Motu

Designing a prototype emissions trading system for Colombia

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Abstract

The primary objective of a Colombian ETS would be to support the country to achieve its climate targets as defined in its Nationally Determined Contribution (NDC): a 20 - 30% reduction in GHG emissions compared to the business as usual scenario by 2030. An ETS, like a carbon tax (which could be used at the same time), can also raise revenue. Neither of these pricing policies constitutes a complete climate mitigation policy. On 27 July 2018, Colombia adopted a climate law, which outlines provisions for the establishment of a National Program of Greenhouse Gas Tradable Emission Quotas. This makes Colombia the second country in Latin America (joining Mexico) to enact legislation for what is likely to become a national Emissions Trading System (ETS). Colombia also already has a carbon tax that covers many fossil fuels and an offset system that can be used instead of paying this tax. This paper presents a working model for what an ETS could look like in Colombia and was part of a larger project, funded by the World Bank´s Partnership for Market Readiness with support from the Colombian government. While the working model in this paper was designed specifically for Colombia, taking into account its GHG emissions profile and a variety of contextual parameters, many of its design lessons extend to other countries and/or regions. We designed this model with the aim of including all sectors and covering nearly all the country´s emissions.

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Keywords
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Summary haiku

Emissions trading
may come to Colombia.
All sectors could join.

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Executive Summary

On 27 July 2018, Colombia adopted a climate law, which outlines provisions for the establishment of a National Program of Greenhouse Gas Tradable Emission Quotas. This makes Colombia the second country in Latin America (joining Mexico) to enact legislation for what is likely to become a national Emissions Trading System (ETS). Colombia also already has a carbon tax that covers many fossil fuels and an offset system that can be used instead of paying this tax.

This paper presents a working model for what an ETS could look like in Colombia and was part of a larger project, funded by the World Bank´s Partnership for Market Readiness to develop a proposed roadmap for an ETS in Colombia, with support from the Colombian government. The paper is based on a report presented to the Ministry of Environment and Sustainable Development and used by the Colombian government in their considerations prior to passing the new law. The aim of this paper is to facilitate discussion on the different options and develop a coherent place to start designing an emissions trading scheme.

The paper builds on the approach from *Emissions Trading in Practice: A handbook on design and implementation*, published by the World Bank's Partnership for Market Readiness together with the International Carbon Action Partnership (ICAP), and prepared jointly by a team of experts from Motu Economic and Public Policy Research and Environmental Defense Fund (EDF) in collaboration with Vivid Economics. While the working model in this paper was designed specifically for Colombia, taking into account its GHG emissions profile and a variety of contextual parameters, many of its design lessons extend to other countries and/or regions. We designed this model with the aim of including all sectors and covering nearly all the country´s emissions. The work builds on the experience of Motu researchers and our collaborators with emissions trading systems in New Zealand and internationally.

Objectives of an ETS in Colombia

The primary objective of a Colombian ETS is to support the country to achieve its climate targets as defined in its Nationally Determined Contribution (NDC): a 20 - 30% reduction in GHG emissions compared to the business as usual scenario by 2030. An ETS, like a carbon tax (which could be used at the same time), can also raise revenue. Neither of these pricing policies constitutes a complete climate mitigation policy. Companion policies such as research, education or regulatory changes will mitigate more effectively when pricing policies complement them by changing the economic environment; companion policies will make pricing more effective at driving mitigation by making it easier for entities to respond to price signals.

Another objective of a potential ETS in Colombia is to contribute to the country's green growth and low carbon strategies and to attract investment for resilient and sustainable economic growth. The final key objective of a potential ETS in Colombia is to complement the peace process, including regional consolidation and on-going social and economic development.

In addition, the use of an ETS can often produce a variety of co-benefits, including reductions in flooding through avoided deforestation and reforestation, increased efficiency, and health benefits from a reduction in air pollution.

Summary of Model

Scope

The scope of the working model ETS includes the energy sector, industrial processes and fugitive emissions, the waste sector, and the agriculture and forest sectors. In Table 1 below we describe where each sector could have its emissions measured and regulated.

Table 1 Scope for proposed working model for an ETS in Colombia

Sector	**Coverage**	**Point of Regulation**
Energy	Oil, oil liquid fuels, and natural gas	Upstream: Producers, Ecopetrol[1], importers
	Coal	Large coal mines
		Large users of coal
	Biofuels	Upstream: Ecopetrol/refineries
	Biomass	Large users of biomass
Industrial processes and fugitive emissions	Industrial processes	Industrial sites
	Coal (fugitive emissions)	Large coal mines
	Producers of petroleum and its derivatives (fugitive emissions) and natural gas	Large extractive sites and refineries
Waste	Solid waste	Landfills
Agriculture	Livestock	Slaughterhouse
	Livestock – jurisdictional programme	Jurisdiction (Region)
	Livestock – voluntary offsets programme	Landowner
Forests	Deforestation	Large land development projects that deforest
	Avoided deforestation	Jurisdictional
	Reforestation – jurisdictional reward programme	Jurisdictional reward programme for Departments
	Reforestation – voluntary programme	Offsets for individual landowners.

[1] Colombia's oil and gas company (previously state owned)

International Linking

Colombia´s ETS could be designed with the idea that it could link to other emissions trading markets in the future. Full linkage with another ETS would not be immediate, which would allow the Colombian system to develop without the risk of price volatility or external effects on the price of allowances. Initially, the ETS could link internationally as a seller - where Colombia could sell any additional emissions reductions it achieves beyond its NDC. Even if Colombia chose not to directly link with another ETS, the greater control over emissions achieved through an ETS would likely facilitate the country's ability to deliver international transfers of mitigation outcomes (ITMOs) and obtain funding to achieve these. Eventually Colombia could consider linking as a buyer as well.

Cap

The ETS would have a cap defined in tonnes of carbon dioxide equivalent. The ETS would allow for banking, but not borrowing of emissions units. The ETS could state the cap for the first five years, and after each year, it would announce the cap for another year. For example, if the ETS began in 2018, the cap would be announced for 2018, 2019, 2020, 2021, and 2022. In 2019, the government would announce the 2023 cap and so on.

Allocation

Most allowances would be distributed through an auction. Companies in emissions-intensive trade-exposed industries might receive some free allowances calculated by output-based allocation. Companies in sectors with significant stranded assets might receive some free allocation that could be based on either historical emissions or historical output with fixed sector benchmarking. Small firms that would be points of obligation might initially receive some free allowance allocations as a way to reduce compliance issues and ease their transition into the market. Actors in some sectors would receive allowances on the basis of removals (e.g. reforestation or other removal activities).

Price Controls

In this working model we also present two options for price controls. The first is the establishment of a price corridor using a two-tiered carbon tax to act as both a price floor and ceiling. There should be a mechanism to automatically increase the floor and ceiling over time as well as to increase them if emissions are failing to decline as much as expected. The second option presented allows the government to sell a limited number of reserve allowances at fixed pre-established prices to help contain the price. Revenues from payment of the price ceiling tax or the sales of allowances at the level of a price ceiling could be used to finance additional mitigation to make up for any increase in emissions.

Next Steps

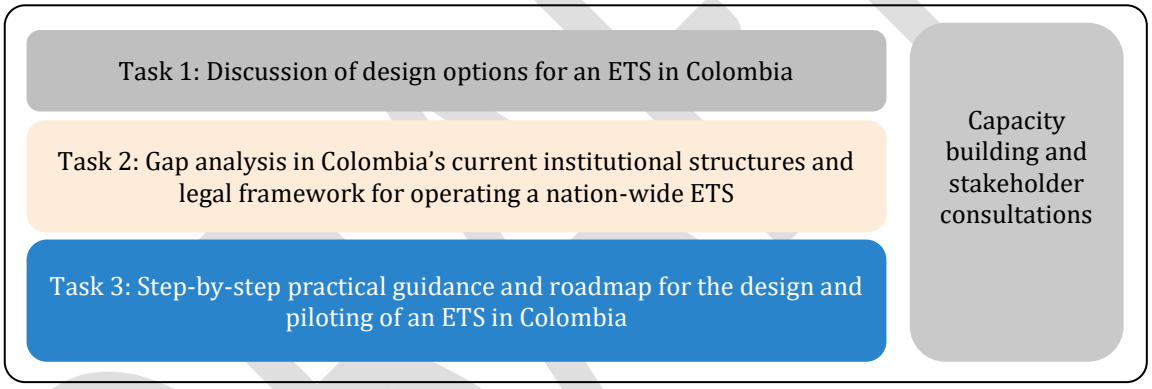
Strong institutions for the governance and operation of an ETS are critical to its success. Similarly, strong measurement, reporting, verification and compliance are fundamental elements for the system´s credibility and operation.

1 Introduction

1.1 Project overview and objectives

The World Bank´s Partnership for Market Readiness, with support from the Colombian Ministry of Environment and Sustainable Development (MADS) and the National Planning Department (DNP), commissioned this project to develop a "roadmap for the assessment and design of a Greenhouse Gas Emissions Trading System in Colombia". The project was delivered by a consortium of international and Colombian organizations: the Carbon Trust, Motu Economic and Public Policy Research, Econometria, Universidad de los Andes, Environmental Defense Fund, and Fedesarrollo. Since this project was completed, on 27 July 2018, Colombia adopted a climate law, which outlines provisions for the establishment of a National Program of Greenhouse Gas Tradable Emission Quotas. This report is now being released to help inform discussions around any subsequent decisions regarding an ETS.

Figure 1. Project structure



The specific objective of this report is to present a working model describing what an ETS in Colombia could look like if it were part of the national climate mitigation policy package. The report is structured as follows: Section 1 is the executive summary; Section 2 provides an introduction to this project; Section 3 briefly summarizes Emissions Trading Systems; Section 4 describes considerations for designing an ETS in Colombia; Section 5 presents a working model for the scope of a Colombian ETS; Section 6 presents options for linking a Colombian ETS internationally; Section 7 presents a working model for the design of a cap for a Colombian ETS; Section 8 presents a working model for allocating allowances in a Colombian ETS; Section 9 presents a working model for temporal flexibility and price control; Section 10 discusses the evaluation process and Section 11 describes the project's next steps.

1.2 Methodology and approach

The working model that we present was created following the approach outlined in *Emissions Trading in Practice* (ICAP; PMR, 2016), a handbook for the design and implementation of ETS

that was developed by the Partnership for Market Readiness and the International Carbon Action Partnership and was authored by Motu Economic and Public Policy Research and Environmental Defense Fund (EDF), in collaboration with Vivid Economics. Following this approach, our team has explored many options for each of the core components of an ETS (e.g. scope, coverage, point of regulation, linking, cap and allowance allocation, compliance and oversight, phases, temporal flexibility, price stabilization). We have discussed each potential variation in the design of the core components during which our international team has provided insights based on international experiences with ETSs and the Colombian team has contributed knowledge regarding the Colombian context and conditions. Additionally, we have spoken with experts to understand in more detail specific aspects of the Colombian economy. This iterative process has been used to create an initial working model that was then presented to different local stakeholders (e.g. ACOLGEN, ACP, ANDI, ANDEG, Andesco, UPME, WWF, Bolsa Mercantil, and FEDEGAN) who provided us with valuable feedback to refine the model.

This report is based on Task 1 of the project and constitutes one of three reports that were produced, each corresponding to one of the project´s three principal tasks, as shown in Figure 1.This report should be read in parallel with the Handbook *Emissions Trading in Practice* (ICAP; PMR, 2016) which provides more in-depth explanations of the issues and provides useful information on the international experience.

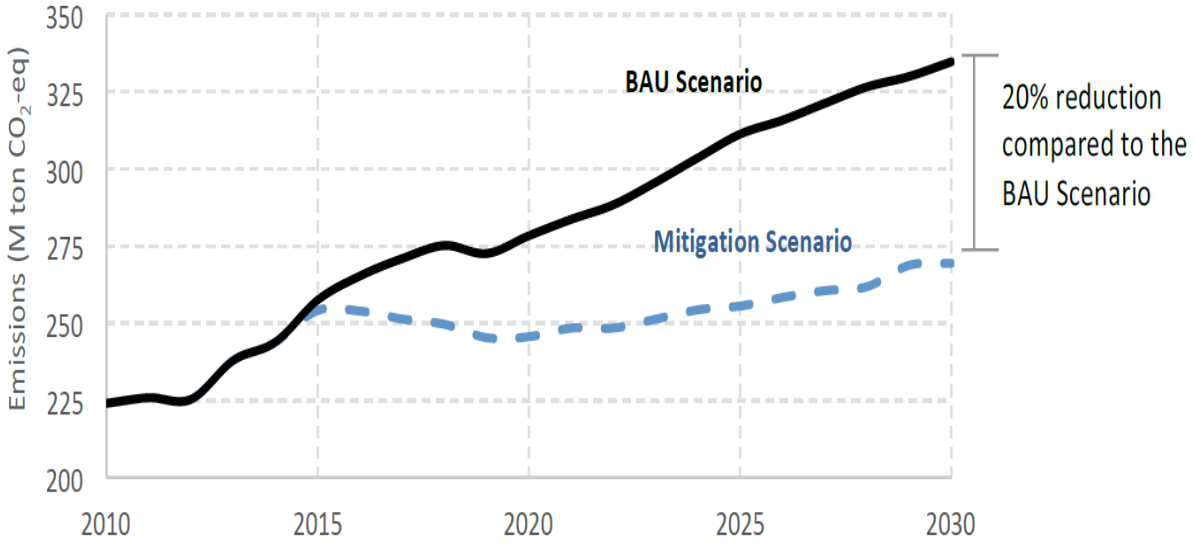
1.3 Colombia's climate change commitments and carbon pricing initiatives

In September 2015, prior to the adoption of Paris Agreement at the COP 21, Colombia submitted its NDC which states the country's intended commitments to mitigate and to adapt to climate change (Government of Colombia, 2015). On 16 June 2017 Colombia passed a law to ratify the Paris Agreement.[2] The mitigation objectives that are signalled in the NDC are a 20% reduction of GHG emissions compared to the Business-as-Usual scenario (BAU) by 2030. This commitment could increase to a 30% reduction with international support.

