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Earthquakes in Texas doubled in 2021. Scientists cite years of oil companies injecting sludgy water underground.

The surge in seismic activity from increased underground pressure is shaking the West Texas ground and rattling longtime residents.

BY **ERIN DOUGLAS** FEB. 8, 2022 4 AM CENTRAL

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An injection well facility just outside of Odessa, seen on Jan. 31. 📷 Eli Hartman for The Texas Tribune

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MIDLAND — One local said it sounded like a pickup truck had rammed into the side of their house. Another said it sounded like the air conditioner fell off the roof. A third compared the experience to getting off of a rollercoaster, dizzy and a bit shaky.

“In the hardest ones we’ve experienced, there is a bunch of shaking, and the pictures shook off the walls,” said Christina Bock, 45, who lives in Gardendale, a rural community north of Odessa in the heart of West Texas oil and gas country. Earthquakes have dislodged her deck from the house and left cracks in her walls, she said.

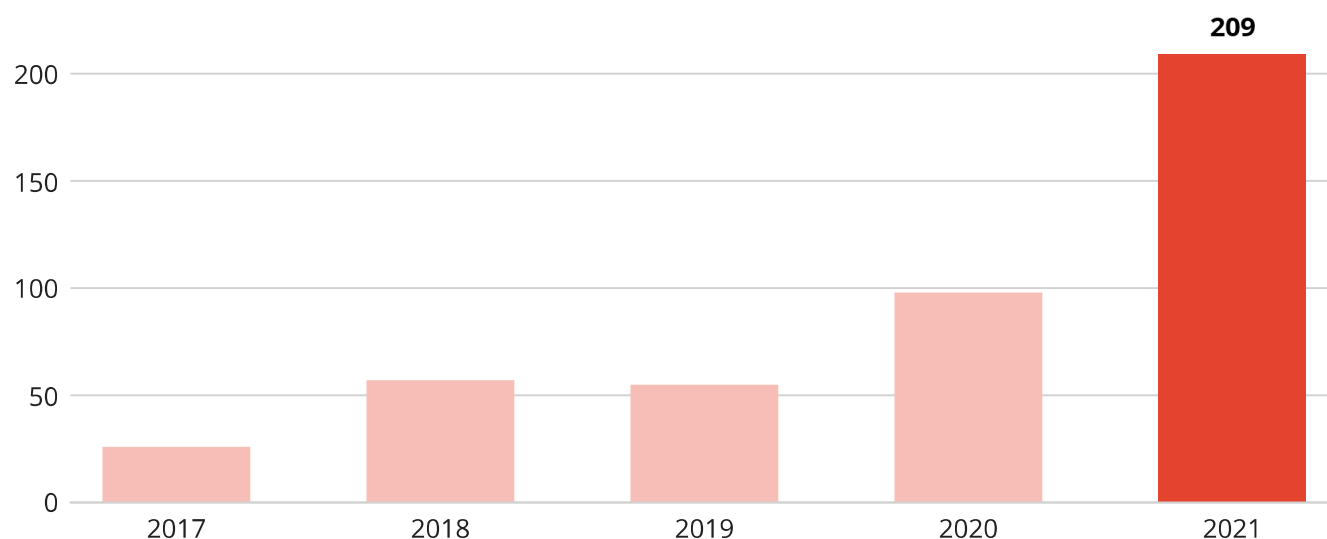
“You’ll hear a loud bang. If you’re inside, you assume it’s a car wreck or that something exploded outside,” said Bock, a paralegal who has lived in Gardendale for 13 years. “The scary thing is that they are happening pretty much daily at this point.”

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More than 200 earthquakes of 3 magnitude and greater shook Texans in 2021, more than double the 98 recorded in 2020, according to a Texas Tribune analysis of state data maintained by the Bureau of Economic Geology at the University of Texas at Austin.

Texans rattled by seismic activity in 2021

Texas saw a surge in the number of earthquakes of 3.0 magnitude and greater last year. The number of such quakes has jumped eightfold since 2017.



Note: Earthquakes below 3.0 magnitude are excluded from data analysis because seismometers may not detect 100% of the earthquakes that occur in Texas below that magnitude.

