

Carraro, Carlo

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Panel 3

THE ROAD TO COPENHAGEN: WHAT AGREEMENT CAN ACTUALLY BE EFFECTIVE AND STABLE?

Introduction

CARLO CARRARO

Professor of Environmental Economics and
Econometrics, University of Venice

Preparatory talks to the next round of negotiations seem to indicate that a comprehensive agreement to mitigate climate change will not be easily attainable, despite the intentions of the US administration and the high expectations surrounding the Copenhagen meeting. One key issue is to what extent fast growing economies, and especially China, should take actions to reduce their growth of emissions. And whether fast growing economies are actually willing to take such actions. What are then the prospects for an agreement in Copenhagen? Can the world live with a few opt-outs, in particular from large developing countries? Are there policy measures to enhance the participation incentives of developing countries? The purpose of this paper is to address these questions by analyzing: (i) the incentives for the major greenhouse gas (GHG) emitting countries to participate in an international climate policy agreement, i.e. in a 'climate coalition'; (ii) the effectiveness of such climate coalitions in actually reducing GHG emissions, even when some countries opt-out; and (iii) the size of transfers that could actually enhance the incentives to participate in a large climate coalition.¹

The analysis is carried out using the World Induced Technological Change Hybrid (WITCH) model

¹ Most results presented in this paper are extensively discussed in Bosetti et al. (2009). The author is grateful to Valentina Bosetti, Enrica Decian, Romain Duval, Emanuele Massetti and Massimo Tavoni for insightful discussions and excellent collaborations. Financial support from the OECD is gratefully acknowledged. The author is also grateful to participants at the 8th Munich Economic Summit for many helpful comments.

(Bosetti et al. 2007 and 2009). WITCH has two major strengths in this specific context. First, it belongs to the class of so-called integrated assessment models (IAMs), i.e. it incorporates explicitly the gains from emission reductions in terms of avoided climate change through regional damage functions that feed climate change back into the economy. Also, WITCH has a game-theoretic structure, i.e. the 12 model regions and/or coalitions of regions behave strategically with respect to all major economic decision variables – not least emission abatement levels – by playing a non-cooperative Nash game. Therefore, when deciding whether or not to cooperate on GHG emission control, countries take into account how their decisions affect all other countries, and whether these countries will cooperate or remain outside the coalition.

Let us underline that incentives to sign a climate agreement will ultimately depend on a wide range of economic and political factors, not all of which can be captured by a climate-economy model. Nevertheless, useful insights can still be gained by focusing on economic incentives, which in the WITCH model include the avoided damages and the abatement costs incurred both within and outside a coalition.

Assessing the incentives for the major regions of the world to participate in an international climate policy agreement

The assessment of the incentives for the major regions to participate in an international climate policy agreement crucially depends upon the estimates of climate damages. Two different assumptions on climate damages ('low', following Nordhaus' estimates of climate damages; and 'high', following the estimates in the IPCC FAR) and two assumptions of the pure rate of time preferences (0.1 percent as in the Stern Review and 3 percent declining as in Nordhaus' work) are considered in our analysis. Damage functions are also specified to reflect the following major features of climate change:

- Damages from climate change are unequally distributed across world regions. Some countries may benefit from climate change (e.g. Transition Economies (TE) or Canada) at least for limited increases of temperature. Other countries, e.g. some developing countries, are more vulnerable and may suffer large losses. Sub-Saharan Africa (SSA), South Asia and Western Europe are likely to suffer the greater losses from climate change.
- Marginal abatement costs are also unequally distributed across world regions. Abatement costs are likely to be lower in India, South East Asia (SEASIA), SSA and China. They are much higher in Japan, Western Europe and TE.
- Taking into account both damages and abatement costs, Russia, the Middle East countries and China appear to have lower incentives to participate in a coalition than most other countries, *ceteris paribus*. In particular, a robust positive correlation is found between abatement costs and the magnitude of free-riding incentives, as measured by the welfare gain from withdrawing from a 'grand coalition' consisting of all countries.

These preliminary conclusions are useful to proceed with the identification of coalitions which are both effective, i.e. large enough to achieve a significant climate objective, and stable, i.e. not undermined by free-riding incentives.

