An oil drilling boom in an area of the southwestern United States called the Permian Basin has led to the release a lot of gas into the air. This raises concerns for the global environment and local residents, but new technology could significantly improve public oversight. By **Ben Heubl**

THE DARK SIDE OF THE LATEST TEXAS OIL BOOM

GETTY IMAGES

SUZANNE FRANKLIN SMELLED gas: "It was horrendous. We often woke up with terrible headaches from the stench overnight. I started feeling ill". Sue and her husband used to live four miles outside the sleepy town of Verhalen, Texas. During their time there, oil wells began to spread like weed around them.

Franklin believes the US oil drilling boom in the Permian Basin made her ill. She and her husband were lucky enough to get out. An oil company paid them off, financing their move to Fort Davis, where they can breathe cleaner air at higher elevation. Yet she still feels poorly. She can't name the firm that paid her to leave, as she signed a waiver agreement. Now 40 miles away, she feels safer from the invisible danger of the wells.

Big and small oil and gas businesses in the Permian Basin contribute to gas pollution that some fear could leave many of the region's two million residents with lasting damage. The Basin, one of the USA's largest oil-drilling regions, gets its name from thick deposits of rocks from the Permian geological period. It catalysed a renewed drilling boom that elevated America to 'become great again', at least among drillers. Donald Trump, who ran with this slogan as presidential candidate in 2016, helped. The US is now the largest oil producer in the world. 2019 was an extraordinary year for domestic oil exploration in the Basin and it brightened the landscape with flaring stacks like never before. Gas emissions spiralled.

New drilling technology played a role. It boosted efficiency in volume extraction. Franklin vividly remembers lit flares burning the abundant gas: "It never went dark. The light from the flare when it was burning was like daylight outside our bedroom window, day and night."

The gas from oil extraction and gas processing has global consequences. The International Energy Agency warns that methane emissions are the second-largest cause of global warming today. Generally hailed as a transitional solution to renewable energy sources at the beginning of the fracking boom, the preponderance of peer-reviewed research since then suggests that, thanks to its methane pollution, oil and gas are at least as bad for climate as coal.

Globally, methane emissions are on the rise. Oil extraction is partly to blame, though other sources include agriculture and waste management. However, as latest estimates by the EPA suggest, 28 per cent of methane emissions are natural gas and petroleum-system related.

One reason why gas is wasted during oil production is that capturing it is often uneconomic. Another is frail and ageing infrastructure that enables gas to leak. As economic downturn worsens amid diving oil and gas prices, fewer firms can afford the repair or construction of new gas-transport infrastructure. Early studies suggest that 2.3 per cent of gas production may leak uncontrollably. Yet in the Permian Basin the figure could be much higher. Environmental group Environmental Defense Fund (EDF) estimates loss rates at 3.5 per cent.

Flaring (gas burned openly) and venting (unlit gas released) wastes around 8 per cent

A flare at Apache Corporation's Deadwood natural gas plant in the Permian Basin in 2015

of global natural gas production and adds 6 per cent to global greenhouse gas emissions. When markets turn awry drillers waste more gas, as unfavourable gas prices disincentivise leak prevention. Collectively, such squandering is costly. New Mexico may be wasting $275m worth of natural gas while missing out on another $43m in tax and royalty revenue each year, according to analysis by Environmental Defense Fund.

It's not only environmentalists that call for an end to the release of gas; executives at leading operators in the Basin, such as Pioneer Natural's CEO Scott Sheffield, have urged fellow drillers to cut the gassing, but well-funded firms have an edge. Media pressure is also higher on large firms.

Unlit flares

However, experts caution that aiming for eradicating the eyesore of burning flares may be counterproductive. Flares can be spotted from satellites. Venting is invisible. In theory, that gives drillers an incentive to extinguish the flames and fly under the radar.

Sharon Wilson at Washington-based environmental group Earthworks says she has noticed this first-hand. Wilson uses her expensive optical gas imaging camera to track flaring and venting breaches in the Basin: "On venting instead of flares being lit, I noticed there was a huge increase starting last November [2019]". She thinks it's due to public outcry against lit flares that spiralled in number around that time. The volume of flaring across the Basin peaked at the end of last year. "If you don't light your flare, there's just a pipe sticking up from the ground, and it doesn't look like much, unless you have an optical gas imaging camera, you can see the gases blasting into the air", she says.

