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Paying for carbon emissions reduction

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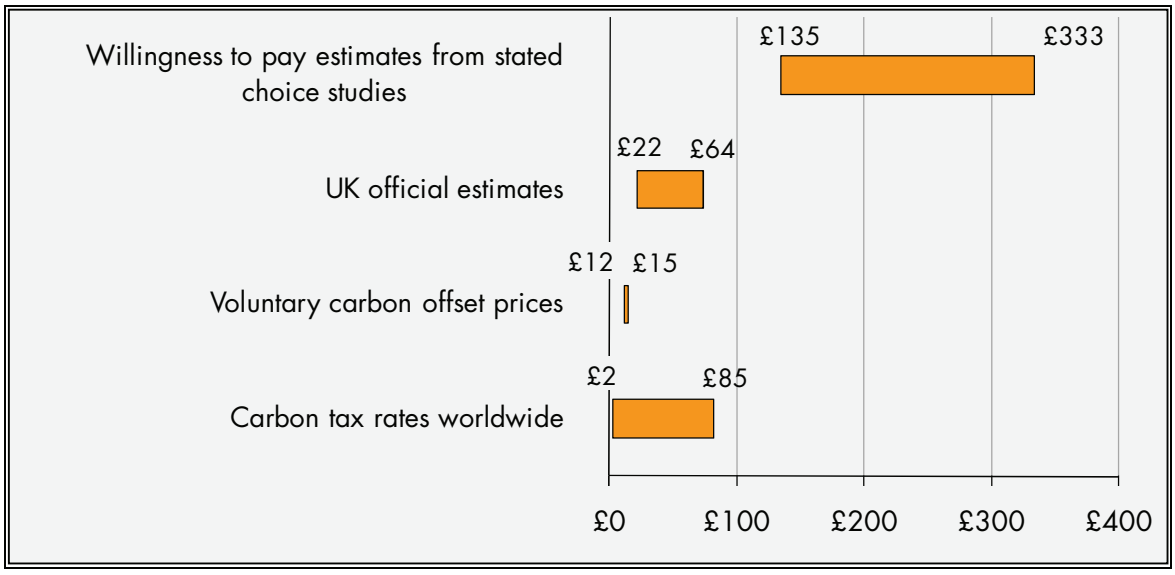
Introduction

This paper explores how much British citizens might be willing to pay for carbon emissions reduction, and the implication of this for climate change policies. Much of the current valuation of carbon focuses on cost measures, notably the marginal social cost of carbon, which measures the damage imposed by each unit of carbon emitted; and the marginal abatement cost, which reflects the cost of reducing emissions. These measures reflect how much people should pay or have to pay, but there is relatively little policy research on how much people are willing to pay, a measure of the value they place on carbon emissions reduction. This paper begins to address this research gap. The willingness to pay method reflects people's subjective welfare, so the method is useful for putting a value on public goods. This paper draws on the willingness to pay values from a suite of four stated choice studies in the water sector, and seeks to extend the use of these values for wider climate change policies. Across the studies, the values that the public placed are on the order of hundreds of pounds per tonne of carbon dioxide reduced (Figure 1). This value is an order of magnitude higher than the "official" damage estimates of carbon (i.e. what the public should pay), suggesting that there is an opportunity for a large consumer surplus (a social benefit) even if a carbon tax is introduced to pay for the damages.

Figure 1: Range of values for a reduction of 1 tonne of CO_2 differ by an order of magnitude



Part 1: How much are people willing to pay for carbon emissions reduction?

Paying for carbon emissions reduction is a classic "free-rider" problem. Individuals, firms, and governments have little incentive to cut their carbon emissions: while they would have to bear the full costs of cutting emissions themselves, the benefits (from reduced climate change risk) would accrue to the entire global community. Yet, from looking at a number of recent RAND Europe studies, we found that there seems to be a high stated willingness by the public to pay for measures to reduce environmental impacts. This finding raises new questions about the role and potential acceptability of a carbon tax.

