitters' climate impacts with event attribution. In a paper just published in *Nature Climate Change*, for instance, Friederike Otto of Oxford University and colleagues (including Professor Allen) conclude that carbon emissions from America and the European Union each raised the frequency of a particularly devastating heatwave in Argentina by roughly a third. This increased chance, the scientists argued, could be interpreted as their share of responsibility for a scorcher four years ago. Many courts already accept probabilistic arguments, for example in cases of occupational hazards. In Britain and America judges have ruled that firms "caused" workers to be exposed to toxic substances if the risk of exposure doubled.

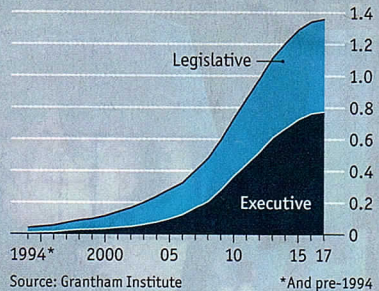
Ms Marjanac expects attribution suits on similar grounds as the science develops. In the meantime most plaintiffs are sticking to settled science. In Norway, Greenpeace is relying on the widely accepted findings of the Intergovernmental Panel on Climate Change, which says that, to meet the Paris goal, oil production should be wound down, not ramped up. The Californian counties have taken care to sue only those carbon majors with operations in the state.

Plaintiffs are also using established legal arguments, albeit in novel ways—alleging, for instance, that rising sea levels caused by companies' carbon emissions constitute trespass on county land. They are learning from one another. A lawsuit modelled on Urgenda's is under way in Belgium. On October 23rd an Irish court agreed to hear another. A court in Oregon will hear a similar one in February. A group of Brazilian NGOs hopes to file its own by April. Following successful lawsuits against cigarette manufacturers, courts are putting new stress on the fact that energy firms have long known about the harm caused by carbon emissions but have done nothing about it.

Defendants, for their part, usually argue that, whatever the climate science or the harms caused by greenhouse gases, they are simply not liable. Climate treaties presume that each country is responsible for its own emissions, says Fredrik Sejersted, Norway's attorney-general, who will ar-

Laws of nature

Global number of climate-change laws and executive policies, cumulative total, '000



gue the case against Greenpeace. "So Norway does not have a legal responsibility for emissions from oil and gas it exports." No one denies that the Netherlands emits carbon dioxide, says Edward Brans, an environmental lawyer who is representing the Dutch government in its appeal against the Urgenda ruling. The question is: "Are the government's actions unlawful?"

America's Supreme Court is highly unlikely to discover "a constitutional right to a stable climate" any time soon, says Michael Burger of Columbia University's Sabin Centre for Climate Change Law. Its courts hesitate to rule on issues generally regarded as the preserve of the legislature or the executive branch. Federal courts often decline to consider lawsuits regarding negligence, nuisance, trespass and the like stemming from carbon-dioxide emissions, arguing that these are already regulated by the Environmental Protection Agency (EPA) under a federal law, the Clean Air Act of 1963, which prevails over common law in its remit.

For now, plaintiffs approach state courts because federal statutes do not displace common law at the state level. In climate-friendly jurisdictions such as California, a jury could conceivably find in their favour, says Tracy Hester of the University of Houston. But he adds that, if President Donald Trump or Republicans in Congress relieved the EPA of its obligation to regulate greenhouse gases, the way may be opened for lawsuits in federal courts.

Courting the public

In Norway an opinion poll in August found for the first time that more people would prefer to leave some oil in the ground in order to limit emissions than to extract it all. This may not influence the Oslo court's decision. But as citizens' concerns about climate change grow, so will the prospect of real-life verdicts that resemble Kirkenes's fictional one.

Correction: In "Looking the other way" (October 28th) we said that the budget for the UN Development Programme is \$12bn a year. In fact, this is the sum spent by the UN on all forms of economic development. Sorry.