Georgetown University academic Raphael Calel also thinks restrictions on flaring can push oil producers toward greater venting. Together with Paasha Mahdavi of UC Santa Barbara, he made a case in an opinion paper for the *PNAS* journal in June. Overzealous anti-flaring policies could lift the global warming potential by a factor of 16.2.

Environmental Defense Fund's Colin Leyden has heard of the theory, but EDF's data is limited and can't support the venting thesis. However, that doesn't mean it's not happening. The fact that New Mexico's methane emissions reached one million tonnes per year, surpassing all prior estimates for the state – an equivalent of 22 coal-fired power stations – is a valid concern.

Some current reduction in flaring is down to the coronavirus pandemic. Price and market conditions have taken a beating, but people on the ground, like Wilson, keep seeing unlit flares regularly.

"Sometimes, the flares would go out and a lot of times the one that was to the east of us, not even three-quarters of a mile away, the flare would be out", says Sue Franklin. Complaints by the Franklins support *E&T*'s findings. VIIRs satellite nightlight flaring data – using three near-to short-wave infrared channels – reveals how gas flaring mounted in specific areas, then decreased before Covid-19. A burning stack is hotter than most other forms of combustion sources. Stacks reach easily 1,500°C and exceed temperatures of sites like volcanos (thought false positives are possible).

E&T plotted a five mile-section around Sue Franklin's old home near Verhalen and measured progression of flaring for the several sites that mushroomed around her place since 2018. Our findings show that flaring in the area increased, but dropped in the second half of 2019 – the exact moment when Wilson found more evidence of unlit flares in the same area. Wilson takes videos with her OGI camera and makes them publicly available on YouTube. One recorded in November shows an unlit flare for a Primexx company well, 1.4km east of the Franklins' old home.

Poor air quality caused by local gas emissions from oil wells is a public health emergency for citizens across the Permian Basin, warns advocacy group Clean Air Task Force. The EPA cited toxic pollutants including benzene, a known carcinogen, and found ozone smog caused health problems, affecting asthma, bronchitis and emphysema.

The pandemic made things worse. As lockdown confined people to their neighbourhoods, activists begged the city council in Arlington to suspend drilling work near working-class areas, where rates of childhood asthma and Covid-19 soared.

Clean Energy Wire, a news service, took pictures of signs outside the site near Franklin's home that prohibit 'smoking, flames and open lights' and warn that hydrogen sulfide (H2S) 'may be present'.

Otherwise invisible, H2S emits a rotten-egg odour, matching Franklin's account. Overexposure can cause pulmonary oedema, an abnormal build-up of fluid in the lungs causing shortness of breath. "After a while, I started feeling like I couldn't even get a breath in. I get this tightness in my chest", Franklin told *E&T*.

Primexx, a private oil-and-gas exploration and production firm based in the Southern Delaware Basin of West Texas, maintains at least two wells less than a mile from the Franklins' old house. *E&T* approached Primexx's CEO Chris Doyle and media team for comment on recent venting practices, but without success. In 2019 Primexx flared 22 per cent of the gas it produced, according to data supplied by Environmental Defense Fund based on records from the Texas oil and gas regulator RRC.

Short term speculators

A damaging number of new and aggressive equity-backed operators came to market and drilled as if there was no tomorrow: "Companies that are really focused on short-term revenues just continuously drill and don't worry about reducing emissions, says David Lyon, analyst at Environmental Defense Fund.

Early protagonists for this trend quickly grew to become giants. When it started, Diamondback used a classic wildcatter's strategy by borrowing to hoover up acres quickly. Now it's one of the largest producers in the region. Subsequent examples show how quick buying, drilling and selling causes havoc.

DoublePoint Energy, which flared 0.8 billion cubic feet (bcf) of its total production and has an above-average flaring rate, was originally formed out of two privately-backed energy firms. It pledged to make aggressive gains in its acreage position 'through bolt-on acquisitions' and now wastes more than many other operators.

