Future perspectives for climate action
How economics can prescribe more than an energy charge

An essay on how economics can contribute to resolving the climate problem, for the BslK project 'The Matrix'

Essay
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Foreword

The Matrix has been a multi- and transdisciplinary project under the Dutch Bsik program 'Climate Change and Spatial Planning' between 2009 and 2010. The Matrix aimed to develop concrete action perspectives to the climate crisis in a partnership between climate science, economics, urban planning and social sciences that were each represented by a 'steward'. The stewards have each written an essay on the links between their science domain and the climate issue. These essays have emerged into 'common themes' and a series of debates in the Netherlands which were held in 2009 in the Fundatie van Renswoude in Utrecht.

This particular essay on the role of economics in shaping and solving the climate problem from Sander de Bruyn formed input into these debates.

The full report on the Matrix can be downloaded from:
http://www.klimaatmatrix.nl/

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1 Introduction

Climate change is one of society's major challenges for the 21st century. If we fail to reduce our greenhouse gas emissions, the consequences for planet Earth and its inhabitants will be far-reaching. Over the past few years those consequences have been spelled out dramatically in a number of popular-science books.[1] And while the science may have been popularised, it is rooted in thorough analysis of the scientific research, much of it under the auspices of the IPCC, the Intergovernmental Panel on Climate Change. The message is clear: if we are to avoid those consequences, our carbon emissions must be drastically reduced.

At the same time it is important to realise that the problem of climate change is ultimately not a technological issue but a social one. The technologies we need for creating a zero-carbon economy are all already available. Energy efficiency measures on a grand scale, wind turbines, solar panels, electric vehicles, underground carbon sequestration – it has all already been developed, tested and implemented. And by combining biomass with carbon sequestration we can even remove carbon from the natural cycle. What we are failing to do, though, is organise the implementation of those technologies – and the funding thereof. Which immediately brings us to the pivotal issue: the Earth's climate is a collective, public good to which no-one has property rights. The climate belongs to everybody and nobody at all, and if we are to avoid the trap so seminally described by Hardin in his *Tragedy of the Commons* there is no choice but to embark on a complex journey of negotiations between governments, citizens and industry. It may justifiably be queried whether that journey can be completed in time, and whether the road ahead will not be paved with too many social obstacles.

In principle, economists should be well-placed to play a key role in tackling these obstacles. After all, economic science already developed a consistent perspective on environmental pollution (as unpaid for damages) early last century and has helped usher in numerous policy instruments (including tradable emission rights and environmental charges) that are now employed in the service of climate policy.

My personal experience, however, is that an economics doctorate does not always put one in the easiest of positions in debates on climate change. In the first place, economics is seen by many people as being largely responsible for the mess we've got ourselves into. Thanks to our feverish consumerism and unquenchable thirst for ever more, we're now saddled with carbon emissions well in excess of what nature can safely absorb. And that's due, at least in part, to the free market philosophy is the view widely held, and as an economist you're therefore obviously partly to blame. Purely as a result of that intuitive study choice made 25 years ago, you suddenly find yourself on the bad guys' side.

There again, as an economist you sometimes find yourself welcomed to discussions as some kind of saviour who can explain exactly what structural changes need to be made to the economy to slash carbon emissions. For many non-economists this is glaringly straightforward. Just downsize the economy and rein in the market to create space for things of real value. *Small is beautiful*. After which follows the inevitable smear that these are obviously proposals with which an economist could never agree. Which is indeed correct:

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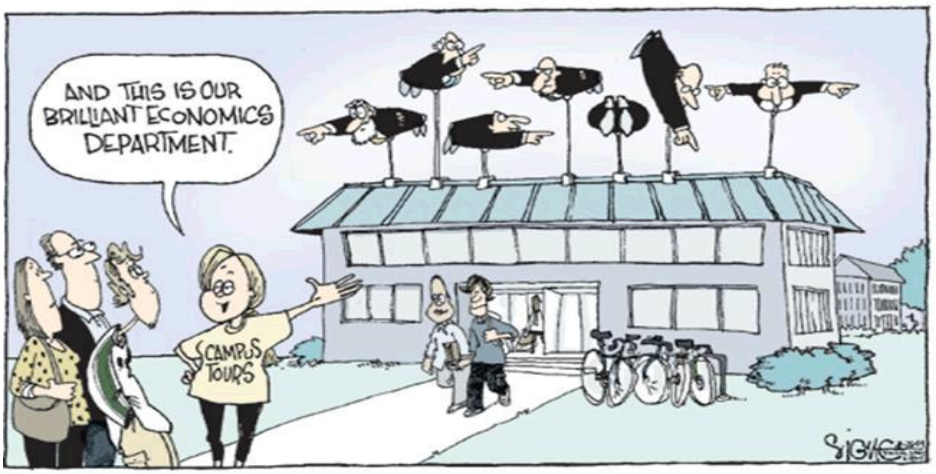
[1] See, for example, Lynas, M. (2009), Six Degrees: Our Future on a Hotter Planet.

as an economist one is all too aware of the social costs to which these kinds of proposals might lead if implemented. Countries where the economy has undergone years of 'downsizing' all too often subside into civil war, with catastrophic destruction of human, social and natural capital as a result. And so economic growth should be seen more as a *condition humaine* than as some kind of necessity so coveted by economists.

But this said, I can well imagine the distrust in which economists are held. Economists have managed to gain a reputation for being interested in little more than short-term profits. And was it not John Maynard Keynes himself who once wrote "in the long run we are all dead"? And is the current credit crisis not the ultimate proof that 'more market' coupled with 'short-termism' has brought society to the very edge of the abyss? No way, then, that the climate problem should be left to these kind of folk to resolve.

Economists are indeed overrepresented in the community of climate sceptics and climate cynics. Climate sceptics like Hans Labohm in the Netherlands are not convinced of the fact that global warming is human-driven. They accuse international climate researchers, the fruits of whose work are compiled by the IPCC, of tunnel vision in which the facts are subjectively reported and unwelcome data selectively omitted. For economists the IPCC's discussion model, with its pursuit of consensus, is indeed rather an anomaly, for in their discipline there's usually far more room for debate. As the old joke goes: economics is the only realm of science in which two economists can win the Nobel prize for two mutually contradictory theories. Which of course does not prevent economists from presenting their pet theory as the absolute truth.



The discussion model of economic science: diametrically opposed to the IPCC's consensus model.

While economists as climate sceptics may weigh in to some extent on the climate debate, the influence of economists as climate *cynics* extends far further. By the latter I mean those economists who, while accepting global warming as a fact, conclude from their professional vantage point that there's very little we can do about it, for according to their calculus the cost to society of reducing carbon emissions vastly exceeds the economic benefits. This school of thought, of which the Danish economist Bjorn Lomborg is perhaps the best-known representative, holds that we would be better off spending our money on other noble causes. Thus, investments in malaria control, for example, would prevent far more deaths than investments in

averting climate change, or so he holds.[2] This school of thought enjoyed considerable political prestige under George W. Bush and has set international climate negotiations back a long way over the past decade.