[2] When ratifying the Paris Agreement, governments can submit their first NDC. If they choose to not submit a new NDC, their INDC becomes their first NDC. In the case of Colombia, the country has now ratified the Paris Agreement therefore its commitment is now called NDC. https://unfccc.int/process/the-paris-agreement/status-of-ratification

Figure 2 shows the 20% GHG reduction scenario compared with the government's projected BAU.

Figure 2. Colombia's BAU GHG projections are in black and are compared with the 20% mitigation scenario (Government of Colombia, 2015)



Within the documentation for its NDC, Colombia has stated that it will consider the use of market-based mechanisms to achieve its target. Calderón et al. (2016) explore the potential for price-based policies to contribute to greenhouse gas mitigation in Colombia.

In December 2016 Colombia established a carbon tax. This tax adds COP $15,000/ tonne of CO_2, $5 U.S. dollars, to natural gas, liquefied petroleum gas (only when used by industry), gasoline, kerosene and jet fuel, diesel oil (ACPM), and fuel oil when used for energy generation and will increase every year by 1 point and inflation until the tax reaches 1 UVT (unidad de valor tributario)/ tonne of CO_2 (El congreso de Colombia, 2016, pp. 168-170). The tax does not apply to the departments of Guainía, Vaupés and Amazonas for gasoline and diesel oil (ACPM). Companies that are required to pay this tax can instead be exempted from the tax if they demonstrate complete 'carbon neutrality' based on the purchase and cancellation of offset credits equal to their emissions. These offset credits must be verified by an accredited entity under the National Accreditation Body of Colombia (ONAC) and must be based on mitigation activities occurring within Colombia.[3]

In August of 2016, a voluntary carbon market, the Mercado Voluntario de Carbono Colombia (MCC), was launched. This platform can be used to sell offset credits that are created through a variety of forestry and agriculture projects (Mercado Colombiano de Carbono (MCC), 2016).

[3] Credits for mitigation outside Colombia were allowed during the first year under methodologies other than the Clean Development Mechanism (CDM), which was only accepted for projects within Colombia. For more information, see Decree 922 issued by the Ministry of Finace on June 26, 2017 available here. For more discussion, see: Carbon Trust, EDF, IETA, 2018. "Colombia: An Emissions Trading System Case Study," available here.

2 Introduction to Emissions Trading Systems (ETS)

2.1 What is an ETS and how does it work?

As stated in Section 1, this report should be read in parallel with *Emissions Trading in Practice* (ICAP; PMR, 2016) which provides more in-depth explanations of the issues involved in designing an ETS and the international experience. Nonetheless, here we provide a brief introduction to an ETS. In this section we address questions such as: What is an ETS and how does it work, what is the difference between an ETS and a carbon tax, what is involved in designing, developing, and the annual operations of an ETS. Additionally, we will discuss common misconceptions about ETSs.

An Emissions Trading System (ETS) is a market-based instrument that is used to reduce GHG emissions by addressing a market failure (Motu Economic and Public Policy Research, 2012). GHG emissions generate what economists call a negative externality, a cost resulting from one party's activity that affects another party and which the first party did not have to take into consideration. GHG emissions impose a cost on society by producing climate change. This cost is not reflected in the costs faced by those who can control the emissions (either the producers or consumers of emission-intensive goods). This is the market failure that market-based instruments such as ETSs and carbon taxes seek to rectify. In doing so, they facilitate and incentivize the reduction of GHG emissions.

An ETS is sometimes also called a cap and trade system. The government places a cap or a limit on the amount of emissions that are permitted. The scope of an ETS refers to the sectors, gases, companies and other sources of emissions that are regulated under the program and collectively must emit within the cap's limit. The cap is broken down into allowances, which are emissions permits, each of which typically conveys the right to emit 1 tonne of CO_2 equivalent. Each regulated entity must buy allowances either through an auction or in the market or they may receive some allowances from the government. They must subsequently surrender one allowance for every tonne of CO_2 emitted. Non-regulated entities, or organizations that are not required to participate in the ETS, may still choose to participate in the market for allowances.

Organisations may purchase and sell allowances in the market. This is the trade aspect of cap and trade. For example, consider Companies A and B that both emit GHGs and are covered under the scope of the ETS. Company A has decided that measures to reduce its GHG emissions are costly and it emits more than the number of allowances that it is currently holding. Company B, on the other hand, has found implementing carbon reduction measures relatively easy and has more allowances than it requires to comply. Company B can sell its extra allowances to company A, such that both companies remain in compliance and the total cap on emissions is not exceeded.

2.2 What is the difference between an ETS and a carbon tax?

Both an ETS and a carbon tax can help to address the market failure that GHG emissions present. The difference between an ETS and a carbon tax is that an ETS limits the number of emissions permitted but allows the price for 1 tonne of CO2 equivalent to be set by the market. In contrast, a carbon tax works the opposite way: the tax sets the price of emissions, and given this price, the market will respond with the corresponding quantity of GHG emissions. In reality, governments often use hybrid policy approaches, which may combine management of both emissions quantities and prices. Governments who choose ETSs include approaches to manage emission prices and governments who choose taxes may have goals to limit emissions and may change the tax if those are not met.

2.3 What are the benefits of an ETS?

The ICAP report "Benefits of Emissions Trading (Eden, Under, Ackworth, Wilkening, & Haug, 2016) summarized the benefits of ETSs. We briefly discuss their findings below.

2.3.1 Environmental Effectiveness:

ETSs are effective at reducing GHG emissions. "Estimates of emissions reductions attributed to the EU ETS range from 3% of aggregate emissions to 10-28% at the firm level, with the impact on emissions being greatest during the beginning of phase II (2008 – 2010)" (Eden, Under, Ackworth, Wilkening, & Haug, 2016, p. 4).

Governments frequently adopt ETSs because of the ability to directly limit the quantity of emissions and the resulting clear emissions pathways (ICAP, 2015). An ETS can set progressively declining caps that are in line with national climate targets.

2.3.2 Economic Impacts

ETSs offer a cost-effective method for greenhouse gas emissions mitigation. ETSs and broad-based carbon taxes have been found to incur the lowest costs per ton of abated emissions compared to other policy approaches. ETSs allow firms flexibility in terms of choosing when, where and how to reduce emissions.

The performance of the California's ETS and economy demonstrate the potential of ETS to decouple GHG emissions and economic growth. "For example, during the first year of operation, emissions in California's ETS decreased by 0.6% while the state's GDP grew by more than 2%" (Eden, Under, Ackworth, Wilkening, & Haug, 2016, p. 5). Similarly, between 2005 and 2013, emissions from the power sector in RGGI states decreased by more than 40% while the regional economy grew by 8%. Furthermore, multiple studies show that ETSs can be a driver for the deployment and innovation of low carbon technologies.

2.3.3 Other public policy objectives

ETSs have the potential to support further public policy objectives. First, ETSs generate revenue. ETS jurisdictions had raised more than USD 24 billion through auctioning by 2015 (Eden, Under, Ackworth, Wilkening, & Haug, 2016). These funds may be used to invest in further climate action, to lower other taxes, or to compensate vulnerable populations. Additionally, ETSs can create co-benefits, particularly relating to public health, energy security and forest conservation. "From 2009 – 2013, the reduction in hazardous pollutants in RGGI states has led to an estimated USD 10.4 billion in health savings from avoided illness, hospital visits, list work days and premature deaths" (Eden, Under, Ackworth, Wilkening, & Haug, 2016, p. 5).

2.4 Key factors for the successful implementation of an ETS

No one single element will guarantee a successful ETS. Nonetheless below we describe factors that will contribute to an efficient and successful ETS.

- Political and public support for an ETS
- Close collaboration between the government, stakeholders, and ETS regulators
- Involvement and participation of stakeholders
- A design that reflects local circumstances, needs and priorities
- A regulatory and legal framework that is favourable for an ETS
- A robust Monitoring, Reporting and Verification system

- Strong capacity to develop and operate the ETS

Box 1. The FASTER Principles for Successful Carbon Pricing

The World Bank and the OECD jointly developed the FASTER Principles for Successful Carbon Pricing (World Bank; OECD, 2015). The principles were developed based on practical experiences implementing carbon taxes and ETS.

Fairness: "Reflect the "polluter pays" principle and contribute to distributing costs and benefits equitably, avoiding disproportionate burdens on vulnerable groups";
Alignment of Policies and Objectives: Use carbon pricing as one "of a suite of measures that facilitate competition and openness, ensure equal opportunities for low-carbon alternatives, and interact with a broader set of climate and non-climate policies";
Stability and Predictability: Implement carbon prices, within "a stable policy framework, that give a consistent, credible, and strong investment signal, whose intensity should increase over time";
Transparency: Be "clear in design and implementation";
Efficiency and Cost Effectiveness: Ensure that design promotes "economic efficiency and reduces the costs of emissions reduction"; and
Reliability and Environmental Integrity: Allow for a "measurable reduction in environmentally harmful behaviour".

2.5 Common misconceptions about an ETS

A few common misconceptions about emissions trading systems are important to avoid. In this section we address six of the most common misconceptions. First, frequently emissions trading systems and carbon taxes are referred to as "either/or" meaning that a country must choose to use either an ETS or a carbon tax. However, these two mechanisms are not exclusive and can be used in combination. Similarly, emissions pricing is often presented as though it competes with other policies to reduce emissions. While in some situations it can be a substitute (e.g. for targets for renewable electricity), it can often be a complement. For example, training and information programmes to facilitate uptake of new lower emission technologies will have a greater effect if those technologies are also more profitable because of an emissions price. A fuel efficiency standard that raises the cost of new vehicles will lead fewer people to hold on to their old inefficient cars if those cars are much more expensive to run.

Another common misconception is that allowances are always distributed for free. This misconception is partially because air pollution markets do often give allowances for free. In contrast to an ETS, in an air pollution market (e.g. to limit emissions of particulate matter) polluters cannot easily pass the costs on to consumers because they compete with producers in other less polluted locations that are not affected by air quality regulation. Some ETSs give most allowances away for free (e.g. South Korea and the EU ETS in its early phases) but others do not (e.g. New Zealand and the Regional Greenhouse Gas Initiative; RGGI).

Another misconception is that allowances in an ETS are the same as permits for particulate matter emissions. The key confusion here is that the location and timing of the particulate matter emissions is relevant to its environmental impact which means that the 'permit' is specific to emissions from a particular place. That is not true for GHGs, so only aggregate caps are needed, rather than caps on particular sectors or firms, and the banking (carry over from one period to another) of allowances is also possible.

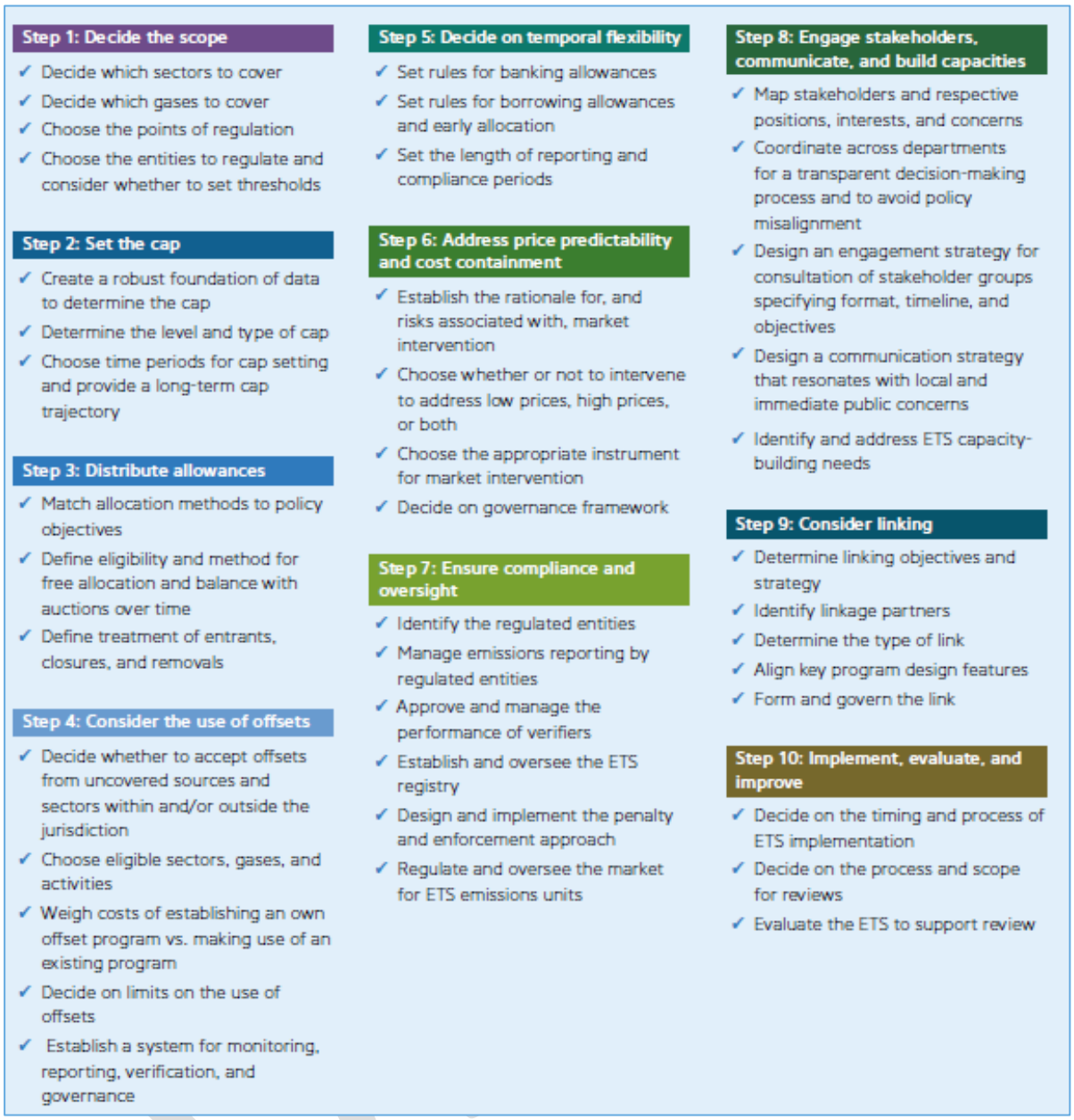
Similarly, sometimes people think that each sector has a separate emissions cap (or that firms have individual caps according to the allowances they receive for free). In fact, an ETS only has a single aggregate cap for all sectors and sources that are covered by it. This allows allowances to be traded among different firms and sectors, and to flow from sectors with low mitigation costs to sectors with high mitigation costs.

