GLOBAL CCS INSTITUTE

Brief

Financing BECCS in developing countries

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Introduction

The most recent findings of the International Panel on Climate Change (IPCC) strongly indicate that carbon capture and storage (CCS) will play a crucial role if the world is to meet global emissions reduction targets to keep temperatures below 1.5 degrees Celsius (ºC). A special emphasis has been placed on biomass energy with carbon capture and storage (BECCS), which has the potential to deliver negative emissions.

In its special report *Global Warming of 1.5ºC*, or SR15, the IPCC defines four illustrative model pathways compatible with limiting global warming to 1.5ºC. The pathways account for recent technological developments and also include integrated land use models with representation of biomass availability. As shown in Figure 1, Pathway 1 (P1) requires such radical changes to human behaviour as to make it extremely improbable; the remaining pathways (P2-P4) all require negative emissions through the deployment of BECCS.

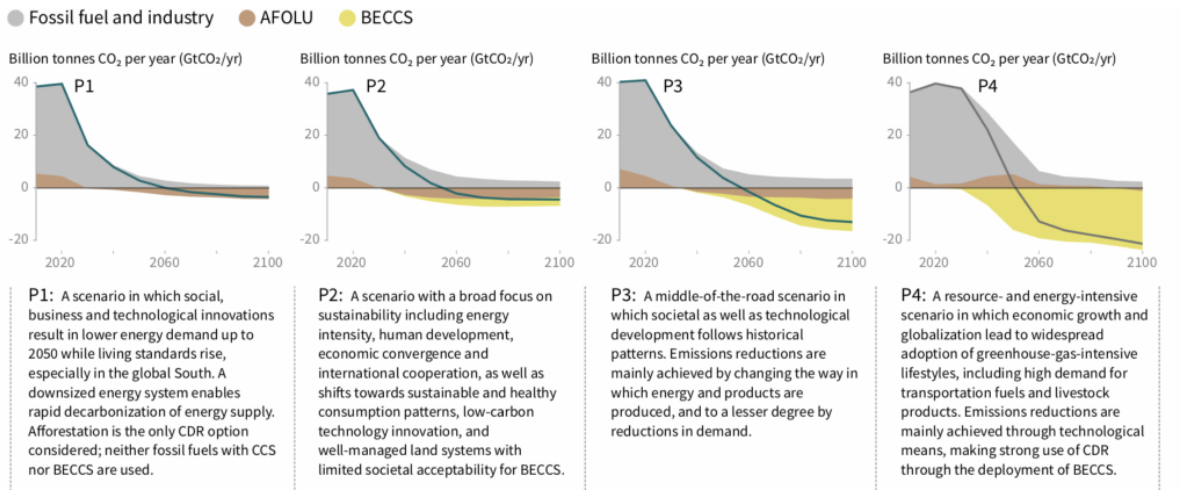

Figure 1: IPCC Illustrative 1.5ºC Pathways (IPCC, 2018)

BECCS is a promising class of technologies for carbon dioxide (CO_2) removal and consists of the capture and permanent geological storage of CO_2 stemming from biomass transformation or combustion. Several industrial sectors can implement this technology, including the biofuel sector which is predominantly made up of bioethanol production. Bioethanol is one of the few renewable alternatives to oil and gas-based liquid fuel, with which it can be easily blended to be used as a transportation fuel.

As countries seek to decarbonise transport, demand for bioethanol is set to grow globally. By integrating CCS into the production process for bioethanol, negative emissions can be created. It is forecast that a significant proportion of the world's bioethanol production will come from developing countries (International Energy Agency, 2018). This paper focuses on how the production of bioethanol with CCS can be supported by climate finance providers, and the pivotal role Brazil can play in facilitating this process.

