

Development without Carbon:

Climate and the Global Economy through the 21st Century



Elizabeth A. Stanton

Stockholm Environment Institute-U.S. Center

November 2011



Copyright © 2011 by the Stockholm Environment Institute

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes, without special permission from the copyright holder(s) provided acknowledgement of the source is made. No use of this publication may be made for resale or other commercial purpose, without the written permission of the copyright holder(s).

For more information about this document,
contact Elizabeth A. Stanton at liz.stanton@sei-us.org
Stockholm Environment Institute – US Center
11 Curtis Avenue
Somerville, MA 02144-1224, USA
www.sei-us.org and www.sei-international.org

Cover art: Flooding in Chalco, Mexico, in February 2010, which displaced thousands of people / Flickr-MagisRevista, by Enrique Carrasco S.J.

Acknowledgments:

Funding provided by SEI. Many thanks to my colleagues Frank Ackerman, Ramón Bueno, Victoria Clark, Marion Davis, Marisa Escobar, and Francisco Flores for comments on an earlier draft of this report.

Table of Contents

Executive summary.....	4
What is fair?.....	4
An emissions budget.....	4
Three scenarios of future emissions.....	5
Without Development.....	5
Development with Carbon.....	6
Development without Carbon.....	7
Policy-driven emissions intensity reductions.....	8
Case Study: Latin America and the Caribbean.....	9
Discussion and recommendations.....	10
1. What’s at stake.....	11
Climate, poverty, energy.....	12
An emissions budget.....	13
Three scenarios of future emissions.....	14
2. What is fair?.....	15
3. Without Development.....	18
4. Development with Carbon.....	22
Faster economic growth.....	22
Faster population growth.....	23
5. Development without Carbon.....	24
Policy-driven emissions intensity reductions.....	26
Case Study: Latin America and the Caribbean.....	28
6. Discussion and recommendations.....	30
References.....	32
Technical appendix.....	36
Forecasting GDP growth.....	36
Forecasting population growth.....	39
Forecasting GDP per capita growth.....	39
Forecasting greenhouse gas emissions.....	39

Executive summary

Economic development and the eradication of energy poverty are increasingly seen as key components in a comprehensive strategy to prevent dangerous climate change, along with greenhouse gas emission reductions and adaptation measures. But the current crop of climate economics models used to guide policymakers assumes very little economic growth in the poorest countries.

This report examines the implications of the no-development assumption that underlies many climate policy targets, and finds that, taking developing countries' right to future emissions as a given, economic development in the poorest countries requires more stringent mitigation actions by their richer neighbors, both to reduce industrialized countries' emissions and to provide funding for emissions reduction measures in the developing world. Projections of slow economic growth in the developing world, in contrast, would tend to create the expectation that the poorest countries will use up a relatively small share of the global 21st century emissions budget, leaving more "emissions space" for the high- and middle-income countries. Assuming that economic development will fail or falter has the effect of weakening the urgent call for rich countries to reduce their emissions.

It is hard to imagine a resolution to international climate negotiations that does not involve sustainable low-or-no-carbon development – here referred to, for simplicity, as "development without carbon." For countries that, to date, have emitted very little, a choice between current economic development and avoiding future climate damage is an impossible dilemma.

This report reviews the literature regarding the connection between energy, poverty, and emissions mitigation; sets out principles for an equitable climate policy; explores three future economic growth and emissions scenarios; presents a case study showing the impact of these three scenarios on Latin America and the Caribbean; and concludes with recommendations for setting climate policy targets.

What is fair?

Much has been written about the equitable allocation of future emissions, but there can be no single, definitive answer to what is right or fair in climate policy. In the emissions projections presented here, climate equity is approached in this way: The poorest countries have the same right to future emissions that richer countries asserted over past emissions. The historical and present-day big emitters have a special responsibility to assure that emissions levels are consistent with avoiding dangerous climate change. This responsibility extends both to lowering their own emissions, and to paying for emissions reductions in poorer countries.