The final two common misconceptions are that an ETS is like a voluntary crediting system and that the market will self-regulate and not require MRV and penalties for noncompliance. An ETS is not voluntary for the sectors and types of organizations that are included in its scope. Thus, MRV and strict compliance are critical to the operation of an ETS, as with any environmental regulation.

2.6 What are the key steps to design an ETS?

Figure 3 below outlines the ten key steps that are involved in designing an ETS. Although each one of the steps is necessary to implement an ETS, these do not necessarily have to follow a specific order. For each of the ten steps, this project has considered the various options that Colombia might want to explore and, after consultation with experts from various stakeholder groups, we have drafted an initial working model.

Figure 3: Checklist for the 20 steps of ETS design from (ICAP; PMR, 2016)



2.7 What mechanisms will need to be developed for an operational ETS?

After the decision to implement an ETS is agreed and the system is designed, the different mechanisms and elements of the ETS will need to be defined and developed. This will include the following decisions and actions:

1. Define the institutions that will implement and operate the ETS. As a government mandated instrument, the overall coordinator of the ETS is usually a national authority. Enforcement is usually carried out by various departments.
2. Define and identify the entities that will be regulated in the ETS and simultaneously define and establish the mechanisms to monitor, report and verify (MRV) emissions associated with those entities.

3. Define the cap, the emissions limit from sectors covered by the ETS.
4. Issue allowances and define how to distribute allowances.
    - Define the rules for any free allocation of allowances as well as how an auction would operate.
    - Develop an ETS Registry: A registry is needed to track the ownership of allowances in order to facilitate trading. Allowance trades are legal only when they are recorded in the registry.

1. Define the frequency with which allowances must be surrendered and mechanisms to confirm that all emissions are supported by allowances.
2. Define sanctions for covered entities that do not surrender sufficient allowances.
3. Define any mechanisms to ensure predictability of prices within the market.
4. Define rules for crediting and using reductions from sources not regulated under an ETS (if the use of "offsets" is considered).
5. Define the rules for linking with other ETSs (if linking is considered).
6. Define procedures to review, evaluate and improve the performance of the ETS. The ETS should periodically be evaluated and updated to improve the functioning of the system and to respond to changes in external circumstances.

2.8 What is involved in the annual operations of an ETS?

Once the ETS is set up, the annual running will involve:

1. Distributing allowances via auction or free allocation
2. Participants trading allowances and informing the registry
3. Verifying the emissions associated with each point of regulation and that sufficient allowances are surrendered
4. Periodically evaluating how the ETS is working and revising its operation accordingly

3 Designing an ETS for Colombia

Experiences to date with the design and operation of ETSs demonstrate that a "one size fits all" approach is ineffective and there is a need to tailor the design of an ETS to local conditions (Motu Economic and Public Policy Research, 2012). This means not only taking into account sector-specific economic and technical characteristics and more broadly the institutional capacities for the administration of an ETS, but also the desired outcomes and objectives for an ETS. To this end in this section we outline the goals that we have identified for an ETS in Colombia and summarize high level characteristics that will strongly influence the design of an ETS.

3.1 Objectives of an ETS in Colombia

Our starting premise is that the primary objective of an ETS in Colombia is to support the country to achieve its climate targets as defined in its NDC, a 20 - 30% reduction in GHG emissions compared to the BAU scenario by 2030. Another objective of a potential ETS in Colombia is to contribute to the country's green growth and low carbon strategies and to attract investment for resilient and sustainable economic growth. An ETS also has the potential to deliver significant co-benefits such as increases in efficiency and productivity for the energy, industrial, agriculture, and forestry sectors, health benefits from a decrease in air pollution, reductions in flooding through reforestation, and protection of biodiversity and community livelihoods through forest preservation. These co-benefits can provide additional motivation to include certain sectors in an ETS. The final key objective of a potential ETS in Colombia is to complement the peace process, including regional consolidation and on-going social and economic development.

3.2 Colombian context that will influence the design of an ETS

3.2.1 General and sector specific factors that affect the design of an ETS in Colombia

In this section we discuss how national conditions in Colombia will affect the design of an ETS. Later in the section, we discuss the context of specific sectors.

- Colombia has a market-oriented economy which should facilitate a relatively smooth transition to the use of an ETS. In short, market based regulation, such as an ETS, is in line with the current regulatory environment in Colombia. Nonetheless, institutions and norms may very well require adaptation. This topic was explored in Task 2 of the wider project.
- The regulatory frameworks in the energy sector allow 'upstream' regulation to transmit prices through the supply chain. The electricity sector is managed in a market oriented way and a mechanism is included to add the carbon tax to the fuel price. The liquid fuel sector is a concentrated one at the higher levels of the supply chain (production, import and wholesale) and regulatory management allows these companies to include the carbon tax within their wholesale price.
- Existing policy instruments in the agriculture and forestry sectors allow inclusion of those sectors in an ETS. Slaughterhouses already collect levies; autonomous Regional Corporations (CARs) are existing jurisdictional authorities responsible for managing environmental issues at a regional (often large watershed) scale.
- There are limitations in data and analysis related to climate change actions in Colombia.
- Environmental authorities currently have limited capacity and power to regulate and supervise.
- There are important fiscal restrictions at the national level. Solutions that are proposed would ideally raise revenue and be financially self-sustaining.

- As mentioned above, Colombia has approved the implementation of a carbon tax for certain fuels (e.g. petroleum products and natural gas).

3.2.2 Sectoral Context

Colombia´s GHG profile provides a guide as to what sectors need to be targeted to ensure coverage of a large percentage of the country´s emissions. Figure 4 shows the breakdown of sectoral emissions for the years 1990 and 2010 as well as their projected emissions out to 2020 and 2050. Figure 5 provides a detailed breakdown of projected GHG emissions across sectors under business as usual. It is based on the 2010 National GHG inventory.

Figure 4 Shares of emissions across key sectors: historic and projected data taken from (IDEAM et. al. 2015)

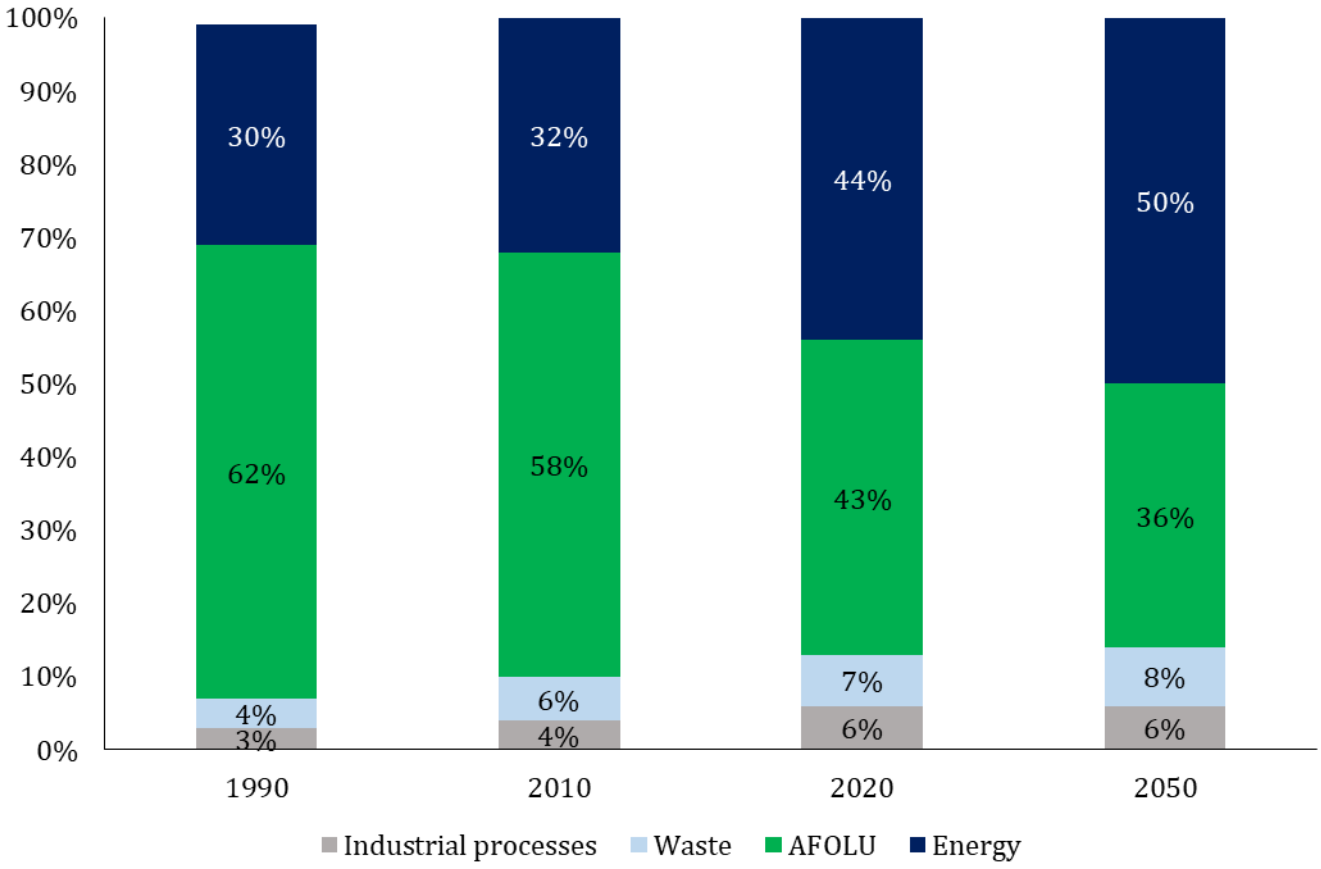
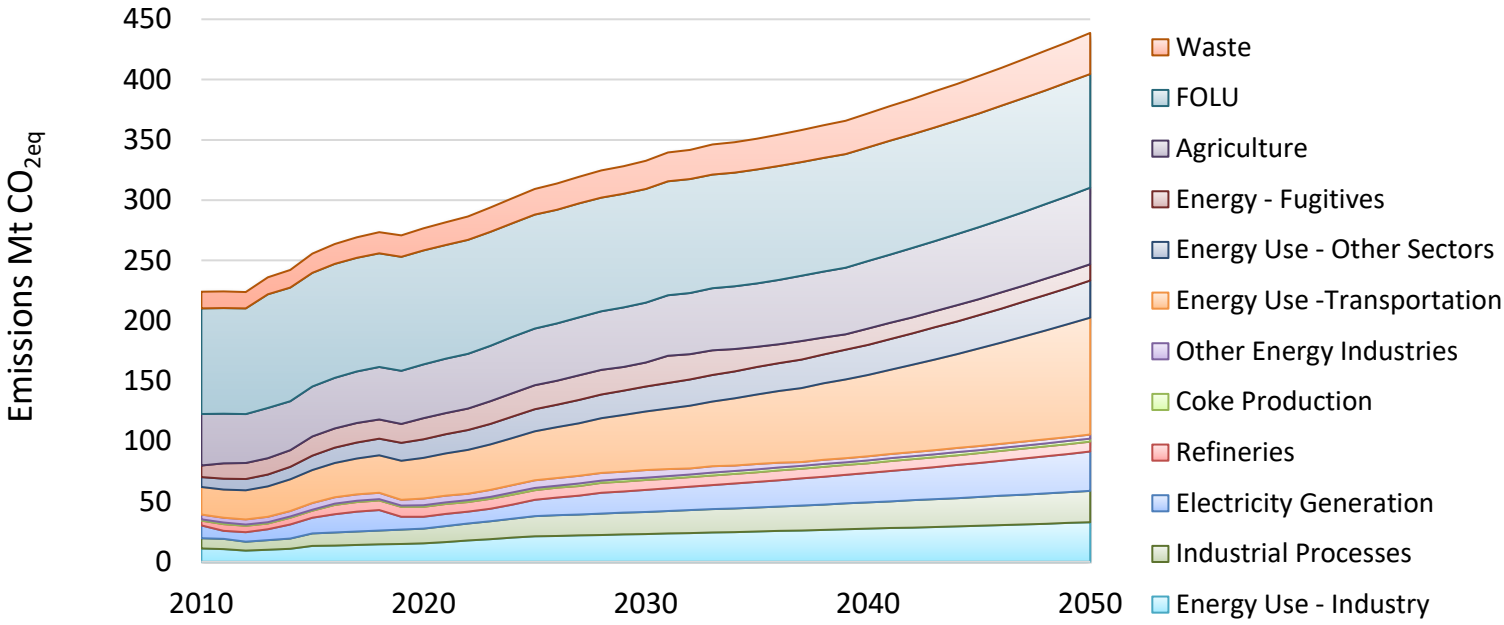


Figure 5 Projected BAU emissions by sector to 2050



Based on Colombia´s emissions profile, the agriculture, forests and land use (FOLU), energy and transport, industrial processes, and waste sectors are all significant sources of future emissions, with important implications for the country´s climate mitigation strategy.

