Eco-Competitiveness and Eco-Efficiency: Carbon Neutrality in Latin America

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INTRODUCTION

In 2014, world per capita greenhouse gas emissions, expressed in carbon dioxide equivalent terms (CO_2e), exceeded 7 tons. Per capita emissions for Latin America and the Caribbean were even higher, at 9 tons CO_2e. To achieve international goals for the stabilization of atmospheric concentrations of greenhouse gases, the Intergovernmental Panel on Climate Change (IPCC) is calling for annual emissions to fall to 2 tons per capita by the year 2050 and 1 ton per capita by the year 2100. It is clear that we face a moral problem: everyone needs to, and can contribute to, the fight against climate change (Pope Francis, 2015).

Improvements in eco-efficiency—defined as a combination of reducing waste and reducing the use of raw inputs—offer one strategy for reducing greenhouse gas emissions while also lowering production costs. In addition, changes in culture—at the level of individual businesses, countries, or both—can enhance the eco-competitive position of these businesses and countries. This paper describes three examples from Costa Rica and shows how the goal of achieving carbon neutrality can provide incentives for improving eco-efficiency and eco-competitiveness.

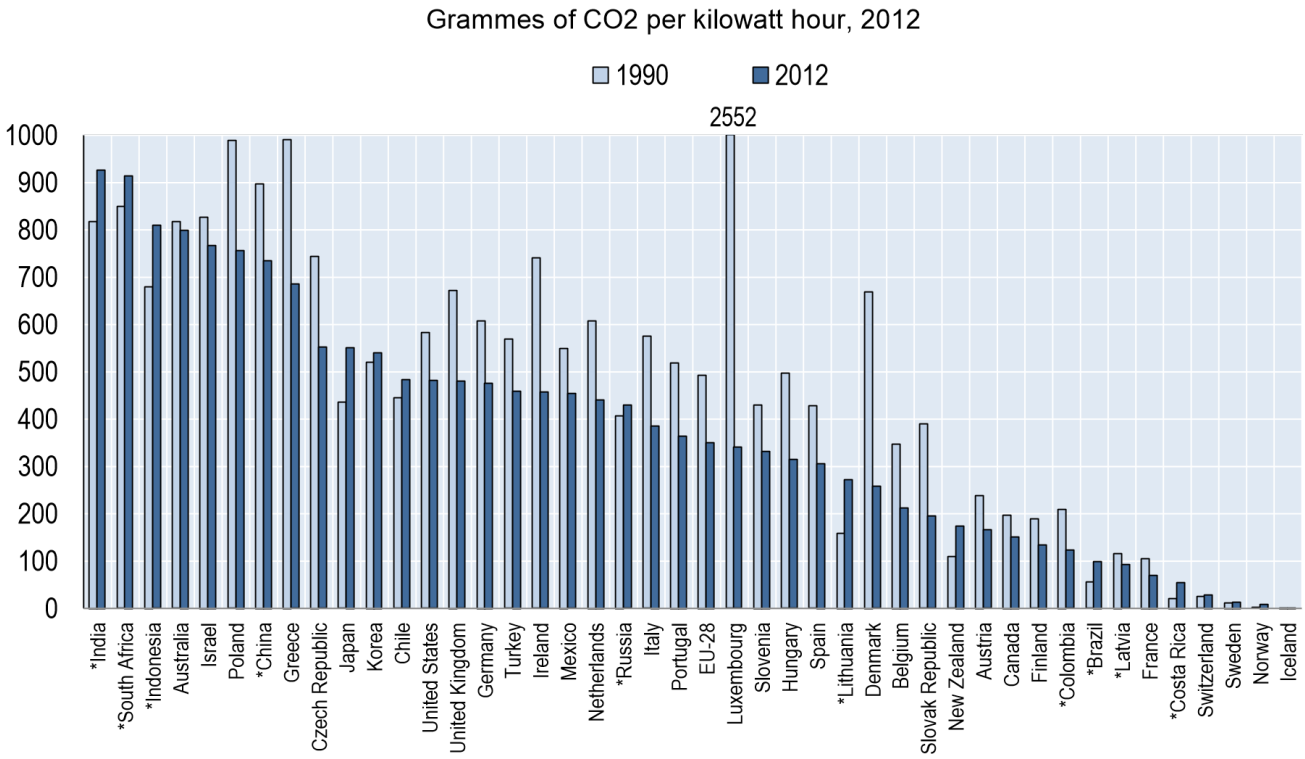
LOW CARBON GROWTH PER UNIT OF GDP

Figure 1 shows changes in the carbon intensity of the electric power sector between 1990 and 2012 for a wide range of developing and developed countries. The chart shows that India and China had higher carbon emissions per unit of electricity production in 2012 than the United States, Mexico, and Brazil. India and China are changing their power mix to one that includes cleaner sources:

China is adding hydropower and nuclear, while India is focusing on nontraditional sources like solar power. But both countries still face a long journey to greater eco-competitiveness.

Meanwhile, Costa Rica is among the nations with the lowest emissions per unit of electricity generation. In fact, only four countries (Iceland, Norway, Sweden, and Switzerland) had a less carbon-intensive electricity mix in 2012. In 2015, Costa Rica passed a milestone, logging more than 75 consecutive days of 100% renewable electricity production (Fendt, 2015).

Figure 1: Carbon intensity of electricity generation



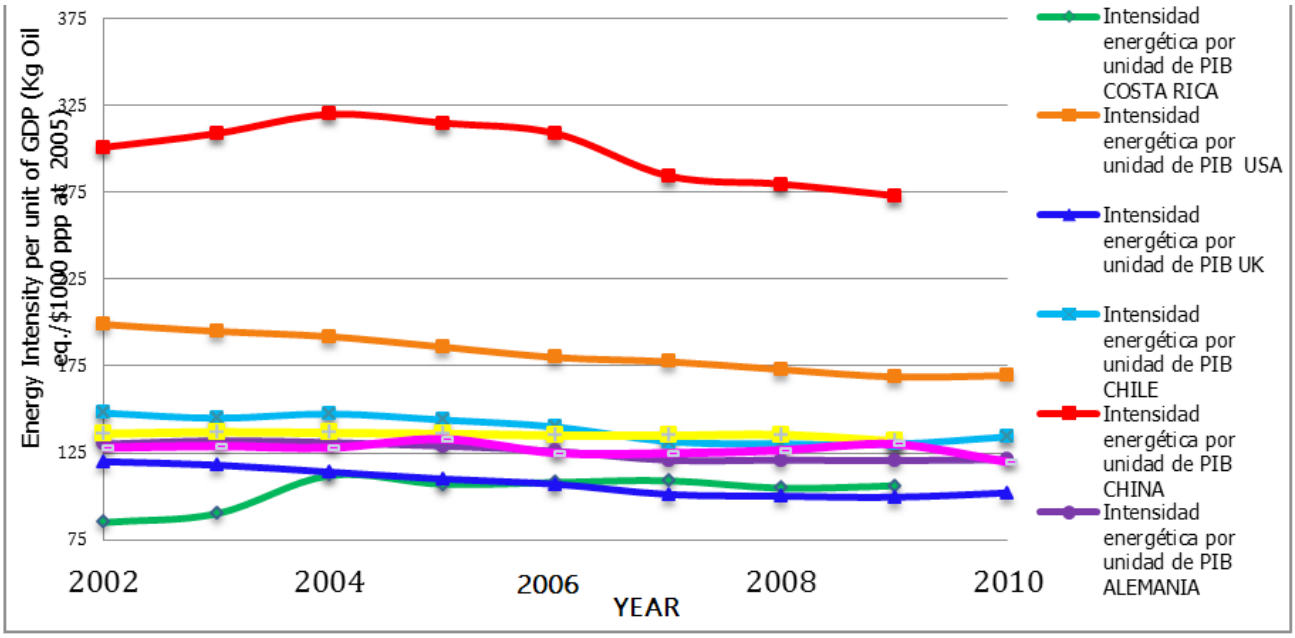
Reprinted from OECD (2015, p. 79); OECD's source is International Energy Agency database, *CO_2 Emissions from Fuel Combustion Statistics*: http://dx.doi.org/10.1787/888933272500.

