Policy Brief on policy analysis
1/2013

LIMITS

LOW
CLIMATE
IMPACT
SCENARIOS
AND THE
IMPLICATIONS
OF REQUIRED
TIGHT
EMISSION
CONTROL
STRATEGIES

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1. Modeling Durban platform scenarios

International climate policymaking is increasingly focused on the negotiation process under the Durban platform for enhanced action. This platform provided an interesting opportunity for discussing post-2020 emission reduction commitments beyond the traditional divide of developed versus developing countries. A refocus on the major economies might help achieve more than expected, and calls for new analytical thinking about the best policy instruments which can be put into place to provide adequate incentives to join the coalition. Integrated assessment models are tools which are heavily used to assess the implications and the interactions of climate mitigation policies globally, and which play an increasingly important role in the scientific debate about climate change mitigation. Global coupled energy-economy-land use-climate models are thus needed to assess the feasibility and socio-economic implications of 2 degree pathways.

The LIMITS project has set this as a central objective, and has evaluated 2 degree scenarios that were tailored to represent a set of plausible outcomes of the Durban platform negotiations on a post 2020 climate treaty. To this end, seven leading IAMs have run 12 scenarios, outlined in Table 1. The scenario design has addressed the most important features of the 2C space: the long term climate objective of both 450 and 500 ppm-eq, which would yield reasonably high and even chances of achieving 2C respectively, the level of ambition in 2020, with a more lenient reference policy ('weak') reflecting the unconditional Copenhagen Pledges and a more stringent version ('stringent') based on conditional Copenhagen Pledges, the level of international cooperation till 2020 and 2030, and finally, the burden sharing scheme to be adopted once the international treaty is signed (no sharing, per capita convergence and equal effort).

Scenario Type	Near term Target / Fragmented Action	Fragmented Action until	Long-term Target	Burden Sharing
Baseline	None	N/A	None	None
Reference	Weak	2100	None	None
Reference	Stringent	2100	None	None
Benchmark	None	N/A	450 ppm CO2e	None
Benchmark	None	N/A	500 ppm CO2e	None
Climate Policy	Weak	2020	450 ppm CO2e	None
Climate Policy	Stringent	2020	450 ppm CO2e	None
Climate Policy	Weak	2020	500 ppm CO2e	None
Climate Policy	Stringent	2020	500 ppm CO2e	None
Climate Policy	Weak	2030	500 ppm CO2e	None
Climate Policy	Weak	2020	450 ppm CO2e	Per Capita Convergence
Climate Policy	Weak	2020	450 ppm CO2e	Equal Mitigation Effort

Table 1: Scenario design of the LIMITS study.

2. Implications of Durban scenarios for achieving 2C

The scenarios have helped to understand the feasibility of attaining 2C for the set of Durban Action policy frameworks considered (DP henceforth). As highlighted in Figure 1, both baseline scenarios as well as fragmented climate policies (weak and stringent) lead to average temperature increases at the end of the century which are way above 2C, and in the range of 3-4.5C. On the other hand, stringent stabilization as investigated by the DP scenarios peak in 2020 and lead to a complete or near-complete phase out of global emissions by 2100. Simulations with a climate models indicates that the probability of overshooting 2°C before 2100 ranges from 24-41% for 450 ppm to 36-59% for 500 ppm CO2e.