And so the conclusion must surely be that economic science has acted more as a brake than a motor when it comes to addressing climate change. Rather than getting to grips with removing the 'social obstacles' to effective climate policy, economics has above all cast doubts on the very rationale of such policy. In this essay I shall try to remedy this to some extent and look in greater depth at the role economics can play in contextualising and resolving the climate problem. The essay has a three-part structure. First of all I discuss the costs and benefits of tackling climate change. Do the costs of investing in carbon cuts indeed outweigh the benefits, as many economists assert? And is the fact that investing in malaria control yields far greater benefits to society indeed an argument *against* investing in emission cuts? In this part of the essay I discuss the remit of economic science when it comes to the job of analysing the climate problem. In the second part I consider the role played by economic science in shaping policies on mitigation and adaptation, thereby distinguishing several levels of social obstacles that make resolution of the climate problem through mitigation such a complex issue. In the third part I weave together the ideas presented in the first two parts and present three hopefully inspiring proposals for a possible future agenda for addressing climate change.

My analysis here will hinge more on mitigation than on adaptation. This is due in the first place to the natural tendency of economics to be geared towards mitigation, because this ties in immediately with the standard economic framework of 'externalities'. At the same time, though, for us in the Western world I feel it is simply perverse to pursue adaptation as a climate strategy unless accompanied by massive efforts on mitigation. For lest we forget: the greatest impacts of climate change will be felt not in Western countries but in the developing world.[3] The challenge of adaptation is not so much adaptation here, but adaptation there. The main focus for us, in the affluent West, must be on mitigation.

2 Mitigation or tacit adaption?

In 1988 the founding fathers of environmental economics, Baumol and Oates, wrote in the very first textbook on the subject:

"When the 'environmental revolution' arrived in the 1960s, economists were ready and waiting. The economic literature contained an apparently coherent view of the nature of the pollution problem with a compelling set of implications for public policy."[4]

In (welfare) economics environmental problems are regarded as allocation problems, with demand for a clean environment exceeding supply thereof. One reason for this is that supply of a clean environment is limited because the consequences of pollution are not factored into decisions on production and consumption but passed on to others, giving rise to what economists call an externality, or external effect. Pigou (1924) gave the example of sparks

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2 Lomborg (ed.) (2004), Global Crises, Global Solutions.

3 Global Humanitarian Forum (2009), The anatomy of a silent crisis. Human impact report, climate change.

4 Baumol and Oates (1988), The Theory of Environmental Policy, p.1.

from a train locomotive that might disadvantage landowners by burning down their crops or forests. Because the risk of forest fire was not factored into the locomotive owner's decision to run the train, overall social welfare was lower. Pigou demonstrated that imposing a charge on the locomotive owner equal to the marginal damage of the forest fires would maximise welfare. If the benefits of running the train exceed the costs of the forest fires, the train should continue to run. If the costs of the forest fires exceed the benefits of train operation, the locomotive owner would opt voluntarily not to run the train in view of the charge imposed.

In a direct interpretation of this theory, then, the economist should concern himself with determining the marginal damage when there is an external effect like pollution.[5] When climate change became manifest in the early 1990s, the main issue was also what the marginal social damage of climate change would be. A related issue was how the costs of mitigation would compare with the benefits. Initial studies by Cline and Nordhaus indicated that the costs of mitigation far outweigh the benefits.[6] From a meta-analysis of 125 studies Richard Tol derived a median value of approximately $ 4 for the loss of welfare resulting from one tonne of CO_2. While recognising the broad range of values reported, he deems it very unlikely that the actual damage would exceed $ 14/tCO_2[7] Returning to Pigou, this implies that the government would need to impose a charge of € 3/tCO_2 in order to internalise this external effect. At the petrol pump, for example, this would translate to an extremely modest price rise of 1%: a price level around 15-30 times lower than what is deemed necessary to keep climate change-induced temperature rise to below 2°C.[8]

It is important to realise that Richard Tol's result is due above all to the particular nature of the climate problem. Because today's emissions will continue to contribute to rising atmospheric CO_2 levels for a very long while to come, the costs and effects of abatement measures are separated by a huge gap in time. According to today's economics, to invest now in something that will take several decades to yield returns is unviable. Indeed, this is why economic analysis of the climate issue leads to an in-built, tacit preference for adaptation or delaying mitigation until the relative costs have fallen significantly as a result of income growth and technological advance.[9]

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5 For a critique of this position, see Hueting, who has argued that it is not externalities but the fact that scarcity is unpriced that should be the pivotal notion of environmental economics. Hueting, R.(1980), New scarcity and economic growth (Dutch original: 1974).

6 Cline (1991), The Economics of the Greenhouse Effect, Economic Journal 101 (407): 920-37; Cline (1992), The Economics of Global Warming. Institute for International Economics; Nordhaus (1991a), A sketch of the economics of the greenhouse effect. American Economic Review, 81(2): 146-50; Nordhaus (1991b), To slow or not to slow: the economics of the greenhouse effect, Economic Journal, 101(7): 920-37; Nordhaus (1993), Optimal Greenhouse-Gas Reductions and Tax Policy in the 'DICE' Model. American Economic Review, 83 (2): 313-317.

7 The majority of the 125 studies were based on so-called Impact Assessment Models. Tol (2005), The marginal damage costs of carbon dioxide emissions: an assessment of the uncertainties. Energy Policy 33(16): 2064-2074; Tol (2007) The social cost of carbon: trends, outliers and catastrophes. Economics Discussion Papers, 2007-44.

8 De Bruyn et al. (2010), Why the EU could and should adopt higher greenhouse gas reduction targets: a literature review. CE Delft.

9 The Integrated Assessment Models assume that future generations will be wealthier than today, which means they will be better able to afford the costs of adaptation or accelerated mitigation.

It goes without saying that these conclusions have sparked a good deal of controversy, among economists too, being challenged from a variety of angles. First, there is a group of economists who hold that cost-benefit analysis cannot be applied to climate change at all.[10] While this kind of analysis is fine where marginal changes are involved, as in the case of bridge construction, for instance, transformation of the Earth's climate involves *systemic* change, implying a change in *all* prices, and a massive increase in all-round uncertainty. This uncertainty cannot be adequately captured by such cost-benefit analyses, these economists hold. In the Dutch BsIK programme 'Climate and Spatial Planning', Ekko van Ierland has, for example, recommended narrowing the domain of economic inquiry when it comes to mitigation. Economic science should take as its point of departure specific political targets – limiting temperature rise to 2°C, say – and then, by means of cost-efficiency analyses, determine how these targets can be secured as efficiently, i.e. cheaply, as possible. This is equivalent to Hennipman's statement that economics is a teleological science. Economists should not themselves be setting politico-economic objectives, for that is the task of politicians and physicists. Within the stated boundary conditions they should then be working in pursuit of efficient allocation.[11]

Further support for the teleological position has been given by ethicist Marc Davidson, who charges that the climate issue is all about damages and that the economic analysis of these damages should be made subordinate to moral-legalistic considerations. With a certain pleasure he cites opponents of the abolition of slavery in the 19th century who held that the presumed benefits would not weigh up against the costs. The moral-legalistic considerations in question are that inflicting damage on others is unethical, regardless of whether they are alive today or in some distant future.[12] Consequently, while a cost-benefit analysis can certainly be performed, it can have no moral authority, according to Davidson.

