Low Carbon Prosperity Summit

Wednesday 9 February 2011, Brussels

Background note by Prof. Dr. Ottmar Edenhofer[1]

1. Climate stabilization will cost 1-2.5% of cumulated global GDP until 2100

Integrated model analyses reveal that stabilizing the climate at 2°C (450ppm CO_2) is technically feasible at costs of 1-2.5% of cumulated GDP until 2100 (Edenhofer et al. 2010). But the window of opportunity for climate policy is narrow and closing. If the world continues investing business-as-usual until 2030, the 2°C target will no longer be technically feasible. Postponing global policy until 2020 boosts global mitigation costs by about 50% (Edenhofer et al. 2009, Figure 1). This also entails an overshooting of CO_2 concentrations, thus lowering the probability of achieving 2°C. More ambitious stabilization levels leave even less scope for delay and non-linearly increasing costs are observed in modeling exercises (Figure 2).

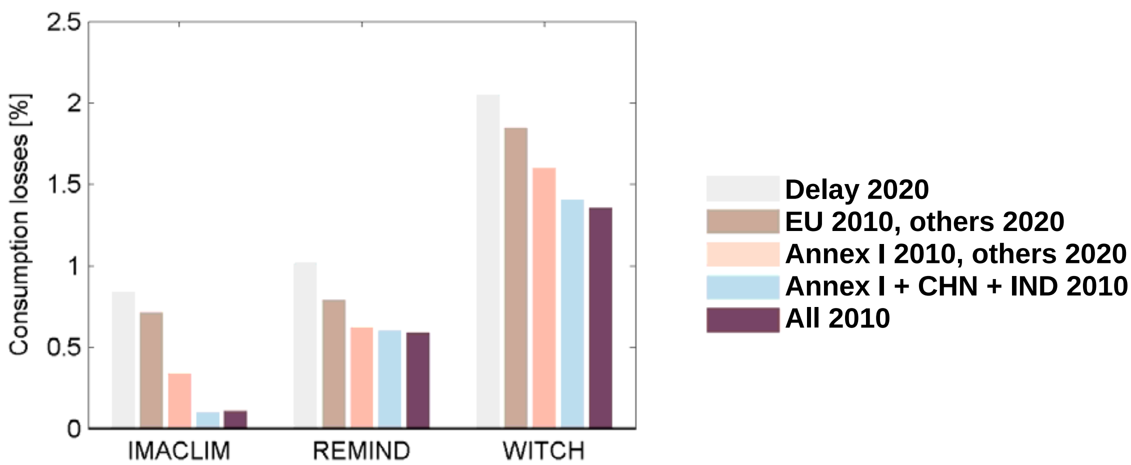

Figure 1: Global mitigation costs (displayed as consumption losses) for various scenarios with delayed participation in a global carbon market, and a benchmark case with global participation from 2010 (All 2010). Percentage changes are relative to baseline using a 3 % discount rate. Source: Edenhofer et al. 2009.

[1] Contact: Prof. Dr. Ottmar Edenhofer, Potsdam Institute for Climate Impact Research (PIK)
P.O. 60 12 03, D-14412 Potsdam,