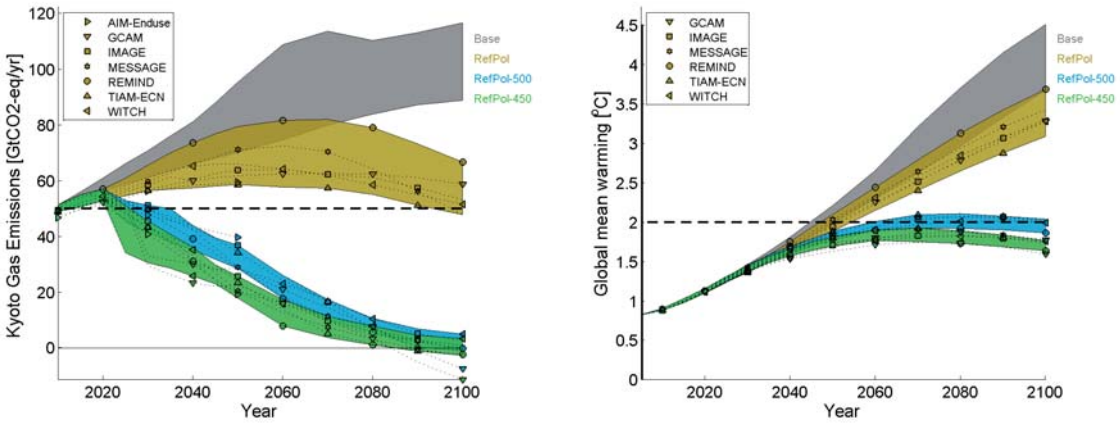

Figure 1: Emissions (left) and Temperature (right) pathways in the LIMITS scenarios

An important consideration for the feasibility of international climate negotiations will be the effort requires in terms of decarbonization rates and economic costs. Results indicate that the rate of action in the next one or of two decades will be crucial for determining the feasibility of achieving 2C: the larger the emission gap to cost effective scenarios, the higher will be the increase in the rate of emission reduction and of policy costs (Figure2). This indicates that emissions gaps above 10GtCO2e, corresponding to global delays to 2030 or to low effort in 2020, would jeopardize the chances of implementing 2C compatible policies, by increasing the decarbonization and economic effort above levels which would be already significant in the case of comprehensive and rapid global action.

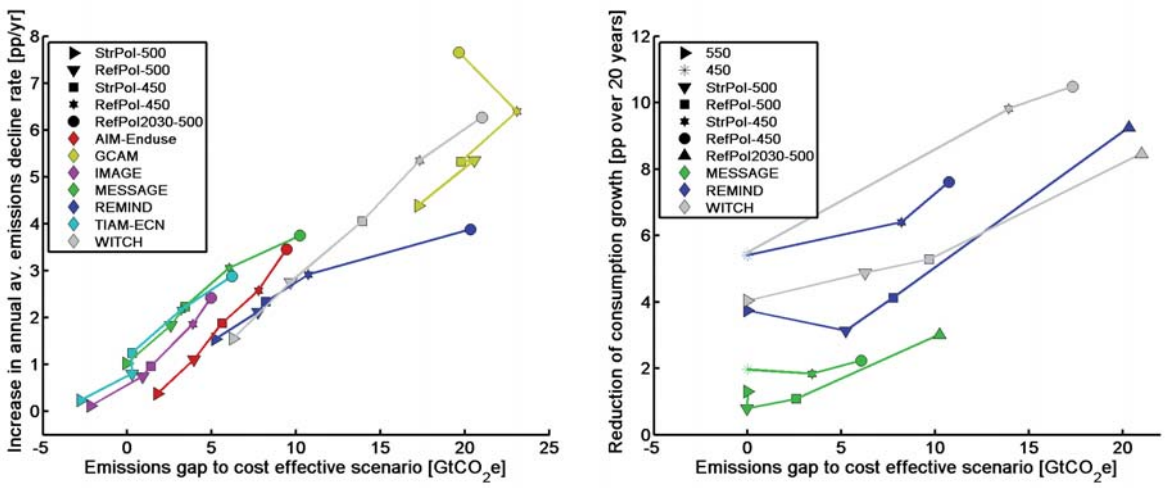

Figure 2: Decarbonization and economic effort of the climate policies in relation to the emission gap to idealized scenarios with full cooperation.