Another group of economists has doubts about some of the assumptions of Cline, Nordhaus and Tol. The main focus of their criticism is the use of a 'discount rate' and the way in which damage is valued. The rationale behind 'discounting' future generations is that those generations will be better off than those today. But precisely the existence of a global climate problem makes that assumption untenable. The economist Weitzman has argued that even if discounting is applied, then *more* weight should be given to future generations than is presently the case.

Another fundamental point has been made by Arnold Heertje. According to Heertje, economics cannot put a value on unique goods at all, because these are not characterised by a market with a sufficient number of 'bidders' and 'askers'. The Earth is unique and irreproducible, and no value can therefore be put on something as far-reaching as climate change. For this reason Heertje holds that performing cost-benefit analyses of climate change is fundamentally misguided.

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10 See, for example, van den Bergh (2004), Optimal climate policy is a utopia: from quantitative to qualitative cost-benefit analysis. Ecological Economics 48: 385-393.

11 Hennipman (1977), Welvaartstheorie en economische politiek (eds. v.d. Doel and Heertje). The 'teleological' interpretation of economic science was already described by Robbins in 1935.

12 Davidson (2008), Arguing about climate change: Judging the handling of climate risks to future generations by comparison to the general standards of conduct in the case of risk to contemporaries. PhD Thesis University of Amsterdam.

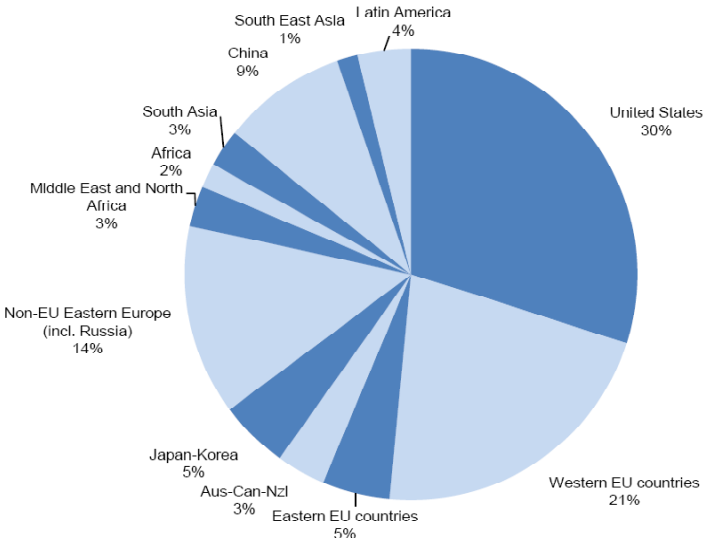
I have neither the pretention nor the intention to say the last word on these matters. I am convinced that the aversion to applying social cost-benefit analysis (SCBA) in the context of climate policy has been prompted more by a flawed presentation of uncertainty by economists than by an opinion that the allocation of scarce resources across multiple objectives should not be the core domain of economic inquiry. When it comes to climate change the uncertainties are immense and in any SCBA these will therefore have to be presented as fairly as possible. Perhaps an honest position would be for economists to recognise that we are simply ignorant when it comes to the costs of climate change: these may be higher than the costs of mitigation, they may be lower. On the time scale involved, the cost of abatement measures, the economic value to be assigned to the damage, the discount rate and, in tandem, future income trends are all so uncertain that it is simply impossible to pronounce on them.[13] And so, having examined the conundrum in greater depth, we realise this is what Keynes meant by his notorious statement that in the end economists have only one certainty: "in the long run we are all dead".

3 Elements of policy: the international context, equity and economic efficiency

At the G8 summit in L'Aquila in 2009 it was agreed by world leaders that global temperatures should not be allowed to rise more than two degrees Celsius above the average temperature at the start of the industrial revolution. To this end the G8 nations must cut their emissions by 80% by the year 2050, with a 50% reduction being asked of China, India and other emerging economies. The response of China and India was immediate: it was out of the question to demand such drastic emission cuts from them already, they said, for that would mean per capita emissions significantly below those deemed acceptable for the United States and Europe. What's more, if the historical emissions that have led to today's elevated greenhouse gas levels are factored in, the discrepancy becomes substantially larger. Europe, North America and Japan, with one-sixth of the world's population, are responsible for 75% of cumulative emissions since 1900, as the following figure shows.

[13] A comprehensive 'climate SCBA' performed in this way will in the end have to conclude that we economists simply don't know.

Figure 1 Historical greenhouse gas emissions 1900-2004, excluding land use and forests



Source: EC, 2009[14].

This highlights one of the pivotal problems of climate policy: the need for international consensus on the allocation key to be used for what Hans Opschoor in 1990 termed the 'environmental utilisation space'.[15] The 'climate utilisation space' has been unequivocally described: to limit warming to 2°C we need to cut annual carbon emissions from almost 50 Gt CO_2-equivalents today to 30 Gt CO_2-eq. in 2100. Compared with a business-as-usual scenario in which we continue to burn fossil fuels without carbon sequestration, this translates to emission cuts of over 100 Gt CO_2 by the year 2100.[16] Of these, 40 Gt would have to be secured by 2050 and global emissions would have to start declining within the next few years.[17] The problem, though, is that we simply have no idea how the available 'utilisation space' is to be allocated. In the long term, some quantity will have to allocated uniformly among the countries and peoples of the world, but what is that quantity? Are we talking about per capita emissions, cumulative per capita historical emissions, per capita costs of emission cuts, costs per unit income earned or costs per unit utility or social welfare[18]? In this context the United Nations refers to "common but differentiated responsibilities", but the exact meaning of the phrase is still far from clear.

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14 EC (2009), The Economics Of Climate Change Mitigation: How To Build The Necessary Global Action In A Cost-Effective Manner, Jean-Marc Burniaux et al. ECO/WKP(2009)42.

15 Opschoor, H. (1990). Ecologisch duurzame economische ontwikkeling: een theoretisch idee en een weerbarstige praktijk, in: Nijkamp and Verbruggen (eds.), Het milieu in de Europese ruimte.

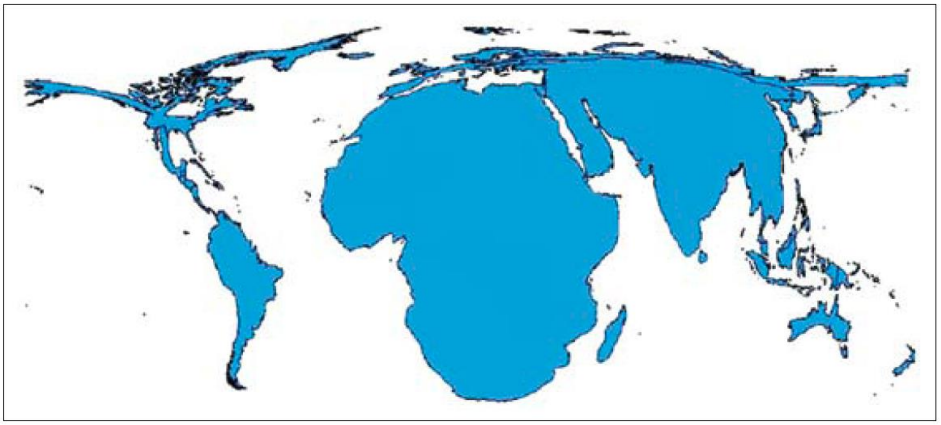
16 IPCC (2007); stabilisation at 2°C temperature rise interpreted as the B1 scenario, BAU as the A1F scenario.