Source: Bureau of Economic Geology at the University of Texas at Austin


Credit: José Luis Martínez

The record-setting seismic activity is largely concentrated in West Texas' Permian Basin, the most productive oil and gas region in the state. Scientific studies show that the spike in earthquakes is almost certainly a consequence of disposing huge quantities of contaminated, salty water deep underground — a common practice by oil companies at the end of the hydraulic fracturing process that can awaken dormant fault lines.

During hydraulic fracking, oil companies shoot a mixture of fluids and sand through ancient shale formations, fracturing the rock to free the flow of oil. But oil isn't the only thing that's been trapped underground for millions of years: Between three and six barrels of salty, polluted water also come up to the surface with every barrel of oil.

The cheapest, and most commonly used, way to dispose of this “produced water” is to drill another well and inject it into porous rock formations deep underground.

A horseback rider takes an evening stroll through a residential neighborhood in Gardendale on Sunday, Feb. 6, 2022.

A rider passes by a pumpjack during an evening horseback ride through a residential area in Gardendale on Sunday.  Eli Hartman for The Texas Tribune

For years, oil companies have loaded those formations with hundreds of millions of gallons of the black watery mixture — which contains a slurry of minerals, oil and chemicals used in fracking — every day, slowly increasing the pressure on ancient fault lines. An analysis by Rystad Energy provided to The Texas Tribune found that the amount of wastewater injected underground in the Permian Basin quadrupled in a decade, from 54 billion gallons in 2011 to 217 billion gallons last year.

In a 2021 study published in the Journal of Geophysical Research, scientists at the U.S. Geological Survey and the University of Texas found that the vast majority of seismicity since 2000 near Pecos — a city roughly 100 miles southwest of Midland — was likely triggered by increased wastewater disposal. State regulators, too, have found that an increase in seismic activity most likely occurs as a consequence of saltwater disposal.

“The cumulative volumes [of water] increase the pressure, and that is the force that

triggers the fault to slip,” said Alexandros Savvaidis, a research scientist at the Bureau of Economic Geology at UT-Austin.

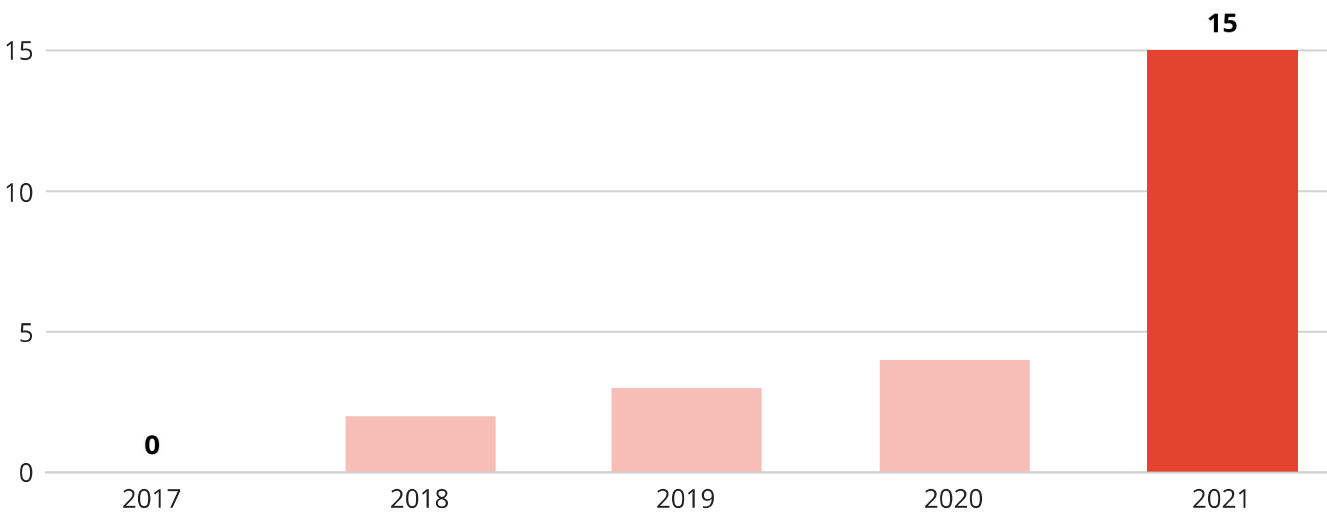
The result is that communities like Gardendale, where Bock lives, as well as the bustling cities of Odessa and Midland — which many oilfield workers, engineers and service workers call home — are experiencing not only more frequent earthquakes, but stronger ones.