3. Investment needs and technological transition

Achieving stringent climate policies consistent with a 2°C climate change target would require a considerable upscaling of investments into low-carbon energy and energy efficiency, reaching approximately $45 trillion cumulative between 2010 and 2050, or about $1.1 trillion annually (see Figure 3). This represents an increase of some $30 trillion ($10-55 trillion), or $0.8 trillion per year, beyond what investments might otherwise be in a reference scenario that assumes the continuation of present and planned emissions-reducing policies throughout the world. In other words, a substantial "clean-energy investment gap" of some $800 billion/yr exists – notably on the same order of magnitude as present-day subsidies for fossil energy and electricity worldwide ($523 billion). Unless the gap is filled rather quickly, the 2°C target could potentially become out of reach.

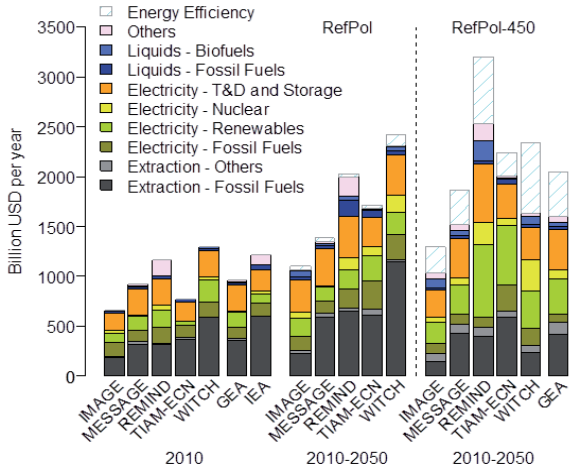

Figure 3. Global annual energy investments (both supply- and demand-side) across the various models in 2010 and average annual investments from 2010 to 2050 in the Reference and 450 scenarios. Also included estimates from the International Energy Agency and Global Energy Assessment.

A major decarbonization of the energy sector will be particularly needed (figure 4). Results indicate that average annual capacity additions for low-carbon energy technologies such as solar and wind power would need to be several times higher than the maximum average annual capacity additions rate observed in the recent past (i.e. for coal-based power plants, at a little over 50 GW/yr).

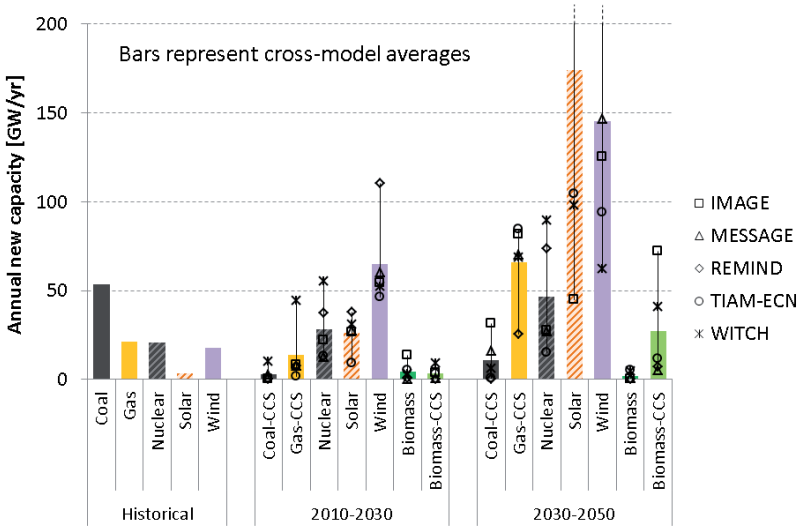

Figure 4. Average annual capacity additions (history and short to medium term future) for various fossil-based and low-carbon energy technologies in the RefPol-450 scenario.

4. Sharing the effort among the major economies

The aim of the LIMITS project –inspired by the new negotiation process in the Durban process- is to assess the implementation of 2C policies in the major economies. To this end, we have assessed the regional consequences of the Durban Action scenarios as designed in LIMITS. Regional issues are extremely important due to the differentiated distribution of costs and benefits of climate change policies.