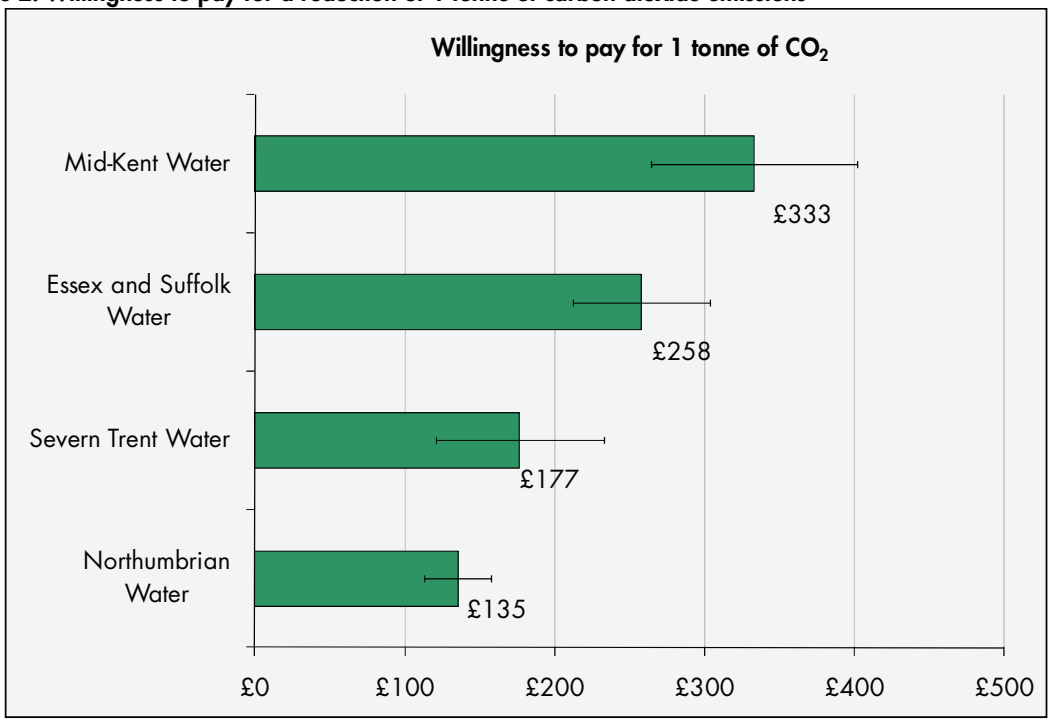
Over the period 2007–2008, RAND Europe carried out a series of studies on behalf of four different UK water companies to quantify customers' willingness to pay for service improvements. Environmental attributes were evaluated alongside "more tangible" attributes, such as frequency of hosepipe bans, availability of water meters, and leakages in water mains.

The method used was stated choice, a well-established quantitative technique in environmental economics that is commonly used by the government for evaluation and appraisal of public policies (1). The method is particularly useful for valuing public goods that do not have a market to determine the price. A description of the method is presented in the Appendix.

The RAND Europe studies found that households are willing to pay between £1.45 and £2.97 more per year on their water bill in exchange for climate change related improvement. The proposed plans to achieve the carbon savings vary from study to study: Northumbrian Water and Essex and Suffolk Water would change their operations, Severn Trent Water would generate more hydroelectric power, and Mid-Kent Water did not specify how they would achieve the carbon dioxide reduction. It was stated in the surveys that the price change would affect all households' water bills; thus, in this situation there is no free-rider as every household contributes.

Considering the proposed carbon dioxide (CO_2) reduction by the water companies and the total number of households being served, the potential saving is around 0.01 tonne of CO_2 for each household per year in each of these studies. The premium of £1.45–£2.97 per year per household water bill translates to a willingness to pay of £135–£333/tCO_2 (pounds per tonne of carbon dioxide).

Figure 2: Willingness to pay for a reduction of 1 tonne of carbon dioxide emissions



Note: The potential saving is around 0.01 tonne of CO_2 for each household per year, so these values represent the willingness to pay per year collectively of about 100 households.

There are variations in the willingness to pay value within each study depending on the respondents' household income and socio-economic background. In carrying out each of the original studies, we found that households with a high income are willing to pay more, mainly because they are less cost-sensitive, while there is no clear evidence that they are more ecologically conscious (2).

There are also variations in values between studies, due to the income and socio-economic mix of the region where the survey was carried out. Studies carried out in the south of England resulted in higher values than studies carried out in the north. In this paper, we focused on the average values from each of the studies and the ranges across all four studies (Figure 2)[1]. Although it is difficult to determine the reliability of the results from a single study, a review of four studies provides credence to the values found. We found that the public's willingness to pay for carbon emissions reduction is on the order of hundreds of pounds.

