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Proposed 45Z tax credit guidance may overstate soil organic carbon accumulation gains from on-farm practices

There is growing interest from U.S. policymakers, industry, and government officials to credit soil organic carbon (SOC) accumulation associated with the cultivation of biofuel feedstocks within life-cycle emissions accounting frameworks for transportation fuels. Proponents of this approach argue that SOC gains from on-farm management practices such as cover cropping and no- or reduced-tillage farming could measurably lower the life-cycle emissions intensity of biofuel made from feedstocks such as corn and soybean and also provide an incentive for farmers to implement these practices.

While several programs offer soil carbon offsets, the Section 45Z Clean Fuel Production Tax Credit of the U.S. Inflation Reduction Act is one of the first policies to include these types of credits in a life-cycle accounting framework for transport fuels. Interim guidance from the U.S. Department of Agriculture (USDA) allows producers to credit SOC changes from conservation management practices such as cover cropping and no- or reduced-tillage farming towards their biofuel feedstocks.

However, the calculation of these credits is controversial due to the high degree of uncertainty over the magnitude of soil carbon gains from cropping practices, as well as the permanence of those gains. The interim guidance eschews site-specific measurement entirely and utilizes a model-only approach that does not require establishing a baseline, conducting measurements, or ensuring the additionality of land management practices.

USDA's interim guidance suggests that the tax credit could offer significantly more value per tonne of carbon than existing carbon offset programs. At the same time, using modeled SOC estimates in the absence of real-world baselines and measurements risks subsidizing uncertain greenhouse gas benefits and potentially non-additional carbon offsets.

To better understand the risks and trade-offs associated with model-based SOC crediting within LCA-based policies, a new analysis prepared by researchers at California State Polytechnic University Humboldt for ICCT assesses three of the eligible management practices in the interim guidance. The analysis evaluates the modeled

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results compared to real-world, empirical data and identifies the parameters and assumptions in the model that contribute the most to uncertainty and pose the largest over-crediting risks. We highlight three key considerations for implementing SOC accumulation within fuels policies:

