Reducing inequality and poverty while mitigating climate change?

Key challenges for research and practice in middle income countries in Africa and Latin America

A policy brief [1]

Britta Rennkamp*, Alfred Moyo*, William Wills• and Carolina Grottera•

1. Introduction

What is the relationship between emissions, inequality and poverty? Growing wealth supposedly correlates with increasing emissions. Rich countries are historically high in per capita emissions, whereas poor countries have low per capita emissions. African and Latin American non-Annex I[2] countries rank high the statistics in emissions intensity[3] (IPCC 2007). Where are highly unequal middle income countries in this puzzle?

This paper provides some answers to this question and outlines future research on mitigation and inequality within the MAPS program. The question is relevant, because developing countries have come under growing pressure introduce mitigation actions that help to reduce dangerous greenhouse gas emissions. These mitigation actions need to be 'nationally appropriate' (UNFCCC 2007) and different from the developed countries, taking the economic structures, poverty and inequalities into account. Mitigating emissions and reducing poverty at the same time sharpens the trade off. Governments need to decide on expenditure of limited resources on poverty or mitigation. According to previous research this trade off decreases when countries become richer (Ravallion, Heil et al. 2000). This implies that governments have a growing option to achieve both.

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[1] Conference Paper to the Carnegie III Conference on Poverty and Inequality Research at the University of Cape Town in September 2012.

*Energy Research Center, University of Cape Town

•Interdisciplinary Laboratory of Environment (LIMA/COPPE), Federal University Rio de Janeiro

[2] In 2000, the most energy intensive regions (kg of CO2 per US$/GDP) were Africa, Eastern Europe (Annex 1), Middle East, Latin America, East and South Asia (IPCC 2007, 31).

[3] Measured in kg of CO2 per US$/GDP

In the program on mitigation action plans and scenarios (MAPS), researchers in five Latin American countries and South Africa inform stakeholder processes on mitigation actions and scenario plans. A key aspect of mitigation action planning is the question of how to reduce emissions without jeopardizing socio-economic development. Economic analysis of emissions and inequalities in the MAPS countries informs further research and discussion on mitigating emissions and reducing inequality. It builds on previous research on mitigation and poverty in the MAPS programme (Wlokas, Rennkamp et al. 2012). This paper provides an overview of the future research on inequality and mitigation in MAPS. Its main purposes are i) to translate the findings from recent economic research on the relationships between poverty, inequality and emissions into an accessible language for practitioners; ii) to inform practitioners on the research gaps in modelling inequalities, poverty and emissions in highly unequal countries; and iii) to inform further qualitative and quantitative research of mitigation actions, which tackle both reductions in emissions as well as poverty and inequality.

2. Background: Recent research on emissions, poverty and inequality

The research literature shows that economic growth contributes to increasing emissions. This suggests that there is a trade off between slowing climate change and economic growth, which only decreases with growing GDP (Heil and Selden 2001) or if other determinants of growth change.[4] Further economic analysis suggests that with economic growth environmental outputs decrease. Environmental kuznets curves have established that environmental degradation and gdp growth (in different measures) have an inverted u-shape relationship, which means that with growing gdp environmental degradation increases and later declines. Yet, in terms of carbon emissions, this relationship does not seem to hold. Carbon emissions increase with growing income (IBRD 1992; Holtz-Eakin and Selden 1995). One of the first IPCC assessments made a strong case for the correlation between carbon emissions and economic growth[5] (IPCC 1992; IPCC 2007).