17 Stern (2009), A blueprint for a safer planet: How to manage Climate Change and create a new era of progress and prosperity.

18 The difference between income and utility/social welfare is that in the latter the utility of earned income is also taken into account. Clearly, € 500 annual costs for the average Chinese citizen represents a far greater loss of utility than the same figure for a European.

This issue is in probably far more urgent than currently suggested in many (economic) modelling studies. The vast majority of economic models assume long-term convergence of incomes and economies, which would obviously make longer-term allocation issues a great deal easier. Such convergence is not borne out by the empirical evidence, though, for over the past forty years the income gap between rich and poor has only widened.[19] To complicate matters yet further, we now know the impacts of climate change will be very unevenly distributed around the globe. As a recent analysis by the Global Humanitarian Forum shows, the worst of the effects will be felt in the world's least developed nations.[20]

Figure 2 World map of projected mortality due to climate change



Source: Climate Change and Global Health: Quantifying a Growing Ethical Crisis, 2007, Jonathan A. Patz, Holly K. Gibbs, Jonathan A. Foley, Jamesine V. Rogers, and Kirk R. Smith

What this map shows, in no uncertain terms, is that climate change is inescapably bound up with 'Third World' issues of malnutrition, drinking water shortages and premature mortality from malaria and other diseases.

If global carbon emissions are to be curbed, CO_2 must be assigned a price, a view now shared by a broad cross-section of politicians, economists and other scientists. Compared with the size of our income, the costs of CO_2 emission cuts are in many cases relatively low. Nicolas Stern has estimated the loss of income arising if we opt to stick to the 2°C limit at 2% of global income at the very most – equivalent to just one year's average growth in nominal world GDP. In other words, if the world opted today to settle for a year without wage rises and put the money in a 'climate action fund' and this fund were used to finance judicious climate measures, we could put the entire climate problem behind us in one fell swoop. This seems an attractive and perhaps even reasonable proposal. But is it realistic?

Analyses of the cost of curbing greenhouse gas emissions to within the available 'utilisation space' are based on a combination of model simulations and an analysis of the cost of emission abatement technologies. An analysis of this kind was recently carried out by McKinsey. The following figure shows the global marginal reduction cost curve for CO_2 emissions in 2030. For a reduction of 40 Gt in 2050 we need to have secured around 20 Gt in 2030. If CO_2 were to

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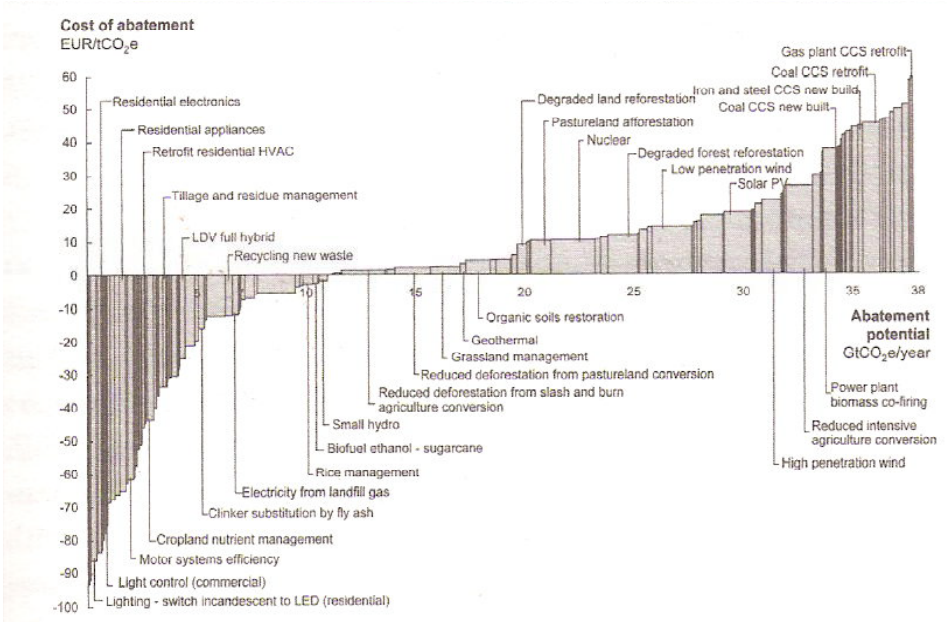
19 Sutcliffe (2004), World Inequality and Globalization. Oxford Review of Economic Policy, 20(1).

20 Global Humanitarian Forum (2009), The anatomy of a silent crisis. Human impact report, climate change. GHF, Geneva, Switzerland.

be priced worldwide at € 10 per tonne, the market should ideally ensure that all the technologies cited in this cost curve up to 20 Gt reductions are indeed implemented.

Figure 3 Abatement costs in €/t CO_2-eq. in 2030 according to McKinsey



Source: Stern, 2009.

The problem with this, though, is that until such time as CO_2 is assigned a (worldwide) price, one-third of the abatement potential – the portion associated with pure economic benefit – will not be utilised. This is because implementation of these technologies is apparently not deemed 'cost-effective' by businesses, consumers and governments alike, even though the cost curves show that such action would be precisely that. There are numerous explanations for this, but the most important is perhaps that businesses and consumers do not base their decisions solely on the costs calculated by McKinsey and the like. McKinsey's curve, for example, takes as its point of departure a 10-year payback period, which for consumers and industry by no means always reflects reality. Research has shown, for example, that in decisions to buy a new car people factor in fuel savings over no more than 2 or 3 years, if at all. In addition, the costs shown in a cost curve like the one above are static rather than dynamic. Once we really embark on large-scale substitution of conventional fuels by renewables, fossil fuel prices will plummet. Economic theory tells us that, given the likelihood of a politically motivated slackening of demand in the future, it makes sense to accelerate the pace with which fossil fuels are being exploited and marketed today. This implies a substantial drop in the price of such fuels, which will then push abatement costs up well beyond the levels shown in the figure. What's more, in a scenario like this energy prices will be more volatile. Industry will respond by adding a 'risk premium' to their investments in energy efficiency over and above the returns they are willing to pay shareholders, leading to a further rise in costs. If capital is scarce, as it is today in many parts of the world, there is also the risk of 'crowding-out'. Because some of the available capital is being used for CO_2 abatement measures, investments in new production capacity become even more appealing. What is at stake is not the absolute cost of CO_2 emissions abatement, but its relative cost compared

with other investments. If those investments become more attractive, the returns on abatement measures need to increase if such measures are indeed to be implemented by consumers and industry. These kinds of feedback loops mean the costs shown in Figure 3 above will prove to be a major underestimate.