Energy intensity: Another relevant indicator

Energy intensity—sometimes expressed in units of oil-equivalent energy consumption per dollar of GDP (using 2005 as the baseline) is another informative and frequently used indicator of eco-efficiency. Of the countries included in Figure 2, Costa Rica and the United Kingdom have the lowest overall energy intensity, at less than 125 kilograms (kg) of oil equivalent per $1,000 of GDP (adjusted for purchase power parity in 2005). The corresponding figures for the United States and China—the world's two largest economies—are 175 and 275, respectively. Though overall energy intensity has declined in both countries since 2002, the United States and China continue to rely heavily on their ample domestic coal resources. This results in a relatively high CO_2 intensity per

unit of economic output. In many countries, energy intensity should decline over the coming years as more efficient technologies, such as LED lights and “smart” buildings, become available.

Figure 2: Energy intensity per unit of GDP

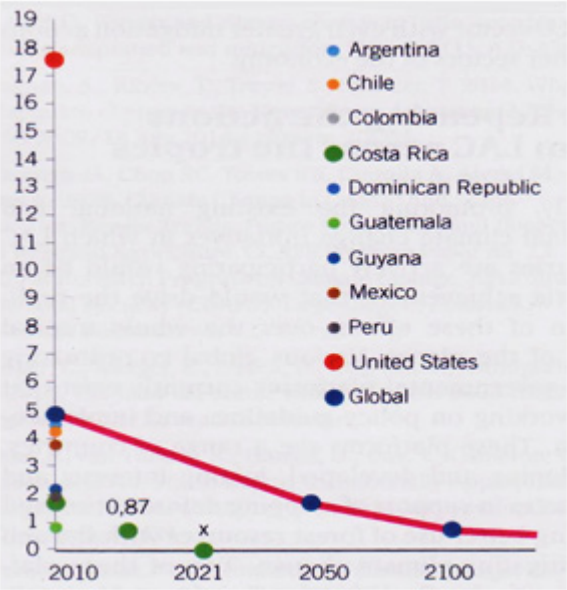


Source: World Bank Data: Energy and Mining; http://data.worldbank.org/indicator/EG.GDP.PUSE.KO.PP.KD. Elaborated by Ana Lucia Alfaro for the Costa Rican Ministry of Environment and Energy.

Costa Rica’s ambitious global warming target: Carbon neutrality by 2021

In 2007 Costa Rica set itself an ambitious climate-change mitigation target: to become carbon neutral by the year 2021 (World Watch Institute, 2015). This would mean that the net balance of greenhouse gases released into the atmosphere by Costa Rica from 2021 onwards would be zero. This does not mean that the country will have zero greenhouse gas emissions; rather it means that emissions will be reduced to the point where offsets are sufficient to cancel all remaining emissions for a net greenhouse gas contribution of zero (in other words emissions [E] minus reductions [R] minus carbon offsets [C] would equal zero, or E-R-C = 0). Costa Rica’s adoption of this target reflected the view that carbon neutrality could be achieved without compromising the country’s national economic development goals.

Figure 3: CO_2e tonnes per capita



Doing so, however, would be no easy task. In 2010, the United States emitted 17.6 tons CO_2e per capita and Argentina almost 4 tons CO_2e per capita, whereas the global average for this year was 4.9 tons per capita. By contrast, emissions for Costa Rica and Guatemala totaled just 1.7 and 0.8 tons per capita, respectively (Figure 3). Costa Rica's 2014 forest census put the country's net emissions (including forest offsets) at 0.9 tons per capita (Castro and Chacón, 2014). The red line indicates the trajectory that the IPCC has suggested would achieve the goal of reducing average per capita global emissions from the 2010 average of 4.9 tons per capita to 2 tons per capita in 2050 and 1 ton per capita in 2100.