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Between 2018 and 2020, Texas recorded nine earthquakes above magnitude 4, almost all of them in the western half of the state. Last year, Texans were shaken by 15 earthquakes above magnitude 4 — including a [4.6 magnitude earthquake](#) in late December that rattled homes from an [epicenter](#) about 30 miles northeast of Midland.

Stronger earthquakes becoming more common

Fifteen earthquakes of at least 4.0 magnitude struck Texas in 2021, six more than in the three previous years combined, data shows. These quakes are 32 times more powerful than a 3.0 quake.



Note: The logarithmic magnitude scale measures the physical size of an earthquake.

Source: [Bureau of Economic Geology at the University of Texas at Austin](#)

Credit: José Luis Martínez

“That was different,” said David Rosen, a geologist who has lived in Midland for almost 50 years. “That was like riding a bicycle over cobblestones.”

David Rosen sits in his home in Midland on Jan. 27, 2022. Rosen was sitting in this chair when a 4.6 magnitude earthquake st...

David Rosen in his home in Midland on Jan. 27. Rosen said he was home when a 4.6 magnitude earthquake struck northeast of Midland on Dec. 27. Rosen said more frequent earthquakes caused him to consider earthquake insurance. 📷 Lauren Witte/The Texas Tribune

While distance, soil composition and other factors determine at what magnitude earthquakes cause damage, earthquakes above magnitude 3 can typically be felt indoors; above a 4, walls may make a cracking sound and dishes can be disturbed, according to the U.S. Geological Survey.

Rosen, who was also a former Democratic Party chair for the county, said it used to be a novel thing, feeling an earthquake in West Texas. His wife felt one in 1991; he didn't. Now, they both feel the quakes fairly often in their home on the north side of Midland.

The huge jump in seismic activity compelled the Railroad Commission of Texas, the state’s oil and gas regulatory agency, to indefinitely suspend underground water injections late last year in a [swath of land from](#) Odessa north to Midland, and west to Andrews and Martin counties. The decision affected all 33 disposal wells in the targeted area.

“RRC staff has determined that [produced water] injection into deep geologic strata — below the top of the Strawn Formation and especially the Ellenburger Formation — across the area is likely contributing to recent seismic activity,” the agency wrote in its justification for suspensions.

