GVST – Contribution to the Stern Review on the Economics of Climate Change

The Stern Review is to examine the evidence on the items listed in the "Terms of Reference for the Stern Review". We would like to provide comments and suggestions to each of those items.

1. General remarks

Projected future climate change resulting from the emission of greenhouse gases depends upon a range of factors, many of which can only be estimated with great uncertainty:

a. Population growth, in the industrial countries and in the lesser developed countries
b. Economic growth, in the industrial countries and in the lesser developed countries
c. Greenhouse gas emission growth
d. Atmospheric greenhouse gas increase as a result of greenhouse gas emissions
e. Impact of rising greenhouse gas concentrations on the radiation balance of the earth
f. Response of the climate system to changes in the radiation balance
g. Response in terms of temperature, locally, regionally, globally
h. Response in terms of precipitation, locally, regionally, globally
i. Response in terms of extreme events, locally, regionally, globally
j. Impact of those changes on natural ecosystems and human activities
k. The direct response of increasing CO_2 on vegetation
l. Economic assessment of g – k

Item 1: The impact of energy demand and emissions

The projection of climate change and the economic assessment of climate change therefore depends critically on a number of socio-economic factors as well on factors related to the natural sciences, as e. g. technology development and diffusion in the markets, calculation of changes in the radiation balance and computer based climate modelling.
Each of the socio-economic factors a – c and l alone is subject to a large range of uncertainties. For instance, future technology development is difficult to foresee, but may have a large impact on future emissions. Extrapolation of present and recent trends decades or even centuries into the future will most likely not capture the true evolvement of future emission trends. History suggests that such estimates are generally too large. Observed CO_2 concentrations in the atmosphere give a comprehensive view of the integral response of the global carbon cycle to past CO_2 emissions resulting from the actual population, economic and energy use trends. Over the past 40 years, atmospheric CO_2 concentrations have on average increased by about .4 per cent per year, reflecting robust world-wide population, economic and energy use growth. Such an atmospheric growth rate should be considered a "business as usual scenario", since it is somewhat unlikely that world-wide population, economic and energy use and CO_2 emissions growth will proceed faster than during the last 40 years.

Therefore, population, economic and emissions growth scenarios which are larger than observed in recent decades should be viewed with suspicion.

In terms of atmospheric CO_2 increase, an extrapolation of the observed growth rate of .4 per cent per year to the year 2100 would result in a CO_2 concentration of about 550 ppm. Temperature increases with the logarithm of CO_2 concentration, so even an exponential increase of CO_2 concentration would only lead to a linear global temperature increase.

Moreover, contrasting the situation portrayed in earlier reports of the IPCC, e. g. IPCC 1990, IS1992, SAR 1995 and TAR 2001, the non-CO_2 greenhouse gases, which were thought to cause an additional large greenhouse effect next to CO_2 have ceased to increase, as in the case of CH_4 or have even begun to decrease, as in the case of CFC 11 and CFC 12. Those gases were thought to contribute about half of the greenhouse gas forcing again of CO_2 alone. Consequently, there has been a steep decline in the rate of greenhouse gas forcing increase in recent years, which is well documented, but which is apparently ignored by many climate model calculations considered and summarized by the IPCC. Most of those calculations assume a CO_2 concentration growth rate in the atmosphere of about 1 per cent per year, about twice the rate observed, even when other non CO_2 greenhouse gases are included.
Further, reflecting the IPCC statement that most of the global warming observed in recent decades most likely is due to greenhouse gases, then one should expect the rate of temperature increase to decrease in coming decades, because the temperature rise in the last decades reflected the large forcing increase of CO_2 and the non CO_2 greenhouse gases. Since about 1990, for 15 years, non CO_2 greenhouse gases did not increase anymore and the total forcing increase due to CO_2 alone was much less, the temperature increase in the coming decades likely will also be less than in recent decades.

Considering that this global temperature increase has been about .16 °/dec, there is at present very little reason to believe that this rate of warming will increase, rather a decrease is more likely. The warming over one century would then at the most be about 1.6° C, at the lower limit of the range 1.4 – 5.8° C given by the IPCC in its last report 2001.
Only by assuming much larger population, economic and emissions growth rates than recently observed could one arrive at much higher values than about 1.6° C.

