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Subsidizing Carbon Capture Utilization and Storage: Issues with 45Q

Issue Brief 19-06 **Jay Bartlett** and **Alan Krupnick** — August 2019

In early 2018, Congress passed a budget bill that also contained revisions to a tax credit for carbon oxide capture, utilization, and storage, increasing the incentives for these activities. The next step for implementing this legislation is for the IRS to write regulations. Over a year later, the IRS asked for comments on how these regulations should be written, in its Request for Comments on Credit for Carbon Oxide Sequestration, **Notice 2019-32**. The comments below are a revised, more readable version of what we sent to the IRS.

The 45Q tax credit has the potential to stimulate innovation and the use of carbon capture, utilization, transmission, and storage technologies to address the threat of climate change. In order to be effective in their goals, the regulations should be informed by economic research and consistent with financial practices. We limited our comments to what the IRS could potentially achieve in its regulations and did not comment on flaws in the legislation. For instance, we believe that the 2023 deadline for beginning construction is too near, given the long lead times in development, but this is dictated by the legislation. With this limitation, we have made suggestions for regulatory language and ideas that we think would improve the efficiency and usefulness of the 45Q legislation as written.

The Meaning of Permanent Storage

For CO_2 storage or utilization in products to be eligible for the 45Q tax credit requires that the CO_2 be permanently sequestered. A great example of utilization with no permanence is the CO_2 in a carbonated beverage: open the can and the CO_2 is back in the atmosphere. We doubt that there are previous precedents for defining permanence in the tax code. Therefore, "permanence" needs to be defined in the regulations, and rules are needed to ensure permanence or credit recovery even if bankruptcies or other unforeseen circumstances occur.

One option is to define "permanence" as a period of time long enough to ensure that the CO_2 does not reach the atmosphere before technological, economic, behavioral, or climate change makes the sequestration unnecessary. Another option is to require the credit receiver to certify that there is a reasonable expectation that the storage facility, geological formation, or product will sequester the CO_2 for the foreseeable future, without specifying a particular period of time and subject to interpretation of what "reasonable" means. The US Environmental Protection Agency's (EPA's) subpart RR and UU guidance (final in 2010) uses "long term" without definition, but envisions an annual submission and reporting process.

We agree that attention must be paid to EPA's monitoring, reporting and verification (MRV) plan. But there are some issues. The MRV plan must include these major components: (1) delineation of the maximum monitoring area (MMA) and the active monitoring area (AMA); (2) identification and evaluation of the potential surface leakage pathways and an assessment of the likelihood, magnitude, and timing of surface leakage of CO_2 through these pathways in the MMA; (3) a strategy for detecting and quantifying any surface leakage of CO_2 in the event leakage occurs; (4) an approach for establishing the

expected baselines for monitoring CO_2 surface leakage; and (5) a summary of considerations made to calculate site-specific variables for the mass balance equation.

We note that the MRV criteria changed from proposed to final. EPA has removed the requirement that facilities report the amount of CO_2 injected in **40 CFR** part 98, subpart UU (Tier 1), but retained requirements that facilities subject to this subpart report the amount of CO_2 received and the source of CO_2 if known. It still seems that the MRV plan requires reporting of amounts sequestered under RR (geologic sequestration) and UU (enhanced oil recovery [EOR]).

The Rules and Conditions to Recapture Tax Credits

Writing rules and conditions to recapture tax credits is complex because of the long lifetimes envisioned for both permanent storage and utilization of carbon oxide. We favor a system where the benefits from sequestration are subtracted from the value of the leaked CO_2, adjusting for the time value of money. The benefit of the 45Q program is primarily sequestering CO_2 that would not otherwise be sequestered. Permanent sequestration would, according to the Interagency Working Group (IWG), result in a benefit equal to the social cost of carbon (SCC). The SCC varies by the assumed social rate of discount and the year in which the CO_2 is sequestered. That schedule could be used to begin the calculation. For example, in 2025 at a 3 percent interest rate, the SCC for permanent sequestration is $46 per ton CO_2 (in 2007$). However, leaked CO_2 would provide a benefit only for the period in which it is sequestered. Thus the $46 figure needs to be adjusted downward.

