EXECUTIVE SUMMARY

Colombia has a small carbon emissions profile relative to the rest of the globe. Yet it is committed to reducing these emissions.

This policy brief explores the possible social and economic implications of three different emissions reduction measures: placing a tax on carbon emissions; capping the allowable amount of emissions from different sectors; changing the country’s energy mix (either to include more renewables, or replacing fossil fuels with cleaner electricity). It also considers how these measures might change the emissions profile for the country.

Results show that a carbon tax of $50 can reduce Colombian energy-related emissions by 33% by 2045.

However it is clear from this study that there is no ‘free lunch’ because a carbon tax has a recessive effect on the economy. And yet, transferring the tax revenues collected by pricing carbon can slow this negative effect on the GDP. Meanwhile adoption of cleaner energy depends on the price of oil, and the timeframes associated with newer technologies becoming more affordable.

These findings will help by providing policy makers with valuable information about the associated impacts of implementing mitigation actions in certain sectors.
INTRODUCTION

In the global context, Colombia is a small emitter of greenhouse gases, most of which come from the agriculture sector (38%). Since the energy mix has a strong hydropower component, Colombia’s fossil fuel-related emissions are only 36.65%.

In spite of this modest emissions profile, Colombia has set out to identify and implement emission reduction measures. These efforts bring together private sector and government initiatives, along with collaborations with experts from universities and research centres.

Four strategies inform the country’s climate change and sustainable development responses: the National Adaptation Plan; the Low Carbon Development Strategy (CLCDS); the National Strategy for Emissions Reduction due to Deforestation and Forest Degradation; and, the Strategy for Financial Protection against Disasters.

Colombia is eager to understand the relationship between the economy and emissions reduction actions for the energy sector. Previous studies showed that imposing a carbon tax as a way of constraining carbon emissions will change the fossil fuel energy mix.

Two studies are being carried out now. One is looking to identify clean development paths for the country; another is looking at the potential impacts of climate change on the economy. Studies until now have focused on the carbon dioxide (CO2) mitigation potential and costs to sectors resulting from emission reduction actions.

This policy brief presents the findings of the most recent study, which joins both the above approaches by assessing the economic impacts of three different mitigation actions, as well as how they change the country’s emissions profile.

This study was conducted by researchers and modellers at the Universidad de los Andes, the Departamento Nacional de Planeación (DNP), and Unidad de Planeamiento Minero Energético (UPME).

CHARTING A COURSE TOWARDS A LOW-CARBON ECONOMY

The starting point

The ramifications, for both the economy and the country’s emissions profile, of three emission reduction measures were modelled, that is:

- placing a tax on carbon of $10, $20 and $50 per ton of CO2
- placing a cap on emissions
- changing the energy mix in two ways - either through introducing more renewable energy (installing cogeneration facilities, small hydro plants, geothermal plants and small wind farms), or of replacing fossil fuels in the industrial heat and steam processes with electricity produced from a greener energy supply mix.

The research team also compared what would happen if the revenue gained from this tax is ‘recycled’ back into the economy by transferring it to households, and if it is not. This works by giving money directly to a family, often in the form of a check.

The modelling considers the implications of these taxes in two possible international oil price scenarios: where the price of oil remains low, at $80 per barrel; and where it reaches a ‘medium’ level of $100 per barrel.

This allowed the research team to compare a baseline scenario for the country’s future economy and emissions profile, where no emissions reduction measures are implemented, with several...
alternative scenarios: three tax scenarios where the oil price remains low; and, a baseline, three tax scenarios and three emissions caps scenarios for the medium oil price assumption.

The baseline scenarios in all of this modelling assumes an oil price forecast of $100 a barrel, and does not include waste and land use in the emissions-side of the forecasting.

Impacts of mitigation measures on emissions

The impact of the three mitigation actions on emissions when the oil price stays at $100 per barrel was considered first.

When a carbon tax is applied

- A tax of $50 per CO₂ ton yields greater emission cuts, sooner, and can reduce Colombian energy-related emissions by 33% by 2045. This is equivalent of 10.4% of the emissions in the different sectors. At a $20 tax, emissions cuts do not go above 3% in any period.
- Smaller taxes had very little impact on emissions, with cuts of less than 1% of the national emissions for a $10 tax, and less than 1.5% for a $20 tax. A $10 tax achieves the same emissions cuts as a $20 tax in most years.

Recycling the tax

- Recycling the revenue taken from tax back to households did not have a significant impact on emissions, relative to a situation where the taxes are not recycled.