4 Scope and point of obligation

This chapter considers how different sectors and GHGs could be included in an ETS in Colombia. In order to do this, we consider which entities can generate data that can be collected to monitor emissions and be required to surrender allowances in order to limit emissions. These points are called the points of regulation or the points of obligation. The costs of including some sources will not be justified by the benefits and a minimum threshold level of emissions will be defined for some regulated entities. The combination of sectors, GHGs and sources included is referred to as the scope of the ETS. We present a model that potentially covers all sectors and nearly 100% of emissions in Colombia as a way to ensure achievement of the NDC.

First, we discuss factors that affect the selection of the scope of an ETS. We then present our current working model for the potential scope of an ETS in Colombia.

4.1 Common issues for choice of scope and points of regulation

When deciding the scope of an ETS there are advantages to making the scope as broad as possible (including a large number of sectors and GHGs) as well as reasons why narrowing the scope could be beneficial. A broad scope increases the certainty that an overall emissions target set for the country will be met; potentially lowers the cost associated with reducing emissions because more activities and therefore more ways of abating emissions are available in the

market; may improve market operations because having a larger number of entities trading promotes liquidity and decreases the chances of any one entity gaining market power, and ensures a level playing field for competition domestically and reduces the likelihood of domestic leakage, such as if a good from a source that does not fall within the scope of an ETS is substituted for a good from a source that is included in the ETS.

On the other hand, narrowing the scope of the ETS can reduce monitoring, enforcement and other transaction and administrative costs. To include sectors and GHGs in an ETS, it is necessary to be able to collect and verify data that allows estimation of emissions associated with covered sources with reasonable accuracy and low costs. Narrowing the scope can also protect sectors and industries that have a high risk of international emissions leakage. These may also be sectors that are considered to face unacceptably high costs from an ETS because they are unable to pass costs onto consumers (ICAP; PMR, 2016).

Narrowing and broadening the scope of an ETS and the associated benefits of each option must be balanced when designing an ETS. Mechanisms such as placing the point of regulation upstream, when possible, using free allocation strategically, and including thresholds typically to exclude small enterprises which account for few emissions and would require large administrative costs can reduce the tradeoffs among these benefits and challenges. Exclusion of a sector or source is also not the only option to manage risks of international leakage. Administration costs and other challenges. In our working model we have sought approaches to inclusion of sources that allow as wide a scope as possible while controlling the challenges that inclusion can involve.

4.2 Proposed coverage of gases

In terms of gases, carbon dioxide (CO_2) is included in every ETS implemented to date. Depending on the emissions profile of the country/jurisdiction more greenhouse gases may be added such as methane (CH_4), nitrous oxide (N_2O), or fluorinated gases. The vast majority of ETS include at least three different GHGs; the few exceptions limited to just CO_2 are the seven ETSs that China is piloting, Japan´s ETSs, the RGGI, and Kazakhstan´s ETS (ICAP, 2016). For purposes of our working model, we will include the basket of six gases covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

4.3 Energy Sector

Our working model for an ETS in Colombia includes the energy sector, including all uses of fossil fuels and biofuels including in the transport and electricity sectors. The inclusion of electric power is a nearly universal choice across existing ETSs worldwide, while the inclusion of transportation varies. All ETSs--except the Japanese ETSs in Saitama and Tokyo which include

electricity emissions indirectly--have included the power sector emissions derived from fossil fuels. California-Quebec, New Zealand, South Korea and Beijing and Shenzhen have included the transport sector (ICAP, 2016). Including the energy sector is fairly intuitive because they typically account for a relatively large percentage of GHGs and emissions are comparatively easy to monitor.

According to Colombia´s second biennial update report, the energy sector accounted for 35% of all GHG emissions in 2014, with 36% of this sector's emissions coming from transportation (IDEAM, PNUD, MADS, DNP, Cancillería 2018). Total energy emissions are expected to grow both in absolute terms and also as a share of total emissions. Consequently, by including the energy sector (inclusive of all transportation emissions), the ETS will cover significant sources of emissions. Additionally, regulation of this sector is relatively straightforward and any effects on vulnerable communities can be managed, as described below. The Colombian carbon tax already covers many energy sources; the same administrative systems could potentially simply be transitioned into an ETS. Inclusion of the energy sector will provide an important source of demand for units in the ETS market. We recommend that all fuels are included in a Colombian ETS from the outset. We next discuss the logic for this recommendation and details.

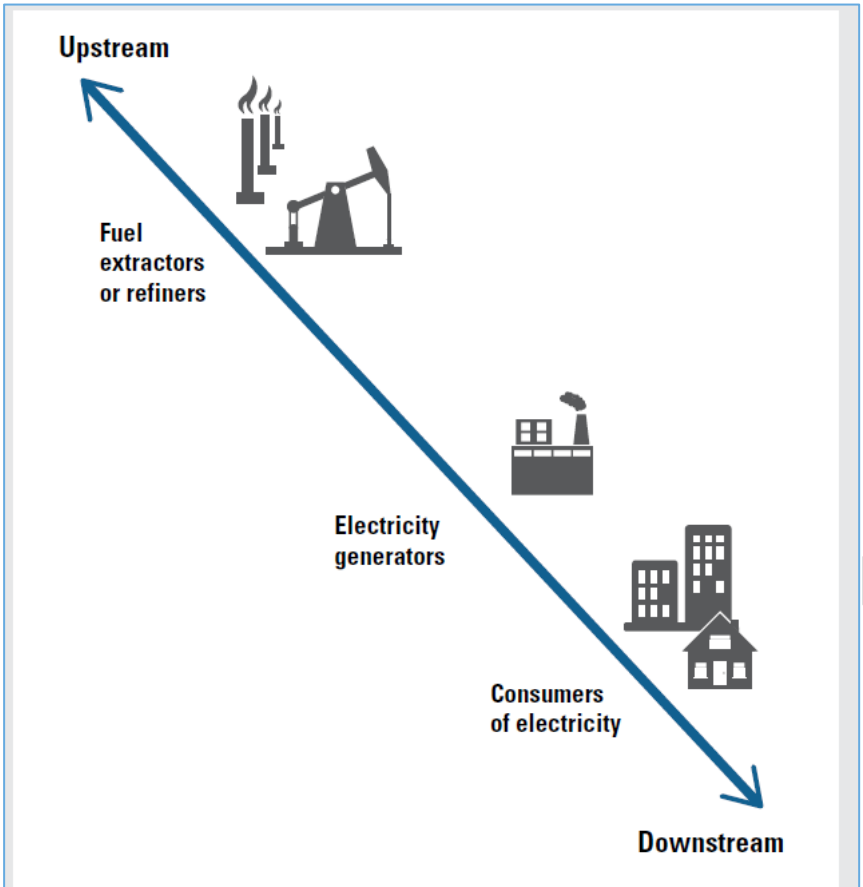
Table 2. ETS scope recommendations for the energy sector

What is included?	Timing of inclusion in the ETS	Point of regulation
Oil, liquid fuels and natural gas	Immediate	Upstream: Producers, Ecopetrol, refiners and importers
Coal	Immediate	Upstream: a. Large mines And downstream: b. Large consumers of coal
Biofuels	Immediate	Upstream: Refineries and importers: Ecopetrol
Biomass	Immediate	Downstream: industrial facilities that use biomass for energy/heat generation

4.3.1 Upstream vs. downstream regulation

Downstream regulation occurs at the point where emissions are produced and emitted into the atmosphere (for example, at the point where fuels are combusted to generate energy) or, in some cases, at the level where a product produced with those emissions is consumed (for example, when electricity is used by industry or office buildings). Upstream regulation occurs at the point where a product (e.g. a barrel of oil), which in the future will release GHG emissions into the atmosphere, is commercialized or enters the market (e.g. through refineries or terminal racks). Regulated entities upstream must surrender emissions allowances based on the embedded emissions in their products (and in the case of fossil fuels, the carbon content of the fuels is a good proxy for the ultimate combustion emissions from those fuels). Figure 6 provides a visual explanation of upstream vs. downstream points of regulation.

Figure 6: Upstream and downstream regulation for the energy sector figure from (ICAP; PMR, 2016)



4.3.2 Why upstream regulation?

A predominantly upstream point of obligation for oil, liquid fuels, natural gas, coal, and biomass and biofuels seems likely to be the most effective potential point of obligation for an ETS because Colombia has:

- well-functioning energy markets;
- a concentrated industry to produce and import oil and gas;
- existing institutions for regulation of energy production and import that are stronger than those at the level of large energy-using companies;
- a large informal sector that could not otherwise be included in ETS; and
- energy sector regulation that allows for costs to be passed down to consumers. This creates incentives for mitigation wherever energy is used.

An upstream point of obligation will cover all emissions from the sector making the system efficient and fair and is a simple, credible system for regulation. Additionally, an upstream point of obligation has administrative benefits because there are many fewer entities to regulate than at the downstream level.

4.3.3 What happens at the point of regulation?

At each point of regulation, the firm would be responsible to report all production or imports of each fuel for domestic use and surrender units to match emissions associated with those. They would likely pass on most costs and incentives to mitigate, to their customers.

4.3.4 Recommendations for the point of regulation for oil, liquid fuels and natural gas in Colombia

The recommended point of regulation for oil, liquid fuels and natural gas is upstream at the producers and Ecopetrol. This is where companies can report production, import and exports of these products. This is the most administratively convenient point that provides comprehensive coverage for these sources of emissions. In the case of coal, we recommend a hybrid upstream-downstream approach as described below, given special challenges with regulated coal producers in Colombia.

4.3.5 Recommendations for emissions from coal

Small scale mining in Colombia presents a set of challenges when considering the sector for inclusion in the ETS. Guiza (2013) estimated that in 2012, 72% of mines in Colombia could be considered small scale mining. While large scale mines can be readily monitored and regulated upstream, the main concerns regarding the inclusion of small scale mining operations in an ETS include high administrative costs, difficulty verifying emissions and concerns surrounding prohibitive costs that would incentivize non-compliance. Because of these factors, we recommend including coal immediately within at ETS based on two points of regulation:

1. regulate upstream at point of large mines (defined based on a size threshold); and
2. regulate downstream at large consumers of coal (defined based on a threshold for firm size – rather than coal use)

Double regulation of direct emissions by firms (large consumers of coal) would be avoided with exempting emissions from consumers based on proof of purchase of coal from a mine that is a point of regulation and hence has already surrendered units.

It is important to note that any coal that is exported will (at least initially) not be subject to the ETS.[4] This means that larger mines will be required to surrender allowances only for the carbon content of coal that is sold into the domestic market. Since a significant amount of the coal used nationally is provided by small mines, we recommend including large consumers of coal as well, as described above. This will allow a larger percentage of emissions from coal to be included in the ETS and avoid a perverse incentive for large users to use coal from small unregulated mines.

[4] At a later point, Colombia might consider regulating exported coal in exchange for the embedded emissions not being regulated or being subject to a border adjustment at the point of import to avoid double regulation of those emissions.

In a second stage, to ensure that all emissions from coal use are regulated, we recommend including coal distributors from medium sized mines. Additionally, we recommend including small mines when they are legalized and organized in associations.

4.3.6 Consumption of biomass and biofuels

Bioenergy is often considered a lower-emission source of energy than fossil energy, because the growing trees and plants sequester carbon. However, there is now recognition that not all bioenergy feedstocks are carbon neutral and that the net climate impacts of bioenergy use vary by feedstock, production methods, and the time frame of analysis.[5]

Burning biomass energy feedstocks produces carbon dioxide emissions just like burning fossil fuels. However, bioenergy can result in net reductions in greenhouse gas emissions when the harvest of biomass spurs increased sequestration associated with biomass production on the land, or when biomass waste material that would have otherwise quickly decomposed to the atmosphere is used for energy. This increase in sequestration or reduction in emissions from the landscape can then provide a counterweight to the combustion emissions, resulting in a net reduction relative to the combustion emissions alone. Time is also an essential factor in this evaluation of the net flux of GHG emissions across the landscape. The time frame used in evaluating the net flux of GHG emissions from bioenergy must be clearly specified and aligned with the time frame of the policy goals.

Exclusion of biomass energy from ETS could constitute a missed mitigation opportunity and potentially create the potential for emissions leakage unless there are appropriate accounting requirements and economic incentives to ensure the production of bioenergy feedstocks is reducing emissions. We recommend that the combustion emissions of solid biomass and liquid biofuels be included in the ETS in order to avoid two potential types of perverse outcomes. The first potentially perverse outcome would be creating an incentive to switch from burning a fossil fuel to burning a biomass or to biofuel whose production does not provide a climate benefit or even potentially increases emissions by, for example, increasing deforestation (e.g. via harvesting wood biomass or clearing land to grow oil palms or other bioenergy crops) . The other perverse outcome would be creating a climate reward and potential windfall gain for existing palm oil plantations or croplands that simply redirect their production from food (or animal feed) to energy uses. This could increase the price of food without any climate-beneficial change in land use or land management.

The recommended point of regulation for emissions associated with combustion of biomass and biofuels is:

1. Large companies that use solid biomass for energy (either electricity or heat); and

[5] Timothy D. Searchinger et al., "Fixing a Critical Climate Accounting Error." *Science* 326: 527-528 (2009); European Environment Agency, Opinion of the EEA Scientific Committee on Greenhouse Gas Accounting in Relation to Bioenergy (2011); H Haberl,. "Correcting a fundamental error in greenhouse gas accounting related to bioenergy." *Energy Policy* 45 (2012): 18-23.