These higher CO_2 abatement costs, worldwide, have an important tangential effect on the viability of government policy. Many of the analyses in the literature assume, in one way or another, a 'Tinbergenesque' central planner: a benevolent and perfectly informed world government that will implement the measures in the most cost-effective manner possible. What has emerged in economics over the past two decades, however, is an increasing interest in *government failure*. Government failure is analogous to market failure in the private sector and occurs when government intervention leads to less efficient allocation of goods and services than projected on the basis of economic analysis. In *A blueprint for a safer planet* Stern mentions this potential for government failure, stating, without further analysis of the issue, that this would push up costs by 25% at most. To my mind, this is a serious underestimate that ignores the complexity of the climate issue entirely.

In my view, governments can never resolve the climate problem in an economically efficient manner, because economic efficiency and social equity are at fundamental odds with one another. Given the very uneven global distribution of income as well as climate change impacts, a situation will never arise in which a single, global price for CO_2 is feasible. It would be fundamentally unjust for a Chinese citizen to have to pay the same carbon tax as a European, because in terms of utility he or she would then have to make a far greater sacrifice than the European.[21] As a result, the marginal costs of emissions abatement are not the same across countries or industries. There are economists who hold that a worldwide emissions trading scheme should be established, with any issues relating to burden-sharing being addressed through judicial allocation of emission allowances. By allocating China a greater number of emission credits than the wealthy nations as measured against current emissions, justice is done to the fact that China is a poorer country requiring further scope for growth. But apart from the extreme difficulty of establishing a suitable allocation key for the countries of the world,[22] the reasoning is also only partially valid. In decisions on production capacity, Chinese industry will not calculate with the average costs of emissions abatement but with the marginal (opportunity) costs. As those marginal costs will be uniform under a global emissions trading regime, developing industries in emerging economies will be hardest hit in comparative terms. While it is true that a global emissions trading scheme will entail a considerable transfer of income from wealthier to poorer nations, this does not mean the latter will be in a better position, in the long run, to create the kind of living standards currently enjoyed in the West.

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21 For those noting that our Chinese friend's CO_2 emissions are also lower, it should suffice to state that in relative terms the emissions associated with his consumption package are many times higher because the poor must devote more of their income to material- and energy-related costs, as remarked long ago by Malenbaum (1978), World Demand for Raw Materials in 1985 and 2000.

22 As pointed out above, this difficulty revolves around the question whether this should this be on the basis of equal costs, equal utility, equal per capita emissions or equal contribution to the reinforced greenhouse effect.

Others assert that China and India should adopt a different 'model of progress' to generate their future wealth, a model that differs from the carbon-intensive model that has been pursued to date. The problem, though, is that no other model exists. The entire process of economic growth and accumulation of wealth rests on the bedrock of natural capital being converted to human capital, thus to increase the productivity of labour.[23] Because labour is initially cheap, the cheapest sources of natural resources must first be used to kick-start the required rise in productivity. If human labour is relatively cheaper than using natural resources, as is the case in large parts of Africa, economic development simply never gets going. Assume, for example, that international climate policy leads to a doubling of the costs of coal-burning. For China this would then put a serious brake on national development, for labour would then likewise have to become a factor 2 more expensive before the country can continue down the development path being pursued today.

As these considerations show, the process of designing an international climate agreement is seriously hampered by there being an inevitable trade-off between economic efficiency and social equity. Climate policy is inescapably bound up with issues of equity. But pursuit of the latter is at odds with pursuit of efficiency – i.e. low costs – and vice versa. In political terms this is complicated yet further by the fact that the UN's 'common but differentiated re-sponsibilities' have as yet evaded definition. All of this has major consequences for the fea-sibility as well as the costs of national climate policy, as I shall now argue.

4 Elements of policy: the national context and the example of emissions trading

As I have explained above, the chances of a uniform, worldwide CO_2 price being agreed on following the outcome of any international climate summit are slender, and consequently prices will continue to vary from region to region.

When it comes to drawing up policy in the EU or the Netherlands, this creates a problem, which can be clarified with reference to experience around negotiations on the European emissions trading scheme. The EU ETS has been up and running since 2005 as a means of regulating the CO_2 emissions of industry and electrical power generators, and each year emission allowances are allocated according to a distribution key agreed to in prior negotiations. If an industry or generator intends to emit more than their allotted CO_2-equivalent tonnage, they must purchase credits on the European emissions trading market. If they emit less than their allotted share, they can sell their residual credits on the same market.

The first two phases of the trading scheme, running from 2005 to 2012, can be seen mainly as a test run. Emission allowances were allocated to ETS participants largely free of charge. Ex-post analysis has shown that industry was assigned far more credits than warranted on the basis of their emissions and that power generators were the ones buying up the residual credits from

[23] Victor, P.A. (1991), Indicators of sustainable development: some lessons from capital theory. Ecological Economics, p.191-213.

industry.[24] Because generators pass their costs on to consumers[25], there were relatively few complaints about the ETS by those involved. Scientific studies have shown, however, that emissions trading has not led to emission cuts, either, the main reason being that credits were so generously issued.[26]

As of 2013 all that is set to change, for from then on the allocation of credits is to be coordinated centrally, at the European level, with the number of credits being reduced each year by 1.74%. Economists have pointed out that in this kind of trading scheme the cost of CO_2 abatement can be substantially reduced if allowances are auctioned rather than issued free of charge.[27] The auctioning of emission credits guarantees the most cost-effective options for CO_2 abatement being taken first and efficient operation of the market. In the majority of cases, free allocation of allowances can be seen as an implicit production subsidy that creates perverse incentives in the ETS. With certain forms of free allocation, costs may easily be a factor 2 higher than with auctioning.[28] In addition, free allocation leads to greater price volatility in the emissions trading market, which in turn hampers investment in low-carbon technologies.[29]

The issue of whether emission credits should be auctioned to industry or issued free of charge was a major stumbling block in the 2008 negotiations on the third phase of the EU ETS. Unsurprisingly, there was intensive lobbying by industry to ensure their arguments in favour of free issue of credits were heard. Their main argument was that industry would risk losing competitiveness if credits were auctioned, because they would have to pay the full CO_2 costs, which their non-EU competitors would be spared. This might in turn result in increased imports of products from (and decreased exports to) countries unburdened by climate policy. As the EU ETS is a closed system, this kind of shift in international trade would lead to a net rise in global emissions, a phenomenon known as 'carbon leakage'. In addition, industry succeeded in raising the spectre of jobs being lost if it had to pay for their emission credits.[30]

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24 Sandbag (2009), ETS S.O.S.: Why the flagship 'EU Emissions Trading Policy' needs rescuing.

25 See, for example, Sijm et al. (2006), CO_2 cost pass through and windfall profits in the power sector. Climate Policy, 6.

26 Ellerman and Buchner (2008), Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the 2005-06 Emissions Data. Environment and Resource Economics 41(2).

27 See, for example, de Bruyn et al. (2008), Impacts on competitiveness from the EU ETS: An analysis of the Dutch Industry. CE Delft.