Fermentation: The lowest hanging fruit

CCS can significantly reduce lifecycle CO_2 emissions from the production of bioethanol from sugar fermentation because the mass of CO_2 produced during fermentation is almost equivalent to that of bioethanol. Moreover, bagasse, which is the organic by-product produced in the process of extracting sugarcane juices, can be combusted to produce heat used in the processing and refinement of bioethanol. There are three opportunities to capture CO_2 from the processing of bioethanol:

- Capture of CO_2 from combustion of bagasse
- Capture of CO_2 from fermentation of sugars to bioethanol
- Capture of CO_2 from combustion of bioethanol.

The least costly of these is the capture of CO_2 from the fermentation process because, unlike post-combustion processes, this doesn't require separation of CO_2 and can be applied at existing biorefineries. In the presence of nearby storage sites, the capture of CO_2 from biorefineries presents itself as a relatively low-cost and commercially ready storage opportunity (Food and Agriculture Organization of the United Nations, 2018).

The relationship between sugar production and bioethanol

Sugarcane and corn feedstocks are the main sources of bioethanol, and their production is dominated by developing countries. According to forecasts, growth in world sugar production is expected to slow over the next decade, with most of the production continuing to occur in developing countries. Together, they will represent 77 per cent of world sugar production by 2027 (OECD-FAO, 2017).

For Brazil, the world's largest producer of sugar, exportation comes at the cost of bioethanol production. Since the 1970s, the Brazilian government set an ethanol mandate, making it mandatory to blend ethanol with petroleum at specified rates. Currently, this is set to at least 27 per cent, but ethanol represents 40 per cent of the fuels market for light-duty vehicles (McKinsey & Company, 2009). This has led to a strong linkage between sugar markets, world crude oil prices and the production of bioethanol. As the price of sugar drops below a certain threshold, and whilst global oil prices remain high, bioethanol production becomes more profitable than sugar exportation. An additional complication to this dynamic is that, between harvests, Brazil must also import ethanol (mostly from the USA) to meet demand.

Although Brazil is expected to maintain its position as the world's top sugar producer and exporter over the next decade, local sugar mills — which have struggled significantly as global sugar prices have declined — are looking to produce as much bioethanol as possible in search of better returns (Figure 2).

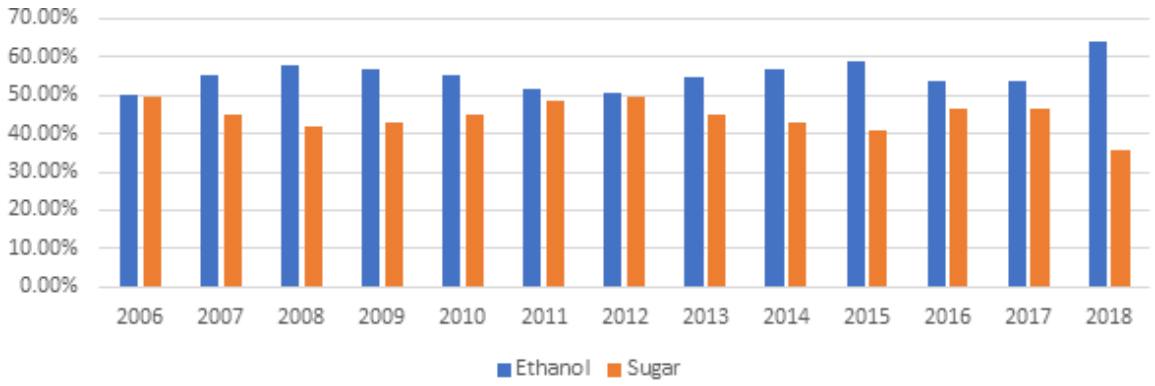

Figure 2: Bioethanol vs Sugar Production in Brazil (Ionova & Teixeira, 2018)

To support sugar producers, and to meet its Nationally Determined Contributions (NDC) of 43 per cent emissions reductions by 2030 (Cantarella, 2018), Brazil's government recently put into place a programme, RenovaBio, which is designed to boost bioethanol production. RenovaBio sets a target of reducing CO_2 emissions from petroleum by 10.1 per cent by 2028 and is set up to encourage fuel distributors to blend more bioethanol into the fuel for transport.