2. Refineries (or importers) of liquid biofuels.

These companies would have an obligation to cover the full emissions associated with the combustion of biomass or biofuels. However, they would have the option to apply for a credit that would either fully or partially offset these emissions. Biomass or biofuels that, for example, are causing deforestation or directly replacing food/feed production would not be eligible for credit. The use of biomass or biofuel feedstocks from existing oil palm or other bioenergy crops should also not receive credits. This is a safeguard against simply redirecting product away from food or feed markets without generating any climate-beneficial change in land use or land management.

Biomass feedstocks that would be eligible for credits that fully or partially offset their associated combustion emissions are described in turn below. The following types of biomass would be eligible for a credit that would *fully* offset their emissions, producing a net zero emissions obligation after the credit is applied:

1. Waste products (e.g. bagasse, logging mill residues, or biogas production from organic residues from municipal solid waste or treatment facilities)[6]
2. Biomass/biofuel feedstocks sourced from a region where deforestation emissions remained below the baseline established as part of the jurisdictional-scale REDD+ program (described in section 4.4.3). This would provide a safeguard against perversely incentivizing biofuels/biomass that are directly driving deforestation. In addition, the government should monitor the production of major crops across the region to ensure that biofuel/biomass production was not displacing agricultural commodity production and creating a high "leakage" risk.

The following sources of biomass or biofuel might be eligible for a *partial* credit, producing a lower emissions obligation relative to consideration of the combustion emissions alone:

1. Biomass/biofuel feedstocks sourced from a region where deforestation emissions were above the jurisdictional baseline (e.g. at the level of a department) if and only if there were additional certification to demonstrate these feedstocks came from *new* palm oil plantations on land cleared prior to a certain date or growing other new biomass crops (e.g. short-rotation woody crops on degraded lands) that were reducing emissions even if the entire region is not performing. The amount of credit provided would account for the additional carbon being sequestered by the biomass/biofuel crops relative to the land cover being replaced. Feedstocks from existing oil palm or other bioenergy crops should *not* receive credits.

[6] Capture and combustion of biogas converts highly damaging methane into carbon dioxide.

4.4 Industrial processes and fugitive emissions from fossil fuel production

Much like the energy sector, industrial processes (e.g. cement, steel and aluminium manufacture) are commonly included in ETSs. Every ETS, except the RGGI ETS in the United States which only covers fossil fuel-based electricity generators, has included industrial processes. Industrial processes accounted for 4% of Colombia's GHG emissions in the 2010 national GHG inventory (IDEAM et. al. 2015b). Nonetheless, industrial emissions have been rising over the past decade. In absolute terms emissions from industrial processes and product use grew from 7.693 GT to 10.538GT between 2010 and 2014, according to Colombia´s second biennial update report (IDEAM et. al. 2018). Emissions from this sector are projected under a BAU scenario to continue rising as a percentage of Colombian emissions and in terms of the absolute quantity of emissions. In addition, direct emissions from the industrial sector include several gases with high global warming potentials, like hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Table 3 ETS Scope for industrial processes and fugitive emissions

What is included?	Timing of inclusion in the ETS	Point of Regulation
Industrial processes	Immediate	Industrial sites
Coal (fugitive emissions)	Immediate	Large coal mines
Producers of petroleum and its derivatives (fugitive emissions) and natural gas	Immediate	Large extractive sites and refineries

Recommendations for the point of regulation

The point of regulation for these sectors is downstream (at the point of emission) because this is where the emissions can be monitored or inferred. Emissions from industrial processes are often produced from the process itself and therefore, unlike fossil fuels, cannot be determined upstream. A capacity threshold will be applied to industrial facilities. This will delineate if a facility must comply with the ETS. The use of a threshold will reduce the administrative costs associated with regulating small facilities in this sector.

4.4.1 Waste

To date, only the Korean and New Zealand ETS have included the waste sector. Our proposed model for an ETS in Colombia does include the waste sector, because it is an important source of emissions. According to Colombia´s second biennial update report, about 6% of GHG emissions in Colombia in 2014 (and 2010) were from waste. Of this, 45% (or 2.7% of total 2014 GHG emissions) was due to solid waste disposed of in managed and non-managed landfills (IDEAM et.

al. 2018). Emissions from waste are expected to rise under the BAU scenario, both in terms of their absolute quantity and as a percentage of total GHG emissions

Table 4 ETS scope for the waste sector

What is included?	Timing of inclusion in the ETS	Point of Regulations
Waste sector (solid waste)	Immediately	Downstream – landfills (including a threshold to exclude small landfills)

Recommendations on the point of regulation

The point of regulation proposed for the waste sector are landfills as this is the only point where emissions can be monitored. Emissions should be calculated for the stock of waste based on landfill technology – not the flow of materials into the landfill. This provides correct incentives to reduce both the quantity of new waste and the emissions from the stockpile of existing waste – e.g. installing technology to capture and use or flare gas. A threshold will need to be set high to avoid regulating very small landfills and hence minimise the risk of illegal dumping. Ideally, the waste sector will be included from the outset of the ETS.

4.4.2 Agriculture

Biological emissions from agriculture (methane and nitrous oxide) have not commonly been included in ETSs because there are some unique challenges, particularly relating to cost effective monitoring and potential impacts on small farmers, when including this sector. Biological emissions from agriculture have been included in the design of the New Zealand ETS, but this aspect is not currently operational.[7] Nonetheless, given the important role of agriculture in Colombia´s emissions profile and hence in meeting its national climate goals, we recommend including the agriculture sector in the ETS. Agriculture, forestry and land use (AFOLU) emissions in total accounted for 58% of Colombia's emissions in 2010 (Government of Colombia 2015). Excluding emissions from land use change (and energy use in agriculture), biological emissions from agriculture accounted for about 17% respectively of GHG emissions in Colombia in 2010 (IDEAM et. al. 2015b). Providing cost-effective price signals for agriculture in the ETS will require multiple points of regulation. Below we describe how the agriculture sector could potentially be included in an ETS in Colombia. We think of the three options presented as a package of programmes to be used in combination with one another to support the agricultural sector in reducing emissions. A package of programmes will be able to incentivize different aspects of the reduction of emissions and will be able to support farmers better in doing so in comparison to any single programme alone.

[7] This is under active consideration in 2019 with New Zealand's interim Climate Change Commission producing a major report on 30 April.

Table 5. ETS scope for the agriculture sector

Programmes	Timing of inclusion in the ETS	Points of Regulation
Livestock	Immediately	Slaughter houses
Voluntary Offset Programme	As early as possible	Landowners
Jurisdictional Programme	As early as possible	Jurisdictional (Regional)

Recommendations for the points of regulation

Because there is no one point at which emissions can be accurately measured, verified and effectively regulated, we propose three points of regulation simultaneously. The level of incentive at each of these points would need to be adjusted to avoid providing an excessive incentive (double counting). For example, at each of two points of regulation relating to the same source of emissions (e.g. cattle), entities could receive or need to surrender only one half an allowance for every tonne of emissions.

Livestock - Livestock, more specifically cattle, produced methane and nitrous oxide emissions equivalent to about 17% of total GHG emissions in 2010, and are therefore important for inclusion in the scope of an ETS (IDEAM et. al. 2015b).[8] The point of regulation for livestock would be at the slaughterhouse where the emissions associated with the lifetime of the animal would be assessed and allowances surrendered. The number of slaughterhouses is not too large, and the emissions cost is a small percentage of the value of the animal. In order to assess emissions in a cost effective and practical manner, we recommend calculating the average emissions factor per animal using look-up tables of emissions factors. Emissions factors could be estimated at the national or regional level. The emissions factor applied to each animal will vary based on the age range, species, and breed of the animal. The age range of each animal can be estimated at the slaughterhouse. The age distribution assessed at the slaughter houses can be verified at a regional level with animal age data collected through the livestock vaccination program. The slaughterhouse would likely pass the cost of allowances back to the owner of the animal (e.g. through a reduction in the price paid for the animal) or on to consumers.

All else equal, older animals have produced more emissions over the course of their lifespan. Since the emissions factors will be based on the age of the animals, the proposed system provides incentives to improve emissions efficiency by increasing production of meat per year of animal life. For example, this could be done by reducing the time it takes to get an animal ready for slaughter. Such efficiency improvements can be achieved through better pasture, better genetic quality of animals and better management. With an emissions price paid

[8] These include both enteric methane and the share of direct and indirect nitrous oxide emissions that come from livestock (88%) (IDEAM et. al. 2015b). These data are from the first Colombian National Inventory, published in 2015.

at the slaughterhouses, it should create a comparative price advantage for producers who can supply animals with lower emissions per ton of beef.

By creating an economic incentive for efficiency improvements, the emissions price could thus lead to more beef production with the same number of animals and/or over a shorter amount of time. Where more profitable alternatives to beef production exist it could encourage land-use change, for example toward horticulture or reforestation. The emissions price could potentially have a small impact on the price of beef (and other ruminant meat – e.g. lamb, venison, goat) which could have a modest impact on beef consumption and potentially an increase in consumption of products from non-ruminant animals. Non-ruminant animal production – e.g. chickens and pigs – produce relatively few greenhouse gas emissions than cattle per unit of meat.

To reduce the economic impact on the sector, the government could also use free allocation or support efficiency improvements in the sector via other government programs, potentially funded with revenues derived from the ETS allowance auction. To the extent that improving the productivity of cattle ranching on existing pasture land is also part of a strategy to reduce pressure on deforestation, these activities could also be supported as part of the forest crediting programs discussed in the forests section of this chapter.

Voluntary offset programme - An ETS could also include a voluntary offset programme in which emission reduction credits are given for mitigation actions that are undertaken in the livestock sector. This could evolve from the existing system for offsets that can be used instead of paying the carbon tax. Voluntary offsets could provide direct incentives to landowners to lower the emissions intensity of their livestock production in ways that would not be fully incentivized by the charge at the slaughterhouse. For example, voluntary offsets could reward activities to sequester carbon in soil or trees (e.g. as part of silvo-pastoral or agroforestry systems). It could also target innovative actions that will have benefits for learning within the sector. Focusing on mitigation actions that are not common also reduces issues around additionality (see below). Land users would need to be recognized, and potentially legally registered, as owners of the land in order to participate and receive payments. Examples of mitigation actions that could be included in the programme include improving pastures (which could be monitored via satellite), transition out of livestock to horticulture (which is likely to be permanent once successfully achieved on land where horticulture is a more profitable use), and silvo-pastoral systems, where existing offsets systems operate. Payments could be a combination of up-front credits when the investment is made and maintenance payments to encourage the activity to continue.

If there is a jurisdictional agricultural emissions program active in the same region (see below), offsets granted to individual land owners could be deducted from the jurisdictional emissions budget (implied by the crediting baseline). This would avoid non-additional credits

entering the ETS. In this situation, the regional body that participates in the jurisdictional programme would also need to be involved in the offsets programme. With no jurisdictional program, an alternative way to avoid adding non-additional offsets into the ETS would be to focus on activities that are not common. If few reductions were expected from a given activity under BAU but a large number of offsets are generated from that activity, you can be more confident that the units generated are additional. These options would both avoid the need for a costly and largely ineffective additionality test for each offset at the farm level, keeping administrative costs low and reducing the scope for manipulation.

Jurisdictional programme – Some strategies to reduce livestock emissions might require action at a regional (e.g. departmental) level. Training programmes for farmers, development of supply chains for horticultural crops, improved breeding stock for animals and support for improved pasture might all be most effectively facilitated by regional bodies, in collaboration with the national government. A jurisdictional programme could provide funding that would support these activities. This jurisdictional programme could be effectively run at the regional level because we understand that relatively few animals are moved between regions because of high costs; this would minimise cross-regional leakage from the programme. It would work by setting a baseline (or budget) for projected emissions from livestock (animals * local animal emission factor; or production * local per kilo emissions factor). Animal numbers (or production- whichever is more reliable) would be monitored and the local emissions factors regularly re-estimated. Emissions reduction credits would be given to regions that can demonstrate a level of agricultural emissions below the agreed crediting baseline. The regions could sell these credits in the ETS market. This would provide the regional authority involved with an incentive to use their local decision-making power and resources to facilitate emission reductions.

Nitrous oxide emissions from nitrogen fertiliser could be feasibly included in an ETS by regulating emissions and requiring surrender of allowances upstream at the level of nitrogen fertiliser manufacturers and importers. However, because fertiliser is most heavily used in the horticultural sector which generally has low emissions and produces food consumed by poorer people and hence is a sector we would like to encourage to grow, we suggest that this small source of emissions for Colombia be excluded for now.

4.4.3 Forests

Forests have not typically been directly included in emissions trading systems because their inclusion can be administratively more complex. New Zealand has the only ETS that has included forests as a regulated sector (i.e. required to surrender allowances to cover any emissions), while other ETSs have included forests only as a potential source of offsets. However, the Colombian forestry sector is a significant source of emissions and we recommend its inclusion in

a partial manner, with a mix of mandatory and voluntary components. Colombia´s second biennial update report showed that land-use change accounted for approximately 36% of Colombia's total emissions and 66% of AFOLU sector emissions in 2014 (IDEAM et. al. 2018). Our proposed model builds on existing forest-related climate initiatives in Colombia. It incentivizes avoided deforestation and reforestation and covers emissions from large institutions or actors carrying out large land developments that create deforestation.