An emissions budget

Goals for greenhouse gas emission reduction are set in relation to expected future emissions in the absence of climate policy, often called business-as-usual emissions. The smaller we think that future emissions will be without climate policy, the smaller our policy actions need to be to counteract those emissions – wishful thinking leads to poor planning. The pace of economic growth in the developing world is a critical, but little discussed, element in determining the overall scale of "21st century cumulative emissions," a (slightly misnamed) measure which adds together all of the annual emissions from 2005 to 2105. The higher the business-as-usual cumulative emissions, the more ambitious climate policy must be to provide a good chance of avoiding dangerous climate change.

The budget for maintaining a 98-percent chance of keeping temperature increases below 2°C (a much discussed policy objective) is approximately 2,700 gigatons (Gt) carbon dioxide-equivalents (CO₂-e) – including both carbon dioxide and other greenhouse gases – of which an estimated 200 Gt have already been emitted. Given this budget, country-level emissions can be viewed as a "zero-sum game": the more

that any one country emits, the smaller the emission budget that remains for other countries. If the poorest economies don't grow very much, they won't use up much of the remaining budget – leaving a relatively large emissions budget for the rest of the world.

Three scenarios of future emissions

This report sketches out a framework for incorporating real economic development in future climate-economics analysis by exploring the potential greenhouse gas emissions, and corresponding mitigation obligations, of three stylized futures for developing countries:

- *Without Development*: a business-as-usual (no policy) scenario with the standard economic growth rates found in climate-economics models;
- *Development with Carbon*: a business-as-usual (no policy) scenario with more rapid economic growth rates;
- *Development without Carbon*: a policy scenario with rapid economic growth and significant public measures to reduce emissions.

For ease of analysis, the 174 countries modeled for this report are divided into four income groups: high-income, high-middle-income, low-middle-income, and low-income.

Without Development

The Without Development business-as-usual scenario models standard economic growth with slow, income-driven reductions in emissions per dollar of GDP; there are no policy-driven emission reductions. With the exception of the group of newly industrializing countries – most importantly, India and China – that already have a running start, economic growth is expected to proceed at a slow, steady pace in developing countries. This growth is insufficient to alleviate poverty in the poorest countries by 2105. As a result of low growth and low emissions in the developing world, high-income countries have more 21st century “emissions space” and, therefore, weaker emissions mitigation obligations. The Without Development scenario closely emulates the business-as-usual scenarios used in many of the best-known climate-economics models.

Many emissions forecasts are based on the assumption that at the end of this century, the 45 low-income countries will have average per capita incomes of \$6,500 a year – matching those of Tunisia, Belize, or Serbia in 2005 – with incomes in the very poorest countries of about \$1,100 a year – matching those of Zambia, Bangladesh, and Haiti. In these forecasts, middle-income countries' 2105 per capita income surpasses high-income countries' 2005 levels, and the development gap between middle and high-income countries is greatly reduced. But the 45 poorest countries – home to 15 percent of the 2005 global population, and rising to 35 percent in 2105 – are left behind.