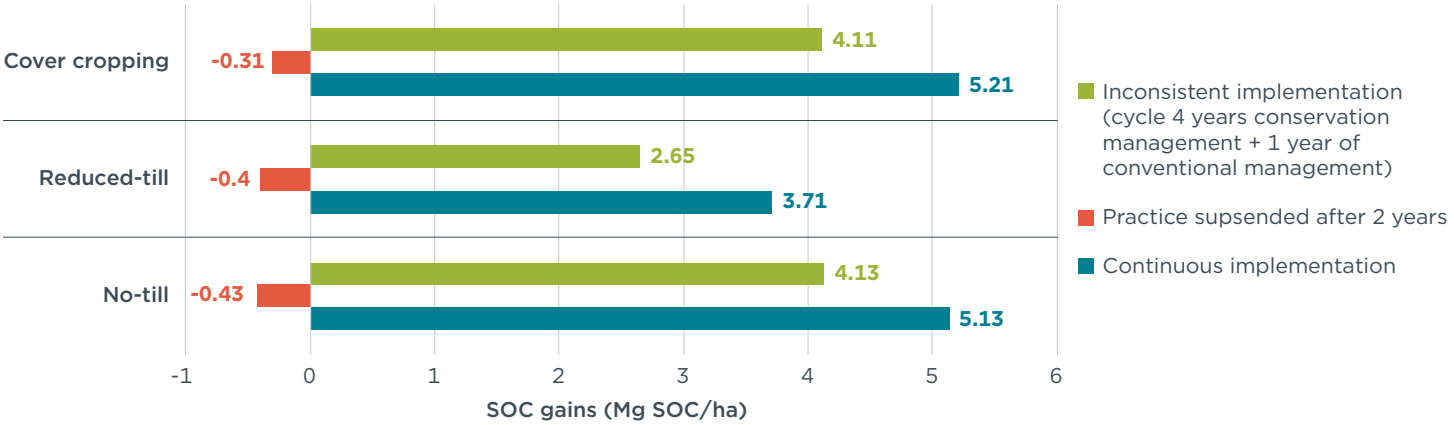
- **Effectiveness**: The study uses a parameterized DAYCENT soil carbon model to evaluate the SOC impacts of cover cropping and reduced and no-tillage farming modeled for continuous cropped corn over a 30 year period, compared to results from the Department of Agriculture's FD-CIC calculator. It finds that **cover cropping and no-tillage farming are the most effective at increasing SOC over a 30-year-period**, while reduced-tillage farming is less effective. All strategies are expected to increase SOC, on average, across the entire U.S. dataset. However, the exact magnitude and permanence of these gains depend heavily on site-specific considerations such as land-use history. Modelled SOC impacts are also sensitive to model uncertainties and assumptions such as the continuous implementation of farming practices.
- **Accuracy**: The study compares results between modeled and empirical SOC measurements using a meta-analysis. Authors find that modeled estimates from USDA's FD-CIC calculator and their own internal modeling using DAYCENT, have a mixed record at reproducing empirical data from field measurements. Across the dataset, measured SOC accumulation showed substantially more variability than measured with model runs. Results across the modeled and empirical datasets over shorter time scales (20 years or less) varied significantly. Over longer time-scales, modeled and empirical data were more comparable; however, for truly long-term trials, study authors identified far fewer datapoints for comparison. The authors infer that the **rate of SOC accumulation is likely not linear and contains higher gains earlier in the period of implementation that level off over time.**
- **Consistency –** Authors evaluate the sensitivity of modeled SOC changes to input parameters including soil type, climatic characteristics, fertilization rates, historical land use, and consistency of applying on-farm management practices. The authors find that the results may vary considerably based on land-use history, existing farming practices, and assumptions of continuity. In particular, they find if a conservation management practice is interrupted with a conventional practice every 5 years, net SOC accumulation reduces by 19%, 29% and 21% for no-tillage, reduced-tillage, and cover cropping, respectively compared to a period of consistent implementation. Further, the authors find that suspending conservation management practices after only two years could lead to a net reduction in SOC over the same 30-year period of analysis. **These findings highlight the necessity of permanence safeguards to ensure long-term commitment to conservation management and ensure SOC gains are maintained.** One potential approach would be to require a minimum implementation period or to establish a payback mechanism that reclaims incentives if conservation practices are not maintained.

KEY TAKEAWAYS

The interim 45Z tax credit implementing guidelines offer a substantial incentive for farmers and biofuel producers to engage in conservation management practices; despite offering a far higher incentive than for comparable soil carbon offset programs, the interim guidance lacks the safeguards generally associated with dedicated carbon offset programs. While there is general consensus that conservation management practices can provide ecological benefits to the soil, the resulting CO_2 emission reductions quantified for energy and climate policies are variable and uncertain.

This study finds that reduced or no-till and cover cropping can in principle generate SOC gains consistent with empirical literature, however, the study identifies several key areas of uncertainty. In particular, the study finds that lack of permanence safeguards could result in substantial over-crediting if practices are not maintained, estimating a more than 100% reduction in SOC gains if practices are suspended after only 2 years. If practices are interrupted every 5 years with 1 year of conventional management, SOC gains reduce between 19% and 29%. This variance is illustrated in Figure 1.

Figure 1
Modeled SOC gains over 30-year period for continuous cropped corn systems



The authors find that using a model-only approach for crediting SOC fluxes in transport fuel LCA risks systematically inaccurate crediting, particularly if used for short-term tax credit incentives that don't require long-term changes in behavior. This could be mitigated through validation with real-world measurements to deliver more verifiable emissions savings. Other safeguards such as establishing a representative baseline using measurements, financial additionality tests, and minimum implementation periods could ensure that emissions reductions are verifiable and long-lasting.

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