Table 6 ETS scope for the forestry sector

What is included?	Timing of inclusion in the ETS	Point of Regulation
Deforestation	As early as possible with international support (can build on existing Visión Amazonía initiative[9])	a. Department-level jurisdictional crediting programme b. Large institutions or actors carrying out large land developments that involve deforestation.
Reforestation	As early as possible with international support	Department level jurisdictional crediting programme; and Offsets for individual landowners[10]

Avoided Deforestation: The point of regulation for a jurisdictional deforestation programme would be at the departmental level. The jurisdictional programme would generate emission reduction credits for the jurisdiction to the extent that deforestation was less than an agreed crediting baseline within the department. This would, at least initially, be voluntary. Thus, there would not be requirements for the jurisdiction to buy allowances if emissions exceeded the baseline, but there could be other disincentives, such as lower access to agricultural credit lines. This crediting baseline should be set below a conservative estimate of what deforestation would be in the case of no jurisdictional program. The department could sell the emissions reduction credits that it generates in the ETS market.

For this programme to contribute effectively to achievement of the NDC, either the crediting baseline must be credibly below business as usual (BAU), by the amount the sector is expected to contribute towards the NDC, and/or the ETS cap should be reduced to account for generous allocation to this sector. This is because if offset credits are generated by the forest sector, without a corresponding tightening of the cap, this will allow emissions under the sectors covered by the ETS to rise by increasing the supply of valid emissions units. This programme would take advantage of existing efforts in Colombia to establish jurisdictional-scale

[9] http://visionamazonia.minambiente.gov.co/
[10] Voluntary programmes (e.g. BanCO2) already exist. Forestry units can be used to offset the carbon tax.

programmes for Reducing Emissions from Deforestation and forest Degradation (REDD+) under the REDD+ Early Movers (REM) and Forest Carbon Partnership Facility (FCPF) programs.

The department could use the funding generated by selling its credits to support further deforestation prevention, other GHG reduction measures, or other public programmes such as education or health. The jurisdiction could also choose to establish a "nested" system in which credits for reductions verified at the jurisdictional level would be allocated to private actors, indigenous communities, local governments, and other possible stakeholders based on actions to provide reductions in deforestation and forest degradation within the jurisdiction.[11]

Deforestation: The second point of regulation would be large entities carrying out large land development projects that involve deforestation. These companies would be fully liable for carbon emissions that they produce through deforestation and they will be required to surrender allowances to the government to cover their emissions. If there is a successful jurisdictional deforestation agreement, where the jurisdictional entity is receiving credits (i.e. deforestation is below the crediting baseline), these allowances could be surrendered instead to the jurisdiction. Alternatively, this legal, and paid for, deforestation could be added onto the jurisdictional deforestation baseline. Legal deforestation in Colombia occurs in two ways: i) through an environmental licensing process for individuals or companies or public entities or ii) the subtraction of forest reserves (by public entities for infrastructure or land programs). Actors or institutions that would be liable for carbon emissions produced in Colombia are those undertaking these processes.

Reforestation: Reforestation efforts could be accounted for in an ETS through two points of regulation:

1. Jurisdictional crediting programme for departments; and
2. Offset credits for individual landowners.

The reason to include both points of regulation is that both jurisdictional governments and individual landowners influence reforestation. Establishing a forestry industry requires infrastructure and coordination as well as actions on specific pieces of land.

A jurisdictional reforestation emission reduction crediting programme at the department level would operate very similarly to the jurisdictional avoided deforestation programme and could potentially be administered jointly. Offsets are generated by levels of reforestation above an agreed departmental-level crediting baseline. The emission reduction credits allocated for measured additional carbon sequestration could be shared directly with large landowners

[11] Methodologies for such jurisdictional "nested" programs include, for example, the Verified Carbon Standard's Jurisdictional and Nested REDD+ (JNR) Standard, described here: http://database.v-c-s.org/JNR..

participating in a voluntary offset system, e.g. they could get half the credits (or half the value of the credits) each. For reforested land where credits were not claimed, the department could receive full credits. The jurisdictional program would need to establish a "buffer" or reserve of credits to guard against possible liability for future carbon losses and/or could operate via an annual rental system, as described below in relation to individual landowners.

Rather than allocating credits directly to landowners, the jurisdiction could also "rent" carbon sequestered each year from smaller landowners through a simplified payment program that would reduce the costs of transacting with smaller landowners. Such a program would work as follows:

1. Create a baseline map of forests and cleared land in a baseline year

   A second map of land could define land where, for ecological reasons, reforestation is not considered appropriate. Land that is cleared in the first map, and not identified as ecologically sensitive in the second, would be eligible for reforestation credits.
2. Encourage landowners to opt into the programme (register) by identifying the location of their land, establishing that they have the right to control it (either legal title or locally-agreed use rights) and providing their bank account details.
3. Create a new map of forest cover in each period (e.g. a year) when new remote sensing data is available (i.e., from satellite, airplane and/or aerial drone). The regulator can identify reforestation by comparing maps, infer the age of forest on each land block registered in the system and estimate the carbon stock eligible for payment based on look-up tables for the region and forest type.
4. Provide payment of the rental value of credits for the estimated stock of carbon on their land to registered landowners through a direct payment to their bank account. They could also receive a notification that thanks them for restoring and protecting forest, points out that they have been paid and encouraging them to continue to protect the forest – and receive increasing payments over time. They are paid for maintaining the forest for a given period with no commitment to continue to maintain it.[12] The more carbon their land stores, the higher their rental payment.

This approach involves minimal transaction, monitoring and compliance costs. These costs have been one of the major barriers to effective offset systems. The use of rental payments avoids the need to impose liability for carbon losses in the event of future deforestation or harvesting (plantations for example) and provides incentives to continue to protect forest. If forest was cleared, the remote sensing would see this and there would simply be no further

[12] The value of rental is driven by the difference between the interest rate implied by the forward price for carbon and the commercial rate of return available to the credit purchaser (or their cost of capital). The purchaser can simultaneously purchase a forward contract and agree to pay to rent units until those units are delivered. For illustration only, the interest rate implied by forward contracts in the New Zealand ETS in 2018 is around 4%. A purchaser in that market with a return on capital of 9% (common among foresters) would be willing to pay around 4.5% of the current unit price in rental so as to be indifferent between buying and holding a unit and renting a unit then buying a unit at the end of the same time period. The actual rental price would be set by the market.

payments. This programme could apply to both plantation and natural forests on land that was already cleared in a monitored baseline year. This programme also has the potential to be a focus for international finance and assistance.

5 International linking

5.1 Options for linking the Colombian ETS internationally

The Paris Agreement (Article 6.2) offers the opportunity for Colombia to overachieve its Nationally Determined Contribution and transfer additional mitigation to other countries in return for financial support.[13] An emissions trading system can support this either directly through linking, or indirectly by providing greater assurance that the future target will be met so that reductions and financial resources can be transferred between Colombia and international buyers.

Linking occurs when one cap-and-trade system accepts units generated under another system as valid for compliance within its program and potentially vice versa. Linking has various economic and political/strategic advantages and disadvantages). It can be one-way (i.e. buy-only or sell-only), two-way (buy and sell), and can also be partial (with quotas limiting trading for example). It can potentially be a way for Colombia to benefit economically via greater foreign investment, to increase its mitigation ambition, and to exercise international climate leadership but needs to be done carefully to balance the possible disadvantages, including losing domestic control over prices and importing volatility from abroad.

Under either a direct or indirect approach to linking Colombia would expect to be a 'seller' in the near and medium term. This means that it could receive funding for reductions that, at a minimum, go beyond NDC achievement. Trades must always be under a framework determined by the Colombian Government, and in the short term would likely be negotiated directly by the government (or smaller jurisdictions in the case of REDD+). Over the longer term, transfers could occur at the level of private entities in Colombia if the international markets are sufficiently mature and domestic climate policy enables them. Over the longer term, Colombia could become a buyer of units and could even pursue establishing a fuller buy/sell link with other markets. The ability to buy would be particularly important in the context of a gradual tightening of Colombia's domestic NDC.

Our working model proposes that Colombia develop a high credibility domestic ETS aligned with emerging best practices to achieve reductions, enable near term opportunities to receive international funding for additional mitigation, and maintain options for full bilateral (buy and sell) linkage with likely linkage partners over the longer term. We recommend that a

[13] Similarly the ICAO agreement means that airlines will need to buy high quality emission reduction units. A strong ETS would make it easier for Colombia to provide these.

potential ETS in Colombia is not immediately linked in a way that would permit allowances to be transferred directly between the Colombian ETS and another ETS. Developing a strong domestic program first, before considering full linking, would allow Colombia autonomy over the near term with respect to the design of the ETS and control over local prices. In addition, no potential 'buyer' ETS currently in place can offer sufficient scale or stability of demand, although important opportunities are emerging as discussed further below.

We suggest that Colombia pursue opportunities to sell a limited amount of credits relative to a national or, for a limited time, potentially jurisdictional crediting baseline. This could be for emissions from all sectors or at the sectoral level, particularly from Reducing Emissions from Deforestation and forest Degradation and reforestation (REDD+), in line with decisions under the UNFCCC, including the Warsaw Framework for REDD+ agreed in 2013. In the short term, Colombia could take advantage of existing initiatives that are underway such as the REDD+ Early Movers (REM) and Forest Carbon Partnership Facility (FCPF) programs. We also propose that Colombia immediately begin conversations over emerging opportunities to sell such reductions relative to jurisdictional or national crediting baseline over the near and medium terms. These opportunities include: 1) The Carbon Offset and Reduction Scheme for International Aviation (CORSIA) agreed on October 6 by the International Civil Aviation Organization (ICAO); 2) Growing interest from countries, including New Zealand and South Korea, to finance mitigation overseas as a way to help meet their NDCs; and 3) Potential to sell credits (and eventually to potentially link bilaterally) to emerging markets such as California-Quebec and South Korea, which are starting to consider international jurisdictional offsets and other linkage opportunities. Regional initiatives such as the cooperation agreed in the Declaration on Carbon Pricing in the Americas (to which Colombia is a signatory) will also help lay the groundwork for effective engagement with international carbon markets in the future.[14]

Specific recommendations

Establishing a strong domestic emissions trading system will support a credible and attractive agreement with buyers. In the context of the Paris Agreement, it will also be important to ensure "no double counting" of "mitigation outcomes." Any emission reductions can be counted towards only one international commitment – or equivalently, the sum of emissions across the group of trading countries must be less than the sum of emissions allowed under their collective NDCs (as well as commitments in international transportation sectors, which fall outside of national commitments). Thus, Colombia needs to make sure that any trade or linkage is designed so that it brings finance to ensure the NDC can be met and exceeded (with only excess mitigation being what is traded), rather than risking non-compliance with the domestic commitment.

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14 https://www.ieta.org/resources/News/Press_Releases/2017/Declaration%20on%20Carbon%20Pricing_FINAL.pdf

- The ETS should cover a high level of emissions to make over-achievement of NDC, and hence ability to transfer reductions abroad, credible.
- The ETS should have a binding trajectory of caps consistent with over-achievement of NDC once the system is fully operational. This will allow the ETS to meet the NDC and to produce excess reductions that can be sold by the government. If in the future, there is a direct market linkage of the ETS, market actors might directly sell credits, automatically tightening the cap and stimulating greater ambition via increased prices.
- The ETS will require a strong, credible MRV regime, linked to a strong National Inventory, both recognised as such by international buyers and the wider international community.
- A clear system for registering and accounting for international transactions so they can be reflected in the reports on the National Inventory to ensure no double counting.

In the short term, even before a full ETS is operating within Colombia, we envision that Colombia could negotiate a sell-only link to international markets via the high-quality jurisdictional (and nested) scale crediting programs for reducing deforestation, forest degradation, reforestation and agricultural emissions reductions, that we propose be created for the Colombian ETS. These programmes would need to operate with sufficiently strict crediting baselines to ensure high integrity units and appropriate contribution of these sector(s) to achieving the domestic NDC for international credibility, acceptable sharing of gains from Colombian over-compliance and to balance the benefits of international sales with the value of using those units for domestic NDC compliance. Colombia might also balance selling some credits over the coming years to receive near term financing with maximizing longer term value by waiting to sell credits later when international carbon prices may be higher.

Credits from these jurisdictional and nested programs could also be sold within Colombia's domestic ETS. Credits will of course be sold into the market that offers the best price. If credits are sold internationally the ETS cap will become more stringent and push up the domestic price. To manage this, and the price uncertainty that could arise from unpredictable volumes of credit supply into a relatively small market, the crediting baseline for the international market could be set more stringently than for the domestic market. Then if the international market price is higher than the domestic one, only a fraction of the credits will be used domestically (those that are not internationally valid). Expensive reductions over and beyond what is needed to achieve the NDC will be financed internationally. If the international price is lower than the domestic price (or there is no international demand), then all credits will be used domestically.

In the context of ICAO, Colombia could also consider opting-in to the ICAO market-based measure for the first pilot phase starting in 2021 to demonstrate leadership, begin developing

the infrastructure for international markets, and create additional demand for Colombia REDD+ units from flights traveling in and out of Colombia.

We also recommend that Colombia engage with other jurisdictions on the development of international market rules within the UNFCCC and ICAO as well as a possible smaller coalition of potential jurisdictions interested in markets (who may form 'clubs) in the Americas (e.g. US, Canada, Mexico, Chile, etc.) including the possibility of joining WCI as an observer, as well as outside (e.g. New Zealand, South Korea). This will allow Colombia to play an active role in shaping the market rules and also ensure close alignment of its system with the requirements of potential buyers and other linkage partners. These types of international dialogues can also be helpful in terms of information sharing and providing international recognition that can help increase domestic support.