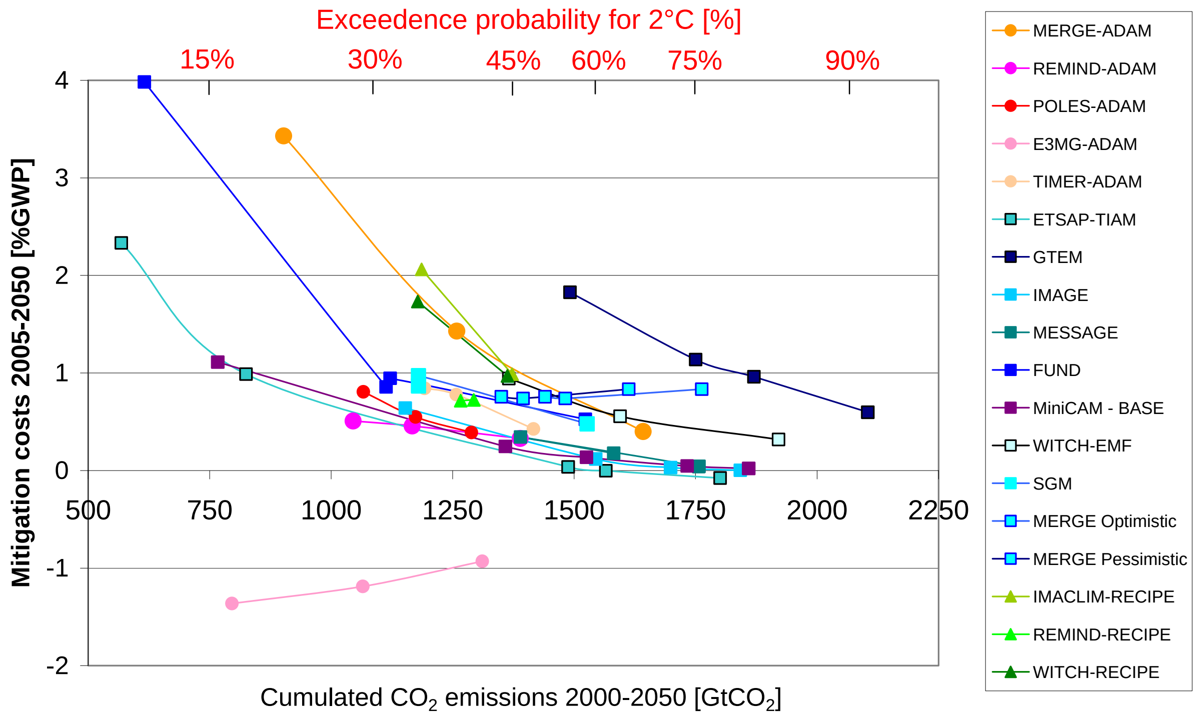

Figure 2: Update of IPCC AR4 mitigation costs. Costs for mitigation are given as as cumulated GWP losses or cumulated abatement costs (as integral of marginal abatement cost curves) relative to baseline GWP (in %, discounted with 5% discount rate) for 2005-2050 depending on cumulated fossil fuel CO_2 emissions from 2000-2050. Results are reported for different model comparison exercises (ADAM scenarios, Edenhofer et al. 2010, in red tones with bullets), EMF-22 scenarios (Clarke et al. 2009, in blue tones with squares) and RECIPE scenarios (Edenhofer et al. 2009, in green tones with triangles). Numbers are only given for scenarios with all technologies and with full participation. The cumulated emission budget is a proxy for the probability of exceeding 2°C (given on the upper x-axis). Source: Knopf et al. 2011.

2. An increasing oil price is the most important risk for climate policy

The IEA expects the oil price to increase over the next decade even if currently proposed energy policy packages around the world will be implemented (IEA 2010). Without a reliable international agreement, the increasing oil price will have three effects:

a) Coal will become more competitive in the power sector in China and India. We have already observed over the last five years that carbon intensity has increased in these regions.

b) Extraction of non-conventional oil will increase, with quadrupling between 2008 and 2035 (IEA 2010).

c) China, South Africa and India will invest dramatically into coal-to-liquid, contributing to more than half of the global 1 million barrel per day production projected for 2035 (IEA 2010).

This process will not be stopped by a scarcity of coal. Coal is abundant and cheap. There is no scarcity of fossil fuels. The binding constraint is the scarcity of the atmospheric disposal space (see Figure 3).

Climate policy transforms the rent income of fossil fuel owners into a climate rent. This rent transformation process is one of the most important reasons why climate policy is perceived as an economic threat. To make ambitious climate policy viable, this distributional conflict needs to be resolved. Innovation and Green Growth have a key role in mitigating this conflict. Without innovation, the climate bargaining problem collapses into a zero-sum game.