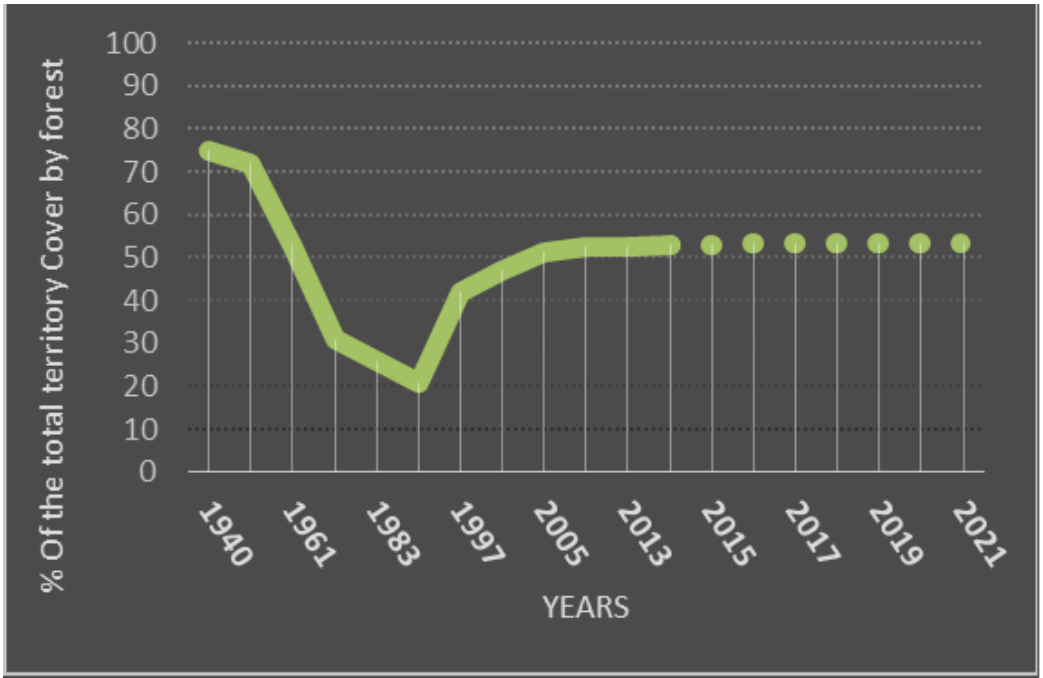
An April 2014 report by this author found that 81% of Costa Rica's progress toward carbon neutrality to that point had been achieved through the offsetting effects of natural forest regeneration. This estimate was based on data provided by local authorities responsible for monitoring the agricultural and forestry sectors and still needs to be confirmed internationally. However, Costa Rica has undoubtedly also made progress in other sectors of the economy, with 27 Costa Rican firms now certified as carbon neutral (Arias, 2015). Despite these efforts, some analyses suggest that Costa Rica will find it difficult to achieve the goal of full carbon neutrality at a national level (Climate Action Tracker, 2015).

Carbon forest offsets: A first success

Under its successful forestry policy, Costa Rica has become the only tropical country to invert its rate of deforestation, increasing its forest cover from 21% in 1987 to 52% in 2013. Associated carbon

benefits offset an estimated 81% of the emissions projected for 2021[1] (Figure 4) with 2.83 million hectares of now mostly regenerated native forests. This success is the result of a sustained social effort, including a fuel tax that has contributed 80% of the $500 million invested in reforestation between 1996 and 2013 (Castro, 2015).

Figure 4: Forest cover as a percentage of the Costa Rican territory



Source: Elaborated by the author based on data from MINAE. Only 2013 presents data from GIZ.

BALANCING EMISSIONS, OFFSETS, AND CO_2 REDUCTIONS: THE EQUATION

Costa Rica uses the macro equation noted earlier to measure its progress toward carbon neutrality and considers only the domestic carbon market. To the extent that Costa Rica participates in international carbon markets through trade in certified emissions reductions (CERs) or voluntary emissions reductions (VERs), the equation would need to be modified, subtracting those offsets that are sold abroad or adding the ones that are bought internationally.

1 The most recent study on forestry coverage, published by GIZ (German International Cooperation Agency) in 2014, used 168 satellite images and more than 300 verification plots to survey the whole country. "RapidEye" technology, with its high space resolution of 5 x 5 meters was applied. The information was processed using a rigorous methodology that allows for a much higher level of precision than in previous measurements. Thanks to this study, detailed information is now available on the quantity of hectares for each of the 10 types of coverage that exist in the country, thus, allowing for a more exact carbon-fixation accounting for the first time.