Colombia can also explore a mechanism to receive funding for transfers of mitigation outcomes that does not require ETS linkage. Colombia could be part of a climate 'team' (www.climateteams.org). A team would work by several 'buyers' working with one 'seller'. The group would agree in advance, and commit to, pricing terms and volumes up to which buyers will definitely purchase, for an initial time period, and the rules and processes for extending the agreement. The team would also negotiate a credible crediting baseline well below BAU that is consistent with the NDC for the country. After emissions are monitored, reductions beyond the crediting baseline would be paid for. The buyers could also, if desired by Colombia, contribute technical support and possibly investment capital, thus working in close collaboration to reduce Colombia's emissions. This structure reduces investment risks for both Colombia and the buyers with whom it works. The climate 'team' could occur independently or within climate clubs.

6 Setting the cap

In this section, we explore guidelines for setting a cap on an ETS in Colombia. First, we briefly summarize the main considerations to take into account when setting the cap. Then we present our working model.

6.1 Choices when setting a ETS cap

Two overarching questions must be addressed when setting a cap: 1) what is the extent of emissions reductions that the ETS seeks to achieve, and 2) will the cap be an absolute or an intensity-based cap. Setting an ETS cap is synonymous with deciding the system´s level of ambition with respect to emissions reduction. A more ambitious cap, a tighter cap that allows less emissions, raises the likelihood of NDC achievement and sale of international units, but implies higher costs. An ideal cap balances this trade-off.

With respect to the second overarching question for cap design, an absolute cap is a fixed limit for emissions whilst an intensity-based cap creates an emissions limit in relation to GDP or

emissions per capita. There is less experience to date with intensity-based caps than with absolute caps. Intensity based caps can pose technical and administrative challenges and have different data requirements than an absolute cap. An absolute cap provides certainty relating to the quantity of emissions and hence progress toward an NDC that, in Colombia's case, is defined in absolute terms. An intensity-based cap provides certainty about the decline in emissions intensity of the economy. Neither is automatically more stringent than the other. Both intensity-based and absolute caps can be designed to accommodate a projected growth in activity and emissions.

This report does not aim to quantitatively propose a cap for a Colombian ETS. This choice is a political decision. Also, the decision on the cap should take into account other design parameters of the ETS, such as scope, temporal flexibility, price control, and linking. Instead we provide guidelines for how the cap can be structured and managed.

6.2 Proposed design of a cap for an ETS in Colombia

6.2.1 Absolute or intensity-based cap?

We recommend setting an absolute cap for the Colombian ETS. First, an absolute cap is simpler to administer – the number of units available to allocate in the ETS is completely predictable. Second, currently the vast majority of ETSs are based on an absolute cap. This makes an absolute cap advantageous because it will be more easily understood internationally. Third, an absolute cap gives greater confidence that Colombia is on track to achieve its NDC. This reduces the risk to Colombia and may facilitate access to international funding for mitigation.

6.2.2 Setting the cap

The cap should be set so that the predicted carbon price is at an acceptable level and so that the ETS will achieve emissions reductions that put the capped sectors on track for Colombia to achieve (or exceed) its NDC, which may be adjusted to increase ambition over time. Setting the cap will also involve determining the percentage of reductions to meet the NDC for which capped and uncapped sectors should be responsible. For instance, it might be less costly for capped sectors to reduce their carbon emissions by 20% below BAU than uncapped sectors. This could be reflected in the ETS cap by making the cap tighter until the marginal abatement cost is predicted to be equal to that in the uncapped sectors. The EU ETS provides an example in which capped and uncapped sectors were responsible for reducing different percentages of their emissions.

> "To achieve the goal of reducing the region's emissions to a level of 14 percent below the 2005 emissions level (equivalent to 20 percent below the 1990 level), capped sectors needed to achieve a 21 percent reduction with respect to the 2005 level, and uncapped sectors needed to achieve a 10 percent reduction with respect to the 2005 level" (ICAP; PMR, 2016, pág. 49).

An alternative way to think of this is that if a sector is excluded from the ETS and managed separately, the cap should be reduced by the amount of emissions expected from the excluded sector. The level of emissions permitted within the set of capped sectors should be established upfront to give the market upfront information regarding the ETS.

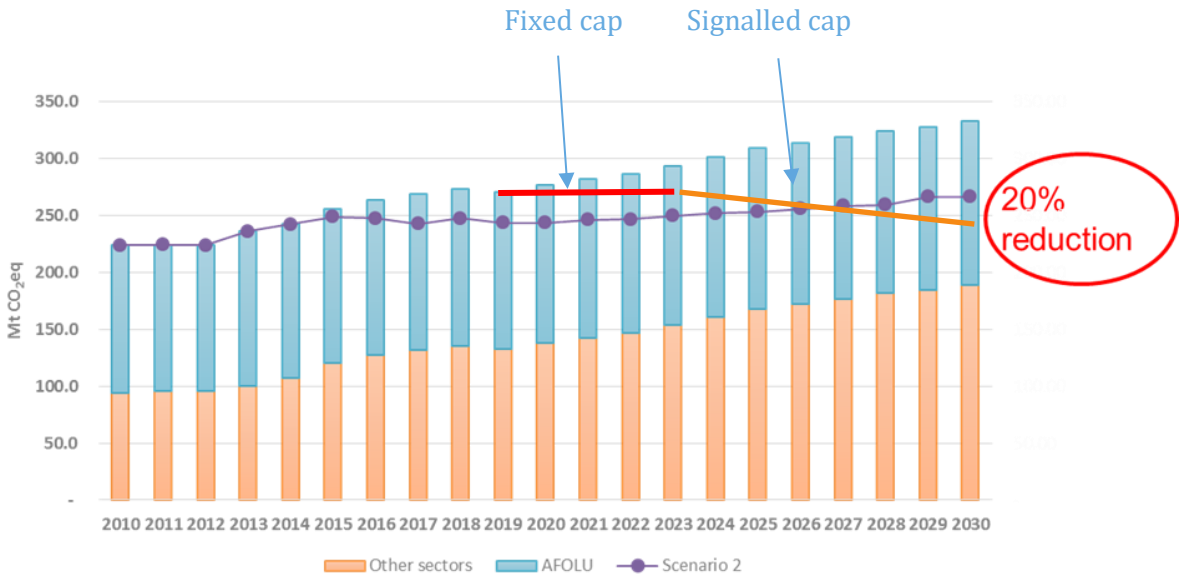
The level of ambition for the ETS can vary over time. We recommend taking the following steps to define the emissions cap over time.

1. Set the cap so that it exceeds expected emissions after mitigation in the early years but is constraining after a few years. Extra allowances in the early years allows a bank to build up which is useful for price management and liquidity (also known as banking).
2. Set a five-year (or longer) rolling cap, in combination with an indicative longer term trajectory. This would entail fixing the cap for five years, annually announcing the fifth year. For example, if the system was announced and implemented in 2018 the number of units would be announced for each year from 2018 – 2022. In 2019, the number of units for 2023 would be announced. The longer path – e.g. to 2030 could be signalled and an annual decline path could be set as a default, in the absence of further changes, but the cap for the later years could be changed. This would provide some longer-term signals while giving strong information about supply in the short term. Any surprises when the next cap (for five years out) was announced would be spread across the units firms expect to use over at least five years. For example, if the new cap is surprisingly stringent, firms might immediately bank extra units for later use and reduce emissions further than previously planned. This would cause prices to immediately rise.

Figure 7 illustrates the proposed parameters for the cap. The purple line shows a mitigation scenario developed as part of a Universidad de los Andes project scenario. It assumes an emissions price of US$20. The purple point in the year 2030 represents a 20% reduction in GHG emissions relative to BAU, which is Colombia´s NDC commitment. The red line is a possible cap for the first 5 years of the ETS. The cap for each year during this period is fixed and is stated when the ETS is established. The orange line represents a signalled or expected trajectory of caps for later years. In 2019, the 2023 cap would be announced. Suppose that we assume that government aims for a desired price of $20 in 2030 in order to achieve the NDC. This price will be determined not by the cap in any individual year but by the cumulative constraint to 2030 and beyond. In the illustration the cap is initially greater than the projected economy-wide emissions with a $20 price; this will allow companies to bank unused allowances. They can use these banked units in 2030 and beyond when the cap becomes more stringent than can be met with a $20 cost of mitigation per tonne (at least according to the modelling). It is important to note that it is likely that, at least initially, not all sectors and sources of emissions (particularly in

the AFOLU category) will be included in the ETS and the cap should reflect this. In this respect, the figure below is a simplification.

Figure 7: Potential emission reductions (US$20 price) and possible ETS cap trajectory



Note: Figure provided by Universidad de los Andes based on modelling documented in (Universidad de los Andes, 2016)

7 Allocation

In this section we describe how allowances could be introduced into the Colombian market for different sectors and when and how to determine the allocation method. We also provide a brief description of the four methods for allocating allowances and the objectives for allocation that may influence their selection.

7.1 Summary of allocation options and considerations for decision makers

Potential objectives for allocation:

1. Managing the transition to an ETS: policy makers may want to manage specific impacts of an ETS. One common impact that policy makers seek to address via allocation is the challenge associated with stranded assets. Stranded assets occur when a firm has made a decision, such as investing in emission-intensive long-lived capital, before an ETS was established. The introduction of an ETS can considerably affect the value of the asset. Policy makers may also want to incentivize the early reduction of emissions or protect consumers from increased electricity prices. Different allocation methods for different sectors can achieve these goals.
2. Reducing the risk of carbon leakage or loss of international competitiveness: these potential risks are undesirable environmentally, economically and politically.

3. Raising revenue: the sale of allowances in an auction provides an opportunity to raise revenue.
4. Preserving the incentives for cost-effective mitigation: policy makers must make sure that the ETS incentivizes cost effective mitigation.

Methods for allocation:

1. Auctioning: Auctioning allowances is both simple and efficient and can reward early reductions as well as manage some distribution effects for consumers. However, auctioning does not in itself protect against leakage or compensate for stranded assets (although revenues from auctions can be directed for these purposes).
2. Free allocation using the grandparenting approach: this approach gives free allowances based on actual or historical emissions. The emissions basis for grandparenting should not be updated as the ETS progresses or mitigation incentives will be distorted. A limited period with grand-parented allowances can be an effective method for compensating industries that have stranded assets. However, there may be challenges with regards to data availability. Also, the level of compensation may not relate closely to the level of stranded assets and it penalizes early action, both of which may be perceived as unfair. Additionally, there is a potential for windfall profits from this method of allocation and it is not very good at protecting against leakage. Any form of free allocation, whether based on grandparenting, or other approaches (fixed-sector benchmarking or OBA) described below, imposes a fiscal cost because allowances could instead have been auctioned.
3. Fixed sector benchmarking with infrequent updating: in this approach firms receive free allowances based on a product or sector level benchmark for emissions intensity rather than on firm-level historical emissions. This results in firms receiving allowances = sector or product benchmark x firm's historic output. This approach incentivizes early action and maintains mitigation incentives. Disadvantages to this method include difficulty in calculating the benchmarks; potential for windfall profits; mixed results for protecting against carbon leakage; potential distortion of price signals; and requiring highly emission-intensive firms to purchase units from the outset of the ETS which can make for a more difficult transition.
4. Free allocation using output-based allocation (OBA) with annual updating: OBA are calculated by multiplying the firm's current output by a pre-determined benchmark. In this sense, OBA is different from fixed sector benchmarking because a firm will receive less (more) allocations, with a slight lag, if their output decreases (increases). The advantage of OBA is that it is very good at targeting carbon leakage and maintains mitigation incentives whilst its disadvantages include that it may weaken demand side mitigation (because it inhibits the pass-through of emission prices to consumers) and

that benchmarks must be calculated and output monitored. OBA can be used to protect final consumers from politically unacceptable price rises.

7.2 Model for allocation in a Colombian ETS

We recommend that a potential ETS in Colombia primarily allocates allowances by auctioning them. This will allow the state to raise revenue, and it is also a simple and effective method to enable those who value allowances the most to access them. In addition, it alleviates any market power concern in allowance market. This might be a concern if some large entities were allocated a large share of free allowances. With the government as the main seller, no regulated entity will be able to restrict the supply of allowances to raise prices.

We recommend that the energy sector be required to buy all of their allowances through auctions (or the secondary market). Prices can be passed through to final users in these sectors, which creates the incentive to reduce emissions, and there is also no concern over international leakage; therefore, there is no need to provide free allocation to this sector.

As stated above nonetheless there are reasons why free allowances can be distributed within an ETS. Below we discuss examples for which some amount of free allocation may be beneficial**.**

Intensive trade exposed sectors: A limited set of 'at-risk' activities are defined as emissions intensive trade exposed (EITE) and, a subset of these are identified as activities that Colombia may want to protect and expand. These sectors would receive output-based allocations, meaning that they would be given free allowances based on production. For each activity where free allocation is deemed necessary or beneficial, an emissions factor would be defined per unit of output. Based on the monitored at-risk activity (e.g. tonnes of clinker production) by each EITE firm in each year, the firm would receive free allowances equal to the Emissions Factor (EF) times the activity level. The EF would decline over time in a predictable way. Providing free allocations to EITE activities will protect against excessive (international) competitive impacts and leakage in some key sectors. Because of foregone government revenues from auctions, this free allocation is costly to the government and the economy, so we would recommend that this form of allocation does not continue indefinitely. Decreasing OBA free allocations will involve a gradual reduction of the EF with the EF ultimately being reduced to zero. It is worth noting that the companies that receive output-based allocation might not necessarily be the points of obligation. For example, an EITE company that is a large user of electricity may receive some free allowances that it can sell in the ETS market. However, based on our proposed upstream point of regulations for energy, this company would not be required to surrender allowances for the GHG emissions related to electricity consumption because those emissions are regulated upstream.

Stranded assets, or assets that were purchased before the cost of emissions could be anticipated and that are much less valuable with an ETS because their operating costs are now high, could be politically chosen to initially receive compensation under the ETS. This compensation would be provided in the form of a fixed amount of allowances determined by grandparenting or a fixed-sector benchmark and distributed over several years. The free allocations would stop once the chosen level of compensation has been completed. The number of free allowances would be fixed because all future assets should be purchased considering the price of emitting GHG emissions under the ETS. Stranded assets will also depreciate with time and eventually be replaced.