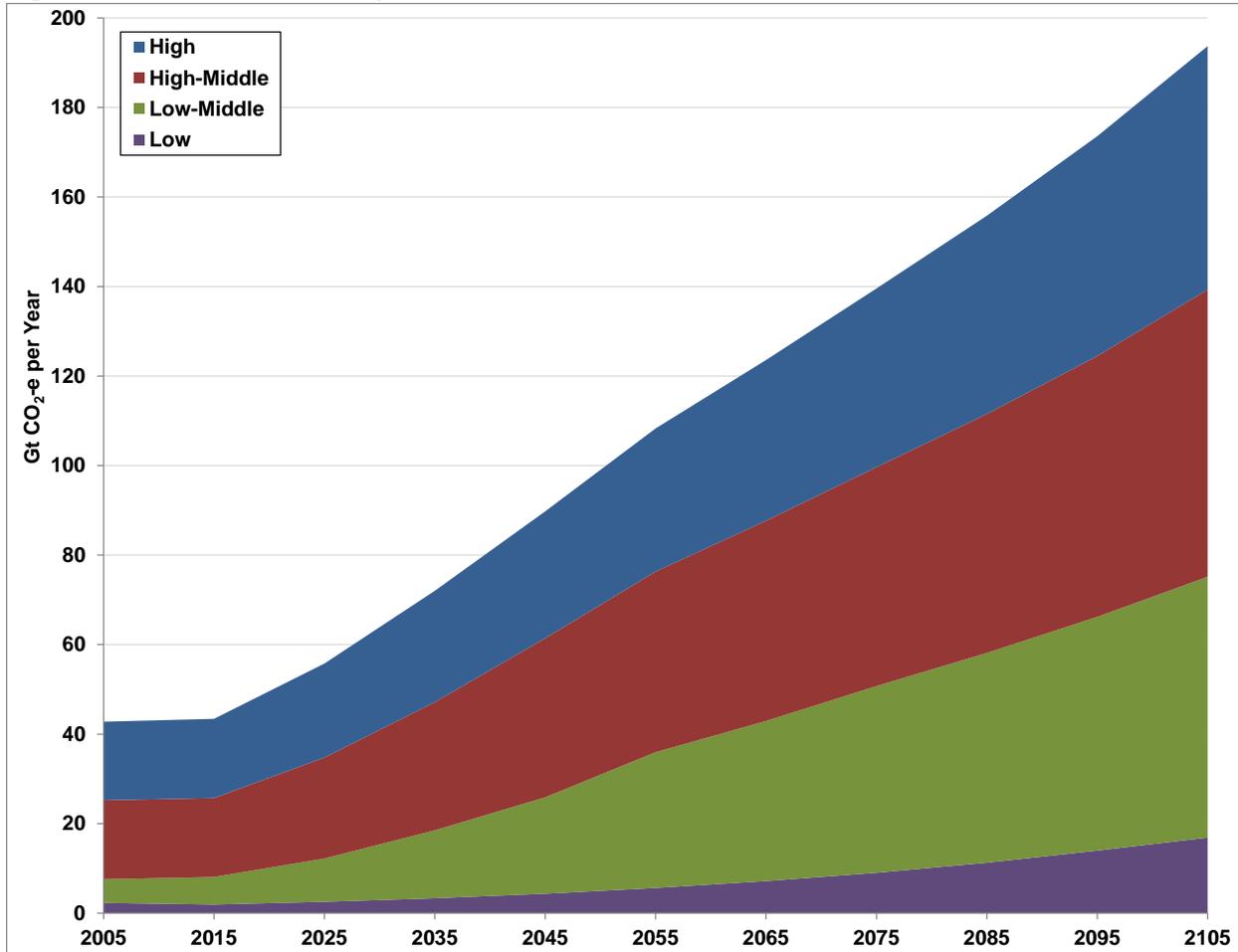
Projections of future annual emissions are based not only on assumptions regarding real GDP growth, but also on expected changes in emissions intensity (or kg of CO₂-e per dollar of GDP). In very general terms – and with many important exceptions – higher per capita income is associated with lower emissions intensity and vice versa. On average, high-income countries' emission intensity is 0.5 kg/\$; middle-income countries, 1.2 kg/\$; and low-income countries, 2.1 kg/\$.

Emissions per dollar tend to fall as technology improves and incomes rise (making relatively more expensive low-carbon technology more affordable). From 1980 to 2005, in most countries, representing 86 percent of today's global GDP and 77 percent of today's greenhouse gas emissions, emissions intensities fell as income rose. A stylized pattern between countries' 2005 per capita income and emissions intensity (each 1-percent increase in per capita income is associated with a 0.34-percent drop in its emissions intensity) is used to model potential future “autonomous” reductions to emissions intensity –

where autonomous reductions, which occur solely as a result of economic development, are contrasted to “policy” reductions, which occur as a result of deliberate policy actions.