However, climate change and poverty mostly fall into the adaptation category in the current research literature and policymaking. However, if we acknowledge recent findings of poverty research, we find that this separation between mitigation and adaptation does not hold anymore. Research suggests that poverty demographics have changed between 1990 and 2010 (Sumner 2010). The majority of the poor nowadays live in middle-income countries, and not only in low-income countries. Emissions in middle-income countries are increasing along with growing energy demands. At the same time, governments set targets to reduce emissions in the long term without jeopardising socio-economic development. A lot of these changes have to do with the vast population in Asia,

[4] This could be for example technological changes, energy efficiencies or structural changes in the economy

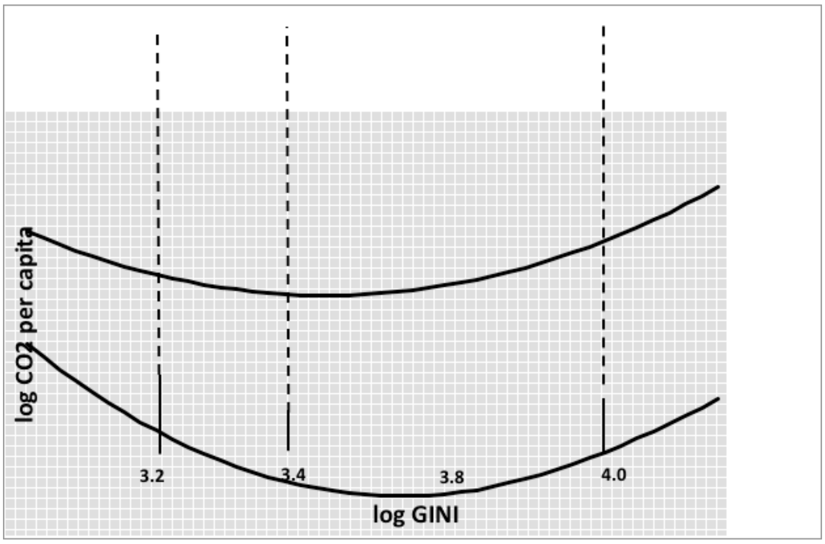
[5] measured in GDP

especially India and China where 2,4 billion people reside, among them 41,6% living under the poverty line of $1,25 per day in India, and 15,9% in China.[6]

Despite the high absolute poverty especially in India, there is less inequality in Asian societies than in the Americas and Africa. Inequality, measured in the Gini index, is the highest in Latin American and African countries. Only few highly unequal countries are in Asia, like Thailand and Kazakhstan.

Researchers also found that income distribution and inequality levels matter for mitigating emissions (Heil and Selden 2001). Their results suggest that the trade off between mitigating climate change and social equality and economic growth continues to exist. Yet, this trade off improves with economic growth and reduces with growing income and more middle income countries. Further recent research found a u shaped relationship between emissions and inequality (Grunewald, Klasen et al. 2011). However, these findings omit any conclusions the quality of the development paths and the kind of economic growth, whether it is based on a technology and innovation driven knowledge economy or pure extraction and export of natural resources.

Figure 1: Estimated relationships between income inequality and per capita CO2 emissions



Source: Grunewald, Klasen et al (2011)[7]

This relationship implies that, firstly, in relatively equal countries, on the left side of the figure, there is an inverse relationship between emissions and inequality. This suggests that when inequality increases, emissions decrease and when inequality decreases, emissions increase. Secondly, in relatively more unequal societies, reductions in income inequality relate to lower per capita emissions. The

[6]UNDP: Human Development Report 2011, 53,7% of the population in India and 12,5% in China are poor according to the multidimensional poverty index that also accounts for energy poverty, education, nutrition etc. beyond income.

[7]The figure below top line is for the 55th percentile of GDP per capita in 2000 and the bottom line is 45th percentile.

Gini and emissions per capita go in same direction, that is when inequality increases, emissions increase and when inequality decreases, emissions decrease.

What does this relationship imply for mitigation action? Ravaillon and Heil (2000) suggest that economic growth improves the trade off between reducing emissions and lower inequality and poverty. This suggests that as soon as there are more middle income countries, these can afford to do both, reducing emissions and combating poverty. Grunewald et al.'s (2011) findings suggest 'an opportunity for pro-poor. Low-carbon development for unequal rich countries' who can engage in reducing poverty and emissions at the same time. For poorer countries only the very unequal ones can engage in poverty reduction and emissions, more equal poor countries would face a trade-off. In the next section, we will investigate the implication of these findings for the MAPS countries.