As a result – and considering that what matters for participation incentives is the balance between abatement costs and benefits from avoided damages – countries with the highest incentives to free-ride are likely to be China, TE and the Middle East countries. *Ceteris paribus*, regions with flatter (steeper) marginal abatement cost curves and/or flatter (steeper) marginal damage curves have larger (smaller) participation disincentives, because they contribute more (less) to the coalition's abatement effort and/or benefit less (more). This is confirmed by the results contained in Bosetti et al. (2009). Their main findings are:

- As a general rule, developing countries incur larger damages from climate change than their developed counterparts. Within the group of developing countries, African countries appear to be more exposed than India and, to an even greater extent, China. Within the group of developed countries, Western Europe would suffer greater damage than the United States, which in turn would be more vulnerable than the OECD Asia-Pacific countries and Canada. Russia would be least affected by climate change.
- Abatement costs under a single world carbon price scenario are also larger in developing countries than in their developed counterparts, due to their higher energy/carbon intensity. Fossil fuel producers such as the Middle East countries and Russia incur the largest costs, reflecting their very high energy/carbon intensity and the fall in world fossil fuel prices. Within the group of developed regions, Western Europe and Japan-Korea would face smaller costs than the United States, also due to lower energy/carbon intensity.

Analyzing the size and stability of possible climate coalitions without international financial transfers

Let us introduce the concept of 'potentially effective coalitions (PECs)'. A set of n countries is a potentially effective coalition (PEC) if the sum of their technical lower bound emission levels (zero), added to baseline (BAU) emissions of non-participating countries (singletons), results in a concentration level which is below or equal to the target by 2100. The existence of at least one PEC is a necessary (but not sufficient) condition for the 550ppm CO₂eq target to be attainable. It is only necessary because a PEC is defined by an emission profile which is lower than the actual emission profile of the coalition. Therefore, if the target is not achieved by the lower emission profile, it cannot be achieved by the equilibrium emissions of the coalitions.

Results in Bosetti et al. (2009) show that only seven politically relevant coalitions (out of 4,095 when the world is divided into 12 regions) are PECs with respect to the 550ppm concentration target in 2100. This means that only few coalitions could meet the 550ppm CO₂eq target by 2100, even if they were able to reduce their own emissions to zero, while the emissions of non-participating regions continued along their BAU path. These few PECs include both China and India, along with most other world regions. Even by 2050, all PECs need to include both China and India, unless all other developing regions offset the non-participation of one of these two countries. Summing up, in all PECs:

- The participation of both China AND India is needed to attain the 2100 target.

- When the goal is GHG stabilization at 550ppm in 2100, PEC are subsets of the 12 regions in which at most three regions are not included (SSA, TE and SEASIA).
- Generally, only SSA or SSA plus another region (SEASIA, TE, Middle East and North Africa, and Latin America) can be singletons. All the other countries/regions should sign the climate agreement for the 550ppm target to be attainable.

Given that PECs are necessary but not sufficient conditions for meeting the target in our analysis, in practice coalitions will need to include virtually all world regions in the course of this century. In fact, when account is made for the economic unfeasibility of zero emissions, and for the free-riding incentives of non-participating regions, only a very broad international coalition excluding no region other than Africa can achieve the target by 2100.

The cost-benefit analysis in Bosetti et al. (2009) suggests that only a grand coalition finds it optimal *as a whole* to stabilise overall GHG concentration below 550ppm CO₂eq, and only at the high climate damage and low discount rate. Smaller PECs, including a grand coalition excluding Africa, achieve less ambitious targets. This is because they do not fully internalise the global environmental externality, and allow a larger number of (non-participating) countries to free-ride (thus increasing their own emissions).

Unfortunately, although this grand coalition can, and *as a whole* has an incentive to achieve the target, it does not appear to be internally stable. Most regions gain more from non-participation than from participation in a grand coalition. The same conclusion holds for all other, smaller PECs. In addition, neither the grand coalition nor any other PEC is *potentially* internally stable either, i.e. no set of international financial transfers can be found that would offset the free-riding incentives of *all* participating countries *simultaneously*. This is because the overall welfare gain from any PEC relative to the non-cooperative outcome is not large enough to give each country/region its free-riding payoff. After compensating all losers in the coalition, the remaining coalition surplus is too small to offset free-riding incentives.

Summing up, two additional important policy messages emerge from the analysis:

- When emissions of countries belonging to a PEC and the related emissions of singletons are the equilibrium ones, i.e. emissions are the outcome of a cost benefit strategic decision analysis, then only the grand coalition (all countries) achieves the 550ppm target in 2100. The grand coalition less SSA gets close to the target. All the other coalitions cannot achieve the target.
- However, no PEC, not even the grand coalition, is *stable*, i.e. there is always at least one country/region that gains from free-riding on the other countries' abatement efforts.

