Way Down in the Hole: Energy transition, clean-energy goals set the stage for carbon capture's growing importance

Technology seen as major tool in meeting ESG targets, limiting climate impacts

The U.S. is the global leader in carbon-capture technology.

Carbon dioxide has value to the global economy and capturing it must be factored into decarbonization plans.

The 45Q tax credit is a key incentive that can help make carbon-capture projects economical.

Tax credits can add up, but aren't enough for many types of projects.

Potential changes to 45Q could expand its use, incentivize new types of projects.

1. Introduction

The idea of capturing carbon dioxide (CO_2), cooling and compressing it into a neither-liquid-nor-gaseous state, and pumping it deep underground for permanent storage would have baffled the crude oil wildcatters and pipeline builders that created the modern energy industry back in the 1940s and '50s. But times have changed. The oil and gas business is entering an extraordinary era of transition, and producers, midstreamers, and refineries alike need to keep abreast of what's happening regarding carbon capture and sequestration (CCS), how it will affect them, and — ideally — figure out ways to profit from it. That's the impetus behind RBN's latest Drill Down Report, in which we take a detailed look at efforts to reduce emissions of man-made CO_2 by capturing it from industrial sources and piping it to specially designed wells for permanent storage.

Sequestration is the permanent storage of CO_2 in the ground — way down in subsurface geologic formations — with the aim of keeping that greenhouse gas (GHG) out of the atmosphere and slowing the pace of climate change. CO_2 sequestration has become a hot topic in the energy space the past few years, and it would be fair to say that, with ESG issues and last year's COP26 meeting in Glasgow enjoying such high-profile attention, sequestration is going to be front-of-mind for producers, midstreamers, and refiners as far out as they go with their planning cycles.

First, a couple of definitions. If CO_2 is captured and stored, and that's all, the process is called CCS and utilizes a Class VI well (right side of Figure 1) for long-term storage in saline formations. On the other hand, if the CO_2 is used for some other process before it's stored via a Class II well, it is called carbon capture, use, and sequestration (CCUS) — the most common example being enhanced oil recovery (EOR, left side of Figure 1).