3. Analysis: Inequality and emissions in middle income countries

The MAPS countries are all middle income countries with significantly high levels of income inequalities. According to the findings of previous research the trade off between reducing poverty, inequality vs. emissions improves for middle income countries (Ravallion, Heil et al. 2000). Others qualify that this only holds for highly unequal middle and low income countries (Grunewald, Klasen et al. 2011). Therefore, we try to find out where on the u shape the MAPS countries would be and what this posistion implies for mitigation and poverty reduction. The log GDP levels from our own calculations almost correspond with those for middle income countries in the previous research, presented in the table below.[8]

Table 1: GDP, emissions, inequality and poverty in MAPS countries in 2000

Country	Real GDP Per Capita ($)	Log Real GDP Per Capita($)[9]	Log Per Capita emissions (mt)	Log Gini	Poverty headcount ratio at national poverty line [10]	Poverty headcount ratio at $1.25 a day (PPP) [11]
Argentina	9174.00	9.12	0.04	3.92	-	4.7
Brazil	7787.18	8.96	-0.65	4.09	36.63	12.32
Chile	9450.84	9.15	0.06	4.09	26.84	3.15
Colombia	5820.66	8.67	-0.91	4.05	46.3	13.48
Peru	5022.79	8.52	-1.14	3.90	46.6	10.1
South Africa	5894.39	8.68	0.81	4.03	30.7	22.32

Source: Upenn (2011), World Development Indicators and authors' calculations.[12]

[8] Unfortunately the authors of Grunewald et al (2011) did not make available their data set yet, so we used the indicated sources UPenn (2011). Penn World Table, University of Pennsylvenia http://pwt.econ.upenn.edu/php_site/pwt_index.php.

[9] Natural logarithms used for all the variables

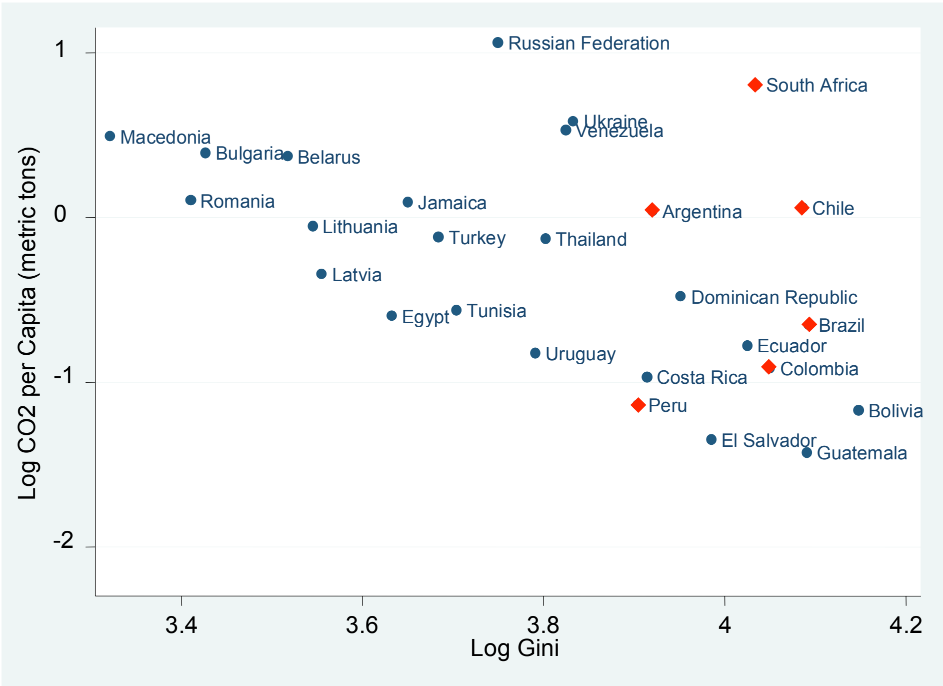
[10] World Bank Development Indicators in averages (1960-2008) as 2000 data set had more missing values