These conclusions apply in particular to the following six 'politically important' coalitions: (i) 'the grand coalition' to which all countries belong; (ii) the coalition formed by industrialised countries and by China, India, Russia and Latin America; (iii) the coalition with industrialised countries, China, India and Russia; (iv) the coalition with industrialised countries, China and India; (v) the coalition with industrialised countries and China only; (vi) and, finally, industrialised countries only. Only (i), the grand coalition, can actually achieve the 550ppm target by 2100.

Analyzing the size and stability of possible climate coalitions with international financial transfers

It is therefore relevant to analyse whether there are transfer schemes that can stabilise the grand coalition or other climate coalitions. First, the coalition surplus could be used to transfer resources to countries with the largest incentives to free-ride. If the coalition surplus is large enough to offset all coalition members' incentives to free-ride, then the coalition is Potentially Internally Stable (PIS). Unfortunately, as shown in Bosetti et al. (2009), there exist no transfer scheme and no coalition that can be shown to be PIS.

Although no set of transfers is found to address the free-riding incentives of *all* countries *simultaneously*, there is little doubt that transfers can improve the prospects for broad-based participation in international mitigation action. In practice, one powerful way to implement such transfers is through the allocation of emission reduction commitments across countries. For instance, allocation rules could be designed to shift some of the costs of action away from developing countries, which in general have larger free-riding incentives than their

developed counterparts. Illustrative allocation rules² under a global emission trading scheme (ETS) are explored in Bosetti et al. (2009), with the following results:

- The cross-country distribution of mitigation costs varies drastically across alternative allocation rules, reflecting the wide variance in the sign and magnitude of each region's net permit imports. By 2050, developing regions are projected to gain significantly (relative to BAU) from rules that would grant allowances in inverse proportion to each region's contribution to past cumulative emissions, or from rules that would cover their projected BAU emissions. To a lesser extent, and with greater variance across countries, they would also benefit from allocation of allowances in inverse proportion to emissions per capita, or emissions per unit of output.
- By contrast, developing regions incur sizeable losses during the first half of this century under grandfathering or full auctioning of international allowances. Russia loses under all rules except grandfathering. Overall, given the heterogeneity of outcomes across alternative rules, these could in principle be combined to achieve any particular distribution of mitigation costs.

These negative conclusions are partially offset by the following consideration. Let us quantify the amount of resources that developed countries could transfer to developing countries for the grand coalition to be stable. The sum that the industrialised countries should be ready to transfer is about 10 percent of their global welfare (about 3 percent of their discounted sum of future GDPs). With these transfers, which are net losses for developed countries, developing countries can be induced to sign a global deal and to adhere to a long-term climate agreement.

Sensitivity analysis

The PECs previously described are the union of all PECs identified in the four scenarios considered in this report: (a) high damage, low discount rate; (b) high damage, high discount rate; (c) low damage, low discount rate; and (d) low damage, high discount rate. Therefore, our analysis of potential effectiveness is robust to different crucial parameter specifications. Results on profitability also hold for the four scenarios.

However, the conclusion about the environmental effectiveness of the grand coalition, the only coalition that attains the 550ppm target in 2100, is limited to the scenario with high damage and low discount rate. In all other cases, no coalition attains the 550ppm target at the equilibrium. Therefore, only if the discount rate is low and future damages, in particular risks of future catastrophic events, are adequately taken into account, can the grand coalition yield an equilibrium emission profile consistent with the 550ppm target in 2100.

Finally, the conclusion that no coalition is stable and cannot be stabilised by a self-financed transfer scheme (no PIS) holds for the four scenarios and is therefore robust. However, it should be acknowledged that the main findings on coalition stability are subject to a number of limitations. Although the results are reasonably robust to the alternative damage and discounting assumptions, there are also wide uncertainties surrounding more distant climate impacts (beyond the 2100 horizon considered here), future emission trends, and the cross-country distribution of damages and risks. Also, the analysis focuses on immediate, irreversible and self-enforcing participation to mitigation action, thereby abstracting from other possible bargaining options including, for example, delayed participation, renegotiation, sanctions or joint negotiation in multiple areas (e.g. linking climate and international trade negotiations).³ Furthermore, the co-benefits from mitigation action such as in terms of human health, energy security or biodiversity, are not taken into account. Previous OECD analysis indeed suggests that such co-benefits are large, although the participation incentives they provide are not straightforward (Bollen et al. 2009; Burniaux et al. 2008). Finally, removal of fossil fuel subsidies is also omitted from the analysis. Insofar as phasing out subsidies would bring an economic gain and lower the carbon intensity of a num-

