Enhanced Oil Recovery:
A Threat to Drinking Water

Public lacks the information to understand the most common oil production practices; regulators lack the data, oversight tools, and financial resources to guarantee drinking water protection.[1]

What is enhanced oil recovery?

Enhanced oil recovery (EOR)[2] is the most common oil recovery practice in the U.S., accounting for an estimated 60% of total crude oil production. Despite its prevalence, EOR is largely unknown to the public, poses threats to groundwater, and lacks adequate oversight from state and federal regulators. EOR involves the injection of fluids underground to increase the flow of oil and gas to the surface. There are four primary types of EOR:

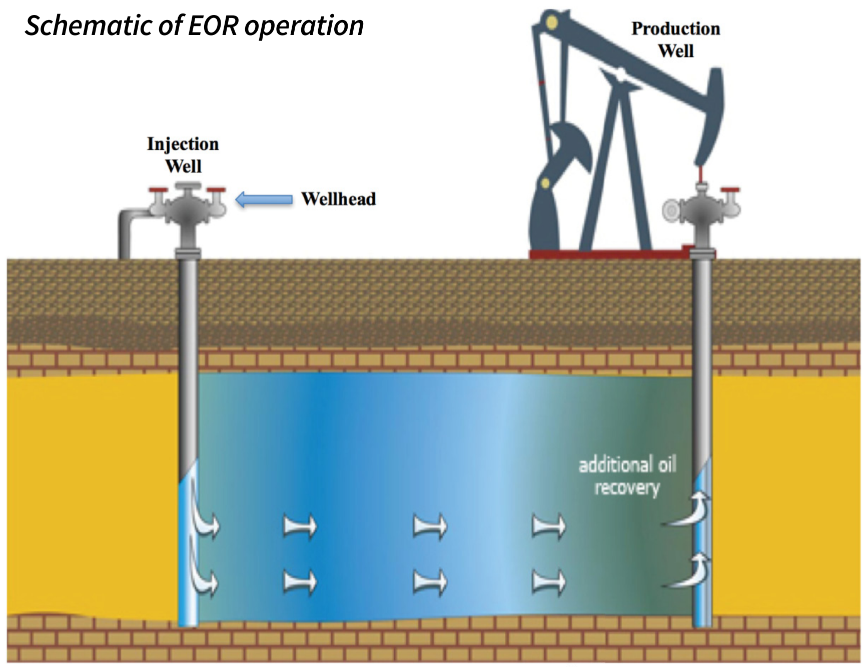
Waterflooding: The injection of water underground to push oil through the formation and into an oil well — accounts for approximately 50% of total U.S. crude oil production.

CO_2-EOR: The injection of CO_2 to mix with oil to aid in recovery — accounts for approximately 5% of total U.S. crude oil production.

Thermal EOR: The injection of steam underground to increase the flow of heavy oil — accounts for approximately 4% of total U.S. crude oil production.

Chemical EOR: The injection of bacteria or added chemicals in water for oil recovery — accounts for less than 1% of total U.S. crude oil production. *Note: the use of chemicals is not unique to chemical EOR. Oil companies often use chemical additives in other EOR and oil production processes.*

Schematic of EOR operation



Source: Bernardo Llamas, Benito Navarre, Fernando Vega, Elias Rodriguez, Luis F. Mazadiego, Ángel Cámara and Pedro Otero (2016). Greenhouse Gas Emissions – Carbon Capture, Storage and Utilisation, Greenhouse Gases, Dr. Bernardo Llamas (Ed.), InTech, DOI: 10.5772/63154

**Image has been altered from its original source to point out certain well components.*

Hydraulic fracturing (fracking) is <u>not</u> commonly considered a form of EOR. Fracking and other forms of well stimulation, permanently change the geology of the formation, creating new pathways for oil or gas to flow. EOR, by most definitions, instead utilizes existing subsurface pathways and injection is used to increase the pressure and/or to reduce the viscosity of the oil to facilitate flow to the surface.

How is EOR regulated?

The **Safe Drinking Water Act** (SDWA) called on EPA to implement the **Underground Injection Control** (UIC) Program, which regulates injection practices to protect **underground sources of drinking water** (USDWs). EOR is regulated under UIC's **Class II** program. Many states have been granted primacy by EPA to oversee their own UIC programs and develop their own regulations. As of 2016, there were about 184,000 active and idle Class II injection wells, nearly 146,000 for EOR and the remaining 38,000 for disposal of oil and gas wastewater. Of these EOR Wells, EPA has direct oversight of just over 5,500. The rest are overseen by primacy state programs.