[11] *ibid*

[12] PPP Converted GDP Per Capita, derived from growth rates of consumption, government expenditure and investment, at 2005 constant prices, unit: 2005 International dollar per person (2005 I$/person)

The values suggest most of the MAPS countries mostly correspond with middle income countries, as in (Grunewald, Klasen et al. 2011). The relationship between emissions and inequality for MAPS countries to closely resemble that depicted by the curves for the middle income countries (45th and 55th percentile of log GDP). These values of log GDP per capita that correspond with these percentiles were 8.16 and 8.74 respectively. This shows that all MAPS countries are middle income countries, which rank in the on the right hand side of the of the average curve across all the countries, illustrated in the figure below.

Figure 2: Relationship between emissions and inequality in selected middle income countries in 2000



Source: Author's calculations based on the WIDER World Income Inequality Database and Oak Ridge National Laboratorydata (WIDER 2012)

The comparison of the figures 1 and 2 suggests that in the year 2000, the MAPS countries were to the right of the average turning point estimated to be around log GINI 3.8 by Grunewald et al (2011). If and how the actual u-shape applies remains questionable, as each country has different and multiple turning points. The individual turning points can only be found out analysing emissions and inequality data in time series. This is a possible subject to further research, beyond the scope of this brief. In the next section we illustrate these relationships in a time series for Brazil and South Africa.

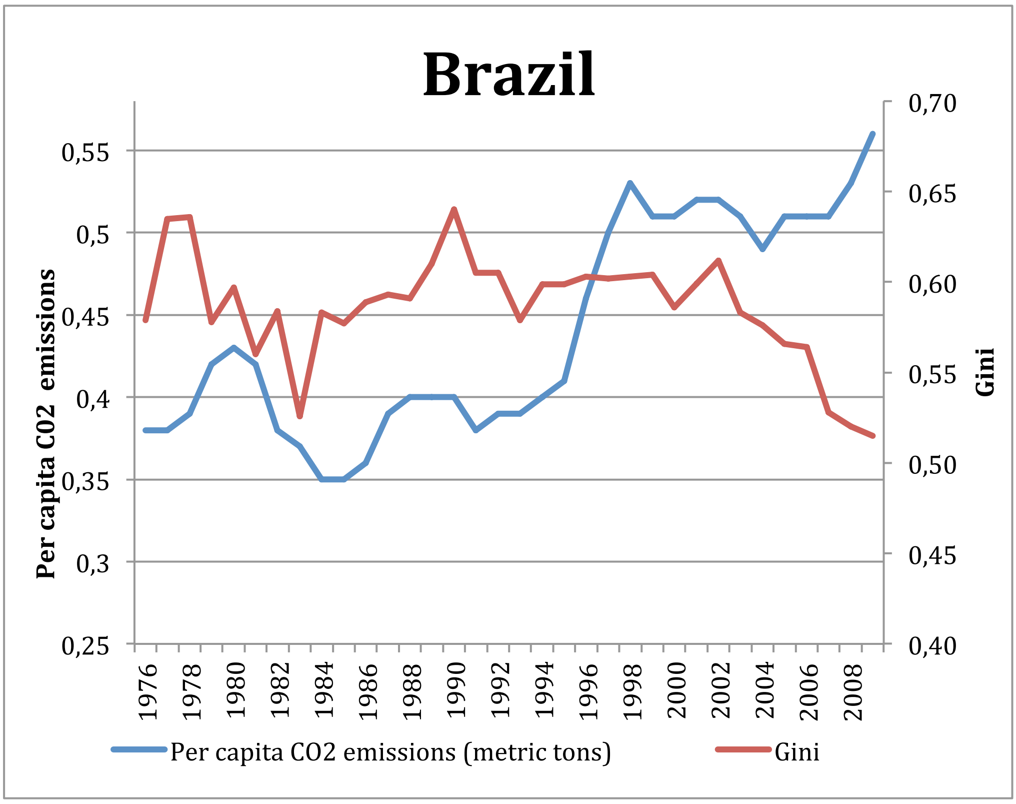
INEQUALITY AND CARBON EMISSIONS IN BRAZIL AND SOUTH AFRICA

In this section we analyze the relationships between per capita emissions and inequalities in a time series. The purpose is to find out how this relationship reflects in individual development paths in two MAPS countries.