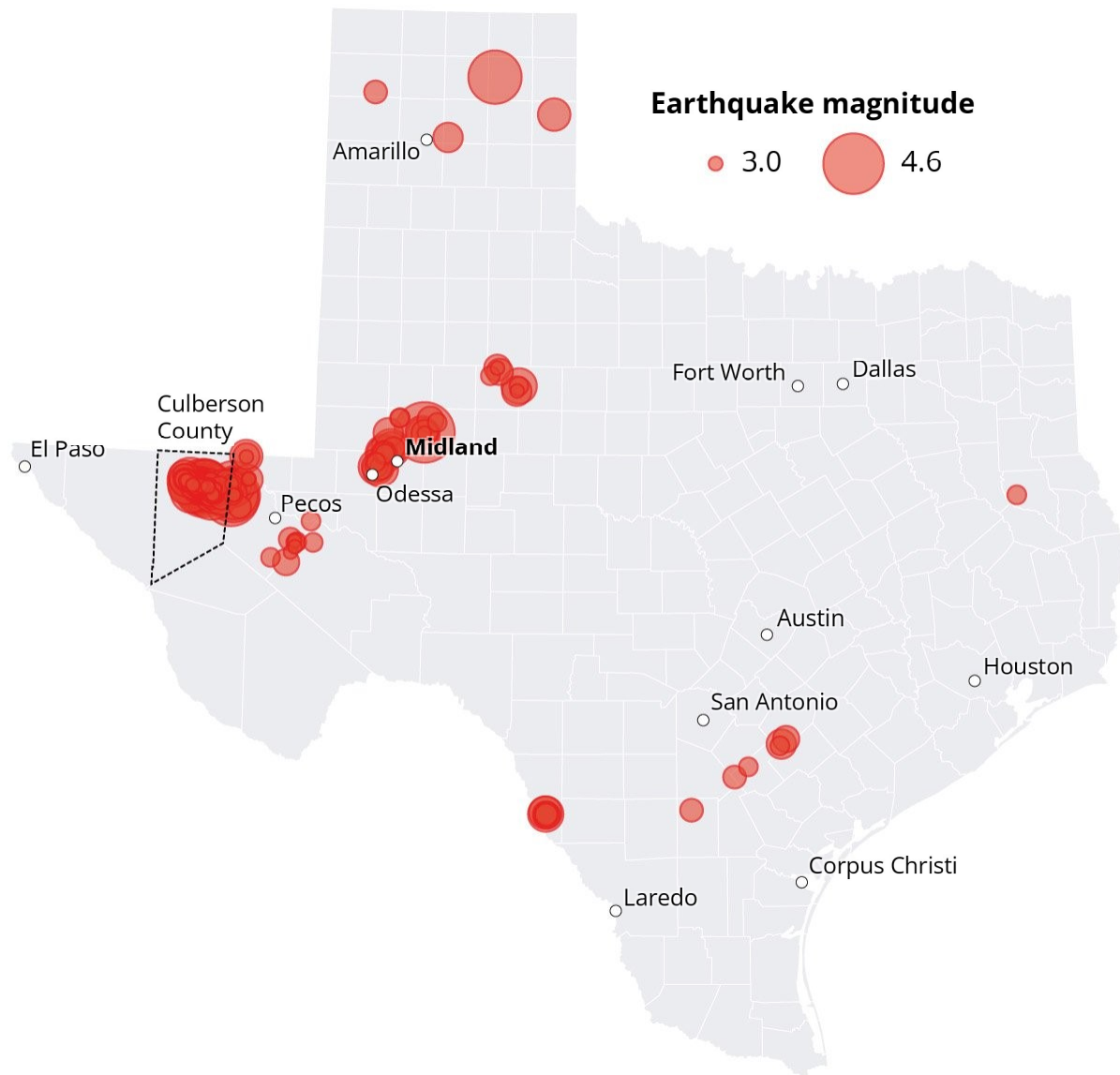
It may take months after the injections halt for the area to stop shaking, scientists said, since the pressure needs time to ease.

Since October, two other areas of West Texas — a [region north of Stanton](#), about 25 miles east of Midland, and an [area that straddles Culberson and Reeves counties](#) between the Guadalupe Mountains and Pecos — have also been categorized as areas of concern by the agency because seismic activity has increased, though regulators have not yet suspended produced water injections there.

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West Texas shaken by hundreds of earthquakes in 2021

A massive amount of wastewater produced from the hydraulic fracturing process is injected deep underground — a practice that has awakened long-dormant fault lines, scientists said. The map shows quakes of 3.0 magnitude and above.



Source: Bureau of Economic Geology at the University of Texas at Austin

Credit: José Luis Martínez

Instead, the agency instructed companies to work together and come up with a plan to limit seismicity to earthquakes under 3.5 magnitude after 18 months.

Andrew Keese, spokesperson for the Railroad Commission, said in a statement that the agency hopes the industry can cooperate to reduce the magnitude and frequency of the quakes. If it fails, the agency is “prepared to implement actions of its own if needed,” he wrote. An industry plan to reduce seismicity in the Stanton region is due in mid-April, Keese said.

“Operators have already made adjustments in the volume of water injected,” Keese said.

Rosen, the former Democratic Party chair, said he considered buying earthquake insurance before deciding it wasn’t worth the cost unless the quakes get even stronger. Still, he’s disappointed in what seems to him to be reluctant action by state regulators to the increasing seismic activity.

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“[The Railroad Commission] has been getting feedback for months,” he said, “and finally they decided to temporarily suspend disposal for a couple of wells. That’s a pretty sluggish response.”