In the business-as-usual, Without Development scenario, there are no policy-induced emissions reductions; the only changes to emissions intensity are based on the autonomous-emissions-reduction pattern. Twenty-first-century cumulative emissions reach 10,800 Gt CO₂-e, with low-income countries contributing just 6 percent of this total (see Figure ES-1; annual emissions for each income group are the lines dividing the areas, and cumulative emissions are the colored areas).

Figure ES-1: Without Development annual CO₂-e emissions, 2005-2105



The 21st century cumulative emissions budget for keeping temperature increases under 2°C is 2,700 Gt CO₂-e. Assuming little or no emission mitigation policy in the Without Development scenario, low-income countries are expected to emit about a cumulative 700 Gt in the 21st century, leaving 2,000 Gt for richer countries. A policy gap of 8,800 Gt exists between target cumulative emissions in high and middle-income countries, and expected business-as-usual emissions. Meeting this policy gap through emissions reductions would require substantial policy-driven decreases in emissions-intensities.

Development with Carbon

What if low-income countries experienced genuine economic development? In 1985, India’s real per capita income was \$1,035 – very similar to that of Haiti before the 2010 earthquake. In 20 years, India’s per capita income more than doubled, reaching \$2,300 in 2005. Extended standard growth projections

have India's per capita income exceeding \$9,300 by 2035, and reaching \$45,900 by 2085, the result of 3.9 percent average annual growth over the 100-year period. Contrast this to the 21st century per capita income growth expected for Haiti by climate-economics models, on average just 2.0 percent per year reaching \$7,200 in 2105.

What would happen to emissions if Haiti (and every low-income country) were able to follow India?

Faster economic growth in the Development with Carbon scenario brings all countries out of poverty, but the pace of reductions in emissions per dollar remains slow and, again, is driven by income growth rather than policy. This scenario represents an alternate vision of business-as-usual.

With faster economic growth in the Development with Carbon scenario, incomes converge around the world. Twenty-first-century cumulative emissions reach 20,700 Gt CO₂-e, 21 percent of which originates in the poorest countries. In this scenario, low-income countries emit a cumulative 4,400 Gt in the 21st century exceeding the entire global 2,700 Gt budget. The policy gap for richer countries' emissions reduction is 16,300 Gt.