Low Carbon Fuel Standards can support BECCS

As with the California Low Carbon Fuel Standard (LCFS), the mechanism for RenovaBio will be a system that allocates carbon intensity (CI) ratings to transportation fuels alongside tradeable decarbonisation credits from biofuels, referred to as CBios (Minsterio de Minas e Energia, 2018). The latter will be assigned to biofuel producers' biofuels, the amount of which will depend on the fuels' life-cycle emissions reductions. In turn, fuel distributors will be required to purchase CBios from stock exchanges, thereby creating demand for them. Through RenovaBio, Brazil expects to increase the production of bioethanol to 18 per cent of its energy mix by 2030 (Ministerio de Minas e Energia, 2018), allowing it to meet a significant part of the commitments it made at the COP21 climate summit in 2015. Importantly, Brazil also exports bioethanol to the USA, where Brazilian bioethanol qualifies for sale in the LCFS-driven biofuel market.

The LCFS targets a 10 per cent reduction in carbon intensity of transportation fuels over the next 10 years (Board, 2016). Fuel standards, however, limit the proportion of bioethanol that can be blended with gasoline, limiting the emissions reductions that can be achieved through blending. This is done to broaden the range of vehicles that the blended fuel is compatible with. Since value is created by way of tradeable credits, producers will be incentivised to achieve the strongest reduction in carbon intensity. Bioethanol with CCS will, therefore, provide suppliers with the distinct advantage of being able to deliver a lower carbon intensity fuel — through negative emissions — whilst complying with blending ratios such as in the LCFS.

The other benefit of applying CCS to bioethanol production is in the context of land requirements and the environmental impact of farming. The negative emissions produced means that the same level of decarbonisation can be achieved with less land, thereby increasing a bioethanol producing country's capacity to contribute to emissions reductions without additional environmental cost. This presents bioethanol producers with a significant opportunity, and may also benefit sugar producers outside of Brazil, who have less capacity to farm sugarcane or other sugar crops. Over time, they may also switch from sugar exportation to bioethanol produced with CCS. A significant number of developing countries

already contribute towards the global production of biofuels (Figure 3), suggesting that the missing link in this emerging low emissions industry is CCS.