[1] The error bars indicate a 95% confidence interval of the estimated mean willingness to pay values.

Part 2: How much should people pay?

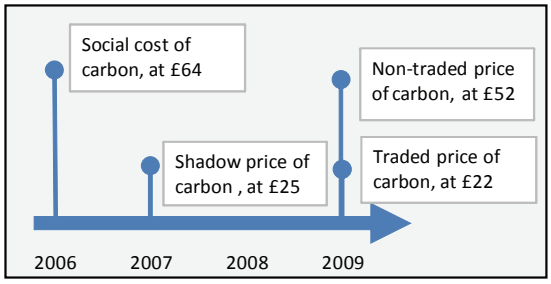
To put these willingness to pay values into context, we examine how much people should pay, or have to pay, according to "official" estimates. Climate change scientists and economists use models to estimate the cost of carbon. It is a complex problem and involves making assumptions about the baseline scenario of energy use, the future atmospheric concentration of carbon, the mitigation costs, technological development and discount rates, so different models result in slightly different values.

Official values for policy appraisal

The UK government's "official value" of one tonne of carbon has been revised repeatedly (Figure 3). In 2006, the Stern Review, an influential government publication on the economics of climate change, reported that the "social cost of carbon" was around £64/tCO_2 (2007 prices)[2] (3). This value was calculated based on lifetime damage costs associated with greenhouse gas emissions. Then, in 2007, the UK government recommended the "shadow price of carbon", which was valued at £25/tCO_2 (2007 prices) (4). The "shadow price" was estimated using the same methodology as the "social cost", but assumed a different stabilisation goal[3].

More recently, in July 2009 the UK government revised its guidance and recommended two official values: the traded price of carbon (£22/tCO_2) for policy appraisal in sectors covered by the EU Emissions Trading Scheme and the non-traded price of carbon (£52/tCO_2) for other policy appraisal (5). These values are based on estimates of the abatement costs that will need to be incurred to meet specific emissions reduction targets.

Figure 3: The UK "official value": timeline



Note: Value in 2007 prices

The EU trading scheme

Joining the EU Emissions Trading Scheme (EU ETS) is an important part of the UK government's effort to limit carbon emissions. It is a "cap and trade scheme" in which an overall cap imposes an absolute limit on the amount of CO_2 that participating countries can emit. The overall cap is divided up into individual emissions permits (one permit represents one tonne of CO_2) for trading between participants. The limited number of permits within the cap gives them scarcity value and therefore a market price on CO_2. In the EU ETS, the average price for 2008 was £18/tCO_2 (6). The market price in 2009 became even lower, only £9/tCO_2 in March 2009, as a result of the slowdown in economic activities (6).

[2] This value is converted from the Stern review's value of $85/t$CO_2$ (2000 prices) for the central "business as usual" case.

[3] A 550ppm CO_2 equivalent (CO_2e) stabilisation path was assumed.

Different approaches, different order of magnitudes

So far, this review has covered a number of conceptually different approaches for determining the value of one tonne of CO_2: the damage estimates approach and the abatement costs approach (used by the UK government), the market price approach (in the EU ETS)[4], and the stated willingness to pay approach (used in a number of RAND Europe studies). The value of a tonne of carbon varies, depending on the approach used[5].

The values vary by orders of magnitudes: from a few pounds (EU ETS), tens of pounds (values for government appraisal) and hundreds of pounds (from willingness to pay studies). But, if given the choice in the real world, are people willing to pay at all?

[4] It should be noted that the market price of one tonne of CO_2 at the EU ETS does not correspond one-to-one with carbon reductions, as the actual saving comes from the difference between the emission level with and without the cap. This limits the comparability of the market price with the other values reviewed.

[5] In theory, the damage costs and the abatement costs should be the same. But this is conditional on the identification of an optimal stabilisation goal despite the uncertainties of future developments, and the presence of a single carbon market covering the whole economy. Therefore, this is not the case in practice (5).

Part 3: How much would people pay if contribution were voluntary?

The voluntary carbon offsetting market sheds light on the question of whether there is an altruistic willingness to pay for carbon reduction in real markets. The voluntary carbon offsetting market works in this way: environmentally concerned individuals, businesses, or governments voluntarily compensate their own greenhouse gas emissions from specific activities by buying carbon credits from offset providers; offset providers then invest in emission reduction projects elsewhere, usually in the developing world where the cost of abating carbon emissions is low. In this paper we examine the offsetting schemes for air travel as an example. Air travel was chosen because it is the most carbon-intensive activity for an average UK citizen (7).

