

# Fossil fuel emissions measured specifically in California's atmosphere

By Hilary Lamb

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Researchers have measured fossil fuel emissions in California by looking at concentrations of radiocarbon in the atmosphere. This is the first time such a large area has had its fossil fuel emissions independently assessed.

CO<sub>2</sub> emitted from burning fossil fuels is widely accepted to be the primary driver of climate change. For years, governments, companies and other organisations have been moving to reduce their dependence on fossil fuels. These efforts have intensified following the implementation of the Paris Agreement in 2016.

The Paris Agreement – to which almost every country is a signatory – strives to keep the global average temperature rise to below 2°C above pre-industrial levels in order to avert the most catastrophic impacts of climate change. Many governments have made commitments to shift to cleaner sources of energy in order to reduce their carbon emissions, among other actions.

While the US withdrew from the Paris Agreement in 2017, California has firmly retained its own emissions reduction policies, such as the Global Warming Solutions Act 2006, which aims to reduce the state's carbon emissions by 80 per cent by 2050.

An important aspect of these policies is monitoring change in emissions; the Paris agreement requires for 'stocktakes' to be performed every five years. The Intergovernmental Panel on Climate Change (IPCC) provides a standardised method for calculating CO<sub>2</sub> emissions, although some factors vary between regions, causing complications when calculating fossil fuel emissions on sub-national scales.

"We generally think there's quite a good understanding of how much CO<sub>2</sub> is emitted from fossil fuel combustion," said Dr Heather Graven, the Imperial College climate scientist who led the study.

"But some challenges can come up when we make these calculations, which are based on how much fuel is burned, how much is bought and sold and moved around. Some of those numbers are more reliable on larger scales [...] but then as we go down to smaller regions we become a bit less certain."

Due to these uncertainties, a "top down" approach to measuring CO<sub>2</sub> emissions from fossil fuels – by measuring CO<sub>2</sub> in the atmosphere – could help more reliably measure emissions within regions. While many instruments already exist to measure atmospheric CO<sub>2</sub> concentration, there remains a challenge in separating natural CO<sub>2</sub> with CO<sub>2</sub> released by burning fossil fuels. This is not such a problem when monitoring other greenhouse gases, such as methane.

"When we measure CO<sub>2</sub> concentration in the atmosphere it could be CO<sub>2</sub> coming from a mixture of different sources. So if we have plants conducting photosynthesis it could be taking up CO<sub>2</sub>, or if plants are respiring they could be contributing CO<sub>2</sub> to the atmosphere and that's happening even in similar regions; even in a city we might have parks and trees that are contributing to the CO<sub>2</sub> that we see," Graven told *E&T*.

In this Nasa-funded study, the researchers chose to take an extra measurement in order to distinguish between these different types of CO<sub>2</sub>; they accounted for concentrations of radiocarbons. Fossil fuels contain fewer radiocarbons due to millions of years of radioactive decay. The ratio of radiocarbon to other types of carbon, the researchers determined, is lower in emissions from burning fossil fuels.

The UK and US researchers took measurements at nine monitoring stations located across the state for three months, and combined their data with an atmospheric circulation model specific to California, which accounts for how gases mix through the atmosphere. In this case, the independent measurements matched with the reported emissions from the California Air Resources Board.

According to Graven, if this technique could be employed for longer periods of time, it could prove useful for detecting small changes in CO<sub>2</sub> emissions across other large regions attempting to cut down on this key driver of climate change.

"[These measurements] are important for understanding where our emissions are coming from, so when we make decisions about how to reduce them, we know the most effective ways to do that," Graven told *E&T*. "Then we want to track how it's changing over time, so we can see if we are making progress on reducing emissions."

"It's still in the research stages [but] in the long term it'd be great if this becomes a bit more of a demonstrated technology that governments could employ as part of their air monitoring programs."

