

## Copenhagen Consensus on Climate – Results

The goal of the Copenhagen Consensus on Climate was to evaluate and rank feasible ways to reduce the adverse consequences from global warming. Individual proposals that would achieve this were examined under the eight solution headings of: Climate Engineering, Carbon Cuts, Forestry, Black Carbon Cuts, Methane Cuts, Adaptation, Energy Technology, and Technology Transfers (TTs).

A Panel of economic experts, comprising five of the world's most distinguished economists, was invited to consider these proposals and identify the proposals where investments would be most effective. The members were:

- **Jagdish Bhagwati**, Columbia University
- **Finn Kydland**, University of California, Santa Barbara (Nobel Laureate)
- **Thomas Schelling**, University of Maryland (Nobel Laureate)
- **Vernon Smith**, Chapman University (Nobel Laureate)
- **Nancy Stokey**, University of Chicago

The panel was asked to answer the question:

**If the global community wants to spend up to, say \$250 billion per year over the next 10 years to diminish the adverse effects of climate changes, and to do most good for the world, which solutions would yield the greatest net benefits?**

The sum of \$250 billion per year was chosen by the Center because it is in the order of magnitude of spending that world leaders could commit to in the Copenhagen COP-15 negotiations, and is consistent with the relevant economic literature on the expected costs of dealing with global warming.

The basis for the Expert Panel's discussions and ranking were the Assessment and Perspective Papers: new research commissioned from acknowledged authorities in each policy area.

The Assessment Papers review the existing frontier academic literature and present the economic costs and benefits of one or more relevant policy responses to global warming, as well as outlining the strengths and weaknesses in the applied methodology.

To ensure complete information on each category of solutions, all Assessment Papers are balanced by at least one Perspective Paper, which provides a critique of the assumptions and calculations used in the Analysis Paper.

During their closed-door roundtable meeting at Georgetown University in Washington, DC, the Expert Panel discussed and assessed the new research in great depth, and engaged with the Assessment Paper and Perspective Paper authors.

Based on this work, the panel ranked the proposals, in descending order of desirability, as follows:

## The Ranking

"Very Good"	1	Climate Engineering	<b>Marine Cloud Whitening</b>
	2	Technology	<b>Energy R&amp;D</b>
	3	Climate Engineering	<b>Stratospheric Aerosol Insertion</b>
	4	Technology	<b>Carbon Storage R&amp;D</b>
"Good"	5	Adaptation	<b>Planning for adaptation</b>
	6	Climate Engineering	<b>Air Capture R&amp;D</b>
"Fair"	7	Technology Transfers	<b>Technology Transfers</b>
	8	Forestry	<b>Expand and Protect Forests</b>
	9	Cut Black Carbon	<b>Stoves in Developing Nations</b>
"Poor"	10	Cut Methane	<b>Methane Reduction Portfolio</b>
	11	Cut Black Carbon	<b>Diesel Vehicle Emissions</b>
	12	Cut Carbon	<b>\$20 OECD CO2 Tax</b>
"Very Poor"	14	Cut Carbon	<b>\$0.50 Global CO2 Tax</b>
	15	Cut Carbon	<b>\$3 Global CO2 Tax</b>
	16	Cut Carbon	<b>\$68 Global CO2 Tax</b>

In ordering the proposals, the Panel was guided predominantly by consideration of economic costs and benefits. The Panel acknowledged the difficulties that cost-benefit analysis (CBA) must overcome, both in principle and as a practical matter, but agreed that the cost-benefit (C/B) approach was an indispensable organizing method.

In setting priorities, the Panel took account of the strengths and weaknesses of the specific C/B appraisals under review.

For some proposals, the Panel found that information was too sparse to allow a judgment to be made. These proposals, some of which may prove after further study to be valuable, were therefore excluded from the ranking.

Each expert assigned his or her own ranking to the proposals, and the Panel's ranking was calculated by taking the median of the individual rankings. The Panel jointly endorses this median ordering as representing their agreed view.

If one calculates the total cost of the "Very Good" and "Good" solutions, the expenditure proposed by the Copenhagen Consensus runs to around \$110 billion a year from 2010 to 2020.

## Notes on Solution Categories

**Climate Engineering:** The Expert Panel highly recommends research into climate engineering (CE) strategies. Of the strategies that the Expert Panel considered, solar radiation management (SRM) methods – especially marine cloud whitening – appear to show the greatest promise. The Expert Panel notes that, compared with other solution categories, geoengineering (GE) reduces the risk of "pork barrel politics" and lowers transaction costs. In the case of a low- probability, high-impact situation, CE could play a crucial role because of its speed. The Expert Panel notes that a short-term focus on research into CE would be beneficial in establishing the limitations and risks of this technology, and the identification of these should happen sooner rather than later. They find that research into air capture (AC) would be useful as it appears to have potential as a back- stop technology.

