Review of the Credit Trading System in Title II of the CLEAN Future Act

By Bruce Buckheit

Key Takeaways:

- There is a significant probability this bill will fail to achieve its target for 100% clean energy by 2035.
- The CLEAN Future Act draft (dCFA) defers any serious disincentives for gas-fired generation until 2031 and then hopes to replace all of the growing gas-fired EGU fleet with renewable energy (RE) over a short 4-year period. This is not feasible and sets itself up for failure. This will likely result in future weakening of the post-2035 baselines, sacrificing the goal of 100% "clean" energy by 2035.
- Based on the most likely reading of the ZEE definition and calculation procedures, the dCFA permits generation at less than 0.4 mt CO2e/MWh and does not require "zero emission electricity."
- The starting baseline for Zero Emission Electricity" (ZEE) requirements is based on the 2017-2019 generating mix. This ignores ongoing retirements of coal plants and RE capacity that is under construction today and will be online in 2023. The consequence is a large initial surplus of ZEE, disincentivizing necessary early investment in non-fossil fuel energy.

Credit Trading System

The dCFA includes a trading program, and examination of the overall account balance of this program reveals serious flaws. The dCFA would establish a minimum "Zero Emission Electricity" (ZEE) percentage, starting in 2023, and increasing that percentage over time until it reaches 100 percent in 2035. The baseline ZEE percentage is to be determined by the percentage of a generator's overall generation that is ZEE. Initially this percentage is the average percentage of the energy that is zero-emission electricity during calendar years 2017, 2018, and 2019. Depending on how one interprets the definition of ZEE, this figure is either 37 percent, 60 percent, or 73 percent for the U.S. as a whole. Looking at the U.S. system as a whole, ZEE Credits (ZEEC) for 37 to 73 percent of U.S. 2023 generation would be due in 2024. Thus, depending on how one understands the definition of ZEE, there is either an enormous shortfall or a very large surplus in the credit account Moreover, there has been a large decline in coal-fired generation since the 2017-2019 time frame. The 2017-2019 timeframe averaged 1189 TWh, while the most

recent Department of Energy Information Administration[1] forecasts 885 TWh of coal-fired generation in 2023 and 679 TWh by 2030. This leads to an early surplus of allowances and defers carbon reductions for the program over "business as usual" estimates until year seven of the program.

After the initial year the minimum ZEE percentage increases by one to six percent per year (depending on the interpretation of ZEE) until 2030, when it reaches 80 percent. In addition, if one assumes a liquid and transparent ZEE Credit market, the draft bill would defer effective regulation of gas-fired generation until 2031. At that time, the draft bill would both (1) continue to increase the minimum ZEE percentage and (2) decrease the partial credit for natural gas-fired generation and attempt to force ceasing all gas-fired generation in four years.

How many credits are earned?

The draft bill states in section 201(22) that ZEE is

> "the fraction of electric energy generated by a given generating unit whose generation is not associated with the release of greenhouse gases to the atmosphere."

For RE and nuclear, the fraction of generation that is not associated with the release of generation is always 100 percent. For coal and gas, it is always zero percent. However, the draft bill appears to contradict this definition of ZEE later in Section 201 (22) by providing that the number of MWh of ZEE of a given generating unit is

$$Z\,EEC = G\,x\,(1 - \left(\frac{CI}{CIf}\right))$$

Where G is the generation of the Generating Unit, CI is the Carbon Intensity of the Unit and CIf is the "carbon intensity factor" provided in the bill for a given year

The term "carbon intensity factor" means—

> (A) for each calendar year through 2030, 0.82;
> (B) for calendar year 2031, 0.736;
> (C) for calendar year 2032, 0.652;
> (D) for calendar year 2033, 0.568;
> (E) for calendar year 2034, 0.484; or
> (F) for calendar year 2035 and each calendar year thereafter, 0.4.

[1] The 2017-2019 generation data are from https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=table_1_01. The EIA forecasts can be found at 2021 Annual Energy Outlook, https://www.eia.gov/outlooks/aeo/

These competing definitions are important because they conflate the carbon intensity factor standard with a zero-emission standard. These notions should not be equated, as they lead to multiple implementation scenarios and would permit an attempt to claim zero emission electricity while actually achieving less than this goal. Below I analyze the potential effect of the draft bill based on several possible interpretations of the relationship between target setting and compliance in the dCFA.