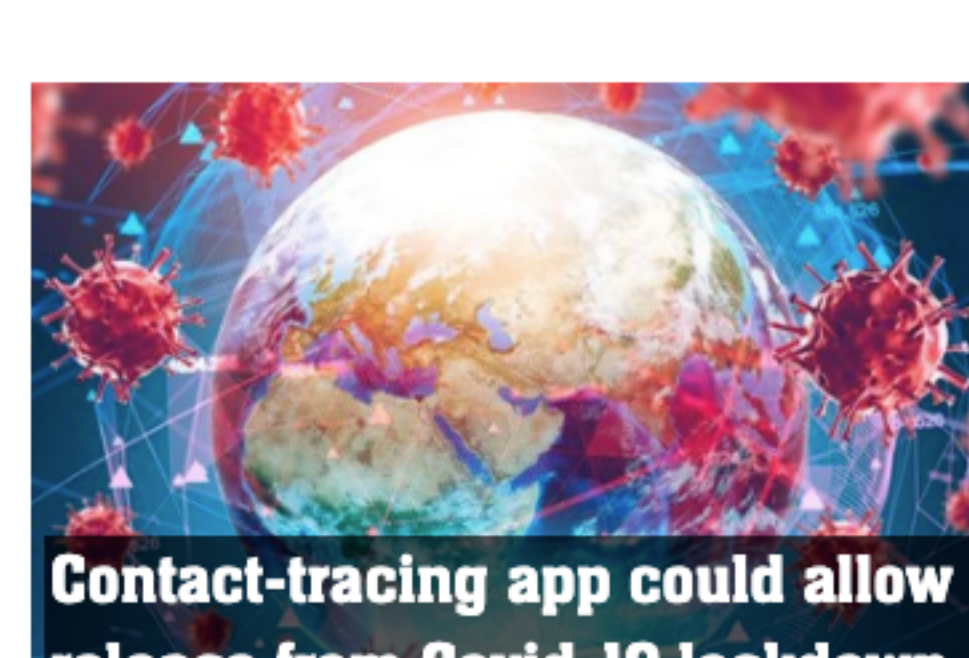
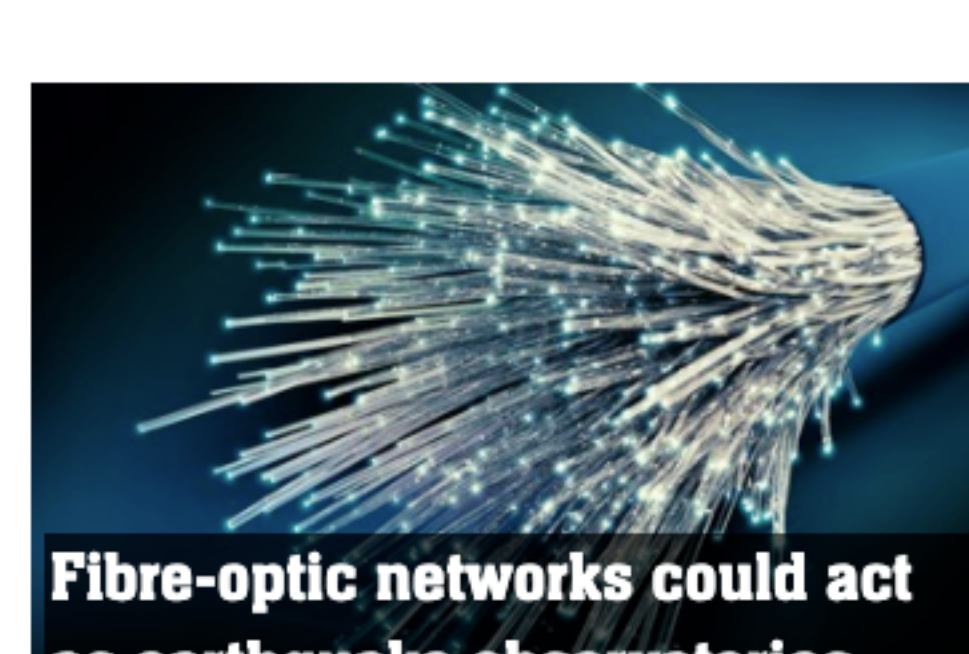
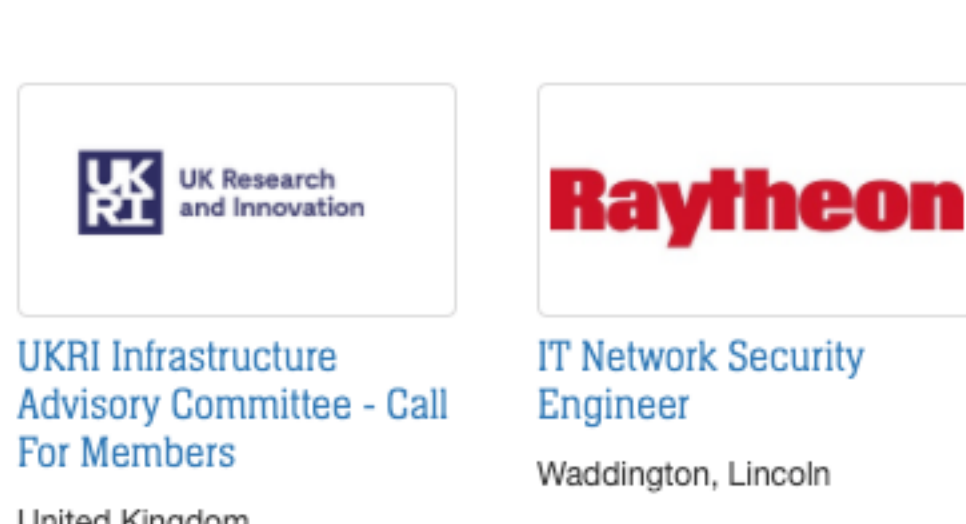