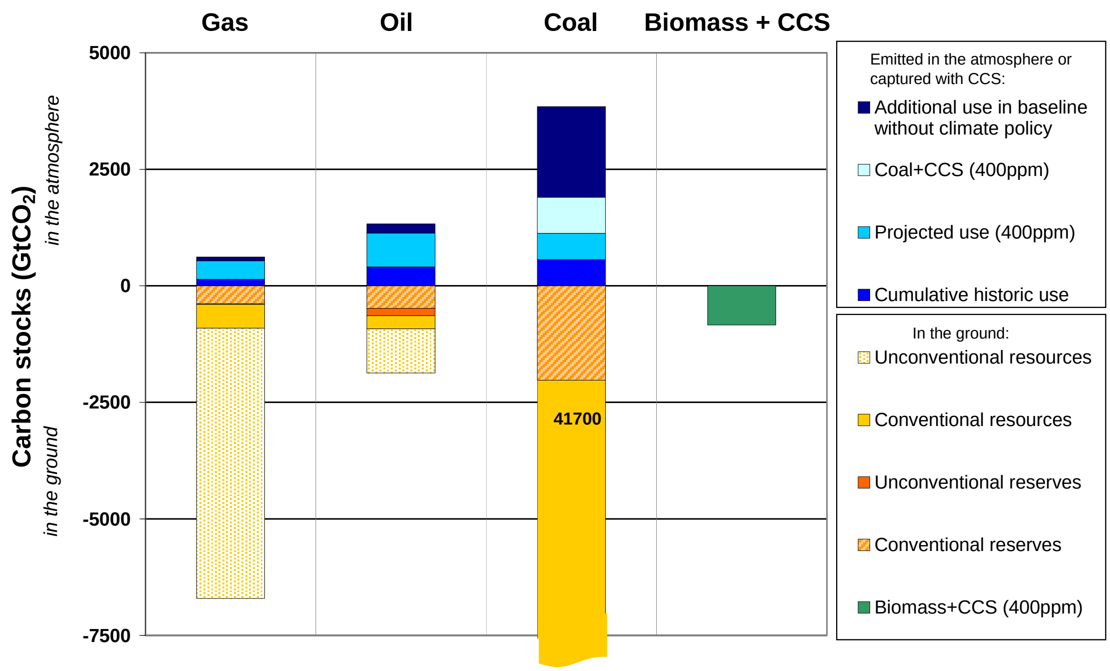

Figure 3: The basic challenge of climate economics: Fossil resources in the ground, and historical and potential future extraction and corresponding CO_2 emissions. Reserves are understood as natural resources economically extractable at current technology levels and prices. Resources are future extractable amounts of natural resources that exceed reserves. Source: Knopf et al. 2010.

3. Green Growth is needed to mitigate climate policy conflicts. Innovation is key for Green Growth

Model studies of decarbonizing global economic growth consistently identify energy efficiency as a crucial – indeed no-regret – option. Cost efficient scenarios always involve the deployment of a portfolio of technologies. Still, some technologies are more important than others: Foregoing specific low carbon technologies raises the cost of reaching a green economy more than others. The availability of Carbon Capture and Storage (CCS) and renewable energy sources turns out to be of pivotal importance.

Without deployment of renewable energy beyond its usage in the business-as-usual case the costs of mitigation may double and models may indeed not be able to report results for ambitious targets (Figure 4, Edenhofer et al. 2010). Moreover, the costs of the transformation are critically determined by assumptions regarding the potential of biomass use. With biomass use of less than 100 EJ per year – compared to 200 EJ per year in the reference case – mitigation costs more than double. Biomass is especially important in combination with CCS, as this allows net extraction of CO_2 from the atmosphere. Increased deployment or a constraint of nuclear energy has only a limited effect on the costs (Figure 4, Edenhofer et al. 2010).

A challenging aspect of a future green energy system is stable network integration of power supply from fluctuating renewable energy sources. Additional grid infrastructure for Europe is needed as well as additional research into storage technologies, and incentives to invest in technologies for balancing intermittent renewable energy supply.

Innovation is key for Green Growth because it enables decoupling of economic growth and emissions at low costs, thus minimizing social conflicts. Climate-friendly innovations will only be competitive if the current and future scarcity of the atmospheric disposal space is reflected in a reliable carbon price. It can be expected that the costs of renewable energy sources and other technologies will be reduced by learning-by-doing and learning-by-researching. On the other hand, lower learning rates of renewable technologies can nearly double the costs of mitigation (Tavoni et al. 2011).

a) b)