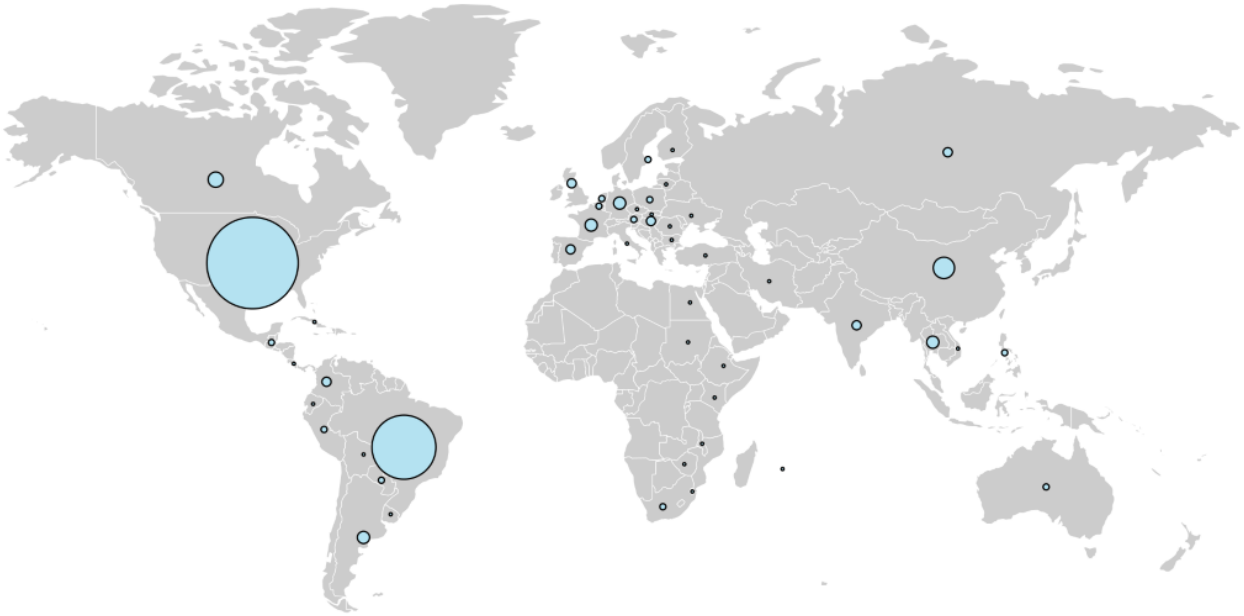

Figure 3: World biofuel production (Statista, 2019). Bubble size indicates volume of ethanol produced.

To avail themselves of this opportunity, developing countries will have to overcome barriers that beset CCS facilities, especially in the context of accessing finance. BECCS facilities require CO_2 handling, compression, transportation and injection infrastructure. CCS adds cost and complexity to biofuel production projects, which in turn increases the risks perceived by investors and financiers. This significantly increases the cost of financing for these projects or makes it difficult to qualify them for debt financing.

During the early stages of developing a BECCS industry, concessional financing along with robust legal, policy and regulatory frameworks will be necessary to de-risk and encourage investments. Fortunately, climate finance — the type of financing that seeks to support mitigation and adaptation actions to address climate change — can play the important role of bridging financing gaps and enabling the development of a BECCS industry in developing countries.

The role of the UNFCCC's Financial Mechanism

The United National Framework Convention on Climate Change (UNFCCC), has a Financial Mechanism that channels financial resources from developed countries to developing countries, so they can respond to the challenge of climate change. The Financial Mechanism is accountable to the Conference of Parties (COP), which is the supreme decision-making body of the UNFCCC. The COP – which is made up of 197 countries – decides on the Financial Mechanism's climate change policies, programme priorities and eligibility criteria for funding. The operation of the Financial Mechanism is entrusted by two multi-lateral funds (MLFs), the Global Environment Facility (GEF) and the Green Climate Fund (GCF), referred to as its Operating Entities.

The Financial Mechanism's Operating Entities

Donor countries pledge resources to these MLFs, which in turn support projects and activities in developing countries. Whilst they differ significantly in their capacities and mandates, The GEF and GCF have a strong presence in developing countries through several UN agencies and development banks. These agencies will be acutely aware of each country's NDCs, and more broadly, their Sustainable Development Goals (SDGs). They will provide guidance to governments to help ensure that projects are designed to meet these.

The GEF and GCF seem well positioned to support these initiatives, but neither has the track record of providing the level of support needed to deploy BECCS facilities at large scale in developing countries.

The GEF

Since its establishment in 1992, the GEF has provided over USD$17.9 billion in grants and mobilised an additional USD$93.2 billion in co-financing for more than 4500 projects in 170 countries (Global Environment Facility, 2019). It targets small demonstration projects using grant funding, and focuses primarily on supporting the development of legal, regulatory and policy frameworks that enable the uptake of specific technologies.

The GEF has historically viewed CCS as an immature technology or one that is too costly for it to fund. Despite this, a USD$10.3 million BECCS project (United Nations Development Programme, 2009) was considered for funding in 2009 through the Special Climate Change Fund (SCCF). This is a small set aside fund, also part of the UNFCCC's Financial Mechanism, for the purposes of supporting new and emerging technology areas. The project, based in Brazil, proposed capturing CO_2 from bioethanol production from sugarcane, but was unable to progress beyond the development stage because costs had been grossly underestimated.

Although additional CCS projects have yet to be funded by the GEF, this serves as an important precedent. The funding provided by the SCCF was a direct response to the COP's request for the GEF to consider whether supporting CCS would be consistent with its strategies, and, if so, how this could be incorporated within its work programs (Scientific and Technical Advisory Panel, 2008).

The GEF's work programs run in four-year cycles; unfortunately, its current funding cycle, which runs from 2018 until 2022, does not include support for CCS. The alternative way in which developing countries can receive climate finance funding for CCS is through the GCF.