Inside a country, the equation for carbon neutrality can be disaggregated by sector or by year into several components:

$$\sum_{i=1}^{n} e_i - \sum_{i=1}^{n} r_i - \sum_{i=1}^{n} c_i = 0$$

where

e_i = company or entity i´s emissions

r_i = company or entity i´s emissions reductions

c_i = company or entity i´s offsets

The equation needs to be calculated for every company and every year to provide a complete picture of the overall CO_2e balance of the economy as a whole. A company that does not achieve carbon neutrality in a given year would need to acquire carbon offsets on the domestic or international offsets market.

Following these guidelines, private-sector entities in Costa Rica have taken action. Three company-level examples illustrate the country's approach. While proprietary business data is considered confidential, all these companies agree that even absent a mechanism for monetizing their emissions reductions, improvements in eco-efficiency have produced significant energy and cost savings. In this way, steps taken in pursuit of carbon neutrality have been to some extent self-financing.

Example 1: Achieving carbon neutrality in Costa Rica's cement industry

Costa Rica has only two cement companies, each with roughly equal market share. The two companies account for roughly 4% of total national carbon emissions or an estimated 702,000 tons of CO_2e in 2015.[2]

In 2015, one company estimated that its CO_2 emissions would total 351,000 tons, approximately the same as its competitor's emissions. Emissions were projected to increase to 432,600 tons by 2021. To achieve carbon neutrality by 2021, the company intends to reduce its direct emissions by

2 It is usually estimated that CO_2 emissions from cement production are 0.52 times the cement's clinker factor. For normal cement, the clinker factor is roughly 70% by weight, with pozzolana and carbonate constituting the rest. We therefore use a conservative factor of 0.45 tons of CO_2 per ton of cement production to estimate emissions from Costa Rica's two cement producers. (The calculation uses information obtained from a personal communication with Irene Campos, Director of the Instituto Costarricense del Cemento y del Concreto.)

86,520 tons through the use of cleaner fuels and energy efficiency improvements, among other measures. In addition, the company will purchase an additional 346,080 tons of CO_2e offsets, mainly in the form of forestry projects involving natural forest regeneration or the planting of new trees. These offsets will cost $1,730,000 or $5 per ton per year.[3] The company is currently in the process of implementing its strategy for achieving carbon neutrality. Table 1 summarizes theoretical costs and approximate emissions for the company in each of four years.

Table 1: Carbon neutrality calculation for one of Costa Rica's two cement firms (2005–2021)

*Year$_i$	e_i tons CO_2e	r_i	c_i	Net CO_2e tons emitted by firm A
2005	258,600	0	0	258,600
2010	292,000	0	0	292,000
2015	351,000	70,200	0	280,800
2021	432,600	86,520	346,080	0 → 1st year of carbon neutrality

* Emission figures for the years 2005 and 2010 are based on empirical data from the Costa Rican Meteorological Institute national inventory. The other figures shown in the table are the result of projections made by the author.

Example 2: Coopedota, the world's first carbon-neutral coffee

At the 2012 United Nations Climate Change Conference held in Doha, Qatar, Costa Rica's 800-member Coopedota coffee cooperative launched the world's first carbon-neutral certified coffee (Carbon Clear, 2011). The cooperative, which is located in the mountains of Costa Rica's central valley, was concerned about damages from climate change and decided to take steps to adapt and mitigate its contributions to global warming "from the tree to the cup."

Globally famous in the industry for its high-quality coffee, Coopedota has been working for years to do its part toward helping the country achieve its carbon-neutrality goal. Self-interest has been at play; climate change has recently begun to affect production—in 2009, for example, output was 15% below the previous year.

Globally, agriculture accounts for almost 24% of greenhouse gas emissions, but in Costa Rica agriculture accounts for 40% of emissions (coffee represents 10%). Coopedota recognized an

3 FONAFIFO (Costa Rica's National Forestry Financing Fund) has estimated that fuel tax investments in forestry offsets have totaled $5 per ton of CO_2e.

opportunity to simultaneously take action against climate change and market their coffee to environmentally aware consumers who would, in the end, reward them for offering a carbon-neutral product.