The dCFA states that the carbon dioxide equivalent emissions factor is set out in metric tons per CO2e over a 20-year period. This analysis assumes an average of 1.1 mt CO_2e/MWh for coal and .45 mt CO_2e/MWh for gas.[2]

Thus, for coal ZEEC = $G\ x\ (1 - \left(\frac{1.1}{.82}\right))$ or G x (1 - 1.34) = -.34G[3].
The bill prohibits negative credits, so coal generation merits no ZEEC. For gas, a partial credit is provided ZEEC = $G\ x\ (1 - \left(\frac{.45}{.82}\right)$ = G x (1 – 0.55) = .45G

Initially, an operator earns one full ZEE credit for each MWh of nuclear and RE, .45 ZEE credit for each MWh of gas-fired generation and no ZEE credit for coal generation. In 2035 the carbon intensity factor decreases to 0.4, reducing and likely eliminating the partial credit for conventional gas-fired generation.[4]

How many credits are due?

Generally, each supplier must submit to the Administrator credits for a specified percentage of its overall generation that is ZEE. Initially this percentage is determined by what is called the supplier's "baseline zero-emission electricity percentage" – the average percentage of the energy that is zero-emission electricity during calendar years 2017, 2018, and 2019. The dCFA would continue this "look back" approach – for 2025 and later the utility would be required to submit "the average of the quantity of ZEEC for such calendar year and the prior two calendar years. In the evaluations below I estimate the baseline and subsequent year ZEEC that would need to be surrendered based on EIA projections for the entire nation and a nominal compliance pathway to the 2035 goals of the dCFA.

Compliance Scenario

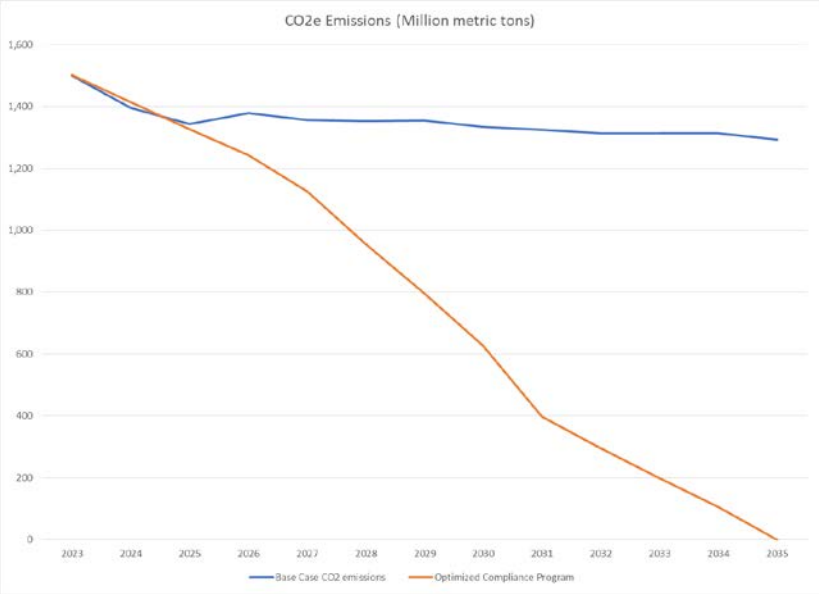
In order to understand the impact of the dCFA I determine the ZEEC credit balance for the "business as usual" (BAU) generation projected by the

[22] These are from EIA, I recognize that many think upstream methane losses for natural gas production and distribution are higher than the agencies are currently willing to recognize, but the problems with the bill are worse if a higher number is chosen, and so, the use of .45mt is conservative for purposes of this analysis.
[3] Where "G" represents the net generation by the utility.
[4] (1-.45/.40) is a negative number.

Energy Information Administration (EIA) and under a reasonable compliance path to reach a zero-emission goal by 2035. Where large positive ZEEC balances occur, the dCFA would not provide a sufficient incentive for the compliance path; where significant negative balances occur, I infer a risk of program failure. This compliance path assumes:

- EIA AEO 2021 projections for "business as usual" generation by source and consumption.
- a linear reduction in coal generation from 2023 levels to zero generation after 2030
- an aggressive but reasonable schedule for ramping up RE to completely replace coal and gas generation by the end of 2035
- coal and RE generation drive the calculation, gas-fired generation is what is needed to make up the forecast generation in a given year
- no change in forecast for future generation
- nuclear generation is per EIA AEO forecast.