There are a number of different schemes in the aviation market. We examined the schemes offered by three of the key players in the UK and found that their CO_2 pricing lies in the tight range of £12.10 to £15.23/tCO_2 (Table 1).

Table 1: Carbon offset pricing lies in a tight range

Offset provider	Cost per tonne* (£/tCO2)
British Airways	£12.10
Virgin Atlantic (myClimate)	£13.30
easyJet	£15.23

Note: Data collected from each airline's online carbon calculator on 20 April 2010

The first airline in the UK to offer a voluntary carbon offset was British Airways (BA), which introduced its scheme in 2005. The price of carbon offsetting was set at £8.63/tCO_2 (2007 prices) at the time. This price reflected the cost of their offset projects, such as planting trees in Uganda and distributing energy-saving light bulbs in Kazakhstan. However, in an inquiry undertaken by the Environmental Audit Committee of the House of Commons, it was revealed that the BA scheme offset an average of only 1,600 tonnes of CO_2 each year between 2005 and 2007, approximately equivalent to the emissions from "four return flights to New York on a 777 or less than 0.01% of their annual emissions"(8). The amount was regarded as "risible" by the House of Commons.

The failure of the early BA carbon offsetting scheme was attributed to the airline's reluctance to advertise and promote the scheme because this would highlight the environmental impact of air travel (8). Since the House of Commons inquiry, BA has greatly improved the visibility and quality of the offset scheme, making the option to offset available on their own website (previously, customers were redirected to the offset provider's website) while providing more information about the scheme. It was reported that some customers offset over 55,000 tonnes in 2008, about 0.3% of BA's total carbon emissions that year (9). Another step forward is

that the BA scheme has been approved by the government's quality assurance scheme in March 2009[6]. It would be interesting to see if this official approval encourages more customers to offset their emissions through BA. This information was not available yet at the time of writing.

The budget airline easyJet launched a carbon offset scheme in 2007. It was reported that the scheme has encouraged customers to offset over 194, 000 tonnes of CO_2 between August 2007 and the end of September 2009, approximately 2% of the airline's annual emissions (10). Their scheme is more successful than BA's scheme.

Virgin Atlantic also started a program in 2007. An innovation which they introduced was to sell carbon offset credits not only online but also onboard, alongside alcohol and perfume, in an attempt to encourage higher uptake. However, the uptake of their program is not publicly available.

While more carbon offset schemes have become available and uptake has increased in the last few years, 0.3% (for BA) and 2% (for easyJet) are still small percentages. It appears that very few people were willing to pay for carbon emissions reduction even at the very low prices quoted (£12.10 and £15.23/tCO_2).

Explaining the differences

We note a stark contrast between the low willingness to pay revealed in these voluntary aviation sector schemes and the high stated willingness to pay in the water sector. Part of the difference may be the gap between stated preference and real economic commitment. But it is worth noting some of the contextual differences between the two situations, as the contextual factors reveal behaviour biases in individuals' decision- making.

Firstly, with the water sector schemes, people expect everyone else to pay as well. Because the premium will be borne by all households who use water, the premium paid would be similar to a tax. Thus, the difference seems to be a microcosm of the global free-rider problem. This emphasises the importance of collective action, the understanding of the public's perceptions of fairness, and the potential acceptability of carbon taxation versus voluntary schemes.

Secondly, a key contextual difference is the type of provider (private companies versus regulated public utilities). Previously, the media has exposed many of the carbon offsetting projects as failures, notably the tree planting project initiated by the music band Coldplay, which ended in 40% of the 10,000 trees dying (11). Additionally, large profit "take-offs" (up to 70%) by the offset providers have also been exposed (12). These reports led to a general level of public distrust. Previous research has also shown that the calculation of CO_2 emissions for identical journeys varies hugely by airlines (13), further deepening such distrust. In an opinion survey by the Department for Transport (14), 15% of the respondents reported that they trust climate change information provided by the government. Admittedly, 15% is low, but even fewer respondents, only 5%, reported that they trust climate change information provided by industry and businesses. These highlight the role of trust when collecting contributions.