The Council of Economic Advisers performed a **meta-analysis in 2014** on the costs of delaying carbon reductions, finding that each decade of delay would cause net mitigation costs to rise by approximately 41 percent. We assume the benefit of temporary CO_2 storage is equal to this cost of delay.

Given this adjustment, for carbon sequestered in 2025 and using a 3 percent social discount rate, the formula for tax recovery would be as follows:

Refund to US Treasury = the tax credit received on the leaked amount adjusted for the time value of money minus the benefit to the environment from the carbon captured before it leaked, or

> refund to the US Treasury = [(tax credit per ton × tons leaked) × $((1 + i)^n)$] – [SCC (3%, 2025) × annual delay benefit × CO_2 leaked],

where i is the interest rate and n is the number of years the leaked CO_2 was sequestered.

We envision that the IRS could develop a schedule of benefits depending on year sequestered and year leaked that would make this calculation straightforward to taxpayers.

One practical concern with the method above is that the future value of the tax credit will grow at an exponential rate, whereas the offsetting benefit of temporary storage will grow only at a linear rate. Thus, toward the end of the 21st century, the refund to the Treasury will increase substantially. An alternative method for the Treasury refund is for the owner to purchase credits for any CO_2 that leaks at a price equal to the SCC in the year of its leakage. The rationale for this second method is that the project has already been compensated for permanently sequestering CO_2, so any leakage represents new emissions of CO_2 in the year of its leakage, which should be priced at that year's SCC.

The IWG has **published SCC estimates out to 2050**, which may be suited for this purpose. Beyond 2050, the SCC should grow at declining linear annual rates. Under this second method, refunds to the Treasury grow at declining linear rates versus exponential rates in the first method, so refund amounts will be more modest in the distant future with method 2. In the event of leakage, owners should have the choice to use either method for refund calculations (likely to be method 1 in the near term and method 2 in the long term), thereby limiting their cost burden.

A complication is that the Trump administration has departed from the IWG estimates by substituting a domestic SCC for a global one developed by the IWG and used in Regulatory Impact Analyses under the Obama administration. We have argued elsewhere

that the global SCC is the conceptually correct metric. Substituting a domestic for a global SCC would dramatically increase tax credit recovery under method 1 but decrease tax credit recovery under method 2.

A further issue is that in the long term, it is possible that there will be no viable owner to make payments in the event of leaks. In other settings, these concerns lead to requirements for bonding when the project begins. In order to address this, the IRS could develop rules for bonding.

Some Issues with CO_2 Utilization

Which Pathways Qualify?

The goal is to make CO_2 utilization a reasonable option. Let's consider an example. Cement has large CO_2 emissions that come from two pathways: fuel use and the decomposition of calcium carbonate in the production process, the latter accounting for half to two-thirds of the sector's CO_2 emissions. Cement is sold into a large market, which we assume in our example is global. Prices vary geographically in this market, for any number of reasons, and over time with supply and demand conditions. Cement also faces competition from substitute products, including some new technologies making cement-like material from low-carbon sources. Further, "cement" is a catchall category that includes a variety of different products with varying attributes. Following are the possible pathways for CO_2 reductions for cement:

- energy efficiency in cement production
- carbon capture of the production-based CO_2, which comes out in relatively concentrated form
- electrification on the fuel side
- carbon capture applied to the fuel source, if burned on site
- new technologies in the development stage:
    - CO2NCRETE, a new type of cement that uses CO_2 and can be taken from low concentration sources with Direct air capture technologies (DAC) or high concentration sources
    - speeding up cement's natural adsorption processes
- accommodating new cement types in building codes that currently favor Portland cement

The first question is which of the above pathways could reasonably be eligible under 45Q and under what conditions. For instance, does capture have to occur first? If so, that would mean energy efficiency improvements, new products, fuel changes, speeding up adsorption processes, and changing building codes would not be eligible. In order to make CO_2 utilization more feasible, the IRS may benefit from making the rules for eligibility as broad as possible and, at a minimum, making it clear which uses are *not* eligible.