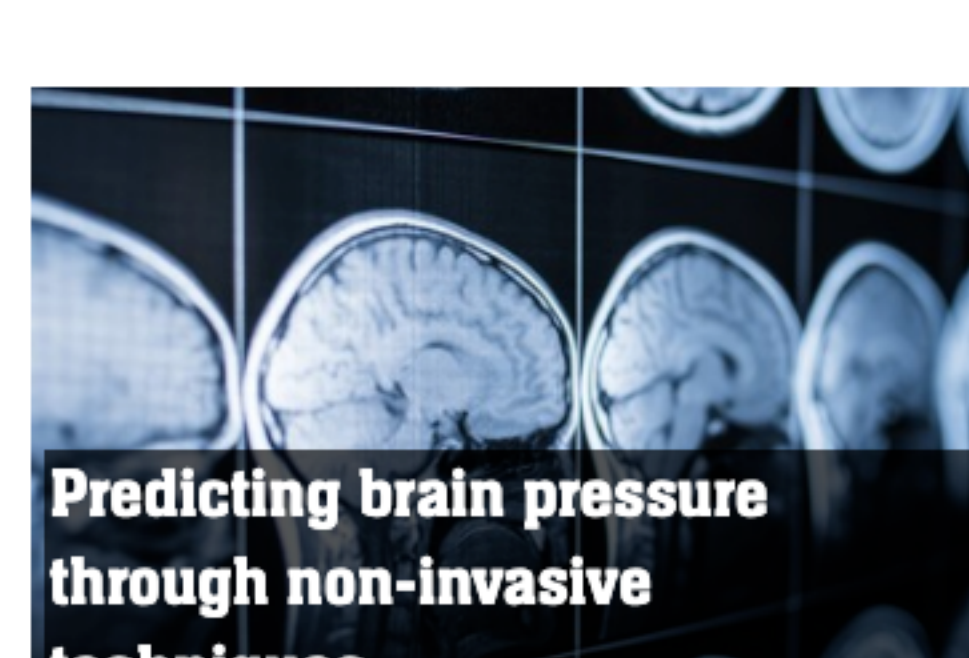
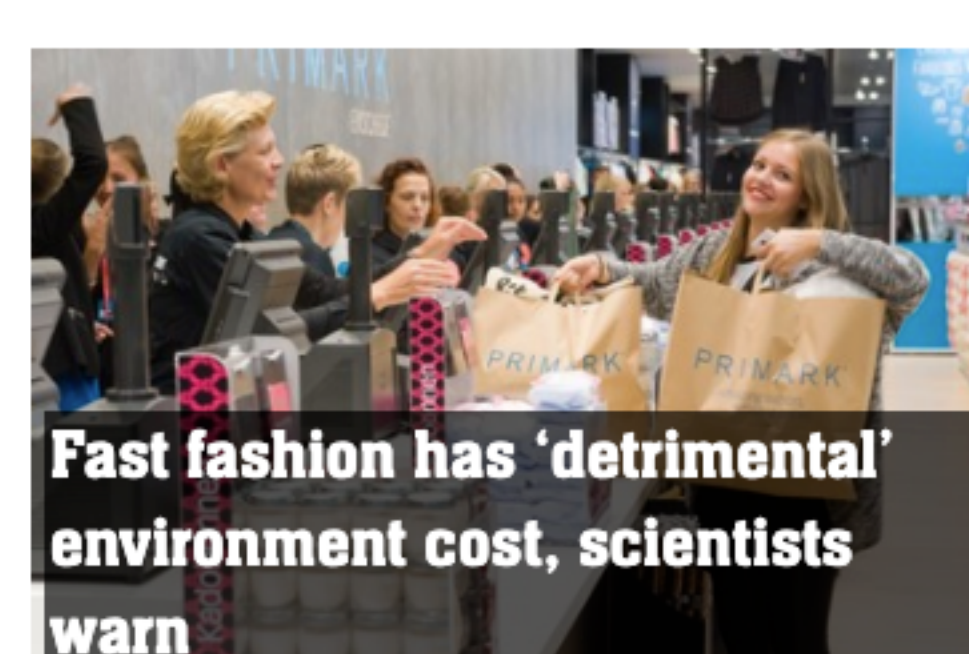
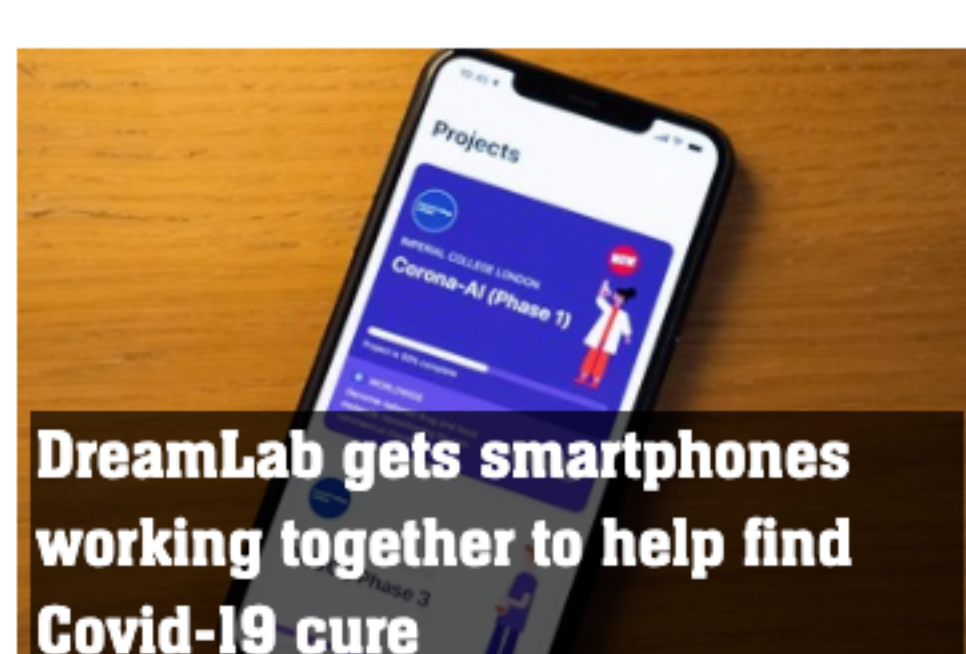