Indeed, the distribution of the mitigation effort -measured in costs- of a carbon tax scenario is found to be quite unevenly distributed, as shown in Figure 5. The chart emphasizes a significant variation of costs across regions, and across models in some instances, but reveals a rather clear three-tier pattern. Advanced economies such as Europe, the US and Pacific OECD bear a cost which is lower than the global average. Fast-growing economies, including Latin America, Southeast Asia, India and Africa, pay a larger fraction of the cost. Finally, energy-exporting countries like Russia and the Middle East bear a policy cost which can be several times the global one.

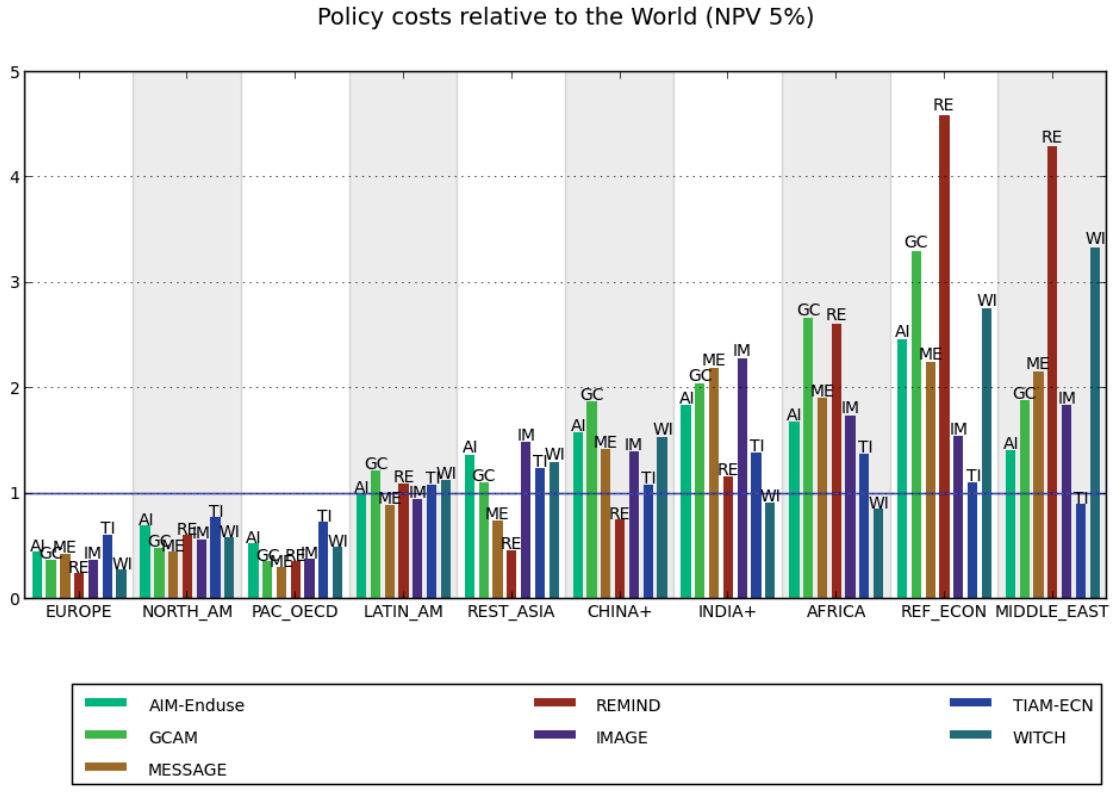

Figure 5: The distribution of regional policy costs. The chart shows regional policy costs across models in the 450 ppm scenario, relative to the global level (indicated by the blue line at 1).

To address the tension between efficiency and equity, in LIMITS we have assessed two burden-sharing schemes, based on resource -and effort-sharing principles, respectively. Our results indicate that the asymmetric distribution of costs could be alleviated by endowing regions with emission permits and allowing free trade of such entitlements. As shown in the next figure, an allocation scheme based on the equalization of climate policy costs across regions would allocate OECD with emission reductions compatible with those enunciated by the Major Economies Forum and the European Commission. China would receive emissions allowances which peak before 2030, and which would return to today's levels by 2035 to 2045. Both China and India would be involved in limited transfer payments in this scenario.