Since 2009, Coopedota's plan for achieving carbon neutrality has focused on reducing energy consumption. Biomass collected during and after the harvest was used to replace firewood and both electricity consumption and water use were cut by 50%. Additionally, wastewater was no longer discharged into the local river.

In 2011, the British Standards Institution certified Coopedota as the world's first carbon-neutral coffee using its PAS (Publicly Available Specifications) 2006 norm. Coopedota believes it is well positioned to serve the European market, which is expected to drive growing demand for low-carbon products after 2020.

Example 3: Carbon-neutral rice from Tío Pelón

Owned by the Gonzales family since 1944, "Hacienda El Pelon de la Bajura" is a 22,500-acre farm in northern Costa Rica. Much of the hacienda is natural dry tropical forest, but the lowlands are used to cultivate rice under irrigation. Rice is also processed on the farm for direct sale to consumers under the "Tío Pelón" brand. Recently, the farm was certified a carbon-neutral corporation and all 2- and 3-kilogram bags of Tío Pelón rice are labeled "carbon-neutral."[4]

The rice mill produces enough electricity to support farm activities and power workers' houses. Rice skins and king grass from the farm fuel a 4.5-megawatt biomass plant. Tropical forest on the farm is protected and a regeneration project is bringing forest back to degraded areas.

Table 2 summarizes data provided to the author by the farm owners. It indicates that not only is the farm carbon-neutral, it provides a surplus of carbon sequestration.

Table 2: C-neutral equation for the Rice Corporation "Tio Pelon Group" 2011-2013

Year	E: Total Emissions	R: Emissions reduced CO_2e	C: Emissions compensated	Net CO_2 per year in CO_2e tons
2011	26259	513	28032	-2286
2012	22418	504	97745	-75831
2013	22004	912	85200	-64108

Note: For all the three years the Corporation is being C-Neutral. Moreover, it has a surplus that could be sold.

4 www.tiopelon.cr/pdf/Declaratoria.pdf.

In theory, this surplus could be sold as carbon credits or offsets in the Costa Rican market or internationally, but how such credits or offsets might be recognized in the context of other countries' mitigation programs is at present unclear (see Stavins, et al. [2014] for a discussion of linkage between different carbon abatement systems).

CONCLUSION

Examples from Costa Rica suggest that it is possible to attain the IPCC goal of dramatically reducing global per capita carbon emissions. Indeed, estimated abatement costs and early results suggest that it may even be possible to accelerate progress toward the IPCC goals. Energy savings alone have been a significant benefit of early efforts to achieve carbon neutrality in Costa Rica and turn the country's economy into an eco-competitive one.

The agriculture, forestry, and land-use sectors account for a high percentage of overall greenhouse gas emissions in many developing countries (worldwide, these sectors represent 24% of emissions but in Latin America their share is 47%). But the same sectors also have the greatest potential for carbon sequestration and offer abatement opportunities that are cheaper than can be found in the energy or transport sectors. In Central America, almost 80% of agriculture, forestry, and land-use carbon mitigation options cost far less than $20/ton.

Costa Rica has adopted a national goal of achieving carbon neutrality, which means that the combination of future emissions reductions and offsets must be equal to projected future business-as-usual emissions. To date, carbon offsets have accounted for around 81% of the country's progress toward carbon neutrality.

Costa Rica's private sector has slowly begun to join the effort, including banks, rural companies that generate and distribute electricity, vehicle dealers, hotels, coffee and rice growers, and companies that produce cleaning products. Another 30 companies are moving toward carbon neutrality.

Achieving the goal of carbon neutrality at a national level will, however, require additional elements:

1. A joint effort by the public and private sectors to define standards and to develop emissions monitoring, reporting, and verification systems that are public, registered, and transparent.

2. A public register for CO_2 transactions, to avoid double counting and ensure the transparency of the system.

Costa Rica's progress toward carbon neutrality—though it could be accelerated—has served as a model for other nations. Both the substance of the policies that Costa Rica has adopted and the multi-sectoral collaboration that the country has employed are serving as a useful guide for those working to address climate change at the sub-national, national, and multilateral levels.

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