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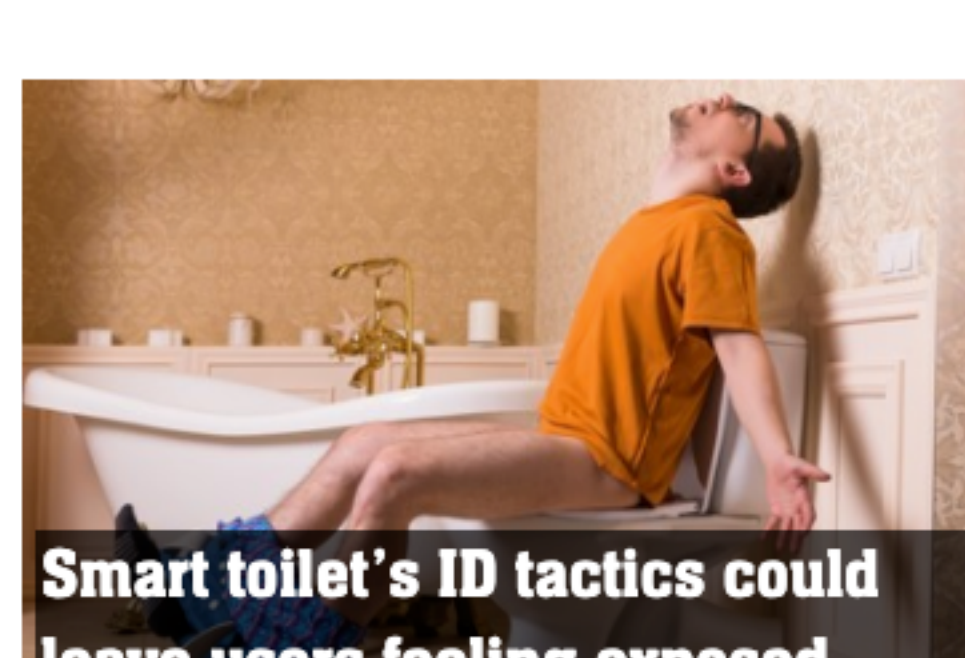
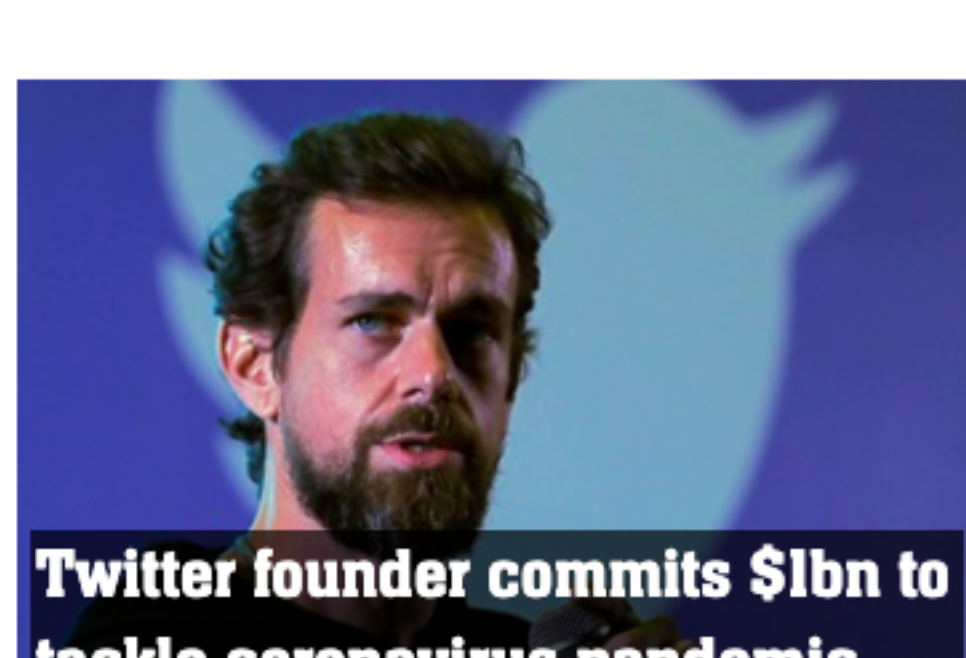