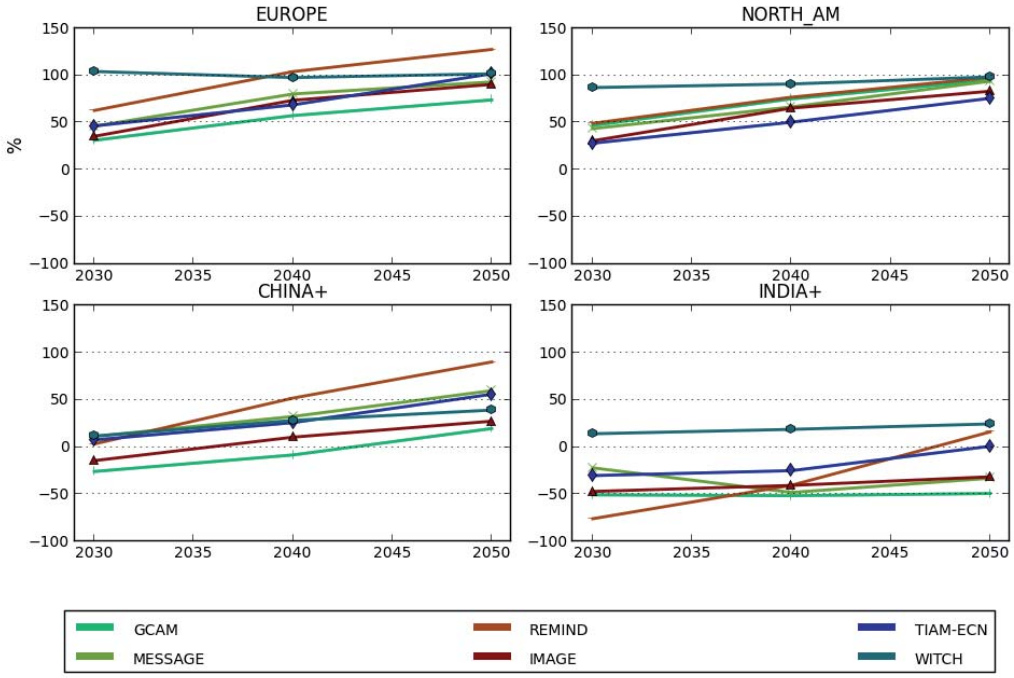

Figure 6: Emission allowances over time for the equal effort scenario, expressed in reductions from 2010 values.

However, finding an equitable solution in terms of cost balancing does not appear to be straightforward, especially when focusing on a resource-sharing rule of convergence to per capita endowments. Endowing regions with emissions permits would require a well-functioning market for emissions. Our results indicate that the size of the permit trade market would be significant in all the assessed regimes, and especially in the per capita convergence one. However, the main actors on the market for the two burden-sharing schemes would be different, with Africa and China being the major players in the per capita scheme, and the OECD and the energy exporting countries in the equal effort.

5. Policy recommendations

Several policy insights have emerged from the scenario analysis of the Durban Action scenarios. First, rapid and fast action is needed to achieve 2C with adequate probability; this would require a commitment to emissions peaking as early as 2020, with later dates leading to lower chances of attaining 2C and to significantly higher transitory decarbonization and economic efforts. In order to make the low carbon transition possible, large scale financing of the order of 1USD Trillion/yr will need to be redirected from fossil to low carbon sources. Another major challenge we have identified is the balancing of regional costs and benefits of climate policies. The distribution of policy costs appears to be quite uneven in the absence of compensatory mechanisms, due to different regional abatement potentials, and different economic structures. On the other hand, differentiating regional commitments would come at an expense in terms of additional policy costs, which we know we need to minimize if we want to achieve the big 2C challenge. Sharing mechanisms based on the establishment of carbon permits markets have the potential to alleviate this tension, but as shown in our project there appear to be no univocal solutions to the dual objective of efficiency and equity.