28 As mentioned above, in a volatile CO_2 market businesses will add an extra risk premium to their investments in CO_2 abatement technologies. In other words, profitability must be greater than in situations with a more stable CO_2 price.

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30 As has been argued on frequent occasions, the claims of industry in this regard are wildly exaggerated. In reality, business and industry are shielded from international competition by a variety of implicit 'trade barriers', including security of supply considerations, transport costs, niche markets and so on. See, for example, de Bruyn et al. (2008).

The outcome, presented by then-President Sarkozy in December 2008, is a scheme whereby industries are allocated emission allowances free of charge if certain criteria are fulfilled.[31] Initial analyses of these criteria show that this essentially translates to 90% of companies receiving free emission credits.[32] Although the definitive form of free allocation is currently being decided, it is clear that this will lead to substantially higher costs for the EU ETS as a whole.

This situation is not unique to the European emissions trading scheme, for any unilateral climate policy adopted while CO_2 prices differ around the world will inevitably lead to the same kind of debates on potential loss of competitiveness. In Japan and the United States discussions on climate action by industry run a very similar course. In the Netherlands, too, in the run-up to the start of climate policy in 1999 there were discussions as to how energy-intensive sectors could be exempted from climate obligations.
As a review of Dutch climate policy from 1999 to 2004 shows, it was the government that footed the bill for virtually all the climate protection measures taken over this period by the entire industrial sector, by way of subsidies, tax-credits for investments in emissions abatement and other such schemes. The costs of climate policy, estimated *ex ante* at around € 25 per tonne of CO_2, proved *ex post* to be around three times higher. [33]

The lesson to be learned from all this is that in a world of non-uniform CO_2 prices the results of government policy will be far from optimum. In their policy deliberations and decision-making, governments are concerned with a whole raft of other considerations beyond carbon and climate.
Because climate policy involves costs, the question of who is to shoulder these costs will be of major influence on the ultimate results. At the national level, too, there is an inevitable trade-off between what is deemed socially equitable or politically acceptable and the most efficient strategy. Stern's claim that the costs may prove to be 25% higher when inefficiencies of government policy (at the global level!) are factored in would seem to me to be a hugely conservative estimate: a figure of 200-300% seems vastly more plausible.

5 From problem to perspectives for action: the role of economic science

The above analysis has clear implications for the role to be played by economists in climate-related studies. It is clear that even Stern would never manage to arrive at a positive net balance if the costs prove to be two to three times higher. Far more than assessing whether the costs of climate policy outweigh the benefits, economists should therefore devote their efforts to reducing the costs of such policy. What institutions can we design to remove the social obstacles faced at present and achieve a better balance between equity and efficiency? Fortunately, this kind of *comparative institutional analysis* has a rich tradition in economic studies.

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31 Formally speaking, the criteria are as follows: companies participating in the EU ETS are allocated free credits if the so-called NACE-4 sector to which they belong satisfies at least one of the following conditions: (a) a trading intensity (calculated as the flow of imports and exports divided by the flow of turnover and imports) of over 30%; (b) a cost price increase, calculated as the additional direct and indirect costs (electricity) divided by the added value, of over 30%, or (c) a trading intensity of over 10% and a cost price increase of over 5%.

32 De Bruyn (2008), Non-paper no. 5.

33 De Bruyn et al. (2005), Evaluatie doelmatigheid binnenlandse klimaatbeleid: kosten en effecten 1999-2004. CE Delft.

In an institutional-economic approach, institutions obviously play a pivotal role. Institutions are to be seen as human rules designed to guide and facilitate political, economic and social interaction.[34] A distinction can then be made between formal institutions (government legislation, private contracts) and informal institutions (taboos, tradition).[35] The importance of informal institutions is that governments cannot lay down regulations for everything. In today's world this is all the more true because of the enormous amount of uncertainty and complexity we face.[36] In practice a (formal) institution, once established, will not always yield the desired result and will therefore have to be judged, among other things, on its *flexibility*, i.e. how well it can adapt to altered circumstance. The scope for such flexibility is largely determined by existing informal institutions, on the standards and behavioural patterns already in place.
The question to be addressed in a comparative institutional analysis is therefore this: what set of formal and informal institutions would contribute best to reducing the inefficiencies of government policy? In doing so, economics will have to choose between an objective and a subjective definition of efficiency, the core concept of our science. In the text box on the following page I offer a way forward on this thorny issue.

Objectivism and subjectivism in comparative institutional analysis
In conducting a comparative institutional analysis one can proceed from an objectively or subjectively determined notion of 'efficiency'. In the former case, efficiency is an objectively measurable quantity and institutions are merely a means of achieving it. Efficiency is then established independent of the process (de Beus, 1989, p. 266). The Coase theorem (Coase, 1960) is then not universally valid, because negotiations do not always generate optimal results. In the realm of environmental economics this implies that to make the notion of efficiency operational we must first uncover social preferences for environmental quality. This is known as the measurement problem of the objectivist tradition.

In a subjectivist interpretation of efficiency there are no such measurement problems. According to this school of thought – with Nobel Laureate James Buchanan as its best-known representative – a result is efficient if there are no other results to which all parties would have agreed. Consensus is here therefore a *precondition* for efficiency (Coleman, 1988, p.144). To a subjectivist, efficiency is always *within* institutions (J. Buchanan, 1986, p.92 *et seq.*), for the subjectivist stance proceeds from the individual preferences experienced by the people involved, which they do so within the institutional structure of which they are a part. If consensus is the sole precondition for efficiency, however, the existing situation will generally already be efficient. This standpoint echoes the scepticism expressed by David Hume about institutional change. As Barry (1989, p.341) explains:
"Hume calmly concludes that, even if everything is not quite for the best in the best of all possible worlds, the disadvantages of disturbing settled expectations and the practice based on them are so great that the public good dictates leaving things exactly as they are. Thus, the criterion for assessing institutions by asking if they serve everyone's interests equally turns out to lead to the uncritical endorsement of the status quo."

To get around this problem James Buchanan (1986, Ch.10) has in mind a *contractarian* approach, whereby an institution only becomes inefficient if there is an alternative institution conceivable to which everyone would agree. The role of the subjectivist economist is now to

[34] De Bruyn et al. (2005), Evaluatie doelmatigheid binnenlandse klimaatbeleid: kosten en effecten 1999-2004. CE Delft.

[35] Hodgson (1988), Economics and Institutions, p.10.

[36] Environmental problems, in particular, are characterised by a high degree of uncertainty and complexity. For one of the first analyses of this issue, see Dryzeck (1987), Rational Ecology.

study alternative institutions with which everyone would (hypothetically) agree. That assent is made formal by establishing a *social contract*. Buchanan stresses the imperfection of information, which means that individuals do not decide directly on the ultimate allocation of whatever is at stake, but on the *process* that will go to determine that allocation. As it is uncertain what the ultimate results of the different institutions will be, it may well be the case that individuals agree to institutional change even though they may prove *post factum* to have lost out (Buchanan, 1986, p.272). In this context it is all too easy to entertain worries about 'disinformation' and draw analogies with decision-making around the invasion of Iraq, say. But I myself think that in psychological terms it is even more improbable that people will agree to institutional change if they have imperfect information. On the assumption that people are risk-averse or conservative, precisely the opposite can be asserted.