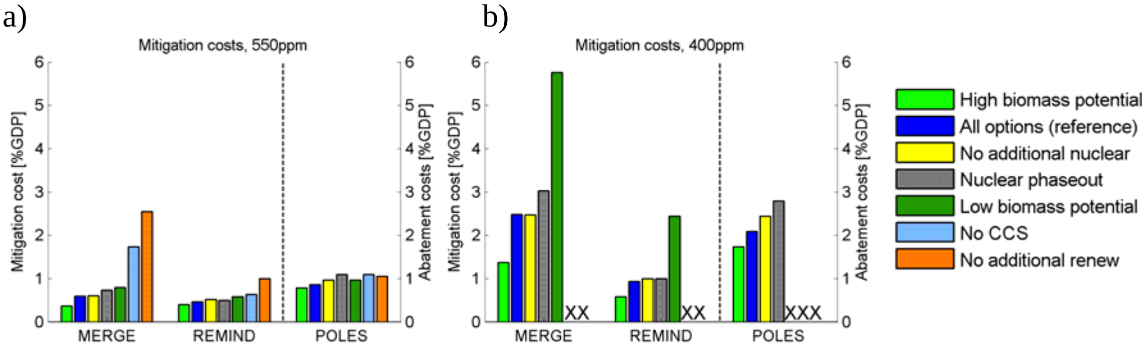

Figure 4: Global mitigation costs as aggregated GDP losses (for the models MERGE and REMIND) or abatement costs (POLES) until 2100 relative to the baseline. “X” indicates a scenario where the target is not achieved. Source: Edenhofer et al. 2010.

4. Technology policy is needed to avoid path dependencies in the energy system: without technology policy, climate policy is more expensive

As innovators cannot fully prevent their knowledge being appropriated by competitors, they will underinvest to green innovation. Therefore, public technology support is warranted from an economic theory perspective to avoid lock-in to suboptimal technology portfolios. Without technology policy, increases in consumptions losses by up to 1% are possible (Kalkuhl et al. 2011).

It is important to distinguish between initial support of nascent technologies which should focus on exploring their potential for further cost reductions; and policies for large-scale deployment of mature technologies which should be harmonized across Europe to ensure that these are installed where they can operate most efficiently.

5. Technology policy without carbon pricing becomes very costly. Innovation for Green Growth cannot substitute carbon pricing

Technology policy should be implemented as a complement to carbon pricing, which is central for driving Green Growth and achieving climate policy objectives in an efficient manner. Energy efficiency improvements and technology push policies alone will reduce the costs of using energy. Thus, reductions in energy consumption will be partially offset by the increased incentive to use more energy (rebound effect). Achieving emission reduction only by means of technology policy therefore requires significant technology expenditures. Technology policy without carbon pricing can increase consumption losses by 50% compared to the optimal policy portfolio (Kalkuhl et al. 2010). A price on carbon internalizes the climate externality and raises the price of competing fossil fuels, thus discouraging their usage. It facilitates the adoption of renewable technologies, energy efficiency measures and other substitution options by enhancing their competitiveness relative to fossil fuels.

6. Top-down and bottom-up are not in conflict

Copenhagen has undermined the confidence in the top-down approach to international climate policy. Many observers now emphasize the advantages of bottom-up approaches and warn against continued reliance on top-down. It is evident, though, that both approaches are complementary and needed. Even in presence of a strong top-down regime, policies and reductions ultimately need to be deployed at the local and regional scale. It makes sense to set up domestic policies at the national and e.g. city scale now, not only to harness low or even negative cost abatement options already available today but to prepare for the implementation of more ambitious policies in the future. In addition, unilateral technology policy reducing the cost of mitigation is an example of how bottom-up measures can facilitate future global agreement by reducing the costs of agreement to emission cuts for national negotiators. In the mid to long-term, ambitious emission reductions relying only on bottom-up measures without an international agreement will be impossible to achieve due to the pronounced free-riding incentives. The only way for bottom-up delivering ambitious reduction would be a (or a series of) technological breakthroughs not anticipated today that deliver low-cost and low-risk technologies outcompeting tradition technologies even in less ambitious green investment frameworks.

Carbon leakage is not a major problem in the mid-term. The cost of carbon share in value-added of almost all exporting industries is negligible, and only a few sectors - iron and steel, lime and cement, aluminum – will be significantly affected. The biggest problem is carbon leakage via international energy markets: reduced EU demand dampens world fossil fuel prices. The short-term drawbacks need to be pitted against the short-term benefits from initiating a transformation towards green growth and enhancing energy security by diversifying energy sources.

