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A cost–benefit analysis of the EU 20/20/2020 package

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HIGHLIGHTS

- ► First cost–benefit analysis of EU climate policy for 2020.
- ► Current carbon price in ETS can readily be justified by CBA.
- ► Emission targets for 2020 cannot be supported unless a low discount rate is chosen.

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ABSTRACT

The European Commission did not publish a cost–benefit analysis for its 2020 climate package. This paper fills that gap, comparing the marginal costs and benefits of greenhouse gas emission reduction. The uncertainty about the marginal costs of climate change is large and skewed, and estimates partly reflect ethical choices (e.g., the discount rate). The 2010 carbon price in the EU Emissions Trading System can readily be justified by a cost–benefit analysis. Emission reduction is not expensive provided that policy is well-designed, a condition not met by planned EU policy. It is probably twice as expensive as needed, costing one in ten years of economic growth. The EU targets for 2020 are unlikely to meet the benefit–cost test. For a standard discount rate (3% pure rate of time preference), the benefit–cost ratio is rather poor (1/30)—so that benefits need to be very much higher, or costs very much lower than typically assumed to justify the 2020 targets. Only a very low discount rate (0% PRTP) would justify the 20% emission reduction target for 2020.

1. Introduction

The European Union aims to limit its 2020 greenhouse gas emissions to 80% of its 1990 emissions (European Parliament and Council of the European Union, 2009a, 2009c) and to meet 20% of its final energy needs by renewables (European Parliament and Council of the European Union, 2009b). The European Commission has published an impact assessment (CEC, 2008a, 2008b), but not a cost–benefit analysis—an earlier cost–benefit analysis (CEC, 2005a, 2005b) covered the ultimate target (2 °C) but not the intermediate ones, let alone the details of policy implementation. This paper fills the gap, estimating the costs and the benefits of reducing greenhouse gas emissions by 20% in a decade.[1]

Climate policy is one of the cornerstones of EU policy. The European Union seeks to be a world leader in this area, an ambition which is broadly supported by the public (TNS Opinion and Social, 2009). The ‘‘climate and energy package’’ for 2020 implements European climate policy in the medium-term. The EU Emissions Trading System (ETS) for carbon dioxide will be expanded in scope, the cap will be tightened, and permits will increasingly be auctioned. There are, for the first time, firm targets for greenhouse gas emissions outside the ETS. There are targets for the market share of renewable energy too, that interact with the emission reduction targets. These policies will raise the price of energy, slow down economic growth, and reduce welfare. In return, emissions will fall, climate will change less, and the impacts of climate change will be reduced. It is reasonable to ask whether the benefits – i.e., the avoided damages of climate change – outweigh the costs. Maybe European climate policy is too ambitious, or maybe it is not ambitious enough.

The results of cost–benefit analyses should always be interpreted with care, because estimates of the costs and the benefits of an intervention are never complete and rarely do justice to the complexity of the situation (Pearce, 1976). These problems are particularly pronounced for evaluations of such problems as

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[1] Note that total emissions in 2008 were very close to those in 1990. Note also that EU emissions were reasonably stable because emissions are increasingly outsourced to other countries, particularly in Asia (Davis and Caldeira, 2010; Helm et al., 2007; Peters, 2008; Peters and Hertwich 2008a, 2008b; Yunfeng and Laike, 2010).

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climate change, which is global, diffuse, unequal, long-lived, and uncertain (van den Bergh, 2004). Nevertheless, cost–benefit analysis, as indeed any form of formal policy evaluation and assessment, is far superior as a guide to good policy than the hand-waving practised by some politicians. The results of this paper should therefore be treated with caution but not dismissed out of hand.

The analysis in this paper is about climate change. The policy package also refers to the benefits of improved energy security, higher employment, and accelerated innovation. I do not attempt to quantify these benefits, or even argue about the likely sign.

In Section 2, I survey the economic impacts of climate change. In Section 3, I study the impacts of greenhouse gas emission reduction. In Section 4, I combine the two in a cost–benefit analysis of the EU 20/20/2020 package. Section 5 concludes.

2. Benefits of climate policy

(Tol, 2009d) reviews the total economic impacts of climate change. There are positive and negative impacts of climate change. Positive impacts dominate in the short run (before 2050, when climate change is largely beyond human control), but negative impacts dominate in the medium and long run. Impact estimates are uncertain, incomplete and controversial but the available evidence suggests that a century of climate change is most likely about as bad as losing one year of economic growth and probably less bad than losing a decade of growth. In the course of decade, the European Union can only have a small effect of climate change. Therefore, estimates of the marginal damage costs are more relevant than estimates of the total damage costs.

The marginal damage cost of carbon dioxide, also known as the "social cost of carbon," is defined as the net present value of the incremental damage due to a small increase in carbon dioxide emissions. For policy purposes, the marginal damage cost (if estimated along the optimal emission trajectory) would be equal to the Pigouvian tax that could be placed on carbon, thus internalizing the externality and restoring the market to the efficient solution.