Credits for Unsold Products

Section (f)(5) lays out the terms under which CO_2 stored in products can qualify for the tax credits. Continuing with the cement example, suppose that a company installs new equipment for capturing CO_2 and embedding the CO_2 in its cement. It then hopes to sell this new product in the market. We argue that the embedded CO_2, to the extent it is permanently stored and transformed in the cement, is eligible for the tax credit irrespective of whether the product actually is sold. It may be that the new cement has properties that make it more desirable than the existing cement types and garners market share. Or it may be that the product is more expensive and builds up in inventory. And the industry's share of CO_2 emissions may go up or down as a consequence of either of these scenarios. But regardless, all CO_2 permanently isolated from the atmosphere or transformed into another substance should qualify for tax credits.

Permanence

It is a very high bar that CO_2 in products must be permanently stored or transformed to qualify for the credits. It may preclude product innovations that eventually will lead to permanent storage but cannot with current technology. Is there any wiggle room on the meaning of "permanent"? This issue has been taken up above.

Applying Lifecycle Emissions to Determine 45Q Credits

Within § 45Q, the term "lifecycle greenhouse gas emissions" is used only in subparagraph 45Q(f)(5)(B), "Utilization of Qualified Carbon Oxide: Measurement."

In this subparagraph, the term refers specifically to calculating the amount of carbon oxide to be credited for utilization. The limited use of lifecycle greenhouse gas emissions within 45Q raises two concerns.

First, if lifecycle greenhouse gas emissions are not applied to facilities sequestering carbon oxide by means of geological storage or EOR, such projects would be credited for amounts beyond their net reductions of carbon oxide emissions. For example, if a power plant installs carbon capture equipment, which captures 90 percent of the CO_2 generated and uses 20 percent of the plant's power to capture carbon, the net reduction of CO_2 emitted is 70 percent. Providing 45Q credits based on the amount of gross CO_2 capture, rather than net CO_2 capture, would credit the power plant an amount that is 29 percent higher than net reductions would indicate (90% / 70% – 1).

Second, if lifecycle greenhouse gas emissions are applied only to projects sequestering carbon oxide by means of utilization, would they apply to both the capture and utilization stages? The definition of "lifecycle greenhouse gas emissions" from the Clean Air Act, with "product" substituted for "fuel" as indicated in § 45Q(f)(5)(B)(ii), is as follows:

> *The term "lifecycle greenhouse gas emissions" means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the Administrator, related to the full product lifecycle, including all stages of product and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished product to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.*

Since carbon oxide is a feedstock in the utilization process, the definition of "lifecycle greenhouse gas emissions" requires that the greenhouse gas emissions related to its production (carbon capture) be accounted for. However, this would result in projects sequestering carbon by utilization being penalized relative to projects sequestering carbon by EOR, for instance. If the power plant in the example above were to sequester carbon by means of EOR, it would be credited an amount 29 percent higher than an identical power plant that sequesters its carbon by means of utilization.

Considering the first and second concerns, applying lifecycle greenhouse gas emissions to all facilities under 45Q would both appropriately credit their net reductions in emissions and treat facilities consistently, whether they choose utilization or EOR for carbon sequestration. Therefore, we favor this approach. While this may exceed what IRS guidance may do, the IRS should seek to address these two concerns—efficiency to the taxpayer and consistency within the tax credit—to the greatest extent possible.