7. Regions are acting even in the absence of a global agreement

Nations at Copenhagen were willing to bring unilateral emission reductions to the table even absent a formal international agreement. The Analysis of a 'Copenhagen forever' scenario shows that expected global warming would be at about 3.5°C. However, there remains a 20% chance that temperatures would rise by 4-5°C (Rogelj et al. 2010). Other analyses suggest that pledges are consistent with "likely" temperature increases of 2.5° C to 5° C up to the end of the twenty-first century (UNEP 2010). The IEA concludes that only "vigorous implementation of Copenhagen Accord pledges to 2020 and much stronger action thereafter" is "consistent with a pathway limiting the increase in temperature to 2°C" (IEA 2010).

8. There is a first-mover advantage for Europe

There are clear indications that many world regions are serious about implementing a reasonable climate and energy policy. If the world is serious about the 2°C, Europe will enjoy a first mover advantage when unilaterally implementing climate policy even prior to other regions that may implement aggressive reductions by 2020 only. Europe is better off compared to the case that it delays action in line with other countries until 2020 (Figure 5, Edenhofer et al. 2009). The benefits of anticipating future emission reductions and avoiding stranded investments exceed the costs of the higher overall emission reduction commitment (Edenhofer et al. 2009). A 30% EU emission reduction goal until 2020 sets a credible commitment for the transformation towards a low carbon economy. To stabilize expectations for investments and innovation, besides the near-term targets in 2020, the long-term benchmark of 80-95% emission reduction until 2050 needs to be bolstered by intermediate targets for 2030 and 2040.

The world-wide acceptance of ambitious climate policies relies upon the visible demonstration of feasibility and benefits of Green Growth. Europe as a pioneer in developing the technologies and institutions of a green economy will benefit not only from a reduced dependence on oil imports (IEA 2010) and improved environmental quality but from supplying world markets with cutting edge technology. 200 years after inventing the industrial revolution, developing the global public good of a "Green Economic Growth" model will bolster European reputation domestically and across the world.

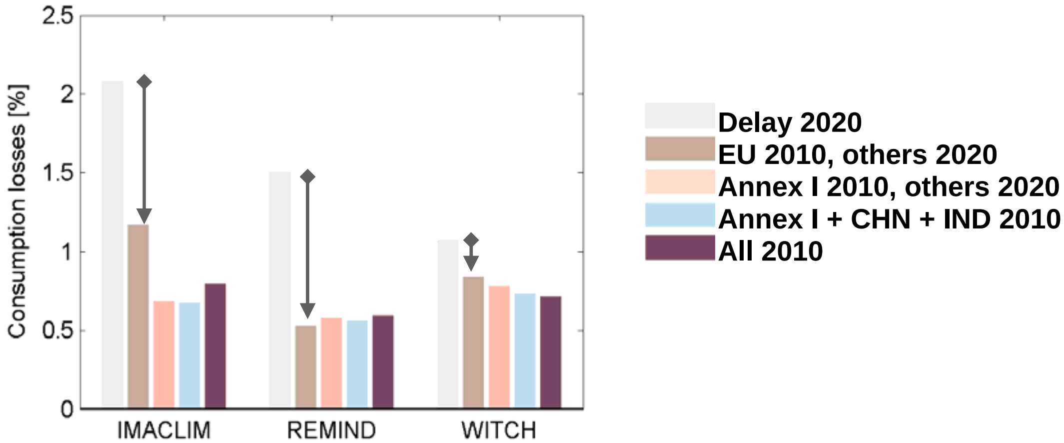

Figure 5: Mitigation costs for Europe (displayed as consumption losses) for various scenarios with delayed participation in a global carbon market, and a benchmark case with global participation from 2010 (All 2010). Europe enjoys a first-mover advantage. Percentage changes are relative to baseline using a 3 % discount rate. Source: Edenhofer et al. 2009.

9. Emission trading is the central pillar in the EU green investment framework

The EU Emission Trading System (EU ETS) is Europe's most important and innovative policy instrument for climate policy. It sets a consistent incentive for green innovation and abatement across all economic activities. The EU ETS should be further developed to become the nucleus of a global carbon market by expanding it across sectors, regions and time.