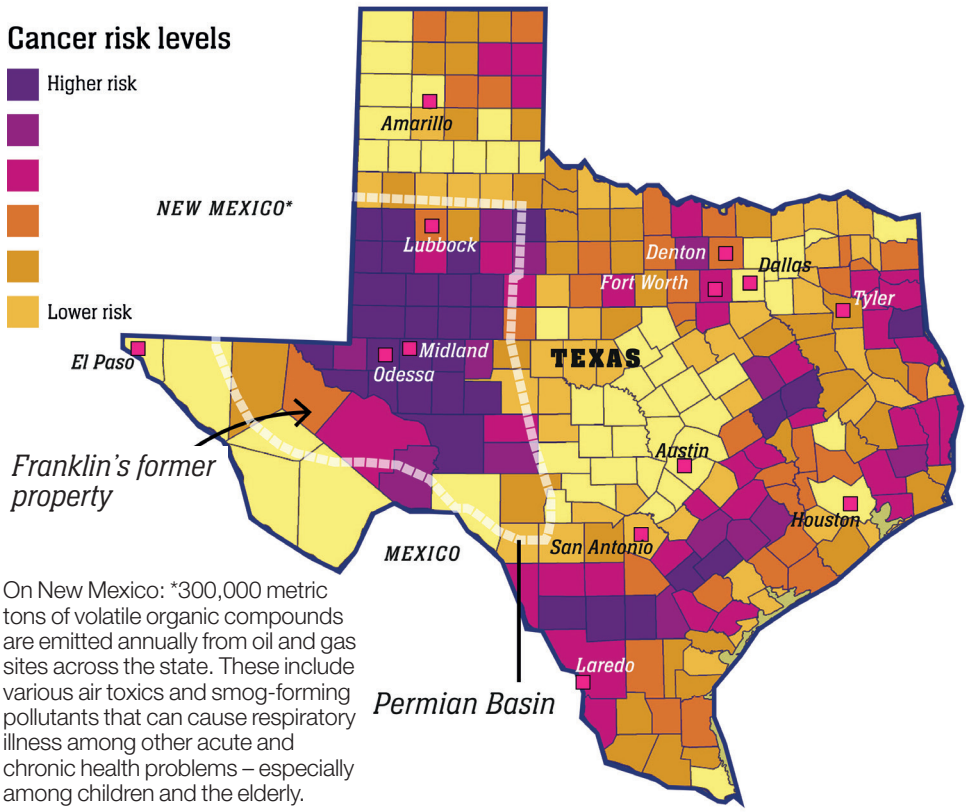
There is only spotty evidence that speculative practices have increased. One is the number of 'drilled but uncompleted wells' (DUCs) which ballooned in the Basin but remained relatively stable or fell for other US oil fields. DUCs increase when prices fall as operators keep oil in the ground in expectation of higher prices in the future. Having them drilled but incomplete gives firms leverage, MIT researchers have written.

Leyden also spotted a tendency for such firms to have higher flaring rates: "firms that looked like they were smaller private >

How toxic air pollution from oil and gas wells affects

Cancer risk from oil and gas air pollution (Texas)

2.3 million Texans live within a half mile of active oil and gas operations



On New Mexico: *300,000 metric tons of volatile organic compounds are emitted annually from oil and gas sites across the state. These include various air toxics and smog-forming pollutants that can cause respiratory illness among other acute and chronic health problems – especially among children and the elderly.

< equity-backed, with flaring intensity rates above 20 per cent, some as high as almost 60 per cent". The business model is the problem. It's about drilling as many wells as you can as quickly as you can, bring the liquids online and then try and get yourself sold".

Many smaller firms like Chinese-owned Surge Operating, which flared 4.4bcf of natural gas (22 per cent of its total production), may have come under more pressure to stay afloat. Smaller firms have less cash to spare for gas transport and are badly positioned to stop leaks – though Leyden also spotted larger culprits performing poorly.

E&T found at least 8 of 15 companies that flared more than 50 per cent of gas produced had fewer than 10 employees across sites, though some of the data pulled from business database DNB proved unreliable.