When emissions are capped

- Both measures - the cap on emissions and the carbon tax - have the same emissions reduction effect in the given period (up to 2045). But the tax brings about the cuts sooner.
- This could be explained by the assumption that new technologies will become cheaper in time. There is an increase in electric vehicles and non-conventional renewable sources for power generation, while industries substitute a small amount of coal with natural gas.

When the energy mix is changed

- This modelling considers the implications of two alternative energy mixes: power generation comes from renewable sources (industrial biomass cogeneration, small hydro plants, geothermal facilities, and small 50MW wind farms); or industry moving from fossil fuels to greener-sourced electricity.
- Total emissions cuts are small – only 0.64% for the ‘greener’ energy mix scenario, and 1.56% in the scenario where industry switches to green electricity.
- Emissions cuts are similar to when a $20 tax is implemented, but it continues to grow as it approaches 2045, unlike in the tax and cap measures, where the size of the cuts varies between periods.

Sensitivity to the oil price

At $80 a barrel

- The transport sector does not electrify the fleet because fuel stays relative affordable.
- Carbon tax boosts the use of electricity: by 2040, there is a 10.56%, 19.94% and 48.17% increase in electricity consumption when carbon is taxed at $10, $20 and $50 a ton.
- Carbon tax boosts the use of natural gas: by 2040, there is a 5.81%, 11.33% and 12.54% increase in natural gas consumption when carbon is taxed at $10, $20 and $50 a ton.
- A carbon tax depresses the use of coal: by 2040, there is a 8.24%, 13.73% and 47.10% decrease in coal consumption when carbon is taxed at $10, $20 and $50 a ton.
- A low oil price scenario postpones and absorbs the negative impact of a carbon tax.

At $100 a barrel

- As the oil price climbs, newer and cleaner technologies are adopted, having a similar impact on emissions reduction as a carbon tax, and will make Colombia’s energy mix even greener.
- Consumption of electricity and natural gas stays the same.
Carbon tax diminishes the use of coal: by 2040, there is a 0.74%, 8.21% and 61.61% decrease in coal consumption when carbon is taxed at $10, $20 and $50 a ton. Above a $20 tax, renewables become competitive for power generation instead of the substitution between coal and natural gas.

Impacts across the wider economy
The macro-economic ripples
- A carbon tax has a small impact on GDP. By 2020 the GDP levels decreases, with respect to base line, by 0.58% for a $10 carbon tax; 0.56% for a $20 tax; and 0.77%, for $50 tax. However, the fact that this model only ran taxes on the energy sector may mean the figures are slightly inflated.
- Transferring the tax revenue back into the economy reduces the negative effect of the carbon tax on the GDP, which gives a stronger case for revenue ‘recycling’.
- A cap on emissions also reduces GDP, even with tax being recycled.
- Changing the energy mix (with more renewables, and with electricity replacing fossil fuels for industry), also has a negative impact on GDP.

The question of wages
- From 2020, all three mitigation options result in wages going down.
- The higher the tax, or the tighter cap, the more time the economy needs to adjust to these negative effects.
- When the oil price stays low, it absorbs the negative effect of the carbon tax in wages. By 2035 all scenarios show a positive trend for wages.

CONCLUSIONS

The most effective carbon tax
Placing a tax of $50 per ton of carbon on emission can reduce Colombian energy-related emissions by 33% in the energy sector until 2045, according to this modelling. Carbon emissions can best be cut by transforming sectors in the following ways:
- Transport sector – using electric vehicles and public transport systems. However electrification of the transport sector is only cost effective if the oil price stays does not decline below its current level.
- Power sector – increasing non-conventional renewable energies as primary sources (geothermal, wind and solar).
- Industry – a carbon tax might push industries to switch some energy production from coal to natural gas.
- Commerce and Households – the energy mix here will remain unchanged.

Modelling the different carbon tax price options produced very similar results, regardless of whether or not the revenue from the taxes was recycled back into the economy (in this case, directly to households). Furthermore, recycling this revenue does not reduce emissions significantly or change the energy mix much.

There is no free lunch
The modelling showed two clear results:
- A carbon tax has a reducing effect on the economy: it reduces the GDP relative to the business-as-usual scenario. As energy costs rise, the wider economy has less money for either consumption or investment. Lower investment translates into a smaller capital stock, and less GDP growth.
- But recycling the tax revenue slows the recessive effect; transferring the money, collected through such a tax, to households does damp the effect on GDP a little.

To access the working paper on which this brief is based, please see www.erc.uct.ac.za or email r.delgado87@uniandes.edu.co