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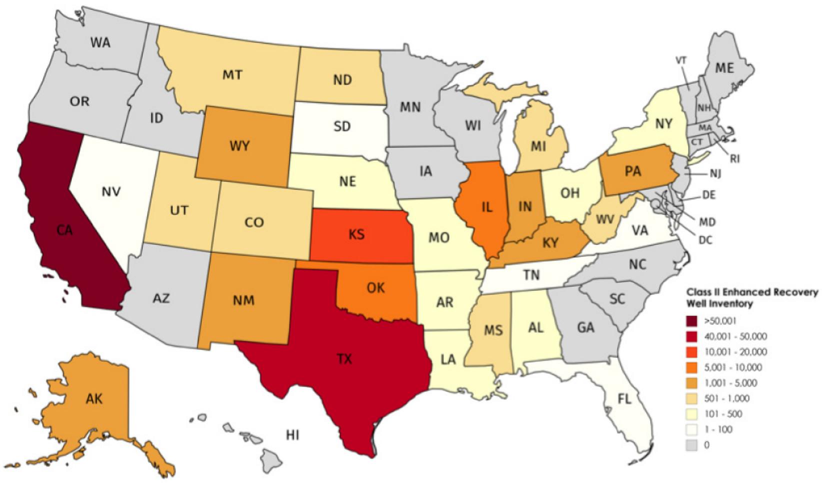
1 For a deeper dive into EOR and the information on this fact sheet, see: "The Environmental Risks and Oversight of Enhanced Oil Recovery in the United States: An overview of class II well trends and regulations in EPA's Underground Injection Control Program" July 2017, Clean Water Action/Clean Water Fund. www.cleanwater.org/eor-risks

2 "Enhanced oil recovery" is the most common used term for these practices. However, the term "enhanced recovery" or "ER" is used as well, implying the recovery of gas, not exclusively oil, is included.

Federal and state Class II UIC regulatory programs have failed to adequately oversee EOR, leading to data gaps, unchecked environmental risk and regulators unable to effectively do their jobs.

- The lack of up-to-date data collection and research on EOR means that basic information is unknown to the public and regulators, including: where each EOR technology occurs, the environmental impacts of EOR activities, the exact makeup of injected chemicals, and production statistics.
- No universal definition of EOR exists, rendering data unreliable and creating potential regulatory gaps.
- There are no requirements to routinely monitor or sample nearby groundwater quality, meaning that potential contamination could go undetected.

2016 U.S. Class II EOR Well Inventory and Location



Data Source: EPA. FY 2016 Underground Injection Well Inventory — By State. June 2017. https://www.epa.gov/uic/underground-injection-well-inventory

Environmental Risks of Enhanced Recovery

Although each EOR technique has unique risks, they share some commonalities:

- Harmful chemicals — either injected underground or naturally occurring in the formation — can contaminate groundwater. Contamination can occur through faulty well construction, geologic pathways, improperly plugged oil and gas wells, or injection directly into underground sources of drinking water.
- Injection wells can blowout, which can cause injected fluids and gases to flow to the surface, harming air, land, wildlife and water resources, and creating workplace hazards.
- EOR can create high volumes of contaminated wastewater, presenting spill and mismanagement risk in the transport, treatment and disposal of this waste stream.
- Some forms of EOR, especially thermal injection, are energy and carbon intense, contributing to air and climate pollution.

To reduce threats to USDWs and the environment, EPA and states must improve oversight of EOR activities.

We recommend that EPA:

- Launch an independent study of EOR's environmental threats, data gaps, regulations and oversight.
- Update the UIC Class II regulations and minimum standards, including definitions of EOR technologies;
- Increase the collection of information to address data gaps and assess environmental risks of EOR;
- Take a more active role in state UIC Program oversight, such as independent audits and more robust annual reviews;
- Work with Congress to increase funding and staffing levels for the UIC Class II Program.

We recommend that States:

- Update UIC Class II regulations to: increase transparency, require disclosure of injected chemicals, and establish groundwater monitoring near injection wells;
- Improve data management by collecting and publicizing more information in an easy to use and accessible format;
- Increase funding and staff levels;
- Improve management of idle, plugged and abandoned, and orphaned wells.