“We’re just paying the price”

Residents of the Permian Basin are used to the noise of drilling construction; the damaged roads from heavy trucks hauling sand, water and more; the trash snagged in mesquite branches blown from camps of the here-today-gone-tomorrow oilfield

workers. Many say they have switched to bottled water or installed water softeners because their tap water turned cloudy with minerals and tastes metallic and salty since fracking took off in the area a decade ago.

But the earthquakes are different, said Bock, the paralegal and mother of two in Gardendale. One contractor's estimate to level her home's foundation was \$8,000, she said. At least for her family, the shaking was the last straw.

"I don't want to stay out here," she said. "Not like this."

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She and her family will likely sell the house and relocate to Central or Southwest Texas in a couple of years, she said.

"Were the earthquakes a reason? I would say about 50% of it, yes," Bock said. "The damage [from fracking] is done, and now we're just paying that price. And this is what it is."

Eli Hilbert, 20, a political science student at the University of Texas Permian Basin in Odessa, said many locals view the earthquakes as part of the natural environment — like the strong winds or tumbleweeds — despite science that shows the phenomena is almost certainly caused by humans.

"People treat them as just a part of life around here," said Hilbert, an environmental advocate who will soon help launch a nonprofit organization focused on pollution and climate change in the Permian Basin.

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Hilbert said it's difficult to get community buy-in to organize around environmental issues because much of the population moves in and out with the oil industry. "You aren't particularly invested in stopping air pollution if you're only going to be here for two years," Hilbert said. "But with the increase in [seismicity] last year, I feel like it's a thing people are becoming more worried about."

Catherine Allen poses for a photo in her home Friday, Jan. 28, 2022 in Midland, Texas.

Catherine Allen in her Midland home. The artist said she has considered leaving town because of the earthquakes. “It seems like disaster is getting closer,” she said. 📷 Eli Hartman for The Texas Tribune

Other residents of Midland, Odessa and surrounding areas echoed Hilbert’s sentiment that the near-daily shakes were beginning to crack the community’s long-hardened endurance to the nuisances and environmental consequences of living with the oil industry.

Ashley Gunter, 40, whose family has lived in Midland for three generations, wonders if the quakes will keep getting stronger and more frequent and eventually make the free-spirited, religious city where she grew up unlivable. “I’m no scientist, but this is not supposed to be happening,” Gunter said. “We don’t live in California.”

Catherine Allen, an artist in Midland, said she has considered relocating because of the quakes. Allen lives in a midcentury house just a few minutes from downtown. It’s the kind of place she says she would love to live the rest of her life in — but she’s not sure if she can.

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“The earthquakes seem to be getting closer, and I’m also not sure if our groundwater is going to be safe for much longer,” Allen said. “It seems like disaster is getting closer, but I always question if I am overreacting.”

Where the water goes

The earthquakes often make the local news, and they spark regular alerts on the neighborhood app Nextdoor. Still, Allen said, she's disappointed at the lack of a broader community discussion about what should or could be done to prevent the seismic activity in Midland.

“Our local leaders do not talk about it, and I don't know how that's possible,” Allen said.

Allen and other residents concerned about the quakes point to the oil industry's power in the Permian Basin as the reason there hasn't been a more aggressive response by local officials. About 30% of Midland's workers are [employed directly](#) by the energy and mining industry, according to [federal employment data](#).

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Midland's City Council has not had a meeting to address the rise in seismic activity, according to recent City Council agendas and member John Norman, who confirmed that the council has discussed seismicity only in casual conversations. He wasn't surprised that it hasn't come up yet, he said.

City Councilman John Norman, Midland district two, says he is not anti-oil and gas, but he is concerned about the earthquake...

John Norman, a Midland City Council member, says city leaders have yet to have a serious discussion about the rising number of earthquakes. He said he's not against the oil and gas industry, but he's worried about his constituents' safety. 📷 Lauren Witte/The Texas Tribune

Norman, who grew up in Midland and worked in the oilfield for more than two decades, said the reason the council has not taken action or formally discussed the quakes is that the injection wells are largely outside city limits. While the quakes shake Midland, it's difficult to see what the city might do to prevent the practice, he said. That's for the Railroad Commission to decide. (Norman praised the agency's most recent response.)