Thirdly, the difference may be explained by the psychological phenomenon known as mental accounting (15). In the case of the water bills, while paying hundreds of pounds for one tonne of CO_2 reduction seems very high, people do not think in terms of tonnes of CO_2 reduced in their mental accounts, but in terms of money paying out of their "water/utility bill pocket". They stated that £1.45–£2.97 per year is acceptable to them. Likewise, in the case of carbon offsetting through airlines, people think in terms of money paying out of their "travel/non-essential spending account". But they regarded a few pounds more of optional payment for non-

[6] The UK Department of Energy and Climate Change approves carbon offsetting programs that demonstrate: (i) accurate calculation of emissions to be offset; (ii) use of good quality carbon credits i.e. initially those that are Kyoto compliant; (iii) cancellation of carbon credits within a year of the consumer's purchase of the offset; (iv) clear and transparent pricing of the offset; (v) provision of information about the role of offsetting in tackling climate change and advice on how a consumer can reduce his or her carbon footprint.

essential spending as too much, particularly with all the other taxes that are visible when buying an airline ticket. That is, the £3 spent on the water bill is different from the £3 spent on offsetting air travel. This highlights the need to better understand how people compartmentalise their spending into different mental accounts with regard to making monetary contributions to combat climate change.

Part 4: Existing carbon taxes

Next, we look at carbon taxes around the world. Although people do not voluntarily pay taxes, according to economic theories tax rates reflect the willingness to pay of the median voter in a democracy. Thus, an overview of in-place carbon taxes gives an insight into what values are considered acceptable by people in different parts of the world.

The UK Climate Change Levy (CCL) taxes businesses by the amount of energy used. It is not generally regarded as a carbon tax, as tax rates do not reflect the carbon content of the fuels used[7]. Also, energy-intensive industries enjoy a reduced levy, and domestic users and the transport sector are exempted (16). The levy is designed to be "revenue neutral", with revenues used to cut employers' National Insurance contributions and to provide support for energy efficiency. Glaister (2009) calculated that that on average the levy charges businesses £9/tCO_2 (6).

Internationally, there are a number of other polities that have implemented a carbon tax, including Finland; Denmark; Sweden; Norway; the city of Boulder in the US; the Canadian provinces of Quebec and British Columbia; Ireland and France[8]. The range of values is large, from the low end of £2.1/tCO_2 in Quebec to the top end of £85.0/tCO_2 in Sweden. The disparity in tax rates is partly a reflection of different countries' social priorities. It is also partly related to the intended policy outcomes—while polities implementing higher tax rates often aim to induce behaviour change (i.e. reduce demand for energy use by making it more expensive), polities implementing lower rates may not do much to change behaviour but focus more on generating funds for mitigation programs (17).

On average, governments have imposed a cost of around £38 for one tonne of carbon emitted, an order of magnitude lower than the British public willingness to pay as suggested by the RAND Europe studies of the water sector.

[7] The levy charges differential rates on the usage of electricity, natural gas, liquefied petroleum gas, and solid fuels (e.g. coal and coke). The rates are 0.43, 0.15, 0.07, and 0.15 pence per kilowatt hour respectively (2006 prices).

[8] Recently, carbon taxes have been hotly debated in France. The French government proposed a carbon tax of 17EUR per tonne of carbon dioxide emitted. It will be levied on oil, coal, and gas. However, it was criticised for giving exemptions to the heaviest polluters and was ruled as "unconstitutional" by the France Constitutional Council. The French government is still determined to roll out this tax. At the time this paper is written, they are revising the tax design.

Table 2: Carbon taxes around the world

	Year of implementation	Price/tCO_2 in local currency	Price in GBP (using 2010 March exchange rates)
Finland	1990	€20	£18.1
Sweden	1991	SEK200–910	£18.9–£85.0
Norway	1991	NOK89–345	£10.1–£39.0
Denmark	1992	DKK90	£11.0
UK	2001	UK£9	£9
City of Boulder, Colorado, US	2007	US$13	£8.6
Quebec, Canada	2007	CAD$3.2	£2.1
British Columbia, Canada	2007	CAD$10	£6.5
Ireland	1 May 2010	€15	£13.6
France	proposed	€17	£15.4

Note: Tax rates are in 2006–2009 prices

Part 5: What does this mean for policy?

In principle, fiscal policy to internalise the impact of carbon dioxide emissions is simple: emitters should be charged a price for each unit of carbon dioxide emitted, and the price should be equal to the damage caused (5). However, in reality, it is not straightforward because introducing a tax is often perceived as politically risky.