BRAZIL

The Brazilian case presents an interesting pattern. Emissions and inequality rates reflect almost perfectly the development path and the economic policy choices. The figure below presents income inequality (measured in GINI) and per capita emissions (here measured in energy emissions, which exclude emissions from deforestation).

Figure 3: Income inequality and per capita emissions in Brazil



Source: Author's calculations based on the WIDER World Income Inequality Database and Oak Ridge National Laboratory data (WIDER 2012)

Between 1974 to the 1990s, inequality and emissions are going in the same direction. This is in line with the logic of a highly unequal society. This period was marked by the military dictatorship, which ended with the democratic elections in 1989 and Fernando Collor's presidency in 1990. The military government introduced the ethanol program in 1974 as a result of the global oil crisis in 1973. The increases in emissions in the 1970s reflect the economic growth in the 1970s, when the economy grew at rates between 10% and 14%. The relationship between emissions and relationship remains convergent until about 1994. This marks the beginning of Fernando Henrique Cardoso's presidency. Economic turbulences characterized the 1980s and 1990s. Cardoso introduced the Plano Real in 1994, and inflation targeting measures later in 1999 in order to reduce the high inflation rates and to consolidate the public budgets. During this period emissions, possibly resulting from GDP growth. After Plano Real (1994), the Brazilian economy grew significantly until the economic crisis in 1999 (Giambiagi 2005). From 2001 onwards income inequality starts to decline.

2002 and 2003 mark political change in Brazil, again. In 2002, Ignácio Lula da Silva was elected President of Brazil and took office in 2003. The financial markets reacted negatively to this political change, because investors feared that the leftist union leader would not continue the debt payment and jeopardize economic estability. The Lula administration payed the debt back quickly and the Brazilian economy grew at an average of 4,5% in the decade of the 2000 (Fazenda 2010). A key contribution to tackling high income inequalities was the introduction of the *bolsa familia* program, which transfers social grants to low-income families on the condition of proving child vaccine and school attendance. In Brazil, about 80% of income, which does not derive from work, comes from governmental transfer payments. The changes in the income distribution contributed at least 50% to the decline in income inequalities between 2001 and 2005 (Barros, Carvalho et al. 2007).

The Brazilian emissions and inequality levels reflect political and economic development paths and the respective interventions.