Item 2: The consequences of climate change

The policy implications of this are quite clear. Even if CO_2 concentrations and temperatures increase with the same rate as in the last few decades, global temperatures 100 years from now will not be higher than 2° C from the present. 2° C is frequently given as a maximum acceptable warming limit. Even without specific greenhouse gas reduction policies, this value will very likely not be reached.
The regional variations of a global temperature increase of that magnitude are somewhat speculative at this point, despite many attempts to regionalize model projections. This is particularly true for precipitation variations.

The impact on extreme weather and climate events is even more uncertain. Frequent claims global warming will increase the frequency and severity of extreme events are mostly unfounded and speculative at best. Claims extreme events have already increased as a result of global warming lack - for the most part - a sound scientific basis. This is particularly true for hurricane frequency and severity, which underwent long-term

fluctuations in the past, but no long-term trend consistent with the warming of global average temperatures.
Despite many claims in the popular media, this is also the case for extreme flooding events, drought, tornados, storms in the mid-latitudes, thunderstorms and hail.
Claims by the re-insurance industry weather and climate related losses have increased dramatically in recent decades can almost entirely be explained by socio-economic factors, such as increase in property values far above the rate of inflation, increasing population density in areas prone to extreme weather events etc. but not to an increase in extreme weather events as such. Those factors have to be carefully separated especially when attempting to estimate “damages” from future climate change. The impacts of any given temperature rise on weather and climate extremes are particularly difficult to estimate.

However, projections of those factors are necessary as input for estimating the economic, social and environmental consequences of anthropogenic climate change.
The impacts thus far estimated from climate modelling and impact studies are tentative and speculative at best. This is the case for the reasons given above, but also because of the fact that impacts are local and the local impacts are difficult to estimate.
Warming rates are the factor that can be estimated best and most impacts dealt with in impact studies are related to warming. The key for impacts of warming will be magnitude and speed of warming. There will be a large difference if warming will be 1° C or 5° C in the next 100 years. Present rates suggest no more than 1.6° C in the next 100 years.
In the scientific literature it is generally agreed that up to that point, warming has both positive and negative impacts, even though there is a large regional variation. Warming and drying in those regions of the earth, where climate is already hot and dry will be rather detrimental, whereas warming in those regions where climate is extremely cold and sub-optimal for plant growth and agriculture will be mostly beneficial. Agriculture in the mid and higher latitudes will likely benefit from warming as long as there is no countervailing impact from either an extreme drying or flooding. The direct effect of increasing CO_2 on plant growth will mostly be positive for a wide range of agricultural and forestial plants. In warmer climates increasing CO_2 can counteract a negative impact due to warming because increasing CO_2 will increase drought resistance of plants.
The human health impact will likewise be divided between being beneficial in cold regions and detrimental in warm regions. Morbidity and mortality has a clear maximum in winter and a secondary summer maximum in the warmer climates, on balance the human health impact will likely be positive, because the decrease in winter mortality and morbidity will be far larger than an increase in summer mortality and morbidity.
This is particularly the case when considering that most warming is projected to occur in winter, causing heating – mostly fossil - demands to decrease with an attendant decrease of air pollutants. Air pollutants are thought to have a detrimental impact on human health.
On the other hand, summer cooling demands may increase in certain regions as the temperature rises and more electricity generation is needed to meet demand.

Equally important is the projected impact of climate change on precipitation. Climate modelling assumes on theoretical grounds that precipitation will generally increase, even though there may be large regional and seasonal variations from the pattern of a general increase; the statistical distribution and the range of extremes may also change. Too little is known at present in which way such changes may occur under a warming scenario.
Historical trends should not be extrapolated into the future, because they may be explained by entirely different processes than warming alone, as e. g. atmospheric circulation changes.

Therefore, a viable and sound economic estimate of the impact of projected climate changes upon a range of economic, social and environmental parameters in the next decades is - at the present - elusive. Research is presently mostly concerned with possible detrimental impacts; and a substantial fraction of that research arrives at the result that climate change has negative impacts only, self-fulfilling a pre-conceived scenario. On the other hand, a large body of research suggests – mostly ignored by the media and special interest groups – that warming also has a range of positive, beneficial or benign impacts. To arrive at a balanced view for the purpose of guiding policy decisions, the full range of impacts and their costs – positive and negative – should be considered.