The GCF

The GCF, which was established in 2011, is structured to support climate change mitigation and adaptation projects though a range of different financial instruments, including loans, guarantees and grants. Unlike the GEF, the GCF is not restricted by the same kind of funding cycles and work programs, so it is able to accommodate changes in technologies and new opportunities for reducing emissions with relative ease.

It also has the capacity to fund large scale projects of the order of tens, or even hundreds, of millions of dollars. This makes it well suited to upscaling activities that may either have been initiated by the GEF or newly planned large-scale projects that are too large and

complex for the GEF to fund. The GCF considers one of its key strengths to be its capacity to leverage the private sector i.e. its capacity to unlock private sector finances is well aligned with the needs of BECCS projects in developing countries, especially in the presence of policy and regulatory frameworks that target biofuels.

So far, the GCF has received funding commitments of approximately USD 10.2 billion.

Approximately 93 projects have been approved. However, CCS facilities have not been funded. The GCF's Governing Agreement specifically recognises CCS as an environmentally appropriate technology but is unlikely to support standalone projects. Moreover, projects funded by the GCF must be transformative and, where possible, make use of public private partnerships (PPPs), for example, infrastructure projects.

BECCS, and more specifically, bioethanol production with CCS, can meet the GCF's criteria. Due to their low capture costs, and in the presence of enabling policies such as RenovaBio and other low carbon fuel standards, these projects may generate sufficient revenues to create an acceptable return on investment.

Supporting public-private partnerships

Importantly, CCS lends itself well to PPPs. One of the ways in which CCS facilities can have their costs significantly reduced is through hub and cluster arrangements. These allow fixed infrastructure costs to be spread across multiple users, bringing down the unit cost of transporting and storing CO_2. So, there are large economies of scale from developing a pipeline that can serve multiple users within hubs and clusters.

In partnership with the private sector, governments have a role in de-risking the first investments in hub and cluster developments. This implies that the most cost-effective BECCS projects will emerge from PPPs.

The GCF promotes projects which employ a least concession for viability approach (Green Climate Fund, 2018). This is to say that the GCF will provide minimum grant funding in favour of debt financing for projects. Currently, one of the greatest challenges faced by CCS projects is that commercial banks find it difficult to qualify them for debt financing. This is because of perceived risks associated with these projects, especially in relation to funding capture facilities.

In cases where debt funding can be applied, it is likely that the cost of capital will be significantly higher than in comparable infrastructure projects. In this regard, the GCF can provide low cost financing to support the funding of capture plants, allowing the less risky aspects of projects, i.e. transportation and storage, to be funded through equity and commercial debt.

Next steps

The production of bioethanol with CCS is a significant opportunity for reducing emissions, in part because of its relatively low cost but also because it has the potential make a significant contribution towards decarbonising the transport sector. To do so, it will have to rely on modifications to existing policies, such as RenovaBio in Brazil, so that market-based incentives in the transportation sector can incentivise the large-scale uptake of BECCS as well as other removal technologies.

As emissions continue to rise, climate experts set more ambitious emissions reductions

targets, making the climate challenge more difficult to overcome. As such, the role of negative emissions becomes increasingly important. By 2023, bioethanol will account for approximately two thirds of worldwide growth of biofuels, reaching up to 145 billion litres (Voegele, 2018), with production being led by the US and a host of developing countries. The IPCC's SR15, which was mandated by the UNFCCC, has made it clear that BECCS will have an essential role to play if we are to meet the climate challenge.

The GCF is a global MLF with significant resources and strong partners, so it is extremely well positioned to help support and enhance initiatives such as RenovaBio. Yet, country ownership, that is, a country-driven approach, is one of the core principles of this fund. It is in this context that developing countries, for which bioethanol production is an important industry, must be the ones to drive the development of BECCS projects. In parallel, the GCF, under clear direction from the UNFCCC, must bring awareness to the support that it is willing to provide to BECCS projects. In this way, the recommendations of the IPCC can be acted upon.

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