SOUTH AFRICA

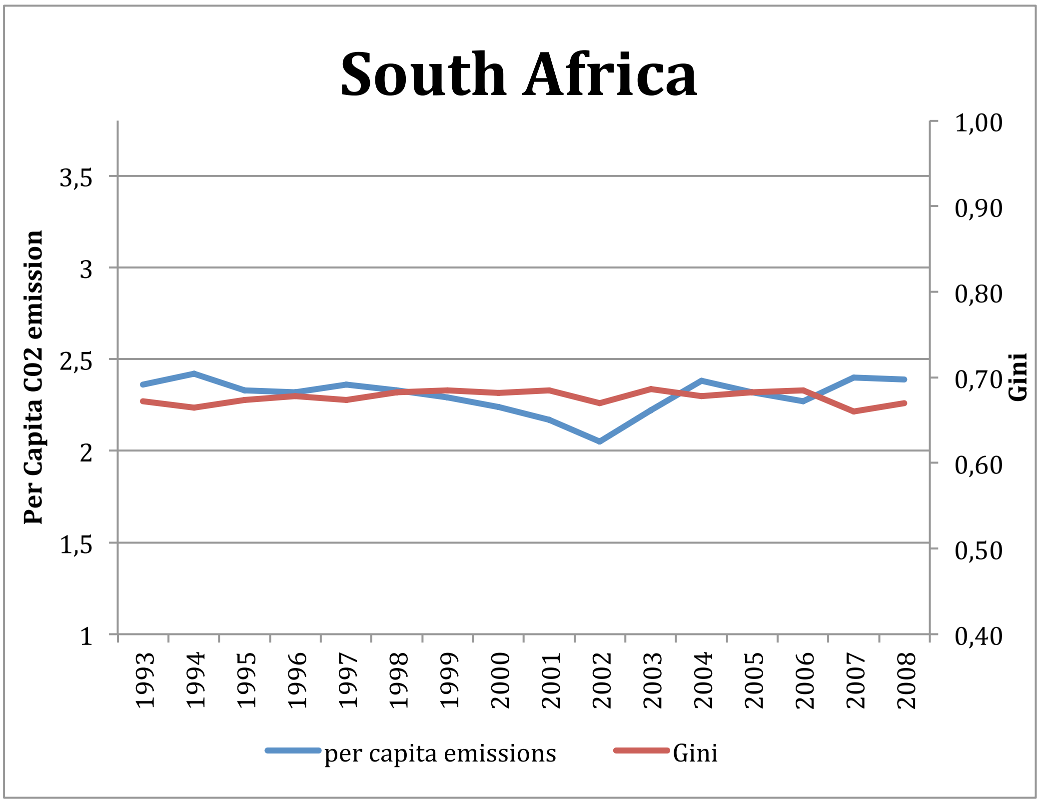
In the South African case, inequality and emissions levels also reflect political intervention.[13] South Africa has historically had high levels in inequality, and later emissions. Inequality and poverty in South Africa correspond to the historically created racial segregation. Apartheid's politics of spatial divide deepened a rural and urban inequality that still prevails. The GINI indicator between the African and White race groups still remain the highest (Leibbrandt, Ingrid Woolard et al. 2010).

Inequality and poverty measures are highly politicized, given the historical cleavages. Poverty measures are even more controversial than inequality. The question whether poverty has declined since 1994 and what the reasons are is highly contested among South African academics. Whereas Statistics South Africa (2002) and Hoogeveen & Özler (2006) found that poverty increased between 1995 and 2000, UNDP (2004) and Van der Berg et al. (2006)find that poverty stabilized or declined over this period. These different results lead to much debate about the

[13] According to the WIDER World Income Inequality Data, between 1980 and 1987 when South Africa had relatively lower level of inequality. As inequality decreased over this period, emissions grew. However, according to the data there was a huge increase inequality between 1987 and 1990. There are questions about the credibility of that data. We therefore use data from the AMPS survey and we get the relationship below for the period 1993 to 2008.

methodologies and data on the measurements of inequalities. As opposed to the Brazilian case, we cannot determine the curves to the distinguished administrations. The crucial political turning point remains in the inequality and poverty research remains pre- or post- 1994.

Figure 4: Income inequality and per capita emissions in South Africa



Source: Author's calculations based on All Media and Products Survey (AMPS) Data and Oak Ridge National Laboratory data

However, the economic and spatial structures of colonial and Apartheid rule, which maintained high inequality levels have been difficult to change. 9% of the white population still possesses 45% of economic assets in the country. The trend of reducing white ownership stopped in 1996. High increases in carbon emissions result from economic growth rates of around 5% from 2000 onwards. In 2001 they dropped to 2% and then continued at 4-5% until the economic crisis in 2009. This might explain the decline in per capita emissions in 2002. The economic growth rates, however, have not helped to reduce inequality and poverty significantly. The economic structure in South Africa does not correspond to the equation of higher growth reduces poverty.

Tait and Winkler (2012) have shown that electrification of poor communities will not affect the overall emissions of the countries significantly. The main source of emissions continues to derive from the energy sector and burning coal. South Africa is potentially well placed to design mitigation actions while continuing social policies to reduce poverty and inequalities, as the main emissions source concentrates in the coal-based energy sector.