For this reason, particularly in the context of the environmental problematique, where conflicts of interest play such a major role, a notion of efficiency for which consensus is required cannot suffice. And there are few who would assert that the current state of affairs with respect to the cited problematique is optimal. Environmental economics, as a scientific discipline, will to my mind therefore have to employ an objectively fixed yardstick of efficiency. The limit beyond which an environmental economics rooted in efficiency can no longer make useful pronouncements will then be determined by measurement problems. Readers will note that this is the same position with which the first part of this essay was concluded.

Literature: De Beus (1989), *Markt, democratie en vrijheid*; Coase (1960), The Problem of Social Cost. Journal of Law and Economics; Coleman (1988), Markets, morals and the law. Buchanan (1986), Liberty, market and state; Barry (1989), Theories of justice.

6 From problem to perspectives for action: scale levels

Above, I have discussed at length the fundamental reasons why the problem of climate change is so hard to resolve. Although the technological means are abundantly available and the costs, according to Stern and many others, are in reality relatively petty, what emerges as the crucial stumbling block is the organisation of how we implement and pay for those technologies. This is due on the one hand to it being unclear what target is to be pursued when it comes to allocating the required emission cuts across the countries of the world (equal CO_2 emissions per world citizen, equal costs per citizen, etcetera) and on the other to the benefits and costs of these cuts not accruing to the same parts of the world. The developing world stands to gain by far the most from robust climate policy, but it is dependent on the developed countries because they are the ones emitting the CO_2. While the developed world may well be prepared to embark on a massive programme of mitigation, what we here fear most of all, it would seem, is loss of jobs and prosperity as a result of potential industrial relocation to countries as yet lacking climate policy.

The question, then, is how we are to escape from the Catch 22 situation in which we find ourselves and which may well lead us down the road of climate disaster. What is needed is action at every scale level of decision-making: global forums, regional alliances, national governments and local authorities, as well as by individual industries and citizens.

Below I present three proposals for *policy changes* that can be implemented by governments. These proposals make no pretence at being an all-embracing *plan de campagne*. To be effective, climate policy at every scale level will have to embrace a plethora of proposals. What my proposals endeavour to do, though, each in their own way, is resolve part of the problem of 'shared responsibilities'. They address the respective administrative levels of the European Union (a Carbon Added Tax), national government (compensation rather than taxation) and local government ('nudging'). Each of these proposals is uniquely characterised in endeavouring to *complement* traditional economic instruments that tax the consumption of fuels or electricity.

Proposal 1: A Carbon Added Tax (EU)

One of the key problems in the current climate arena is that climate policy exerts leverage above all on the production side: the production of electricity, steel, cars and so on. Ultimately, though, a transformation to a low-carbon economy will also have to be achieved via the consumption side. It is on the basis of relative prices and individual preferences that consumers decide what to spend their income on. It is therefore essential that environmental policy targeted at producers is translated to price adjustments at the consumer level.

In a world with a single, uniform carbon price this would indeed be the case. But with non-uniform prices inefficiencies will inevitably occur, which means the translation to consumer prices no longer takes place. Given competition from regions where CO_2 is priced lower or not at all, companies may opt not to pass on the costs of CO_2 abatement in their prices. In the case of free allocation of emission credits on a 'benchmark' basis they may sometimes even have an incentive not to do so. After all, higher emissions due to increased output yields the benefit of a greater number of free credits in the future.[37] In addition, over the past two decades – and in all likelihood in the preceding period, too – there has been a gradual shift of material- and energy-intensive production to non-EU countries, often to countries where CO_2 remains unpriced.[38] Together, these three trends imply that a growing portion of our consumption is associated with CO_2 emissions with no price at all. The upshot is that we, as consumers, cannot make the right choices when it comes to purchasing products and services.

One way to get around this would be to introduce a carbon tax explicitly at the consumer level. A *Carbon Added Tax (CAT)* on 'gross added carbon' could be designed analogously to today's VAT and, with time, even replace it. Although the idea has been proposed before in the literature,[39] until now it has not been adequately elaborated.

With a CAT in place, every company would be obliged to keep 'carbon accounts' detailing how much fuel it uses in its operations. This information is already available in corporate accounts; all that needs to be added is an accountant's verification of the carbon content of the fuels involved. As an example, imagine that a steel producer sells his steel to a car-part manufacturer. He then charges the latter CAT (€ 40 per tonne CO_2, say), but can in turn deduct this on his tax returns. The net increase in cost price for

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37 Davidson (2002), Emissiequota helaas buiten discussie. ESB 87 (4354).

38 De Bruyn et al. (2006), Materiaalverbruik en milieu-impact: data 1990-2004. CE Delft.

39 See, for example, Courchene (2008), Climate Change, Competitiveness And Environmental Feder-alism: The Case For A Carbon Tax.

the steel producer is therefore zero. The car-part manufacturer uses the steel to make a car door. He sells the door to a car-maker, to whom he charges the steel producer's CAT plus that on his own added carbon. In this way he is reimbursed by the car-maker for the CAT paid to the steel producer and can deduct his own CAT on his tax returns. He, too, suffers no increase in cost price. The car-maker then produces a car and passes on the CAT of the steel producer, the parts manufacturer and his own added carbon to the final customer. If the vehicle is being bought as a company car, the company can then in turn deduct the CAT. In the end, therefore, it is only private consumers who pay CAT.

A Carbon Added Tax like this, replacing today's VAT, has a number of benefits. In the first place, carbon costs are shouldered directly by consumers, who will then find that some products have become relatively cheaper (shoe repairs, for example), and others more expensive (like cars). Secondly, the trap is avoided of companies in the Netherlands suffering a loss of competitiveness as a result of environmental policy, on condition that imports are also subject to CAT. If companies exporting to the EU market do not keep carbon accounts, setting a CAT on these imports will be difficult. However, based on LCA studies and empirical data on the carbon content of European products an average figure could be established for the thousands of products entering Europe. In all likelihood, a CAT would be accepted more readily by the WTO than unilaterally imposed border tax adjustments, while also reducing the risk of trade wars.

Proposal 2: Make far greater use of climate compensation (national government)

In the context of climate policy, economic instruments like taxes on fuels (fuel duty) or electricity (energy tax) can effectively reduce CO_2 emissions. It is well-known that the European vehicle fleet is far more fuel-efficient than in the United States, undoubtedly partly as a result of the far lower fuel duty there.

One problem with taxes and charges, though, is that these must be substantially increased as people become wealthier if they are to continue to have a regulatory effect. If we are to achieve a 30-40% cut in CO_2 emissions, enormously high charges will have to be levied on the use of fossil fuels before people decide voluntarily not to use them. With such robust charges, substantial funds will be accrue to the government, since with a regulatory energy charge tax is paid not only on the moiety that needs to be reduced but also on the energy consumption still deemed socially acceptable. Assume that every motorist should be emitting 30% less CO_2. That can be achieved with an extra carbon tax of about € 1 per litre of petrol. People who used to fill up with ten litres now put in only seven – but for that 30% reduction they are penalised with a charge of € 7. For the motorist, this is an abject loss of welfare.