Item 3: The costs and benefits of actions to reduce emissions

The benefits of avoided greenhouse gas emissions are the costs of averted damage due to climate change. Even though those costs are difficult to determine for the reasons stated above, and moreover, there are ancillary benefits associated with climate change, not just costs, economic analyses of the subject mostly conclude that damages, such as there are, rise slowly and gradually with rising emissions and temperatures. Expressed as climate "damage" per t of carbon emitted, a number of estimates lie in the range of 5 – 15 $.

The cost of emission reduction, on the other hand rises sharply with the level of reduction: The first percentage points are relatively inexpensive, and the last percentage points may be exceedingly expensive. There is a steep increase of marginal reduction costs. Marginal reduction costs could quickly rise above marginal damages due to the emission of an extra t of carbon.

The cost of reducing or avoiding the emission of a t of CO_2 should therefore not exceed the estimated cost of climate damage, including ancillary benefits. This should then be compared to the benefit of the emission of a t of CO_2, including ancillary benefits. CO_2 usually is emitted for a reason, such reason being the creation of a benefit to the emitter and to society. For example, the generation of electricity from fossil fuels benefits the emitter because he will make money from selling electricity. The user of electricity on the other hand has a benefit because, as an example, he can store food in a refrigerator, preventing it from rotting, lighting his home etc. There is a general societal benefit from using electricity which has to be added to the simple economic benefit for the electricity generator. Therefore, the entire chain of societal benefits associated with the emission of a t of CO_2 has to be compared to the entire chain of costs and benefits associated with climate change due to the emission of that t of CO_2 in order to arrive at a true cost/benefit ratio of the emission. Simply attempting to estimate the costs associated with climate change by only looking at perceived damages while ignoring the possible benefits of climate change, and more importantly by ignoring the societal benefits associated with the emission in the first place will lead to an illogical and distorted cost/benefit picture.
The costs associated with emission reductions are estimated by a number of studies for a wide range of different areas. Some of those costs per t of CO_2 are lower than the costs associated with the costs of climate change, some, if not most, are higher.
From an economic perspective, it would be irrational if the costs of avoiding or reducing emissions are higher than the costs of climate damages. Climate policy should aim to keep the cost of emission avoidance lower than the cost of damages.

Item 4: The effectiveness of national and international policies

Climate change due to the emission of greenhouse gas is a world-wide problem - if it is a problem - that can not be solved by any individual country, or even group of countries alone. Most of the climate change projected for the year 2100 will not occur as a result of present emissions but as a result of the much larger emissions projected for the coming decades. Presently, world-wide emissions are about 7 GT of C, standard emission scenarios project about 20 Gt of C in 2100, about three times as much. The relative role of present and past major emitters will continue to decline substantially in coming decades. As an example, the EU 25 presently emits roughly 1 Gt of C, about 14 per cent of world-wide emissions. If the EU could cease emitting by some magic trick tomorrow, but the rest of the world would continue emitting according to standard scenarios, the impact on climate change by 2100 would be around .15° C less warming, about 1.85° C instead of 2° C. 15° C is well within natural variations of global average temperature and is barely above measurement accuracy of about .1° C.
This illustrates powerfully that national or even regional - as on the EU level - drastic emission reductions alone will not be capable of reducing warming to any significant extent. Therefore, there is no measurable climate benefit associated with those reductions, but arguably large costs of emission reductions.
At the present, about 85 per cent of world energy demand is supplied by fossil fuels. Most scientific studies do not foresee that carbon free energies can supply more than 10 – 20 per cent of the present and much less of the projected steeply increasing energy demand in coming decades. Fossil energy will very likely continue to provide the backbone of global energy supply in coming decades. Any cutback in the fossil energy supply will have a large negative impact on economic growth, prosperity, employment and social security, which depends on economic growth and employment.
Present international climate policy agreements, as the Kyoto Protocol, will not slow global warming to any significant or even measurable extent. Meeting the Kyoto targets on the other hand will, for the nations who ratified the protocol, for the most part be very costly. Only a handful of nations will meet the Kyoto targets, and then only for factors unrelated to specific climate policies. Among those countries are the economic transition countries in Eastern Europe, Germany and the UK. Most other countries will very likely not meet their targets, mostly because they enjoyed vigorous economic and, in some cases, population growth or both. Meeting the Kyoto targets will be very costly for those countries. It will lower economic growth, employment and social security, but it will not lead to an environmental benefit. The Kyoto Protocol is a political gesture only. Society has to make an informed decision if it is willing to pay a high economic price for a political gesture.