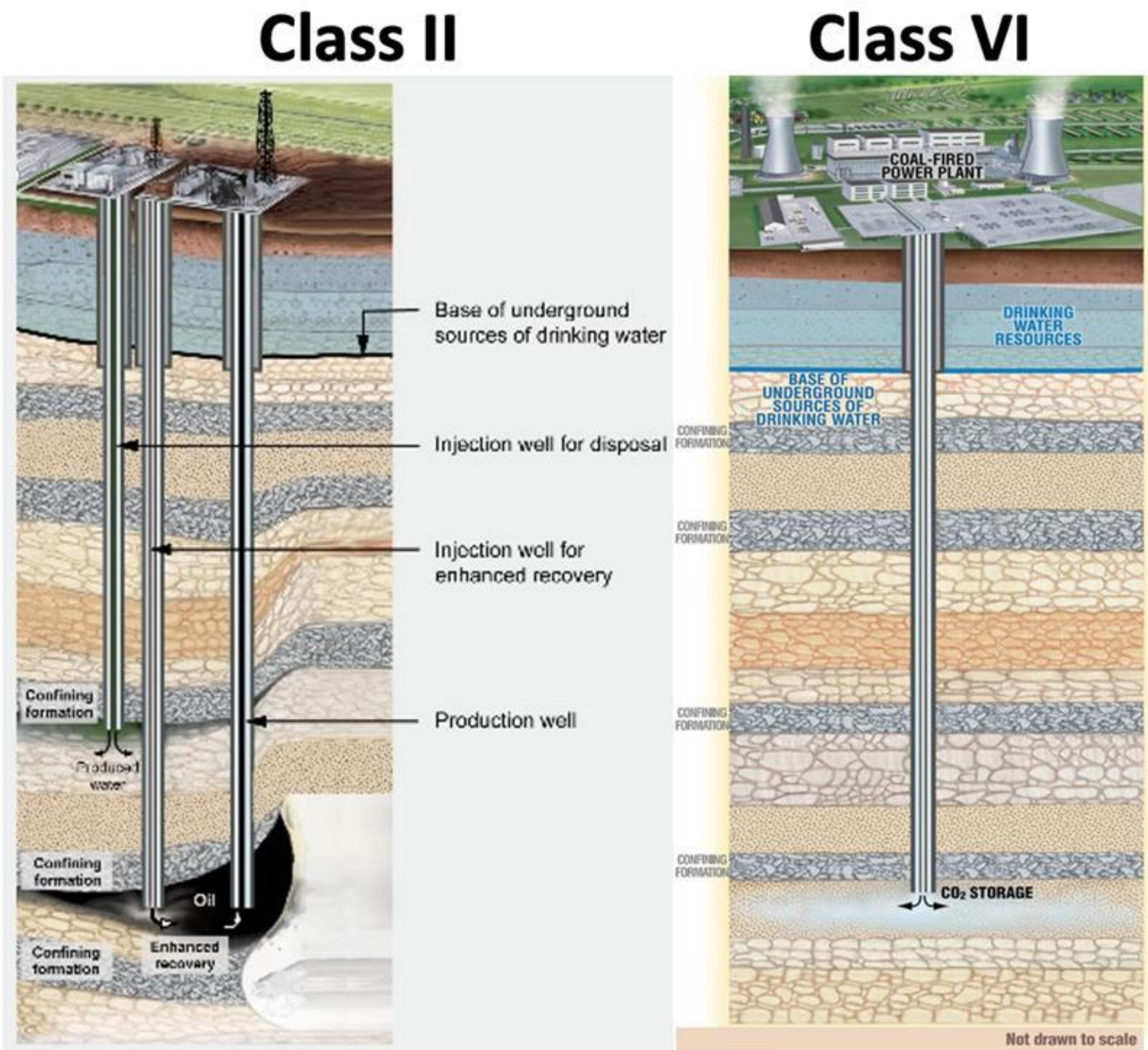

Figure 1. Class II Wells for EOR and Class VI Wells for CO_2 Storage. Source: EPA

During the EOR process, CO_2 is pumped into an injection well and flows through the pores in the rock. On the initial go-round, about 40% of the CO_2 stays down in the pores permanently, which means about 60% comes to the surface with the oil, gas and NGLs, where it hits the recycling and processing complex. After being separated from the hydrocarbons brought to the surface, the CO_2 is pumped back underground into injection wells for another run through the cycle. Recycling is what makes EOR work, both as an oil recovery technique and a way to sequester CO_2, which over time replaces the oil in the producing field.

In addition to EOR, Class II wells can be used for the disposal of other gases and liquids, including "produced water" (brine/salt water) that continuously comes to the surface during oil and gas production. There are other carbon-capture alternatives as well, mostly conversions to make something out of the CO_2, which is referred to as carbon capture and utilization (CCU).

The complexity of capturing and gathering "anthropogenic" CO_2 (A-CO_2) from industrial facilities varies considerably depending on the type of plant involved. Facilities emitting CO_2 can generally be lumped into two buckets: high-purity sources where the concentration of CO_2 generated is close to 100% and low-purity sources where the CO_2 makes up a much smaller portion of the total gases being generated. Examples of high-purity sources are ethanol producers, ammonia manufacturers, and natural gas processing plants. Low-purity CO_2 streams generally come from processes where the CO_2 is a product of combustion, such as in steelmaking or cement production. Put simply, capturing CO_2 from high-purity sources can make economic sense if the capturer can realize between \$30 and \$50 per metric ton (MT) of CO_2, while capturing the gas from low-purity sources is profitable only when the value of CO_2 is considerably higher.

It's also possible to capture CO_2 from power plants, such as the Petra Nova Carbon Capture Project near Houston. Equipment installed at NRG Energy's 610-MW, coal-fired W.A. Parish Unit 8 in Fort Bend County, TX, enabled the capture of up to 92% of the CO_2 from a 240-MW portion of the unit's emissions. Up to 75 MMcf/d of captured CO_2 was compressed and delivered via a new, 82-mile pipeline to the mature West Ranch oil field in Jackson County, TX, for use in EOR. The Petra Nova project operated for three years (until 2020) but was removed from service, primarily due to low oil prices. The revenue generated from selling the crude produced via EOR did not pay for the cost of capturing the CO_2. (For more on the project, see Section 4.3.)

The key to reducing emissions of A-CO_2 from industrial sources and power plants will be capturing CO_2 generated by those facilities, separating out the impurities, and then piping that CO_2 to EOR sites or Class VI wells for permanent sequestration. That's the focus of this report, from the basics of carbon capture and the CO_2 market to the all-important 45Q tax credit and provisions to expand its reach and potential.

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