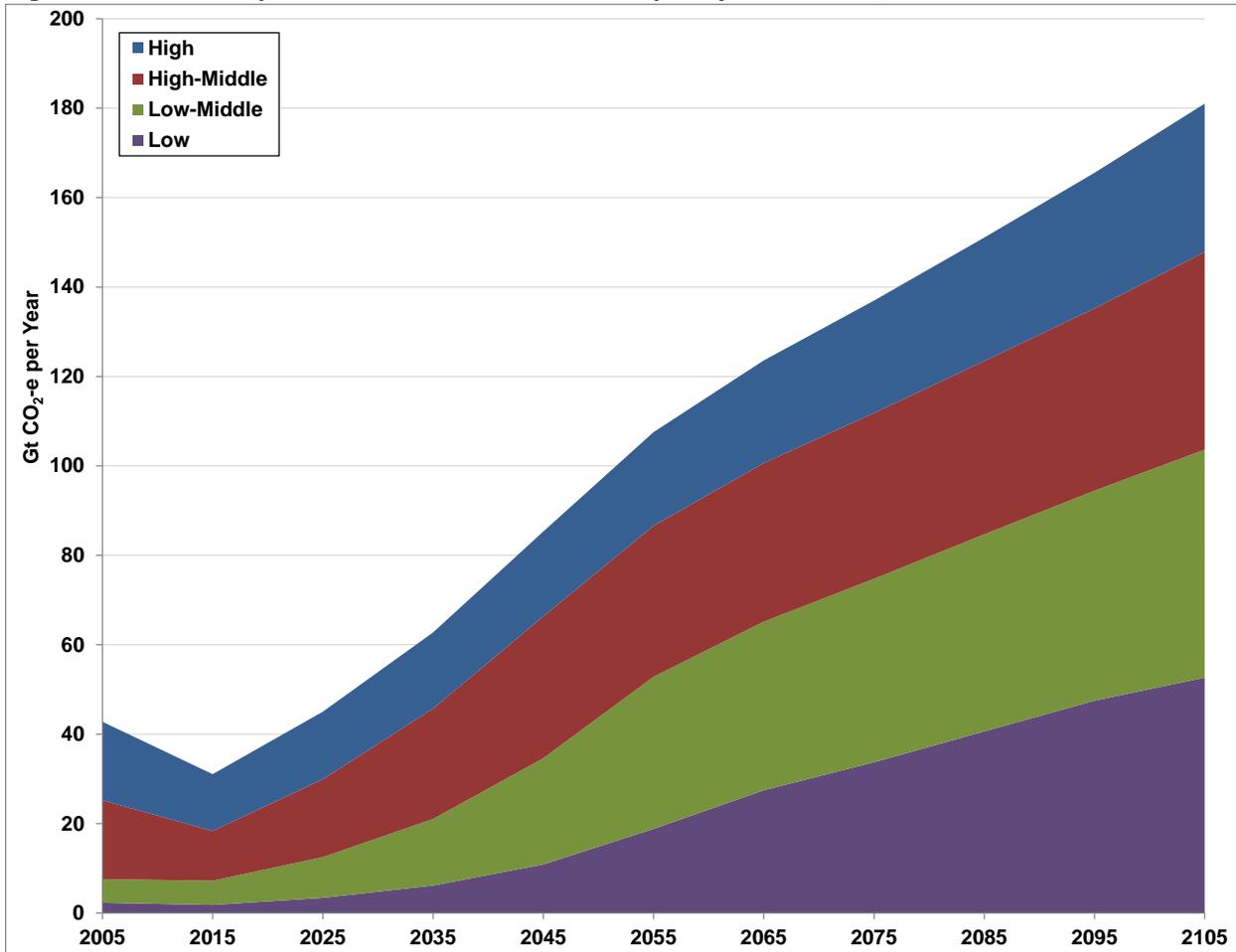
The relative size of the policy gaps in the Without Development and Development with Carbon scenarios demonstrates the potential scale for miscalculation caused by overly-pessimistic economic development projections. In the standard growth, Without Development scenario, richer countries face an 8,800 Gt CO₂-e policy gap; in the faster growth, Development with Carbon scenario, this gap is almost doubled. Using standard growth assumptions to form climate policy is a risky proposition: If economic development is successful, climate policy will fail.

Development without Carbon

In the Development without Carbon scenario, the same faster economic growth is coupled with strong decarbonization policies in developing and developed countries alike. Funding from high-income countries helps to assure that economic development drives a reduction in emissions intensity at every income level. Enhanced emissions reductions are modeled as stronger responses to per capita income growth than predicted from autonomous-intensity-reduction alone. Two levels of policy response are modeled: "mild policy," with a 0.40-percent intensity drop for every 1 percent increase in per capita income (this rate includes both autonomous and policy-induced reductions); and "strong policy," with 0.53-percent intensity drop for every 1 percent increase in per capita income.