National or regional reduction agreements and their implementation into practical politics, in the case of the EU a regional cap and trade scheme applied to industrial installations, will very likely cause so-called leakage effects, where industries affected by those climate policies decide to direct future investments away from those regions subject to climate policies to regions where those restrictions do not apply. A cap and trade scheme is a carbon rationing scheme, which artificially limits the supply of carbon available for industrial use, thereby raising its price. The incentive for industries to reduce carbon use – and CO_2 emissions - has technical limits in existing installations and the only way to meet more stringent reduction targets may not only prompt affected companies to purchase emission rights on the market, but, if the price of those rights is sufficiently high, to curtail production and sell unused rights. The trading scheme will then achieve the objective of reducing emissions, but at the price of production cuts, lower growth and lower employment.

Climate policies generally lead to fossil energy price increases, not just through a trading scheme, but also by a carbon tax or levy. It is very likely that future investment is directed away from regions subject to such climate policies to those regions, where such policies do not apply. In the process, global carbon emissions will not be reduced, but growth will be lost in the regions subject to carbon restrictions. There is no benefit for global climate, only a significant economic loss for those regions applying carbon restrictions.

Carbon rationing schemes, such as the European trading scheme, have their roots and justification in the Kyoto Protocol, which is in essence a carbon rationing scheme on an international level, because it sets carbon quotas for the nations involved. In a world where carbon emissions are closely tied to population and economic growth, restricting carbon emissions implicitly means restricting either population growth or economic growth or both in the absence of any alternative means of supplying energy demand.

Therefore, effective climate policies have to be international, preferably world-wide in scope to avoid leakage effects. Leakage effects are the inevitable result of any "targets and timetables" approach involving only a limited number of countries. Expanding the number of nations subjected to a "target and timetables" approach, in particular to those nations which are growing rapidly (such as India and China, which will very likely be responsible for most of the emissions increase in coming decades), by means of a cap and trade scheme would amount to transferring money from the industrialized countries to those countries. The carbon price for the industrialized countries may be lower in this case, but nevertheless the cost of energy and production would still be higher than in India or China. The leakage effect would be smaller, but still be present.
China as an example has a trade and current account surplus in the order of 50 -100 billion $ a year. Extending a cap and trade scheme to such countries would in effect lead to an exacerbation of those imbalances between them and the rest of the industrialized world. Competitiveness of the industrialized countries would further decline at the expense of rising developing countries

Item 5: Assessments of the economics of moving to a low carbon global economy

Alternatively, an approach to foster clean technology R&D and the diffusion of those technologies in international markets may be the better alternative to international carbon rationing and "cap and trade" schemes.
A range of technology options should be the focus of such R&D efforts to develop lower emitting technologies for a range of applications, both in energy conversion and end-use. Since climate change is a long-term problem, long-term solutions are called for. Investments in the energy infrastructure have a long lifetime of between 20 – 40 years. Climate policies have to be synchronized with the typical life-times of the energy infrastructure to avoid stranded investments. This danger is acute under the present Kyoto based European trading scheme, since it forces a short-term reduction schedule on an existing infrastructure which has been built to last for decades. Technology development and means to enhance market penetration at the time of replacement of existing infrastructure should be the central focus of an economically effective climate policy.

Item 6: Adaptation to climate change

Some amount of climate change can not be avoided. Some of that change may be beneficial, some may be detrimental, see above. Adaptation to detrimental climate change will be key next to mitigation. First and foremost is an accurate estimate of the expected climate change to arrive at a clear picture if, where and when climate change may be detrimental and then devise strategies to adapt.