**Technology:** The Expert Panel believes that increased research into energy technology is vital to ensure a move away from reliance on fossil fuels. There is a significant energy technology challenge to stabilizing climate, demonstrated by the lack of readiness of current carbon-emission free energy technologies. The Expert Panel finds that there is a compelling case for greater research into technologies including (among others) storage for energy, batteries, nuclear energy and nuclear reprocessing technology, fusion, second-generation biofuels, wave energy, geothermal energy, and technology that increases the conversion rate of fossil fuels. They also find that research into carbon capture and sequestration (CCS, carbon storage) is very important because this technology has considerable potential as a "bridging technology" to a zero-carbon future.

**Adaptation:** Whatever other policy options are selected, adaptation will be needed because it is unlikely that all of the impacts of climate change will be avoided. Adaptation is thus unavoidable and may serve multiple purposes, including helping developing countries in terms of development, and non-climate-related disaster readiness. The Expert Panel finds that it is very important to ensure that planning occurs for future adaptation, focusing particularly on anticipatory (or preparatory) measures. In the long term, a combination of proactive and reactive adaptation is an effective means of reducing the damage from climate change. Because of the distribution of expected climate change effects, most adaptation expenditure will need to be beneficial to developing nations.

**Technology Transfer:** Technology transfer (TT) is a promising approach for dealing with climate change, because international cooperation on both greenhouse gas (GHG) mitigation and adaptation must involve transfers of technologies and dissemination of knowledge. While developed countries are beginning to constrain growth in carbon emissions, emissions from developing countries are growing, showing a requirement to ensure that knowledge on mitigation and adaptation strategies and implementation is shared.

**Forestry:** Ecosystems store approximately 1 trillion tons of CO<sub>2</sub> in the biomass of living trees and plants. Methods to increase this carbon efficiently in order to reduce the future damages of climate change include afforestation (planting old agricultural land with trees), reduced deforestation, and forest management. The Expert Panel agrees with the economists' findings that these solutions would have benefits in terms of both reducing global warming and in terms of increasing biodiversity. The forestry solution was not given a higher ranking because it would be a relatively costly way of cutting carbon, and there are regulatory challenges relating to implementation and leakage to be overcome.

**Black Carbon Mitigation:** The Expert Panel heard that mitigating black carbon emissions would be beneficial for health improvements in developing nations as well as in climate change outcomes. However, there is a broad difference of scientific opinion regarding the role of black carbon in global warming, and the research into this field is relatively young. The non-climate, health benefits vastly outweigh the climate benefits, making it more of a health policy proposal. When looking at the proposal to reduce household black carbon emissions in the developing world, the Expert Panel found it difficult to locate large-scale, successful examples of programs, and the evidence suggests that there are both acceptance and transition issues. The costs of implementing vehicular technology solutions is high relative to the benefits. For these reasons, the Expert Panel gives solutions considered under the topic of black carbon mitigation a lower ranking.

**Methane Mitigation:** The Expert Panel heard that mitigating black carbon emissions would be beneficial for health improvements in developing nations as well as in climate change outcomes. However, there is a broad difference of scientific opinion regarding the role of black carbon in global warming, and the research into this field is relatively young. The non-climate, health benefits vastly outweigh the climate benefits, making it more of a health policy proposal. When looking at the proposal to reduce household black carbon emissions in the developing world, the Expert Panel found it difficult to locate large-scale, successful examples of programs, and the evidence suggests that there are both acceptance and transition issues. The costs of implementing vehicular technology solutions is high relative to the benefits. For these reasons, the Expert Panel gives solutions considered under the topic of black carbon mitigation a lower ranking. The Expert Panel notes that commercial-scale extraction of CH<sub>4</sub> clathrate would pose a serious issue, as it could lead to large leakage.

**Carbon Mitigation:** The Expert Panel finds that, while a well-designed, gradual policy of carbon cuts could substantially reduce emissions at a low cost, poorly designed or overly ambitious policies could be orders of magnitude more expensive. Very stringent targets may be costly or even infeasible. The Expert Panel finds that high levels of carbon tax, in the short term, will be a poor response to climate change. They note that the

geographical spread of global warming damage – and its greater damage to developing nations – means that estimates of GDP loss should be treated with some caution, and that the low probability of high impact results from global warming should be taken into account when evaluating carbon mitigation. In addition to the three global tax options in the paper by Richard S.J. Tol, the Expert Panel finds it relevant to scrutinize the impact of a tax on developed nations alone. Therefore, they have considered a scenario from Yohe et al.'s paper proposing a CO<sub>2</sub> tax of \$20 on OECD nations. The Expert Panel has looked at carbon taxes, which are likely to be more efficient than a cap-and-trade scheme. The Panel notes that many politicians are opting for the latter, and that the use of such an emissions trading scheme (ETS) is likely to further diminish the returns of the solutions considered here. They also conclude that the costs and benefits of regulatory interventions (such as energy efficiency standards) to mitigate carbon deserve future examination.