But the industry itself isn't blind to the business risk the quakes pose: At an annual oil and gas industry luncheon hosted by the Midland Chamber of Commerce on Jan. 26, an executive with Chevron Corp. listed the increase in seismic activity as one of the industry's biggest challenges in the Permian Basin.

Ryder Booth, Chevron's vice president of North America exploration and production, called on the roughly 300-person crowd of Midland oil and gas executives, workers and leaders to work together to reduce the earthquakes, pointing to the increase in seismic activity from water injections as one of the industry's major challenges in the Permian.

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“We’re going to have to work together, partner together, to make sure we’re tackling it,” Booth said.

A few companies in the Permian Basin have built recycling facilities for produced water — an alternative to pumping it underground. One such facility outside of Big Spring, northeast of Midland, pipes in produced water from surrounding drill sites up to 20 miles away.

Water pours into the storage pool after going through the recycling process at Breakwater Energy Partners in Big Spring on Jan. 27, 2022.

Workers point to pipes used in the flock loop, where chemicals are added to help remove solids and kill bacteria in the water.

First: Water pours into the storage pool after going through the recycling process at Breakwater Energy Partners in Big Spring on Jan. 27, 2022. Last: Workers at Breakwater Energy Partners in Big Spring. The facility processes “produced water” from fracking, reducing contaminants so it can be used again for oil and gas drilling. 📷 Lauren Witte/The Texas Tribune

“What’s cool about this is that ordinarily, that kind of stuff might be going

downhole, instead of coming to us,” said Jim Hudgins, midstream operations manager at Breakwater Energy Partners, which opened the facility in 2020.

The facility separates the solids from the liquids and presses them into a cake-like material that can be dumped at a landfill. “It looks like a brownie,” said Zac Hall, the recycling operations manager at Breakwater Energy. “You wouldn’t want to eat it.”

Then the brackish-looking water is pushed through 10 large tanks, where chemical reactions remove the impurities until the water looks clear enough to drink — although it’s far too salty for that.

“This is probably five to seven times saltier than the ocean,” Hall said. “It would taste like crap.”

After the solids are removed in the clarifier tanks, they are put into pressers that squeeze out any remaining liquid. Recyc...

A man holds a sample of a clear brine produced by the recycling process at Breakwater Energy Partners in Big Spring on Jan. ...

First: Recycling operations manager Zac Hall holds a piece of the nonhazardous waste extracted from produced water at Breakwater Energy Partners. Last: A sample of the salty water produced during the recycling process at Breakwater Energy Partners in Big Spring. 📷 Lauren Witte/The Texas Tribune

The water is stored in a large, open pool that can hold roughly 63 million gallons of water. The company then sells the water back to oil companies for the next round of fracking.

But recycling facilities, while helpful, are only a partial solution over the long term, Railroad Commissioner [Jim Wright pointed out in a recent statement and op-ed](#). The amount of water needed by oil companies for the hydraulic fracturing process is far less than the amount of produced water being dislodged and dredged up from underground each day. Without a more promising solution on the horizon, the [Texas Legislature in 2021 directed](#) scholars and industry leaders to study the problem.

An operational pumpjack neighbors a trailer home in Gardendale on Sunday, Feb. 6, 2022.

An pumpjack operates near homes in Gardendale on Sunday. The oil and gas industry is one of the biggest employers in the Midland-Odessa area. 📷 Eli Hartman for The Texas Tribune

In the meantime, the earth continues to shake under the feet of West Texas residents. On a recent brisk but sunny Friday afternoon, a howling West Texas wind pushed tumbleweeds across roads, natural gas flares burned across the horizon and a seismometer recorded another earthquake — this one a 3.1 magnitude, just outside Odessa, 14 miles west of Midland.

That same day, Norman, the Midland City Council member, sat in a local coffee shop in his district. He said he worries that the earthquakes could make the area unsafe. He hopes the industry, state regulators and the city can find a solution.

“The oil industry has been good to me and my family, but if you die from an earthquake what does it matter?” he said. “I know this is how we make our money [in Midland]. That’s fine, but the safety and the empathy for human beings — that’s what I try to focus on.”

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José Luis Martínez contributed to this story.

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