² Five rules have been analysed: (i) a grandfathering rule (permits are allocated according to each region's share of world emissions in 2005); (ii) a per-capita rule (each human being receives the same amount of emission permits); (iii) an 'ability-to-pay' rule (permits are allocated every year to each individual worldwide in inverse proportion to the gap between this individual's GDP per capita and average world GDP per capita in PPP terms); (iv) a 'historical responsibility' rule that grants allowances to each region in inverse proportion to its contribution to cumulative world CO₂ emissions over the period 1900–2004; (v) 'no-lose' rule under which the amount of allowances given to Non-Annex 1 regions covers their projected baseline emissions, while Annex 1 regions set their cap – then allocated across them on a per-capita basis – at whatever level is required to meet the 550ppm CO₂eq target. For all the five allocation rules just described, the same conclusion holds: no coalition is stable and no coalition is PIS.

³ However, these limitations have little impact on the analysis of PECs, which is the main cornerstone of the paper's analysis of feasible and effective coalitions. Therefore, most conclusions are quite robust to changes in bargaining options.

ber of (mainly developing) countries, incentives to participate in international mitigation action could improve (for an analysis of the economic gains and world emission impacts of fossil fuel subsidy removal, see Burniaux et al. 2009) .

Another important feature of the analysis is the assumption that even if a country benefits from an international coalition relative to a BAU scenario, it will always prefer to free-ride if that option is even more profitable. While this merely reflects the underlying assumption that each individual country maximises its own welfare, current international redistributive policies, such as official development aid, point instead to some degree of altruism. For instance, with a loss of a few percent in the discounted value of their consumption levels, it is estimated that industrialised countries would stabilise the grand coalition in the high-damage/low-discounting case, i.e. market-based transfers of such magnitude would be large enough to fully compensate other (mainly developing) regions for their free-riding incentives.

Conclusions

The main conclusions reached in this paper can be summarized as follows. Only coalitions including all large emitting regions are found to be technically able to meet a concentration stabilisation target below 550ppm CO₂eq by 2100. Once the free-riding incentives of non-participants are taken into account, only a grand coalition including virtually all regions can be successful. This grand coalition is profitable as a whole, implying that all countries can gain from participation, provided appropriate transfers are made across them. However, neither the grand coalition, nor smaller but still environmentally significant coalitions, appear to be stable. This is because the collective welfare surplus from cooperation is not found to be large enough for transfers to offset the free-riding incentives of all countries *simultaneously*.

If only the grand coalition is effective and profitable, and only in the high damage and low discount rate case, what's next? The attainment of an ambitious target (550ppm, above 2 degrees increase anyway) therefore seems unlikely: it requires immediate global cooperation, perfect foresight and full availability of all technologies. Would it not then be wiser to reduce mitigation ambitions (say from 550ppm to

650ppm, leading to about a 3 degree temperature increase), which is feasible at very low cost if all countries participate but is feasible also without all countries participating from the beginning?

This change in strategy would require additional investments in adaptation, but much later (which is an additional benefit given the economic crisis and development needs in China, India, and the other developing countries). Quite by chance the strategy just described seems to be very close to what is implicitly occurring in international negotiations. Indeed, the goals set by the United States, Japan, and some developing countries seem to lead to a 650ppm path more than to a 550ppm one.

The standard approach to climate policy, i.e. to start with very ambitious mitigation measures in developed countries and wait for developing countries to join the climate coalition, is likely to be very costly and largely ineffective. The approach suggested by this paper, i.e. to focus on less ambitious mitigation measures and develop a long term adaptation strategy in particular in developing countries, seems to be less costly and more effective in controlling damages from climate change.⁴