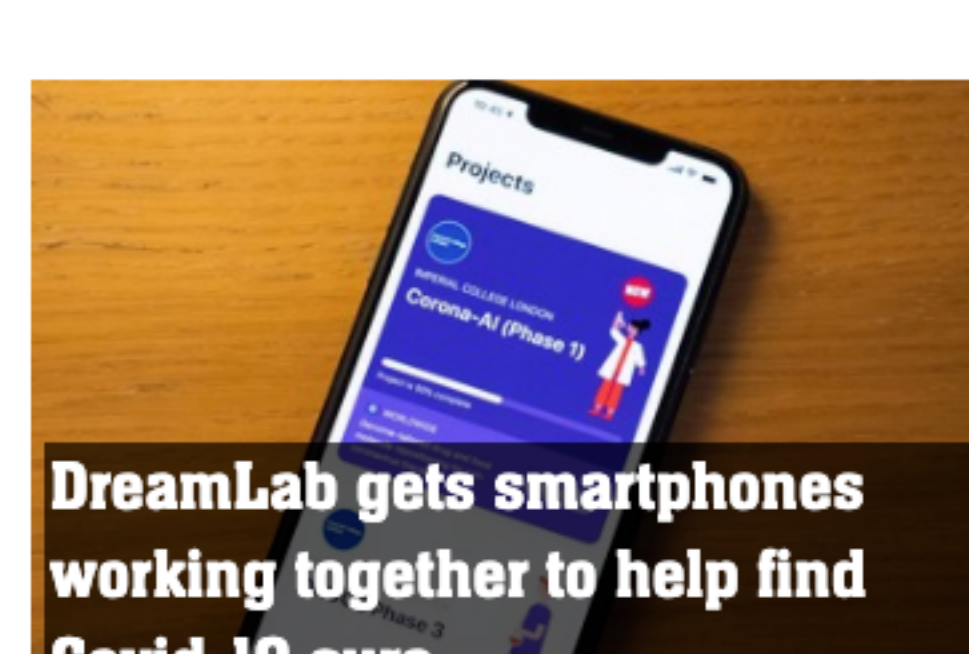
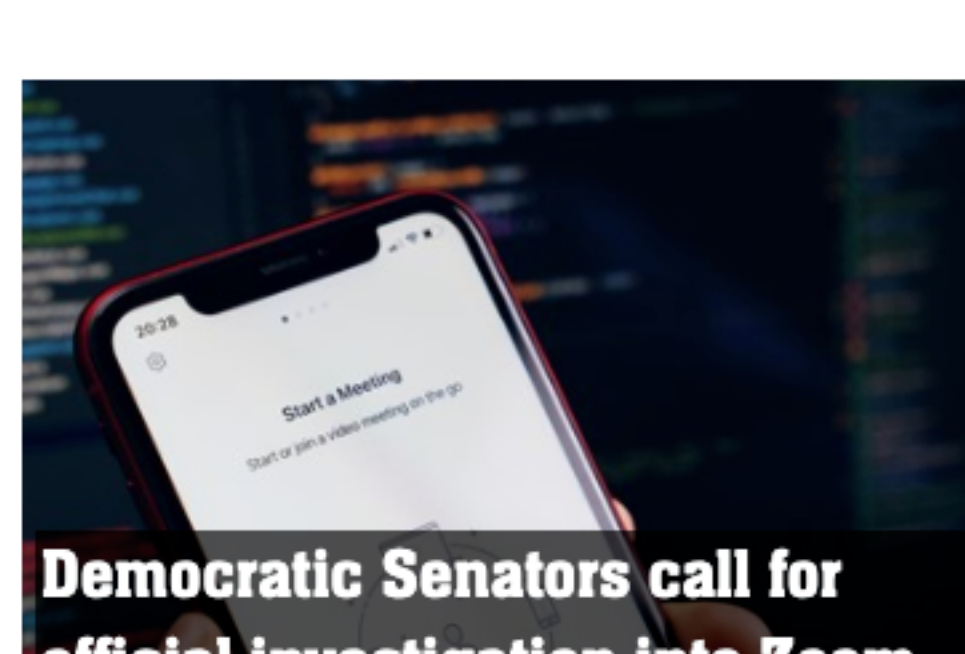
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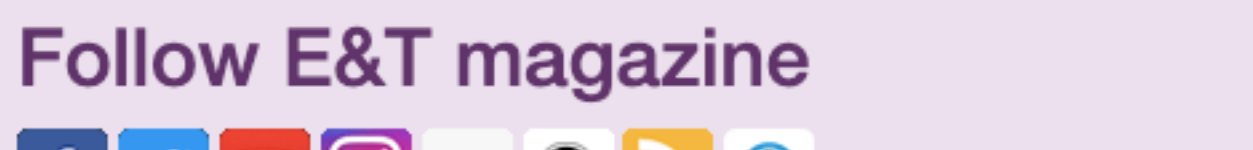
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