In an ideal world, the tax revenues from a carbon tax will be recycled back to society or used to reduce national debt. But the fact that regulatory environmental charges involve major transfers of capital also brings with it the danger of governments deploying the sudden influx of funds for pet projects or noble causes.[40] Particularly in countries where central government is held in less esteem, introduction of regulatory charges will be problematical.

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[40] This was clearly the case in the discussions around use of the auctioning proceeds from the EU ETS, for example. The European parliament was aware that the auctioning of emission

Potential transfers of capital could be considerably limited, however, if other policy lines were adopted. Imagine that motorists were also allowed to *compensate* their climate damage and that this compensation were also set at € 1 per litre of petrol. The motorist from the above example would then continue to fill up with ten litres of fuel, but can now purchase € 3 of compensation to effectuate a 30% cut in emissions. From the motorist's perspective this is a far better alternative.

One of the appealing aspects of compensation is that it can tie in very well with informal institutions. To a growing extent air travel is now being compensated. Companies like Google are seeking compensation for their CO_2 emissions. If we move towards a situation in which CO_2 emissions are seen as morally reprehensible – an informal institution guiding our collective behaviour – there are huge gains to be made.
But the current scope for compensation will then have to change. At the moment, compensation is often realised via (re)forestation projects or CDM projects plagued by major doubts as to their additionality in terms of emission reduction. The current set of options for compensating emissions will therefore need to be extended. In the first place, this can be achieved by buying emission credits on the emissions trading market and then simply destroying them. One's own emissions are then compensated by tightening the emissions trading market, which will in turn lead to emission cuts by the sectors participating in that market. In the second place, the set of options will have to be extended beyond forestry projects and suchlike to include a whole range of technologies presently subsumed under the term 'geo-engineering'.[41] The current literature cites over 15 initiatives that in the very near future will have to undergo further trials and given a price tag. In principle, the so-called long-wave technologies work the same as afforestation by removing CO_2 from the atmosphere. Many of these technologies have few side-effects and could readily be introduced as compensation mechanisms. This does not hold for the so-called short-wave technologies (such as spraying sulphur particles into the atmosphere). Because the costs of these technologies are relatively low, compensation could in this case yield an additional cost benefit, but with this option any undesirable side-effects will have to be identified very carefully. Due consideration will also have to be given to the fact that there are still plenty of moral and political hurdles to be overcome before there is agreement on human engineering of the Earth's climate.

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allowances implied a transfer of funds from industry and consumers to government. The MEPs concerned had been amply briefed beforehand that it would be important to recycle those funds to producers and consumers. By the end of the October 2008 parliamentary session, though, 100% of the potential auctioning revenue had been earmarked for noble causes like development aid, afforestation and so on. In the final proposals of December 2008 the European Council remedied the situation by a clever move whereby existing development funds could also be defined as expenditure of the auctioning revenues. This means de facto that EU governments are now themselves at liberty to decide whether or not to recycle the funds.

41 This was clearly the case in the discussions around use of the auctioning proceeds from the EU ETS, for example. The European parliament was aware that the auctioning of emission allowances implied a transfer of funds from industry and consumers to government. The MEPs concerned had been amply briefed beforehand that it would be important to recycle those funds to producers and consumers. By the end of the October 2008 parliamentary session, though, 100% of the potential auctioning revenue had been earmarked for noble causes like development aid, afforestation and so on. In the final proposals of December 2008 the European Council remedied the situation by a clever move whereby existing development funds could also be defined as expenditure of the auctioning revenues. This means de facto that EU governments are now themselves at liberty to decide whether or not to recycle the funds.

Proposal 3: In project design, consider what is socially desirable (local government)

There is no reason why everything in our world needs to be organised via markets or a system of user and property rights. A case in point is speeding in residential areas. Speeding is formally prohibited and there are sanctions if the law is broken, but in practice the government has opted to install speed bumps in residential neighbourhoods. These ensure the desired behaviour is automatically achieved because it is in motorists' own interests to reduce their speed.

This line of thinking can also be adopted when drawing up environmental policies. To stay with motorists: if the government were to decree tomorrow that vehicle exhaust fumes must henceforth be piped into the car's interior, the problem of vehicle pollution would be resolved in no time. In design geared to what is socially desirable, human behaviour is taken as the point of departure and it is this behaviour that is specifically targeted, using what Dutch philosopher Hans Achterhuis has termed "moralising technology".

In the Anglo-Saxon world this is referred to as 'nudging': encouraging consumers to adopt a desired behaviour, a goal not always effectively achieved by the price mechanism. Increased gas or electricity prices, for example, have only a limited effect on people's behaviour, for the simple reason that people do not make a direct link between their thermostat-twiddling and the costs in question. The thermostat currently gives information on temperature and it is this that guides people's behaviour. A thermostat giving direct information on costs would be more effective by far.

This kind of flanking climate policy has potential in numerous areas, but it is consumers that should principally be targeted. By proceeding from how people actually think and how they shape their behaviour, we can design environments that make it easier for them to opt for what is best for themselves, their families and society as a whole.

Strategies and timescales

Above, I have outlined three possible complementary strategies that can play a part in resolving the pressing problem of climate change. I would stress that these should be seen as potential complements or corrections to existing policy routes; none of them is a comprehensive cure-all for the climate problem. But by considering the climate problem primarily as a social obstacle requiring analysing as such and then employing comparative institutional analysis to determine what options are available for transcending the social dilemmas, we have a far more fruitful strategy than trying to optimise particular taxes or charges, or compare the economic costs and benefits of emission abatement.

The three perspectives for action set out in this essay can all be fleshed out in the relatively short term. The 'nudging' option is one we should start work on immediately. Instead of forcing people into a high-carbon straightjacket, we should consider their real needs. When building a new housing estate, for example, first make sure public transport links are available and only then provide a motorway connection. And make it compulsory for manufacturers to provide consumers with data on the total carbon emissions over their products' life cycles, giving them a choice, and then influence that choice by rewarding good behaviour.

A Carbon Added Tax would require a longer timetable, as it would have to be introduced at the European level. But because fuel use is already fairly well-documented in current accounting systems, within 5 to 10 years a start could be made with a pilot phase with modest differentiation of present-day VAT according to carbon content. One possibility would be to allow member states to first experiment with such a scheme on a voluntary basis.
A comprehensive system could then in principle be up and running within 15 years.

The envisaged change in mind-set behind the second proposal (climate compensation) will perhaps take longer. The aim here is to achieve a change in social mores, with compensation of one's carbon emissions becoming second nature. That a major shift in what is deemed socially undesirable can be effectuated within a few short decades has been demonstrated in the case of smoking, though. 25 years ago, teachers at my secondary school still used to be puffing away at cigarettes in front of the blackboard. Twenty years back we used to go and study in the university library with ashtrays between the books, ten years ago smoking in the workplace was still permitted and just two years ago a visit to the pub meant immersing oneself in a thick blue haze. And yet all that is now a thing of the past – and it's virtually inconceivable that it was ever any other way.