References

- Bollen, J., B. Guay, S. Jamet and J. Corfee-Morlot (2009), *Co-benefits of Climate Change Mitigation Policies: Literature Review and New Results*, OECD Economics Department Working Paper 692.
- Bosello F., C. Carraro and E. De Cian (2009), *The Optimal Timing and Investment Size of Mitigation and Adaptation Strategies*, OECD Report, Paris, forthcoming.
- Bosetti, V., C. Carraro, M. Galeotti, E. Massetti and M. Tavoni (2006), "WITCH: A World Induced Technical Change Hybrid Model", *The Energy Journal*, Special Issue on Hybrid Modeling of Energy-Environment Policies: Reconciling Bottom-up and Top-down, 27 (2), 13–38.
- Bosetti, V., C. Carraro, E. Massetti, A. Sgobbi and M. Tavoni (2009), "Optimal Energy Investment and R&D Strategies to Stabilise Greenhouse Gas Atmospheric Concentrations", *Resource and Energy Economics* 31, 123–137.
- Bosetti V., C. Carraro, E. Decian, R. Duval, E. Massetti and M. Tavoni (2009), *The Incentives to participate in, and the Stability of International Climate Coalitions: A Game-Theoretic Analysis Using the WITCH Model*, OECD Economics Department Working Paper, forthcoming.
- Burniaux, J.-M., J. Chateau, R. Dellink, R. Duval and S. Jamet (2008), *The Economics of Climate Change Mitigation: How to Build the Necessary Global Action in a Cost-effective Manner*, OECD Economics Department Working Paper 701.
- Burniaux, J.-M., J. Chateau, R. Duval and S. Jamet (2009), *The Economics of Climate Change Mitigation: Policies and Options for the Future*, OECD Economics Department Working Paper 658.

⁴ A detailed analysis of the optimal intertemporal and geographical mix of mitigation and adaptation measures is contained in Bosello et al. (2009).

PANEL

Panel 3 was chaired by **Anatole Kaletsky** of *The Times*, London, who pointed out that agreement prevailed at the conference as to the goals but not as to which of the many suggested approaches to follow. He hoped his panel could contribute to “some convergence into a coherent approach that could be considered in a Copenhagen agreement”.

The first short panel statement came from **Karen Harbert** of the Institute for 21st Century Energy at the US Chamber of Commerce, who spoke, from a private-sector perspective, of the need for balancing energy, the environment, economic growth and national security. The United States has been reducing its greenhouse gas emissions since 2001 with the help of several mandatory programs, she observed. The goals of the Obama Administration are even more ambitious, involving very dramatic change, and the policies are needed today to reach these goals. So far US public opinion has not been sensitised to the scale of the changes that are needed, as demonstrated by the extreme difficulties facing the approval of new energy projects. Clean coal projects will make the price of electricity in the United States higher, and this has met with strong public opposition. To reach a 50 percent reduction in global CO₂ emissions by 2050, the developing nations will have to participate, since they will be responsible 80 percent of the expected increase in emissions up to 2050. The principles of climate change policy that the business community can support include the following: equal competition for all countries, realistic goals that do not undermine economic growth, binding global commitments also from the large developing countries, verifiable mitigation actions, protection of intellectual property rights and removing trade barriers to environmental goods and services. It is only on the back of the free enterprise system that success will be possible.

Angelika Niebler, who chairs the European Parliament’s Committee on Industry, Research and Energy, pointed to the EU’s ambitious goals, set in 2007, of increasing the share of renewables in the energy mix by 20 percent, reducing CO₂ emissions by 20 percent and improving energy efficiency by 20 percent – all by 2020. To implement these goals the EU has introduced a cap and trade system, the first emissions trading system in the world. This system still needs improvements to ensure that companies are given the necessary planning security and

that a level playing field in the EU is assured. Nevertheless, with its ambitious goals the EU is well-positioned to take a leading role in the Copenhagen negotiations. Without a successful agreement in Copenhagen among the industrial and developing countries, the EU’s ambitious climate protection plan cannot be further developed.

The perspective of the power generation industry was presented by **Tuomo Hatakka**, Chairman of the Management Board at Vattenfall Europe AG. He stressed that the post-Copenhagen situation will be even more challenging than the Copenhagen negotiations themselves. Since renewable energy is not a silver bullet, an environmentally friendly energy mix must be found. Here, industry must lead by example. The Vattenfall strategy is a 50 percent CO₂ reduction by 2030 in its electricity generation and carbon neutrality by 2050. This goal is realistic, in his opinion, especially because of the positive effects of the learning curve. The technology for carbon capture and sequestering (CCS) already works, and his company will have a pilot plant up by 2015, with commercial use planned for 2020. The primary challenge will be the legal framework and public acceptance, especially with regard to the further development of nuclear energy. Decisions at a national and supra-national level are needed to implement an emissions trading system and to place a price on carbon. This will provide market-based incentives to promote technological development, also for conventional energy, to achieve a balanced energy mix.