Clarification of Terms

1. Qualified Carbon Oxide

Related Text of § 45Q:

§ 45Q(c) Qualified carbon oxide
For purposes of this section-
(1) In general
The term "qualified carbon oxide" means-
(B) any carbon dioxide or other carbon oxide which
(i) is captured from an industrial source by carbon capture equipment which is originally placed in service on or after the date of the enactment of the Bipartisan Budget Act of 2018,
(ii) would otherwise be released into the atmosphere as industrial emission of greenhouse gas or lead to such release, and
(iii) is measured at the source of capture and verified at the point of disposal, injection, or utilization

Comments on Qualified Carbon Oxide:

We would like to see the use of the term "carbon oxide" rather than "carbon dioxide" clarified in the guidance, given the very small number of other substances eligible for the tax credit, why these substances are greenhouse gases, and how their global warming potential (GWP) relates to the GWP of CO2 (usually set at 1.0).

2. Qualified Facility: Utilization and Maximum Size

Related Text of § 45Q:

§ 45Q(d) Qualified facility
For purposes of this section, the term "qualified facility" means any industrial facility or direct air capture facility-
(2) which captures-
(A) in the case of a facility which emits not more than 500,000 metric tons of carbon oxide into the atmosphere during the taxable year, not less than 25,000 metric tons of qualified carbon oxide during the taxable year which is utilized in a manner described in subsection (f)(5),
(B) in the case of an electricity generating facility which is not described in subparagraph (A), not less than 500,000 metric tons of qualified carbon oxide during the taxable year, or
(C) in the case of a direct air capture facility or any facility not described in subparagraph (A) or (B), not less than 100,000 metric tons of qualified carbon oxide during the taxable year.

Comments on Utilization and Maximum Size:

IRS guidance should clarify which facilities would be eligible for the 45Q credits. Section 45Q(d)(2)(A) has been interpreted to mean that facilities that emit 500 kilotons of carbon oxide per year (ktCOx/yr) or less and capture 25 ktCOx/yr or more are the *only* facilities eligible to receive 45Q credits for utilization. For example, the International Energy Agency (IEA) commentary on 45Q noted such a restriction (see the **first figure**). However, the text of 45Q does not support that interpretation. Rather, the text indicates that facilities that emit 500 ktCOx/yr or less and capture as little as 25 ktCOx/yr are eligible for the 45Q credits *only if* the carbon oxide captured is sequestered by means of utilization. For example, a power plant that emits 900 ktCOx/yr and captures 700 ktCOx/yr is not described by subparagraph A and would fit the parameters of subparagraph B. The text does not preclude such a facility from sequestering carbon oxide by means of utilization and receiving 45Q credits for the amount sequestered.

3. Qualified Facility: Beginning of Construction

Related Text of § 45Q:

§ 45Q(d) Qualified facility
For purposes of this section, the term "qualified facility" means any industrial facility or direct air capture facility-
(1) the construction of which begins before January 1, 2024, and-
(A) construction of carbon capture equipment begins before such date, or
(B) the original planning and design for such facility includes installation of carbon capture equipment

Comments on the Beginning of Construction:

IRS guidance on the beginning of construction for the purposes of Internal Revenue Code § 45, the renewable electricity production tax credit (PTC), also provides useful guidance to 45Q. As is the case for 45Q, the PTC is a production-based credit that requires facilities to begin construction by a particular date to be eligible for the credit.

IRS Notices **2013-29**, **2013-60**, **2014-46**, **2015-25**, and **2016-31** establish two methods to determine commencement of construction: a Physical Work Test and a 5 Percent Safe Harbor. A prospective facility must demonstrate, through either of these methods, commencement of construction by the end of a particular year. If the facility subsequently makes continuous progress toward completion or is placed into service within four calendar years following the year of its construction start, it will be eligible for the PTC in the year it is placed into service. IRS guidance further provides a nonexclusive list of excusable disruptions, such as for natural disasters, permitting and interconnection delays, and supply shortages, for which a facility would maintain PTC eligibility despite a break in progress.