Sharon Wilson, an ITC-certified optical gas imaging thermographer, travels up and down the Permian Basin to hunt unlit flares. If she finds abuse, she records and raises it with the regulator by sending in a complaint with questions, such as: "are these permitted emissions? If so, how do you know?" "What kind of permit does this facility have?" and "when did these emissions begin, and how/when will they cease?".

She says that the way the responsible government body handles these complaints is appalling: "Sometimes they never do an investigation," she told *E&T*.

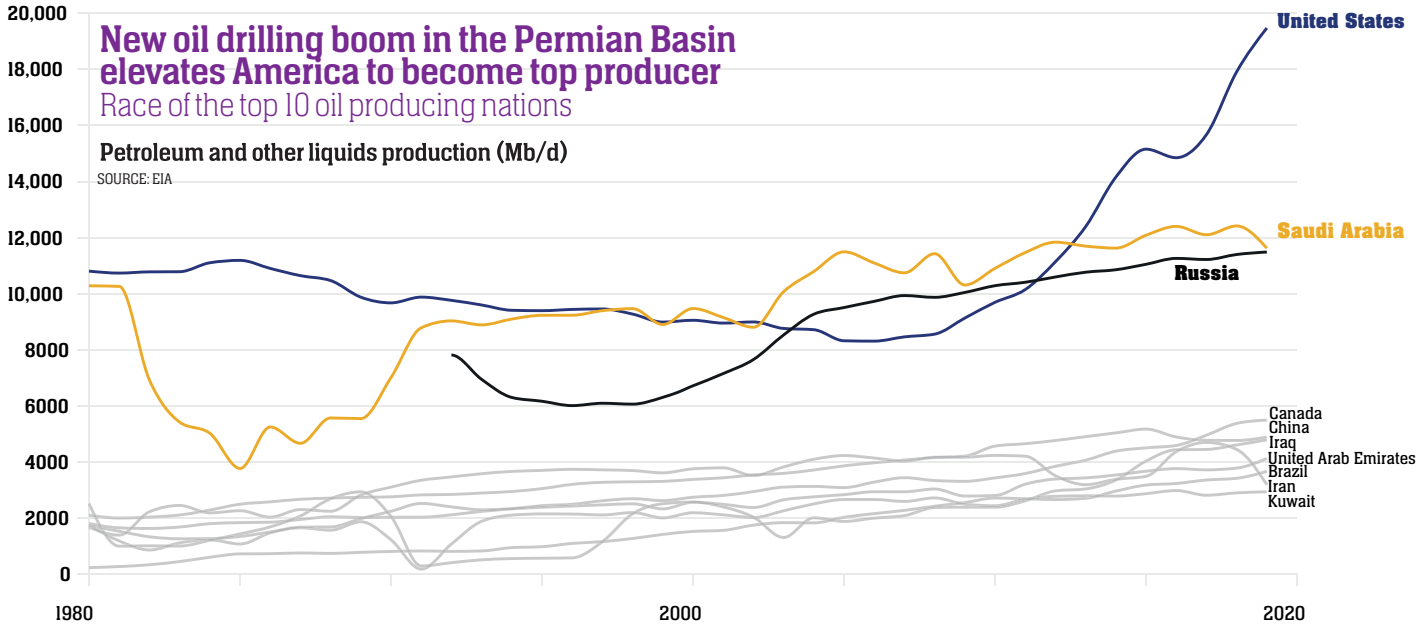
For Earthworks, a non-profits activist group, Wilson does the regulator's work. Her team tallied the jobs Wilson has done and how that compares with that of the regulator. It's her victory, but it brings her little joy because she knows there are hundreds of unpatrolled wells. If the number of times TCEQ (Texas Commission on Environmental Quality) used optical imaging equipment is any indication, Wilson checked more sites than the regulator, though Earthworks only looked at one region in the Midland Basin.

Covid-19 struck a blow in the heart of Wilson's work, making it more difficult to get around, but it was never easy. Part of the regulator's defence is that it takes vast amounts of resources to patrol an area that is the size of Britain.

Workers' health and safety is at stake, but they benefit from Wilson's efforts. The gas is invisible, and without OGI goggles workers may just walk straight into a fume cloud, with potentially lasting effects. Warning signs may not suffice, though they are everywhere.