Johannes Teysen, representing both E.ON and the World Energy Council, observed that the world’s poor cannot be denied access to clean and accessible energy and they too must be involved in a climate change solution. His company wants to be a part of the solution, but to do this stable political support regimes and the help of the markets are needed. Attracting private capital for energy solutions is crucial since the financing capacity of the state will not be sufficient. Regardless of the political framework agreed in Copenhagen, all will depend on technology and investment. The “Third Industrial Revolution” that many call for cannot be planned by the state. It can only come about through intellectual openness, by providing room for creativity and from the willingness to accept risk as well as failure. Making projections to the end of the century is also fruitless since we are sure to have a totally different situation then. Important now is technological openness and an atmosphere where things happen. In

Finland, for example, the political class has created an atmosphere for free discussion; in Germany, unfortunately, the public discussion on future energy sources is much less realistic.

Henning Wuester, United Nations Framework Convention on Climate Change (UNFCCC), stressed that success in Copenhagen is possible if the focus is placed on the right issues. Firstly, the industrialised countries must set ambitious mid-term targets, as they are the highest emitters and can also foster the necessary technologies. "Overall, the level of ambition is not yet high enough". Secondly, the developing countries, many of whom are already doing a lot, must enhance their mitigation efforts, applying the concept of nationally appropriate mitigation action (NAMA). These actions must be "measurable, reportable and verifiable". Thirdly, the resources for adaptation and mitigation must be increased. Since most of the funding for mitigation will come from private sources, incentive mechanisms such as a functioning carbon market must be put in place. Lastly, effective institutional structures are needed, perhaps built on existing financial institutions, to manage global cooperation and "leverage action by the private sector". Here, it is important that developing countries also "have their say on how funds are used". The EU is leading in setting emissions targets, and the United States is slowly moving in this direction, but the necessary decisions on the financial side have not yet been taken.

In the discussion that followed, **Efraim Sadka**, Tel Aviv University, mentioned how incentives could be used to reward good and penalize bad behaviour, such as non-participation in a climate control treaty. **Larry Karp**, University of California Berkeley, agreed and suggested that trade policy be used to encourage compliance. **Carlo Carraro** cautioned that trade officials would be reluctant to use this instrument as it could harm negotiations on free trade. Henning Wuester warned against using trade threats at the present stage of negotiations "where we are striving for a grand coalition". Karen Harbert pointed out that a tax on trade assumes failure in Copenhagen and would only pass on the costs to the consumer: "we should open up trade, which will bring down compliance costs for all countries". Anatole Kaletsky also mentioned the need to address deforestation, "one of the largest contributors to climate change". Henning Wuester pointed out that this issue is on the Copenhagen agenda and

that a system with verifiable compliance could indeed be part of a final agreement.

The problem of population growth was also brought up. A one percent increase in population means a 0.8 increase in emissions, as Carraro pointed out. If we can bribe people to cut down fewer trees, why not bribe them to have fewer children, **Dennis Mueller** of the University of Vienna suggested. This would be cheaper than all other solutions. Henning Wuester pointed out that China is using its population control policies in the Copenhagen negotiations as proof of having lower emissions than otherwise. However, "for obvious reasons we cannot ask the developing world to reduce its population".

Maximising efficiency is a tremendous opportunity, according to Karen Harbert. We need policies that reward efficiency although this is actually counter-productive to the bottom line of energy producers. Energy must become part of the solution to the climate problem and must not be seen as the enemy, since "more prosperous countries are more respectful of the environment". Henning Wuester added that "industry needs some direction that has to be put in place by policy". Long-term direction underpinned by short-term measures is needed.

Several discussants urged governments to invest more in education and research, especially for future technologies. Angelika Niebler, however, defended policy-makers' accomplishments thus far. The transition to renewables has only been possible with the help of politicians, who have also effected a rethinking on energy saving. Political decisions have also created reimbursement systems for feeding into the power grid. The EU emissions trading system will produce the revenue needed to tackle the climate change problem. Henning Wuester was also optimistic that political leadership and support at the highest levels from various countries will increase the chances for success in Copenhagen. He was sceptical, however, about economic models that look far into the future: "goals must allow for corrections, as we see what is possible and not possible". Or as Kaletsky added, quoting Voltaire: "the best is the enemy of the good".