(Tol, 2010) reports 47 studies with 232 estimates of the social cost of carbon. Each of these studies attempts a comprehensive account of all impacts of climate change and their economic values, including weather-related disasters and small-probability high-impact scenarios. These studies make different assumptions about future emissions, climate sensitivity, impacts of climate change, adaptation and vulnerability, valuation of impacts, risks and attitudes towards risk, equity weights, and discount rate. A fair number of these estimates emphasize the potentially catastrophic nature of climate change. Table 1 shows some characteristics of a meta-analysis of the published estimates of the social cost of carbon. One key issue in attempting to summarize this work is that just looking at the distribution of the medians or modes of these studies is inadequate, because it does not give a fair sense of the uncertainty surrounding these estimates—it is particularly hard to discern the right tail of the distribution which may dominate the policy analysis (Tol, 2003; Tol and Yohe, 2007; Weitzman, 2009).[2] Because there are many estimates of the social cost of carbon, this can be done reasonably objectively. The idea here is to use one parameter from each published estimate (the mode) and the standard deviation of the entire sample and use these to characterize a distribution that is skewed to the right and fat-tailed—and then to build up an overall distribution of the estimates and their surrounding uncertainty on this basis using the methodology in (Tol, 2008).[3] The results are shown in Table 1.

Table 1
The mean and standard deviation of social cost of carbon (euro/tonne CO_2) for a Fisher–Tippett distribution fitted to 232 published estimates, and to three subsets of these estimates based on the pure rate of time preference.

	Fitted distribution (weighted)			
	All	Pure rate of time preference		
		0%	1%	3%
Mean	49	76	24	5
StDev	81	71	26	5
Mode	14	35	13	3
33%ile	10	35	10	2
Median	32	58	20	4
67%ile	59	93	32	7
90%ile	135	177	58	12
95%ile	185	206	72	15
99%ile	439	265	103	19

We aggregate all available estimates into a single distribution. This of course hides differences between studies. The discount rate is one of the most important assumptions in estimating the social cost of carbon. We separate the sample by discount rate use.[4] Alternative sample splits are discussed by Tol (2011).

Table 1 reaffirms that the uncertainty about the social costs of climate change is very large. The mean estimate in these studies is a marginal cost of carbon of €49 per metric tonne of carbon dioxide, but the modal estimate is only €14/t CO_2—close to the EU ETS price of €15/t CO_2 in 2010.[5] Of course, this divergence suggests that the mean estimate is driven by some very large estimates—and indeed, the estimated social cost at the 95th percentile is €185/tCO_2 and the estimate at the 99th percentile is €439/t CO_2.[6]

This large divergence is partly explained by the use of different pure rates of time preference in these studies.[7] Table 1 divides up the studies into three subsamples which use the same pure rate of time preference. A higher rate of time preference means that the costs of climate change incurred in the future have a lower present value, and so for example, the mean social cost of carbon for the studies with a 3% rate of time preference is €5/t CO_2, while it is €76/t CO_2 for studies that choose a zero percent rate of time

[2] There are a number of low-but-not-zero-probability scenarios of catastrophic climate change, including massive sea level rise, rapid warming, or widespread warfare. The most optimistic scenarios of climate change would leave us slightly better off. The uncertainty is therefore skewed towards the catastrophic.

[3] I fitted a Fisher–Tippett distribution to each published estimate using the estimate as the mode and the sample standard deviation. The Fisher–Tippett distribution is the only two-parameter, fat-tailed distribution that is defined on the real line. A few published estimates are negative, and given the uncertainties about risk, fat-tailed distributions seem appropriate (Tol, 2003; Weitzman, 2009). The joint probability density function follows from addition, using weights that reflect the age and quality of the study as well as the importance that the authors attach to the estimate—some estimates are presented as central estimates, others as sensitivity analyses or upper and lower bounds. See 〈http://www.fnu.zmaw.de/Social-cost-of-carbon-meta-analy.6308.0.html〉 (Tol, 2005) reports a sensitivity analysis with regard to the assumed uncertainty. (Tol, 2005, 2009c, 2011) report sensitivity analyses with regard to estimate weights and author inclusion.

[4] Studies are not necessarily internally consistent with regard to the rate used to discount impacts of climate change on the one hand and the interest rate used for/implied by the scenario of economic growth. See (Nordhaus, 2008) for a detailed discussion.

[5] The permit price has varied widely between €0.10/t CO_2 and €30/t CO_2 (Benz and Trueck, 2009; Bredin and Muckley, 2011; Chevallier, 2011).

[6] The 99th percentile of the whole sample exceeds that of the sample for a 0% pure rate of time preference because former also includes cases with declining discount rates and with negative time preferences.

[7] Other differences include the assumptions about emission scenario, climate sensitivity, impact estimates, adaptation, valuation, vulnerability, equity weighting, and risk aversion.