Sectors: Including transport and buildings in the EU ETS would roughly double coverage to more than 70% of European GHG emissions. This sets a consistent incentive for innovation and abatement across the European economy. In the road transport sector, current emission intensity regulation of EU car sales and fuel quotas fails to set consistent incentives and needs to be complemented by the European price on carbon. Including road transportation in the EU ETS will trigger appropriate demand side reductions and sets proper long-term incentives for car manufacturers and fuel producers. Given the overall cap, achievement of the environmental objective is certain. A recent study using abatement cost curves from several models demonstrates that given the current EU climate policy setup (abatement goals, access to international offsets), including road transportation in the EU ETS will not raise the emission allowance price, thus mitigating concerns over carbon leakage (Flachsland et al. 2011, see Figure 6)
Regions: Other cap-and-trade schemes are emerging in California, other OECD countries and China. The EU ETS should link to these schemes over time to reap gains from trade and create a harmonized, large-scale OECD market for green technologies.
Time: Investments to emission-intensive infrastructure have a long time horizon. The carbon pricing schedule needs to match these time spans to avoid inefficient deployment

of high-carbon investment. A clear EU ETS budget up to 2050 and clear rules for its revision as new information about international negotiations and technologies arrive will stabilize the European investment framework for the transition to a green economy.

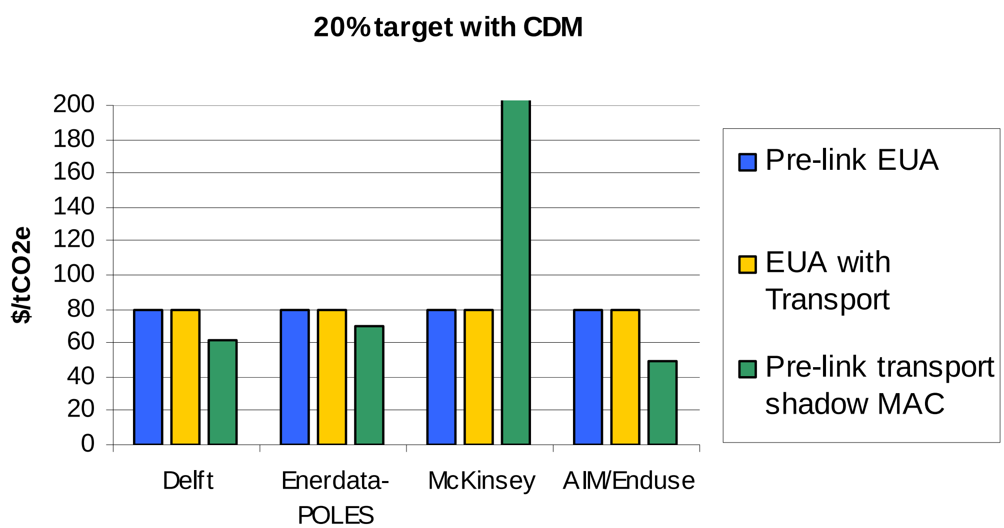

Figure 6: The EU ETS allowance (EUA) price does not change when integrating the EU road transport sector in the EU ETS by 2020, across a range of models (Flachsland et al. 2011).

10. The challenge and value of international cooperation

The EU ETS is one of the most important learning experiments for climate policy. Agreement over the internal allocation of the climate rent was achieved despite significant socio-economic asymmetries across member states. This gives some hope for global negotiations. Technologies are key to reduce the magnitude of the distributional conflict over emission rights and escape from a zero sum game.

In the long-run, a global agreement to overcome the carbon leakage and free-rider problems is inevitable. It currently looks unlikely that green technologies will become so cheap (including their co-benefits) that they will eventually become globally adopted at large-scales even absent deliberate policy initiatives.

Despite conflicts, the EU ETS has been a major driver for a coherent European Climate and Energy Policy of the European Union. Neither is national energetic autarky a reasonable option nor can national climate policy be cost-efficient. In view of the substantial heterogeneity of 27 member states, the success of the EU ETS sets an encouraging example for the development of an OECD-wide carbon market and a further integration of the international community. The EU ETS has the potential to promote Green Growth and innovation towards a low carbon economy.

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