But the key finding of this paper—that the public stated a willingness to pay hundreds of pounds per tonne of carbon—suggests that a carbon tax might be socially acceptable in certain situations. This value is an order of magnitude higher than the "official" estimates of the value of CO_2, indicating that there is an opportunity for a large consumer surplus (a social benefit) even if a carbon tax is introduced to pay for the damages.

Politics

The UK government has so far chosen not to face head-on the issue of taxing households for their emissions. Currently, households are exempted from the Climate Change Levy and pay a reduced VAT rate of 5% instead of the standard rate of 17.5% for their energy use. This was a result of a political decision in the mid 1990s. Before 1993, household energy use was not subjected to VAT. The then-Conservative government announced its intention to impose a VAT on household energy at an initial rate of 8% and eventually at the UK standard rate of 17.5%. The 8% rate was introduced in 1994, but the plan to increase it to 17.5% was abandoned due to objections by Members of Parliament. Later, in 1997, when the Labour government took office, they reduced the rate to 5% as part of Labour's manifesto commitment. At the time, it was estimated that it would save the average household £18 a year, but would cost the Government a loss in revenue of nearly £500 million a year (18). But if households' stated willingness to pay for carbon emissions found in this paper is right (i.e. in the right order of magnitude), it would mean that there is scope for taxing households for their carbon emissions.

Societal concerns

The main reason why the residential sector has been exempted from CCL and pays only a reduced VAT is because of the government's concern about the impact of the levy on the very poor, with an estimated 3.5 million households in the UK suffering from fuel poverty, i.e. spending more than 10% of household income on fuel to maintain a home temperature between 18 and 21 ^{o}C[9] (19). However, this is a rather blunt approach when considering the majority of the UK's 27 million households that do not face fuel poverty. A more nuanced tax system could be designed to recycle tax revenue to alleviate fuel poverty for certain groups.

Furthermore, a main cause of fuel poverty is poor energy efficiency in homes (19). Thus, if the revenue from the tax can be directed to help people to improve the energy efficiency of their home, the tax could also help to reduce fuel poverty. According to the Office of Climate Change, emissions from households' use of electricity and heating were around 27% of UK's

[9] The figure represents the situation in 2006.

total carbon emissions[10] (20). Therefore, encouraging better energy efficiency in homes is a major opportunity for carbon emissions reduction.

Potential uses of carbon tax revenue

The average household can benefit from other government initiatives, such as the Smart Grid initiative. This initiative pledges to provide an electricity grid network that is fitted with information and communications technology, and presents major opportunities for carbon emissions reductions. Electricity distribution operators get more detailed information about supply and demand, and thus will be able to improve their ability to manage the system and shift demand to off-peak times. On the other hand, consumers will be given more information about, and control over, their electricity use, helping to reduce overall demand and providing a tool for consumers to reduce cost and carbon emissions. But the capital investment required for this will be huge. For instance, a domestic roll out of smart meter requires a capital cost of £8.6 billion by 2020. Money needs to be raised for this.

Carbon policy considerations

Most carbon tax proposals are influenced by the "double dividend" literature which suggests that a carbon tax should be revenue-neutral. But at a time when government debt is increasing, the government would need to raise funds to ensure it meets its climate change commitment and protect its people from climate change impacts and fuel price vulnerabilities. Research has shown that the public finds shifting tax from one area to another area "pointless" (21). Instead, the public preferred that the tax revenues to be spent on measures they could understand, such as developing renewable energy and improving energy efficiency. Thus, the government could consider a "hypothecated" carbon tax, in which the revenues generated from taxing households would be ploughed directly back into a specified carbon commission that helps households to reduce their carbon emissions and not into the general exchequer.

The purpose of carbon taxation needs clear exposition. In general, such a payment scheme combines a wide range of functions. At a minimum, these include:

- revealing societal willingness to pay;
- securing payment for abatement and other activities aimed at reducing emissions or harm or at improving sustainability;
- providing incentives for emitters to clean up their act.

Additional functions include:

- aligning willingness to pay and ability to mitigate emissions or harms
- increasing the political visibility of carbon-related issues;
- encouraging the development of better mechanisms.