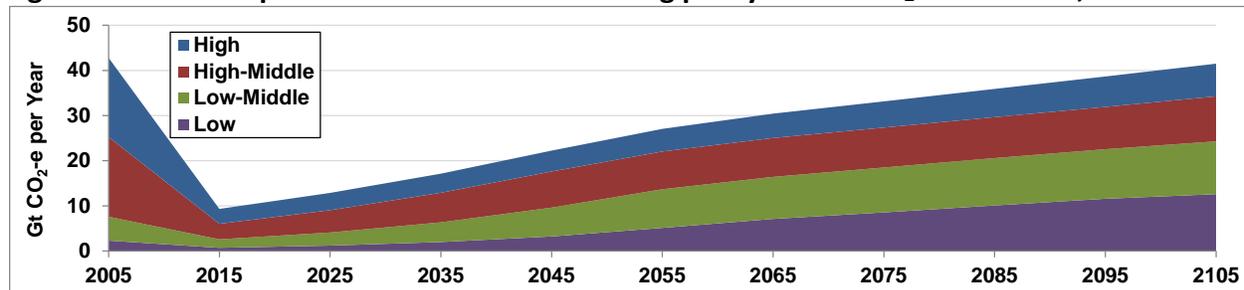
Using the mild policy assumption, 21st century cumulative emissions reach 10,200 Gt CO₂-e, with 2,200 Gt from low-income countries; the remaining policy gap for middle and high-income countries is 9,700 Gt (see Figure ES-2).

Figure ES-2: Development without Carbon – mild policy annual CO₂-e emissions, 2005-2105



Using the strong policy assumption, 21st century cumulative emissions reach 2,700 Gt CO₂-e, with 600 Gt from low-income countries (see Figure ES-3). This rate of emission-intensity reduction was chosen such that the Development without Carbon scenario with strong policy assumption keeps emissions within their 21st century budget for staying below 2°C, leaving no additional policy gap.

Figure ES-3: Development without Carbon – strong policy annual CO₂-e emissions, 2005-2105



Policy-driven emissions intensity reductions

Without some policy-driven assistance, autonomous intensity reductions are drowned out by economic growth. A successful development-without-carbon strategy requires both economic development –

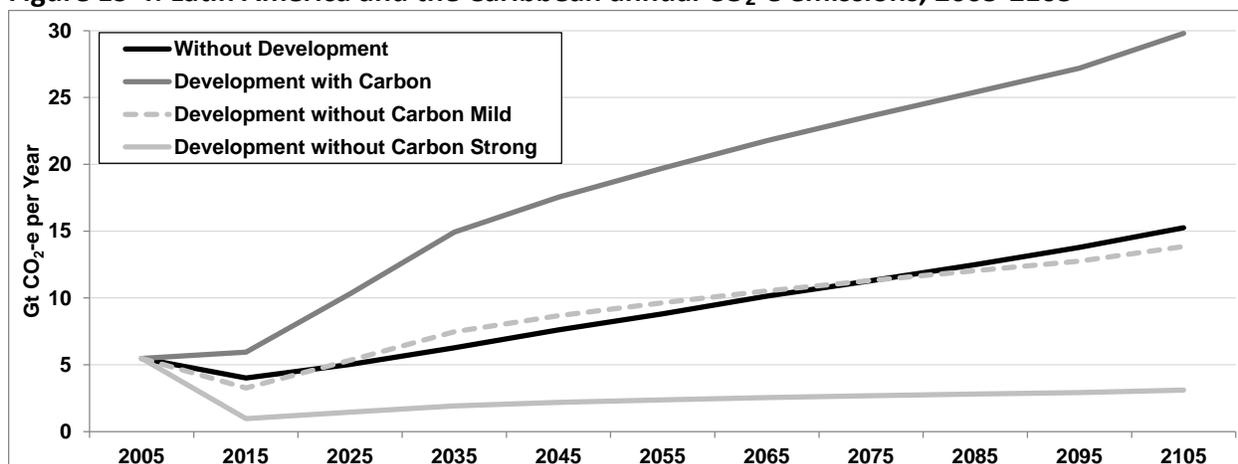
including policies to address energy poverty – and emissions mitigation policy. Climate policy aimed at lowering emissions intensities as incomes grow would need to:

