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Post 2012 Climate Architectures: A Comparative Assessment

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ABSTRACT

In July 2009 the G8 set a goal of cutting emissions of greenhouse gases by 80% by 2050, calling for worldwide emissions to be halved by the same date. Since then, China and India have expressed what have seemed more open positions towards the idea of reducing emissions, while the US appears, on the other hand, to be lowering its expectations on what will come out from the next round of negotiations.

Although it is widely understood that no single country can address the climate change problem on its own, the international effort has apparently run into an insurmountable roadblock.

The prospect of this Policy Brief is to discuss some of the major proposals, put forward by scholars and policy makers, to find practical solutions to these apparently irreconcilable differences. The brief is based on the quantitative work done by the WITCH (World Induced Technical Change Hybrid) modelling team, which aimed at comparing some of the main architectures for an agreement on climate policy. Possible successors to the Kyoto protocol are assessed according to four criteria: economic efficiency; environmental effectiveness; distributional implications; and their political acceptability which is measured in terms of feasibility and enforceability. The ultimate aim is to derive useful information for designing a future agreement on climate change control.

Policy Challenge

With broad recognition that a coordinated global effort is needed to address climate change, negotiations are well underway to find common grounds in the run up to the 15th Conference of the Parties (COP) of the UNFCCC, where world leaders will discuss a new international climate regime.

Despite the efforts, the process is hampered among other things by the difficulties of finding a shared understanding of the implications of the principles of equity, common but differentiated responsibilities and respective capabilities. While an "equitable" deal in Copenhagen should abide by these principles, without commitment by developing countries and in particular more advanced economies, any deal will have limited environmental effectiveness (and political realism). Yet developing countries are unwilling to commit to action unless a clear proposal is made on the financial resources that will be available internationally for adaptation and mitigation.

In an attempt to reconcile differing positions, proposals for a global climate change deal are continuously put forward by negotiators, as well as non-governmental organisations, the academia and leading thinkers.

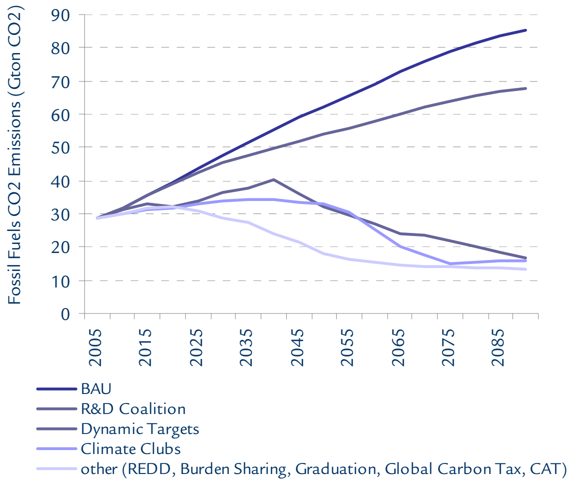
This paper undertakes a first-of-its-kind comparison of some prominent options using a common framework to assess four features of these architectures: economic efficiency; environmental effectiveness; distributional implications; and political acceptability, as measured in terms of feasibility and enforceability. The aim is to derive stylised but useful policy insights for designing a post-Kyoto agreement.

Architecture for Agreement

Proposed architectures for an international deal on climate change are inevitably complex, spanning economic, environmental, social as well as political dimensions. Yet, it is possible to identify key stylised features to derive model proposals. We summarize the investigated proposals by describing different trade-offs in scope and timing, with implications for cost, environmental effectiveness, and political feasibility and characterising each of them .

1. *Global Cap-and-Trade with Redistribution*: This benchmark scenario represents a first best world where all nations participate immediately in a global cap-and-trade system designed to stabilize atmospheric CO_2 at 450 parts per million (ppm) by 2100. Permits are allocated to all countries on an equal per-capita basis.
2. *Global Tax Recycled Domestically*: All countries apply a globally-consistent carbon tax designed to achieve the same stabilization trajectory as the previous scenario. Revenues from the tax are recycled domestically and implementation begins immediately.
3. *Reducing Emissions from Deforestation and Degradation*: Same as the first scenario, except credits from avoided Amazon deforestation are included in the permit market.
4. *Climate Clubs*: In this scenario, a group of mostly advanced economies agrees to abide by its Kyoto target and reduce greenhouse gases emissions 70% below 1990 levels by 2050. Other fast-growing countries and regions begin gradual efforts to reduce emissions below business-as-usual (BAU), but converge to the same level of reductions as the first group after 2050. All remaining countries face no binding targets, but their emissions are limited to BAU.
5. *Burden-Sharing*: Developed (Annex 1) countries commence abatement immediately, with the burden shared on an equal per-capita basis. Binding emissions targets are extended to all other countries, except those in sub-Saharan Africa, in 2040.
6. *Graduation*: Countries adopt binding emission targets as they reach specified criteria for income (capability) and emissions (responsibility). Annex 1 countries compensate for the delayed entry of non-Annex 1 countries by undertaking additional reductions as required to achieve a 450 ppm stabilization trajectory.
7. *Dynamic Targets*: The basic rationale for this proposal is political realism. Different countries adopt different targets over time depending on current and projected emissions (responsibility), income (capability), and population.
8. *R&D and Technology Development*: No binding emissions targets; instead, all countries contribute a fixed percentage of GDP to an international fund for developing low-carbon technologies.

Figure 1. CO2 emissions under the proposed policy architectures



SOURCE: Bosetti et al. (2009)

Key Findings & Recommendations

The authors apply the WITCH climate-energy-economy model to assess each of the proposed architectures along four metrics.