The Physical Work Test requires that physical work of a significant nature begin, but it does not necessitate a minimum amount of work, in either absolute or percentage terms. However, preliminary activities would not be sufficient to meet this test. For example, a wind project could meet the Physical Work Test through excavating for a turbine's foundation but

not by clearing the site. The 5 Percent Safe Harbor requires that 5 percent or more of the total project cost be spent or incurred. The total project cost includes all costs in the depreciable basis of the project and thus would not include land or any property not integral to the project.

For 45Q, the following terms and definitions should be used:

- **Beginning of construction:** Projects that satisfy either the Physical Work Test or the 5 Percent Safe Harbor by January 1, 2024, should be deemed to have begun construction by that time.
- **Continuous progress:** Projects that satisfy either the Physical Work Test and Continuous Construction Test (§ 4.06 of **Notice 2013-29**) or the 5 Percent Safe Harbor and Continuous Efforts Test (§ 5.02 of **Notice 2013-29**) should be deemed to have made continuous progress toward completion. The nonexclusive list of excusable disruptions in progress for the PTC should be applied to 45Q.
- **Continuity Safe Harbor:** A project placed into service within four calendar years following the year of its construction start should satisfy a Continuity Safe Harbor for continuous progress.

Along with establishing a project's beginning of construction, continuous progress, and a Continuity Safe Harbor, the PTC guidance provides definitions and concepts that should be used for 45Q:

- **Facility:** This is defined in **IRS Notice 2016-31** to generally include "all components that are functionally interdependent. Components of property are functionally interdependent if the placing in service of each of the components is dependent upon the placing in service of each of the other components in order to generate electricity."

For 45Q, a "qualified facility" should include all components that are functionally interdependent to capture carbon oxide. This definition of qualified facility would also clarify the term "carbon capture equipment" as being any such equipment that is functionally necessary for the facility's capture of carbon oxide.

- **Look-through for economic performance:** From **Notice 2013-29**, "for property that is manufactured, constructed, or produced for the taxpayer by another person under a binding written contract with the taxpayer, costs incurred with respect to the property by the other person before the property is provided to the taxpayer are deemed incurred by the taxpayer when the costs are incurred by the other person." For example, the owner of a wind project is generally not the turbine manufacturer, but expenses incurred by the manufacturer (if under a binding contract with the project owner) would be deemed incurred by the project owner for the purposes of the 5 Percent Safe Harbor.

For 45Q, similar relationships would be expected; the owner of the facility would likely contract for the manufacturing of carbon capture equipment. The IRS should permit the same look-through as with the PTC to determine when costs are incurred for satisfying the 5 Percent Safe Harbor for 45Q.

An important textual difference between 45Q and the PTC is that 45Q requires both that construction begin on the facility and that construction or installation of the carbon capture equipment begin before the deadline of January 1, 2024. The PTC does not specify requirements for beginning construction on equipment, so it is unclear whether 45Q might require the facility to meet separate 5 Percent Safe Harbor amounts for the facility and for the carbon capture equipment. For 45Q, IRS guidance should clarify which amounts are necessary for the 5 Percent Safe Harbor.

- **Single project and disaggregation:** From **Notice 2016-31**, "solely for purposes of determining whether construction of a facility has begun for purposes of §§ 45 and 48, multiple facilities that are operated as part of a single project (along with any property, such as a computer control system, that serves some or all such facilities) will be treated as a single facility." Subsequently, if certain facilities within the project will not be placed in service by the four-year deadline, or if there are cost overruns and the total project cost is greater than 20 times the amount incurred for

the 5 Percent Safe Harbor, the project may be disaggregated and treated as multiple separate facilities.

For 45Q, the concepts of single project and disaggregation would be relevant if a project plans to operate multiple carbon oxide capture facilities as one project. In this case, the IRS should apply single project and disaggregation concepts to projects under 45Q, as have been applied to projects claiming the PTC.

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