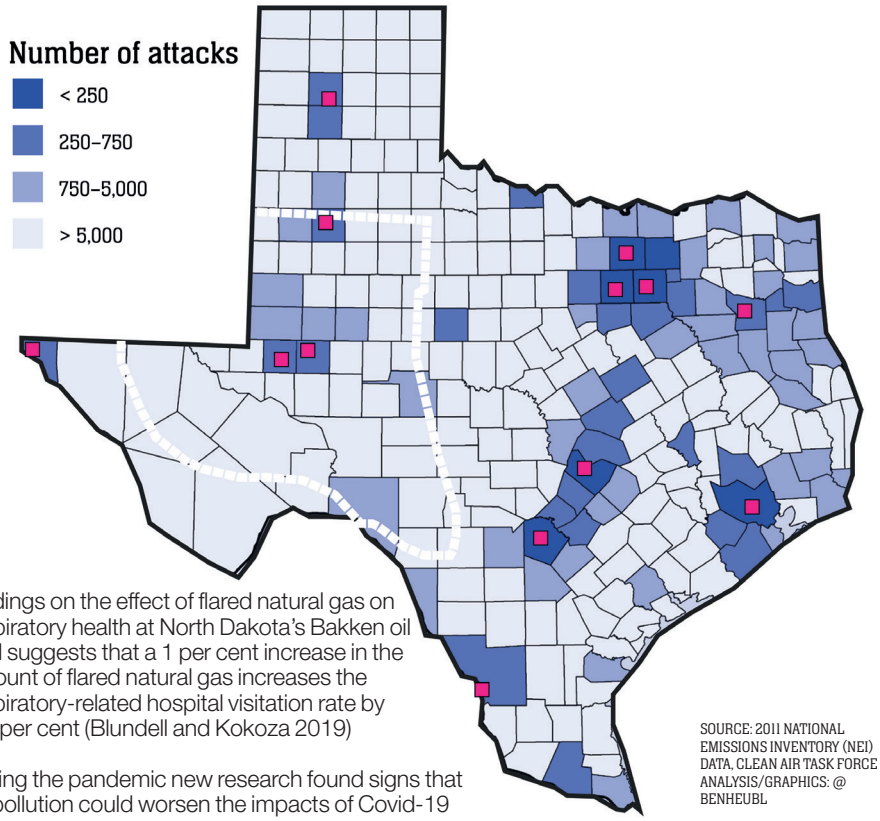
Often what companies say and do misalign. MDC Texas Energy dresses as defender of environmental sustainability, saying it "imposes a draconian operational discipline which provides maximum assurance that well control will be maintained at all time, eliminating the risk of leakage around ground water penetrations". A flaring rate of above 10 per cent is daily fare and leakages keep popping up at MDC's sites. Even a TCEQ investigation didn't stop it.

Other companies keep playing down the problem. After a *New York Times* report found emissions at one of EagleClaw's Pecos sites, the midstream gas processing plant was expected to change. To journalists the firm said safety and security of its employees



residents in Texas

Asthma attacks in children connected to air pollution from oil and gas operations



Findings on the effect of flared natural gas on respiratory health at North Dakota's Bakken oil field suggests that a 1 per cent increase in the amount of flared natural gas increases the respiratory-related hospital visitation rate by 0.7 per cent (Blundell and Kokoza 2019)

During the pandemic new research found signs that air pollution could worsen the impacts of Covid-19

SOURCE: 2011 NATIONAL EMISSIONS INVENTORY (NEI) DATA, CLEAN AIR TASK FORCE ANALYSIS/GRAPHICS: @ BENHEUBL

was important and problems were fixed quickly. But the area and the individual plant kept emitting. Aerial methane tracking shows that it remains high where the plant is, but that plant isn't alone. 18 other oil wells surround EagleClaw's site, so it's hard to attribute pollution to a source. Most of the wells near EagleClaw belong to Callon Permian. On its website Callon claims to be an advocate for 'sustainable development'. *E&T* approached Callon for comment, without success.

After the report in November 2019, Earthworks still found methane leaks at EagleClaw's site in March 2020. Why did nothing change? EagleClaw was not available for comment.