Some small sources that are points of obligation may initially receive some free allowances as a way to reduce compliance issues and ease their transition into the market.

Other actors will receive allowances on the basis of removals or offsets – e.g. forestry, removal activities, or agricultural offsets, as discussed above.

When designing the ETS, studies should be undertaken to identify potential impacts on vulnerable populations. These studies are beyond the scope of this work; however they are important because better understanding impacts on vulnerable populations will allow a package of support to be established to protect them. This could involve adjustments in other social support, tax cuts or improved services (e.g. education, health, public transport or subsidies for low emission electricity). Credits would be given for previously approved emission reduction projects as they are generated through their lifetime.

8 Temporal flexibility and price control

In this section we describe measures to increase the temporal flexibility and recommendations regarding price controls in a potential ETS in Colombia. We start by summarizing the benefits of measures to provide temporal flexibility and price predictability. As with all of the other sections in this report, for a more detailed analysis and explanation of the components and design of an ETS please see *Emissions Trading in Practice: A Handbook on Design and Implementation.*

8.1 Summary of measures for temporal flexibility and price predictability

Temporal flexibility can increase the cost-effectiveness of an ETS. The annual compliance periods may not be conducive to the timeframe required for implementing the most effective mitigation measures. Similarly, temporal flexibility may better encourage the use of renewable energy or new technologies because of the time involved in research and development. Additionally, temporal flexibility can decrease price volatility. Temporal flexibility is typically implemented by a banking system, though it can also involve borrowing.

Certain price control measures may be desirable in an ETS. These will both ensure that the carbon price does not fall too low or rise too dramatically.

8.2 Model for addressing temporal flexibility and price predictability in a Colombian ETS

There are certain mechanisms that can help control the price of allowances either through temporary flexibility mechanisms or price control. The recommendations that aim to maintain an average price in the ETS are described below.

8.2.1 Banking

Because of the benefits of temporal flexibility, we recommend that the Colombian ETS includes banking, allowing ETS participants to bank extra allowances that they have purchased in one year and use those allowances in another, later year. As stated in section 7, we recommend that initially, the ETS issues allowances that are greater than that year´s expected emissions after mitigation for the sectors included so that firms will bank excess allowances from the start. This would provide liquidity and smooth prices. Nonetheless, a significant oversupply of allowances through excessive allocation should be avoided.

Emissions price volatility and uncertainty can create high levels of risk and excessive investment uncertainty that deters low emission investments. We recommend directly addressing the underlying causes of volatility and excessive uncertainty. To reduce unnecessary price volatility, we recommend building ETS market institutions, regulations and oversight to ensure well-functioning markets. This will reduce unnecessary price volatility. Additionally, it is important to build strong, politically stable governance for ETS to limit policy uncertainty, particularly regarding future caps, which leads to price uncertainty.

8.2.2 Price corridor

To provide greater predictability over prices, we recommend implementing a price corridor which means that the price of allowances must fall within a range, with a type of ceiling and floor limiting price fluctuations above and below the specified limits. We recommend that the ETS begins with a narrow price corridor and expand this range as the market develops and information improves. We recommend the use of existing tax levels as the basis for setting the price ceiling and price floor. This would be a way to integrate the ETS with the existing tax system.

As was previously mentioned, Colombia has already established a carbon tax upon the sale of fossil fuels. Colombia also has retributive fees (known as *tasas retributivas*) established in Law 99 of 1993. These fees seek to tax the use of air, water and soil for the deposit of different forms of waste. Studies have been conducted to explore the possibility of using such fees for GHGs as

well.[15] A mechanism based on these two taxes can be established to control allowance price volatility. This can be done in different ways. One of the proposed mechanisms includes the following elements:

1. The establishment of a floor price at allowance auctions (the primary market). The floor price can be fixed in the allowance auctions and made equal to the value of the carbon tax, for the corresponding year. In principle, this would prevent prices in secondary market from falling below this level, unless of course, auction allocations are too small relative to the allowances in secondary market. The price floor would be binding whenever the demand for allowances at the auction is a less than the total number of allowances available at the auction. This is equivalent to the government buying back some allowances to keep the allowance price from falling below the floor.
2. Regulated agents that directly pay the carbon tax (producers and importers of liquid fuels and natural gas) would surrender allowances for the emissions associated with these fuels (including fugitive emissions and those originated in chemical processes during refining). However, to avoid paying twice for the same emissions, as they surrender allowances these entities would receive a rebate for the carbon tax they have already paid.[16] The additional cost incurred by these regulated agents to comply with the ETS would likely be passed through to final consumers.
3. Besides using the carbon tax level as price floor in allowance auctions, we propose that the national government implement a high retributive fee for GHG emissions, as a mechanism to prevent allowance prices from rising to politically unsustainable levels. Regulated agents can choose whether to surrender allowances or pay this fee. In this way, the retributive fee will act as a price ceiling and reduce the possibility of regulated agents facing excessively high prices.
    - The rate could be set, and adjusted automatically, to always be significantly higher than the price that is anticipated in the market.
    - The retributive fee sets an upper limit for the allowance price, since it is cheaper to pay the fee than to buy allowances at any higher price.
    - Revenues from payment of the fee could be required to finance additional mitigation to make up for any increase in emissions. Such a requirement is tied to the price ceiling added to California's cap and trade program in 2017.
    - One advantage of the use of the retributive fee mechanism is that if this fee is not paid, and agents also do not surrender sufficient allowances, the non-compliance sanctions

[15] It would be based on the principle of taxing the use of the atmosphere for the "deposit" of GHGs.
[16] If the tax and allowance system can be closely integrated, the payment of tax, surrender of allowances and rebate would be simultaneous. The point of obligation would simply face the net cost (the higher of the tax and the allowance price) but the revenues collected might go to different entities. The tax revenues are currently dedicated to the Sustainable Colombia Fund, to support sustainable development and environmental protection as part of the peace process.

associated with the retributive fee would be triggered. This would provide a strong compliance sanction through existing legal mechanisms to support the ETS.

When the Emissions Trading System is consolidated and stabilized, the State could decide to eliminate the carbon tax, in the form that is currently defined, if it maintains a minimum auction price. This would simplify the system.

8.2.3 Cost containment reserve of allowances

An alternative method to avoid excessively high ETS prices is to establish an additional limited supply of allowances that would progressively enter the market as prices rose. This supply can be created by reserving a fixed amount of allowances still consistent with the cap. Different tranches of these allowances are automatically offered for agents to buy at fixed prices, significantly above the auction floor price. If the market price reaches these levels, it will become attractive for market participants to purchase reserve allowances, thus helping to contain prices from continuing to climb to even higher levels. This approach also provides a limited amount of flexibility to increase the supply of allowances and thus emissions in the event of higher prices, allowing some control over the acceptable levels of emissions at different prices. This model of a tiered cost containment "reserve" was adopted as part of California's as well the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade programs in the United States. In 2017, a price ceiling mechanism was also added to California's cap-and-trade program to provide added cost containment assurance beyond that provided by the allowance cost containment reserve.[17]

Another way to provide a long-term price support, is for the government to offer (put) options that would give agents the right to sell allowances back to the government at a fixed minimum price. Similarly, the government could offer (call) options that would give agents the right to buy allowances at a fixed maximum price, preventing prices from rising too high. The amount of these options and the dates upon which they would be valid would be limited to allow the government to control the amount by which the cap would be expanded in the event of high prices.[18]

Such price control mechanisms also provide an indication to the market that the government will limit the price of allowances from exceeding or falling below certain levels,

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[17] Under the 2017 extension of California's cap-and-trade program, the cap was significantly tightened and extended through 2030 and, as part of this process, an additional price ceiling was also introduced at a level above the highest tier of the cost containment reserve. This would allow the government to sell as many allowances as are demanded by the market at that price. However, revenues from these sales are required to be used to finance additional mitigation to make up for the increase in emissions permitted by this price ceiling.

[18] The ability to allow wider use of offsets when prices are too high can also be used as a price stabilizing mechanism. This last case was implemented in the RGGI where issuers could implement projects to acquire offsets to comply with the regulation if the price of the negotiable permit reached 7 USD/ton. A problem with this option is that this creates uncertainty in the offsets market and the possibility that the offsets market may not be large enough to prevent prices from reaching too high levels.

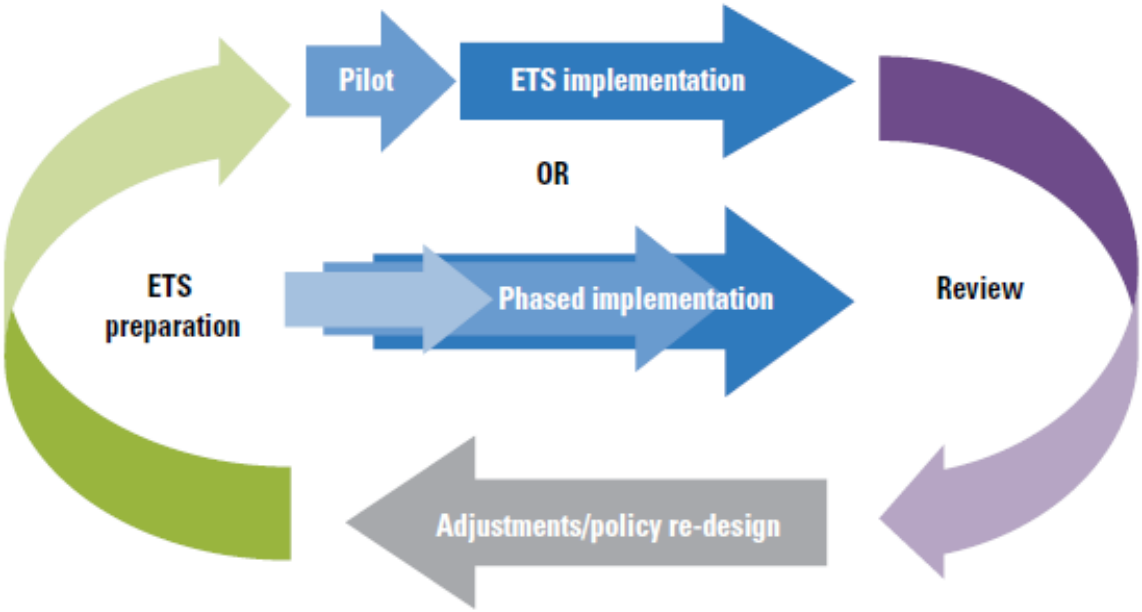
which are deemed too high or too low. This will enhance the credibility and predictability of future prices, helping regulated entities to better plan their investment and compliance decisions.

We recommend beginning with a narrow price corridor (between the floor and ceiling) and gradually relaxing this band over time so that the market can set the price of allowances. This provides price signals that communicate the expected stringency of regulation and cost of mitigation. These signals are useful for investors, for government policy makers and for international observers.

9 Evaluation and review

The initial stages of an ETS in Colombia will be a period of learning for all the actors involved. During this time these actors will not only learn how an ETS operates but also define their strategies going forward. As market conditions change, we expect an ETS to adjust accordingly. To facilitate this adjustment process, we recommend independent assessments, involving relevant parties from all sectors as well as experts. These assessments will help identify changes in external conditions such as economic shocks or the development of cheaper mitigation technologies, as well as changes in international policy which may change the level of ambition desired for the ETS; to incorporate lessons learned in the design of the ETS; to respond to any administrative issues; and to reflect any changes in energy or climate policy that have implications for ETS design. Figure 8 below provides a model for what an assessment process might look like for the Colombian ETS.

Figure 8 The ETS Policy Cycle



There are three types of reviews:

1. Comprehensive reviews that amend fundamental aspects of the ETS;
2. Regular reviews that amend administrative or technical aspects; and
3. Evaluations that support both comprehensive and regular reviews.

Regular reviews should be both scheduled and unscheduled. Unscheduled reviews can react to any urgent problem or address conflicting laws or laws that contain loopholes.

Appendix

Table 7 2010 Emissions and projections forward (2010 National inventory data University of the Andes)

Emissions and CAGRs		2010	2025	2030	2050	2010 - 2025	2010 - 2030	2030 - 2050	2010 – 2050
ENERGY	Power generation	10.42	13.42	18.27	32.70	1.70%	2.84%	2.95%	2.90%
	Refinery	4.11	8.16	8.16	8.16	4.68%	3.49%	0.00%	1.73%
	Coke	1.17	1.77	1.98	2.48	2.82%	2.69%	1.12%	1.90%
	Other energy industries	3.94	6.36	6.28	3.41	3.24%	2.36%	-3.01%	-0.36%
	Demand – Industry	10.92	21.12	23.02	32.71	4.49%	3.80%	1.77%	2.78%
	Demand – Transport	22.66	40.61	48.62	97.00	3.97%	3.89%	3.51%	3.70%
	Demand – Other sectors	8.23	18.19	20.85	30.83	5.43%	4.76%	1.98%	3.36%
	Fugitives	9.76	20.06	19.72	13.38	4.92%	3.58%	1.92%	0.79%
PROCESSES	Industrial processes	8.69	16.81	18.32	26.03	4.49%	3.80%	1.77%	2.78%
AFOLU	Agricultural	42.68	47.06	49.77	63.64	0.65%	0.77%	1.24%	1.00%
	FOLU	87.66	94.35	94.35	94.35	0.49%	0.37%	0.00%	0.18%
Waste	Waste	13.73	21.44	23.39	33.98	3.02%	2.70%	1.88%	2.29%
TOTAL	Total	223.97	309.33	332.73	438.68	2.18%	2.00%	1.39%	1.69%

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