4. Outlook: Key challenges on emissions and inequality in future research

Our analysis of the Brazilian and the South African case identified many turning points and different trajectories, which closely correspond to political choices and industrial development paths. Whether mitigating climate change and reducing poverty and inequality is a trade off and whether this has changed with changing income inequalities cannot be concluded yet. To answer this question we need further research. Firstly, we need to better understand the motivations of social policy and income distribution vs. mitigation policies to find out whether the trade off explanation still holds. This relates to the questions about the quality of economic growth and its income distribution within a society. This understanding will be necessary to find out whether and how mitigation actions can be contribute to reducing inequality and poverty. The qualitative analysis can inform further quantitative work. Secondly, economic analysis contributes to a better understanding how different mitigation actions (e.g. carbon taxes, cap and trade, industrial policies etc.) actually impact on inequality, income distribution and poverty on the one hand and emissions reductions on the other hand.

Within MAPS, both types of research matter. Economic and energy modeling addresses some key issues to inform policy on the impact of mitigation actions on the overall economy, its sectorial composition, inequality and poverty. The CGE model developed for Brazil (IMACLIM-S BR) tries to contemplate all these issues in order to propose policies that are able at the same time to reduce emissions and poverty, and to increase income distribution (Wills and Lefevre 2012). To have a detailed analysis of the impacts of mitigation policies over poverty and inequalities, IMACLIM-S BR splits the households in seven different income classes. For each class there is a detailed dataset regarding energy consumption, expenses with food, services and other items, as well as the wages received by each class, total taxes paid by each class and etc.

The same applies for the South African CGE model developed, which splits households into deciles according to their respective income. The same applies for the South African CGE model with a detailed energy sector (ESAGE), which splits households into deciles according to their respective income. This allows for the analysis of policy implications on poor, middle and high-income households. Recently, attempts have been made to link the ESAGE model with the South African TIMES Energy model (SATIM). SATIM also has the households disaggregated into low, middle and high-income households, based partly on their use of energy. The linking of SATIM and ESAGE allows for variables such as GDP and sectoral growth projection as well as household income projections from ESAGE and to be used in SATIM. On the other hand, SATIM provides ESAGE with information on investment within the energy sector. The linked energy-economics models (SATIM-E-SAGE) provide a more credibible methodology in analysing the potential impact of mitigation actions on poverty and inequality.

The detailed description of the different income classes will allow us to investigate the impact of climate policies and mitigation actions over inequalities and poverty. For example, if a carbon tax[14] is applied, what will the government do with the carbon revenues? Negative impacts of a carbon tax on poor households can be avoided quite easily (Winkler and Marquard 2011). One of the options is to use the carbon revenues to decrease payroll taxes in order to stimulate jobs creation and reduce the burden of the tax over the economy. Another possibility would be the so called "green check" that is simply to divide carbon revenues in equal shares for each household, in order to stimulate the economy with a bigger impact over the poorer classes, likely to reduce poverty and inequalities. Another Brazilian example of recycling the carbon revenues would be to use it to increase the penetration of *bolsa família*, aiming directly on reducing poverty and inequalities. Each of the options has a different impact on economic growth, poverty, inequalities and consumption. The models are flexible enough to simulate a big number of recycling options, and the proposal of the optimal way of recycling the carbon tax is one of the challenges in the near future.[15]

The challenge of modeling these multiple and complex interactions between mitigation actions, poverty and inequalities is huge. Therefore, the assumptions of the models and drivers of national policies need to be well informed through qualitative research. This will be necessary to support the scenario building processes in order to propose future climate policies, which allow middle income countries to reduce emissions and at the same time increase the welfare of its population in a more equal society.

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[14] The reasoning would the same with a cap&trade scheme.

[15]IMACLIM-S BR also has a link with the MESSAGE[15] model. This link is very important under the scenario of a carbon tax (or cap & trade scheme) that changes relative energy prices. A *hardlink* that allows multiple feedbacks is being developed in order to keep new relative prices and total demand of energy aligned with the optimal energy matrix (that generates electricity at the lowest possible cost under certain constraints). Changes in energy prices could also affect, for example, price of food, and this could be a problem for the families specially the ones situated in poorer classes. So, energy security and food security can also be analyzed with this model.

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