Technology

It may seem that without advanced technology, government oversight will remain poor. But Alan Septoff at Earthworks says "tech is a distant priority. Tech won't fix the problem". What's needed is political will and additional resources to address poor oversight.

Monitoring equipment exists, but the regulator has no access, only commercial companies, *E&T* was told. Those that can afford it make a big show out of it. Last April, Exxon Mobil announced "a mix of satellites, drones, planes, helicopters, trucks and fixed-position sensors" to help reduce methane emissions at its 1,000 sites in the Basin.

Covid-19 adds more bad news for the government. Abandoned oil wells – which have mounted since bankruptcies of drillers increased – risk additional pollution.

E&T found one site with multiple active oil drilling grounds right next to the Red Bluff water reservoir, a 1,193-acre lake about 35 miles south of Carlsbad, Texas. According to the aerial survey on methane emissions by airborne scientific research firm Scientific Aviation, it's one of the worst methane polluted areas within the study area. Researchers measured methane emissions of 995kg per hour last November.

Warning signs at an oil drilling site near Verhalen, Texas

Operators like Occidental Petroleum (Oxy), Mewbourne oil, BP-BPX and ExxonMobil-XTO are present in Red Bluff. Environmental Defense Fund data suggests BP, with BPX, has the worst flaring record (though that may include other BPX sites). *E&T* compared flaring volume for the area, and found that levels decreased long before the pandemic, which further corroborates the thesis that some wells extinguished flares, but kept gassing.

If firms report, they are often unreliable. Discrepancies between operators' reports and what sensors find is common, Leyden says. He speculates it's due to satellite data picking up gas processing plants, whereas they aren't reported to the energy regulator RRC but to another regulatory body. The other reason is under-reporting, which may or may not be intentional.

Wilson's work, as helpful it may be, has limits. Once she said the oil operator Primexx called the police on her, alleging she was trespassing, when she was just doing her job filming a plant near Franklin's old home. She used the chance to show the officer first-hand the invisible toxic pollution by letting him watch the site through her OGI camera.

"They [the regulator] don't have the technology to stop methane emission", Wilson says. Even if they had the means to find illegal emissions, penalties may have little effect on drillers, as few have ever been held accountable. It may take months, if not years, to hear back when Wilson finds abuse. One more severe permit violation took 14 months to process, she says.

Experts see a solution in high-resolution satellite tracking. At present, the low resolution of satellite imagery can't track individual oil wells, but capabilities advance quickly. "Remote sensing, we all see that as the future," Leyden says.

One of the first serious attempts to map methane was based on an algorithm from the radiance spectra measured by the TROPOMI instrument on-board the Sentinel-5-Precursor satellite, launched three years ago. The results were eye-opening. Satellite methane tracking tech found methane rates twice as high as for bottom-up evaluations.

What's the timeline for new satellites? Yuzhong Zhang, a Harvard researcher, says high-res satellite methane tracking could become operational in two to three years. Iris, a spacecraft that can monitor methane emissions with a resolution of 25 metres, launched on 2 September.

Even if the regulator has the means to hold drillers accountable, will it happen? A wave of deregulation under Donald Trump has made things easier for drillers. In August, after three years of battle, a pair of regulations were finalised to roll back Obama's 2016 New Source Performance Standards for controlling methane emissions from new and modified oil and gas sources.

That's not only bad for the climate. It's bad for business, say oil and gas exporters. Cutting control measures may backfire if major buyers of gas, such as the EU, attach stringent limits on methane leakage rates of imported gas.

It may not be far-reaching enough just to tighten emissions on paper. Sergey Paltsev, an MIT Energy Initiative research scientist, says the successful recipe for preventing oil-related methane emission is: "Measure and abate". In this investigation, *E&T* has shown that the state regulator fails on both fronts if technology isn't updated. It lacks means to track emissions in the Basin and there are not enough incentives to abate them.

When *E&T* spoke to Franklin in October, she said she still suffers from living near the wells. Recently, she and her husband drove through the area where they used to live: "When we came down the hill near our property, we saw again all this stuff in the air. It immediately struck our lungs. You can smell it and feel it. We both came home with a headache just from driving through it." *