<u>CO2e Emissions Associated with BAU and with the Assumed Compliance Path</u>

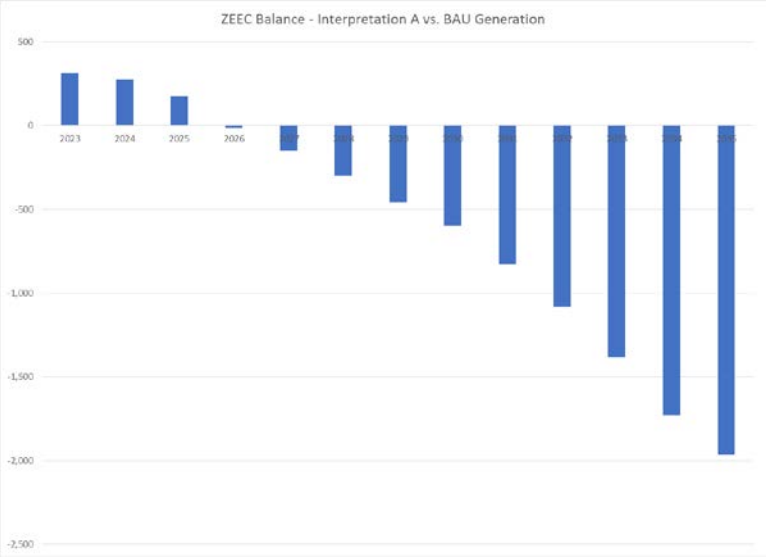


Interpretation A: Natural gas-fired generation is assigned a partial credit for ZEE, nominally (1-(.45/.82)) or .45 FOR BOTH TARGET SETTING AND FOR COMPLIANCE THROUGH 2030.

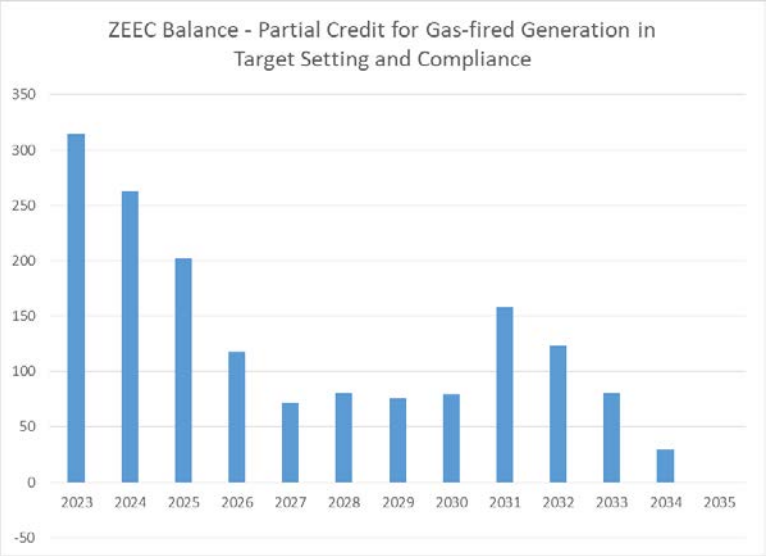
In this interpretation the phrase "*fraction* of electric energy generated by a given generating *unit* whose generation *is not associated with the release of greenhouse gases to the atmosphere"* assigns the (1-(CI/CIf)) value to natural gas generation. Under this interpretation, the baseline ZEE would be 51.5 percent in 2023 and increase by 4 percent per year until 2030, where

it would be 80 percent and increase to 100 percent by 2035. Because natural gas-fired generation is awarded credits at the same rate as is required for that generation through 2030 and because the dCFA uses the 2017-2019 baseline, the net ZEEC balance in a BAU scenario is zero through the middle of 2029. Thus, if the trading program functions well, no net emission reductions are required through that period.

Interpretation A - ZEEC Balance – "Business as Usual"



Interpretation A – ZEEC Balance – "Nominal Compliance Path"



This compliance path generates substantial excess credits through 2033. Under this interpretation, the dCFA would not force generators to adopt a reasonable compliance path until late in the cycle and then requires massive changes in a very short time.

Interpretation B: Existing natural gas generation does not count as zero emissions electricity for target setting or for compliance.

> "ZEE is the *fraction* of electric energy generated by a given generating *unit* whose generation *is not associated with the release of greenhouse gases to the atmosphere.*"

Since all of the electric energy generated by a gas-fired electric generating unit is "associated" with the release of greenhouse gases to the atmosphere, this interpretation assumes that natural gas fired generation does not count as ZEE for the purpose of setting the baseline target. Here the baseline ZEE would be 37 percent of national generation.

The result was very large shortages of credits at the beginning and end of the period. Translating those credit shortfalls into Alternate Compliance Payments at $40/credit yields the payment balances shown below.

Interpretation C: Any generation less than 0.82 CI counted as ZEE – All natural gas-fired generation is ZEE for target setting.

For the U.S. as a whole the baseline ZEE would be 72.6 percent. Thus, overall ZEEC for 72.6 percent of U.S. 2023 generation would be due in 2024. But natural gas-fired generation is awarded only .45 ZEEC for each MWh of generation, leading to large negative balances for the nominal compliance path.

Would the proposed bill lead to "zero emission" electricity?

There is a significant probability that the answer is "no": This bill is poorly drafted and its ability to achieve 100% "clean" energy by 2035 is highly questionable. Friends of the Earth has made its position on the false solutions that qualify as "zero emission energy" in this bill clear. This aside, the dCFA will still be unlikely to achieve its definition of "zero emission energy" due to the fact that the program is so back-end-loaded, it creates a risk of either an energy shortage or the need to relax the 100% ZEE requirement in the later years.

