Economic feasibility analysis for BECCS projects in the state of Sao Paulo, Brazil

Augusto Carvalho, USP, +55 21 99875 2472, carvalho2@slb.com

Virgínia Parente, USP, +55 11 99972 8711, vparente@iee.usp.br

Colombo Celso Gaeta Tassinari, +55 11 97144 2973, USP, ccgtassi@usp.br

**Overview**

This article presents an analysis of the economic viability of developing projects for the capture and geological storage of carbon dioxide from the sugarcane ethanol production process, focusing on the State of São Paulo, where half of Brazilian production is concentrated. In it, the main technical aspects and cost factors for the development of CCS projects were analyzed, based on bibliographical research, consultation with producers and application of economic analysis techniques of Payback, NPV and IRR. The results of the analysis point to a condition of viability in the case of projects aimed at producing low-carbon Ethanol and sustainable aviation fuel, sold on the American market, which have access to monetization mechanisms, such as Low Carbon Fuel Standards of the State of California and 45Z incentive programs, respectively.

**Methods**

This study was based on the collection of information over 2 years of research with some of the main ethanol producing companies in Brazil, reviewing the main characteristics of their production process, including emissions profile and production seasonality effects for ethanol produced from sugar cane and corn.

In addition, bibliographical research was carried out on the most relevant cost factors for the development of CCS projects, retrospectively to the ethanol industry, using as reference the main case studies of industries in the United States.

Finally, for the analysis of economic forecasts, the financial techniques of simple and discounted Payback, NPV and IRR were used.

**Results**

The following conclusions can be obtained from the analysis of economic feasibility made for the three proposed scenario:

The results indicate that current price of CIBO, or LCFS incentive mechanisms do not provide sufficient compensation for the expected CAPEX and OPEX investment costs, required to the development of CCS projects for neither Ethanol, nor SAF, in any of the three scenarios evaluated.

Specifically for the case of CBIO monetization, all three scenarios result on significant investment losses, with expected remuneration from the incentives significantly lower than expected investment costs.

For the cases considered under LCFS incentives, however the expected payback times falls within the project duration time, considering a 6% market discount rate (which excludes the effect of inflation), still result on negative NPV values for the three scenarios.

Finally for the scenarios evaluated to the production of SAF converted from CCS Low carbon ethanol, considering the current maximum value of $195.00/TCO2, granted by the 45Z protocol in United Stated, the analysis demonstrates positive results for the three proposed scenarios, showing increasing 42%, 67% and 109% Return On Investment for the case 1, 2 and 3, respectively.

The results obtained for the evaluated cases are still based on preliminary assumptions and contain high level of uncertainties, due to the lack of solid reference cases and obvious the need to adjust important cost factors, considered from other regions to the reality of Brazilian conditions. Nevertheless, the analysis gives an indication of positive perspective to the development of BECCS project, oriented to the production of Low carbon sustainable aviation fuel, to be sold at American market, with expected promising monetization of project costs, through existing incentive mechanisms.

**Conclusions**

The study brings the attention to the potential for development of BECCS initiatives in Brazil, with focus on the main production region, located at Northwest portion of São Paulo state, that count with presence of solid Ethanol industrial sector, with a large number of production facilities generating significant volume of emissions.

These industries counts with access to solid financial support and are prone to the implementation of new technologies that can help reducing carbon footprint of their products, whilst helping improving profitably, either by improving remuneration from basic production sale, at premium, or giving them access to decarbonization incentive mechanisms, in both local and international markets, such as CBIO, LCFS for ethanol, or 45Z protocol related to sustainable aviation fuel.

In Brazil there is a positive perspective in the future, with the expected of implementation of CCS Carbon market regulation, which is currently under Congress approval process, which are expected to help fostering development of new decarbonization initiatives, including CCS. In addition to that, the ethanol producers are seeking for necessary certification to commercialize Low carbon Ethanol produced in association with CCS projects, at international market, with focus on United States, where the existing incentive mechanisms present perspectives for more attractive monetization.

It is also important to highlight the perceived interest of the ethanol producing sector in the Sustainable Aviation Fuel market, which is expected to offer more attractive incentives for the production of fuels with reduced footprint, based on Ethanol to Jet technology.

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