1. *Environmental effectiveness*, measured as expected temperature change above pre-industrial levels in 2100;
2. *Economic efficiency*, measured as change in gross world product, or GWP, relative to business as usual;
3. *Distributional implications* using the Gini Index to measure income inequality across different regions of the world in 2100;
4. *Potential enforceability*, measured by changes in global and regional welfare with respect to the status quo.

WITCH (Bosetti, Carraro et al., 2006- www.feem-web.it/witch) is a climate-energy-economy-climate model designed to assist in the study of the socio-economic dimension of climate change. It is structured to provide information on the optimal responses of world economies to climate policies and to identify impacts of climate policies on global and regional economic systems. WITCH is a hybrid model because it combines features of both top-down and bottom-up modelling: the top-down component consists of an inter-temporal optimal growth model in which the energy input of the aggregate production function has been expanded to yield a bottom-up description of the energy sector. The model provides a fully inter-temporal allocation of investments in energy technologies and R&D that are used to evaluate optimal and second best economic and technological responses to different policy measures. Countries are grouped in 12 regions that cover the world and whose strategic interactions are modeled through a dynamic game. The game theory set-up accounts for interdependencies and spillovers across regions of the world, and equilibrium strategies reflect inefficiencies induced by global strategic interactions. This allows analyses of both fully cooperative and partial/regional coalitional equilibria. In WITCH, technological progress in the energy sector is endogenous, thus enabling an accounting for the effects of different stabilization policies on induced technical change, via both innovation and diffusion processes. Feedbacks from economic variables into climatic ones, and vice versa, are also accounted for in the model dynamic system.

The table below illustrates an assessment of the proposed architectures along the four metrics identified.

Table 1. An assessment of the proposed policy architectures along four criteria

	(1)	(2)	(3)	(4)
BAU	3.75	-	0.200	-
R&D Coalition	3.58	0.37%	0.181	12
Dynamic Targets	3.02	-0.24%	0.156	5
Climate Clubs	2.95	-0.32%	0.158	6
REDD	2.76	-1.20%	0.197	4
Burden Sharing	2.76	-1.44%	0.196	3
CAT with redistribution	2.76	-1.45%	0.198	3
Graduation	2.76	-1.47%	0.158	3
Global carbon tax	2.76	-1.49%	0.178	0

Column (1) Environmental Effectiveness (T°C above pre-industrial)
Column (2) Economic Efficiency (GDP change wrt BAU, 5% d.r.)
Column (3) Distributional impact (Gini 2100)
Column (4) Enforceability Countries with positive welfare change, out of 12)

SOURCE: Bosetti et al. (2009)

Several policy-relevant insights emerge:

- All the policy architectures evaluated in this analysis produce warming above the 2°C target envisaged by the IPCC and the European Commission, the threshold level to lower the risk of irreversible changes to the climate system. More aggressive emission reduction strategies are needed than any of those implied by the architectures modelled here, if the 2°C target is to be met. On the other hand, more aggressive measures will imply higher costs and potentially negative effects on the enforceability of the policy.

- There is a clear trade-off between environmental effectiveness and cost, with more stringent policies leading to higher losses of GWP (Gross World Product). The inclusion of credits for avoided deforestation helps reduce costs somewhat, but estimated gross world product losses in all the scenarios designed to achieve CO2 stabilization at 450 ppm (Scenarios 1, 2, 3, 5, 6) exceed 1%, discounted at 5%. The Climate Clubs and Dynamic Targets architectures (4, 7) are significantly less costly, but also less effective. The R&D-only architecture (8) actually leads to slight gains in GWP, but it is also the least effective in terms of reducing emissions.
- There is a clear trade-off between environmental effectiveness and enforceability. If one assumes that countries' willingness to participate will depend on the expected welfare effects of the policy, then the more stringent architectures — because they are more costly — will also be the most difficult to enforce.
- Any of these architectures would produce a more fair distribution of income in 2100 relative to the current situation. In the more stringent scenarios (i.e., those designed to stabilize CO2 at 450 ppm), however, these gains in equality occur in the context of significant overall GWP losses. Of the architectures modelled, the most egalitarian are Climate Clubs, Graduation, and Dynamic Targets (4, 6, 7) because they distribute the abatement burden according to per-capita income and emissions. The inclusion of credits for avoided deforestation (3) also improves equity because most forest-related abatement opportunities are located in developing countries.

Conclusions

Is there a way out from the negotiations logjam? Is there a way to reconcile seemingly incompatible positions? These questions will take time to find answers, surely well after the Copenhagen COP15. But we can at least start identifying some of the key ingredients for the answer to be positive.

There will not be a single and simple answer that can be spelled out in terms of a target and a burden-sharing rule. Participation in an agreement will be partial and dynamically changing, with different countries applying different instruments and policy mechanisms.

However, a loose global agreement on some kind of long term objective will be extremely beneficial as it will allow for a better planning of long term investments decisions and it will spark the necessary short and mid term innovation efforts.

Building on the Clean Development Mechanism, a global carbon market could be developed, which could greatly improve the efficiency of mitigation efforts. The possibility of linking REDD credits in a global carbon market would further improve the prospect. The inclusion of REDD credits would also provide an incentive for commitment on the developing countries' side. A successful international agreement would need to ensure consistency with the environmental target, and provide sufficient financial incentives to enable developing countries, in particular the more advanced among them, to participate. The principle of fairness will need to be reflected, taking into account the responsibility of countries, together with their respective capacities, without jeopardising their right to development. Yet, pursuing extremely stringent targets and, at the same time, trying to keep policy costs down and distributing costs fairly is probably a chimera. A more reality-grounded approach is to follow a milder climate target which can be met with modest losses and which implies reasonable transfers to developing countries. Bringing adaptation into an international agreement, alongside mitigation, is likely to facilitate the identification of an area of compromise.

References

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