- *Support and enhance trends toward lower emissions intensity as incomes rise:* Without policies designed to connect energy poverty reduction and other forms of economic development with emissions reduction, there is a strong potential for low-income countries’ emissions intensity to increase with rising incomes.
- *Offer additional support to countries with anomalously high emissions intensities:* Our projections assume that countries with especially high emissions intensities will jump relatively quickly to the expected technology for their income level. This may be unrealistic without financial and technical support.
- *Accelerate innovation in low-cost low carbon technologies:* Low-cost alternative electricity generation and heating and cooking fuels are a critical component of energy poverty reduction and emissions reduction.

Case Study: Latin America and the Caribbean

Per capita incomes, expected economic and population growth rates, and emissions intensities vary widely across the 32 Latin America and the Caribbean countries. In the Without Development business-as-usual scenario, this region emits a cumulative 900 Gt CO₂-e in the 21st century (see Figure ES-4). With faster economic growth in the Development with Carbon business-as-usual scenario, regional 21st century cumulative emissions reach 1,800 Gt CO₂-e. When policy-induced reductions to emissions intensities are modeled, emissions fall despite converging world incomes. In the Mild Policy Development with Carbon scenario, 21st century cumulative regional emissions fall to 900 Gt CO₂-e; in the Strong Policy scenario regional cumulative emissions only amount to 200 Gt.

Figure ES-4: Latin America and the Caribbean annual CO₂-e emissions, 2005-2105



A successful climate policy for Latin America and the Caribbean will require public actions to enhance adherence to the autonomous-intensity-reduction pattern: support for emissions intensity reductions in countries at risk of exhibiting rising emissions per dollar as incomes grow, such as El Salvador, Grenada, and Trinidad and Tobago; support to countries with anomalously high emissions intensities, such as Bolivia, Honduras, Guyana, and Brazil; and financial support for local energy technological innovation as well as unfettered access to low-cost low-carbon technology developed beyond their borders.

Discussion and recommendations

Is there a path forward that balances climate and development (where development includes an end to energy poverty)? At present, most climate-economics models skirt this issue by implicitly treating the economic development of the poorest countries as if it were doomed to failure. This approach is overly simplistic and short-sighted: it either consigns the poor to remain poor for the next few generations at a minimum, or assures a failure of climate policy by failing to anticipate economic development.

Here are a few questions that the next generation of economic analyses should be asking:

Can development derail climate policy? It is possible that, either on their own or with financial support from the international community, the poorest countries could follow India and China on a path to prosperity? Without targeted funding to support emissions intensity reduction while simultaneously alleviating energy poverty, this optimistic economic development scenario seems very likely to result in higher developing-country emissions. Meanwhile, if rich countries set weak mitigation targets for themselves, based on bad economic advice that assumes a pessimistic growth scenario for developing countries, the 21st century emissions budget is sure to be busted. In this manner, successful development (in combination with poor foresight) could indeed derail climate policy.

Can climate policy derail development? A global climate policy powerful enough to force developing countries to slow growth is a little hard to imagine, given the mood and track record of the international negotiations process. In theory, strongly enforced per country or per person emissions caps, enacted without supporting policy to aid reductions in emissions intensity, could slow or even stop economic growth in poor countries. In practice, this outcome is of most use as a counterfactual – a description of a world no one wants or expects. To make strong climate policy and strong economic development compatible will require significant investment in measures to enhance and support income-driven reductions to emission intensity.

What are the poorest countries in the world entitled to? They have every right to continued economic growth, very little history of past emissions, and somewhere between very little and no responsibility to pay for future emissions mitigation. Taking such a pro-development stance seriously in climate-economics modeling requires the examination of the impacts of faster economic growth in developing countries. Even if complete poverty eradication is regarded as unlikely, climate policy should be designed to allow for the best-case possibility that every Haiti could grow like India.