In order to decarbonize by 2035 approximately 2300 TWh of coal and gas generation would need to be replaced by RE/EE, or almost 200 TWh/year RE generation – above current and anticipated levels of RE. While substantial, this is by no means unachievable. EIA projects an increase of 100 TWh of RE in 2023 and 150 TWh in 2024, but these figures are in the baseline that leaves coal and

gas generation at very high levels. Achieving the goals of the bill would require more than doubling this rate of implementation of RE throughout the period, but only doubling the rate of new RE, which is not an order of magnitude increase.

The bill requires a 100 percent minimum percentage of ZEE as of 2035. The carbon intensity factors remain constant until 2030, and then become more stringent over the next five years. While the carbon intensity factors might force retirement of the least efficient units in the system, they would not preclude continued generation from most of the gas-fired fleet. The most efficient combined cycle gas turbines (CCGT) designed for baseload applications have reported in-use CO2[5] emission rates of 0.36 mt/MWh (800 lb/MWh). Load following and peaking units that might be used to support renewable energy development have higher rates (0.45 mt/MWh). Thus, one can expect that their operators will meet the dCFA carbon intensity factors through 2033 (0.568 mt/MWh) and perhaps even 2034 (0.484 mt/MWh). The import of this is that there is little incentive for operators with a full mix of generation to replace gas with RE until 2035, since they get a much better benefit from retiring coal. At which time a massive (and perhaps unachievable) shift from gas to RE would be required.

The dCFA reduces the carbon intensity factor from 0.82 mt/MWh in 2023 to 0.40 mt/MWh in 2035 *and thereafter.* If the intent is to actually achieve "zero emission electricity", the carbon intensity factor should ultimately be "zero", not 0.4 mt/MWh. It can be seen that the overall effect of the dCFA is merely to limit the carbon intensity of U.S. EGUs to 0.4 mt/MWH.

The "bright line" test in the dCFA for future generation of electricity using fossil fuels is 0.4mt CO2e per MWh (882 lb CO2e/MWh), including upstream contributions to overall emissions. The dCFA would permit unlimited generation at less than this rate. One MWh of electricity generated at a rate of 0.399 mt/MWh would generate only 0.0025 ZEEC. But, under the most likely interpretation of the dCFA, the operator would only have to surrender 0.0025 ZEEC for that MWh of generation. If one were to assume that the current EIA projection for 2035 natural gas-fired generation emitted at a rate of 0.399 mt/MWh, 525 million metric tons of CO2e would be emitted in just that one year, not zero.

While one can assume that improvements in the efficiency of these units will continue over the next decades, these technologies are reasonably mature and so future improvements are likely to be small. Estimates of upstream methane losses vary significantly and, if the amount assigned by the agency to the

[5] The reported emissions are not CO2e, and do not include upstream emissions

upstream emission losses is small enough, future designs of "conventional" CCGT might be able to meet the 882 lb/MWh threshold. One hopes that the potential for abuse in setting the upstream emission component of the CO2e emission factor is unlikely, but the last four years have shown that agency misuse (or non-use) of science is possible and the last decades have taught that litigation over these factors is a near certainty

The dCFA provides credit for if the excess heat is used in a combined heat and power application, thereby making it less difficult for a conventional gas-fired EGU to meet the threshold. An additional, and more likely path for continued use of natural gas and coal after 2035 is the application of either partial carbon capture and sequestration of the CO2 generated or partial co-firing with hydrogen or qualified biomass gases. In addition to facilitating the .399 mt/CO2e allowed under the dCFA each of these potential options pose a risk of additional diminished program effectiveness (including the use of captured CO2 for enhanced oil recovery)— or for other environmental harm.

Additionally, the burden of the dCFA's charge may not be shared across the country but would impact certain regions much harder than others. In particular, gas-reliant regions, such as the Northeast U.S., might not have to take any significant action until 2031. This regional discrepancy was demonstrated in the Acid Rain Trading program, which was far less robust and transparent than anticipated, as companies hoarded allowances or only traded within the company. This concern is heightened by the fact that the dCFA's ZEEC trading system cannot begin to operate in 2023 as the draft bill contemplates. The dCFA leaves the criteria setting for the carbon intensity of coal and natural gas-fired generation using fuel from any given mine or well to agency rulemaking, which is to be completed sometime in mid-2023 (or later). Thus, the program cannot commence in 2023 as advertised. Moreover, litigation over any values determined by this rulemaking would take an additional two years, at minimum, to resolve, further delaying implementation of the program. Ultimately, all these factors lead me to conclude that Title 2 of the dCFA is flawed to the point that it is unlikely to achieve zero emission electricity from the power sector by 2035.