Conclusions

In conclusion, the current state of affairs seems to be an exemplar of the global free rider problem, yet the public has stated a willingness to pay for measures to reduce carbon—thus, there is an opportunity for raising funds to combating climate change which is currently not being taken.

The order of magnitude difference observed in different contexts is interesting. The point is that voluntary contribution leads to understatement and mandatory contribution leads to overstatement (in the sense that those who benefit even a bit when the payments are obligatory and environmental improvements are taken into account, will state a very high willingness to pay, whereas those who are made even a little worse off compared to others will state an as-low-as-possible willingness to pay). Further research could seek to investigate how these can be reconciled, and where the true value lies.

[10] This is a 2005 figure.

Through explaining the differences in willingness to pay in different contexts, we have developed some hypotheses about how people's willingness to pay for carbon emissions reduction is influenced by contextual factors, e.g. who else is paying, the type of organisation asking for people to pay, and where the money goes. If this is the case, then governments (and other organisations) should be looking into how best to ask people for contributions to raise funds and to maximise the impact of policies.

Further research

This paper draws on the willingness to pay values from a series of water studies, and seeks to extend the use of these values to wider climate change policies. Those original studies have helped water companies to prioritise their investment. However, using those values beyond the purposes of the original studies has some caveats. The most important one is that the provision of water and sewerage services is not a carbon-intensive industry; the total amount of carbon savings that were evaluated in the studies were very small (about 0.01 tonnes of CO_2 for each household per year). Given that an average person in the UK generates approximately 11 tonnes of carbon dioxide per year, it would be necessary to examine whether the willingness to pay for reduction will level off if a larger range of carbon dioxide reductions are being considered.

This paper is an effort to contribute to the current debate on the role of fiscal policies to combat climate change, and calls for a number of follow-on studies:

- to understand the issue of trust through exploring the differences in the public's willingness to pay for carbon reductions provided by different types of organisation (e.g. other utility sectors, other types of governmental organisations and private organisations)
- to understand the public acceptability of the different means of collecting tax contributions for combating climate change (e.g. a hypothecated tax versus a revenue-neutral one)
- to examine the willingness to pay for a larger range of carbon savings to better understand whether and how the willingness to pay will level off (i.e. the potential for diminishing marginal returns of utility from carbon emissions reduction)
- to study the role of fiscal instruments not just as a means to generate government funds and repay the damages, but to encourage more environmental friendly behaviour (particularly the price elasticity of energy demand, with explicit considerations of the cost of switching to energy efficient measures).

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Appendix: The method we used

The method used was stated choice, a well-established quantitative technique in environmental economics, which is commonly used by government departments for the evaluation and appraisal of public policies (1). The method is particularly useful for valuing public goods which do not have a market to determine the price.

The stated choice method, which typically involves a survey and mathematical modelling, is briefly described as follows. Survey respondents were asked to participate in "choice exercises", in which they had to choose their preferred bundle of potential service improvements from a number of different bundles. Each bundle is associated with a different price, so respondents had to make trade-offs between prices and service levels. A choice exercise can be quite complex; Figure 4 shows an example.

Figure 4: A choice exercise example. Respondents are asked to make a trade-off between prices and service levels and choose their preferred option

	As Now	Alternative 1	Alternative 2
Hosepipe bans Average frequency of hosepipe bans by 2015	1 in 25 years	**1 in 15 years**	1 in 25 years
Metering Percentage of properties with water meters by 2015	48% of properties	**60% of properties**	**80% of properties**
Leakage Litres lost for each property each day by 2015	92 litres/day	**86 litres/day**	92 litres/day
Climate Change Reduction in greenhouse gases created by water service provider X that contribute to climate change	0% reduction	**20% reduction**	**10% reduction**
Cost Change to annual water bill before inflation	No change	**Increase by £10 per year**	**Increase by £4 per year**
Choice (mark "X" in preferred option)			

In this choice exercise, a respondent who cares a lot about hosepipe bans, metering and climate change, and is not very sensitive to price increase, may choose Alternative 1; another respondent who may want to see some improvement but at the same time does not want to pay much, may opt for Alternative 2; and another respondent may be happy with the current level of services and not wish to pay more for improvement, so he/she may choose the As Now option. Respondents are asked to repeat the choice exercises a number of times, each time with varying prices and service levels. This allows the researcher to obtain many data points at different price and service levels for analysis. The stated choice survey data are then used to construct logit models (an econometric method based on random utility theory) [11].

The sample size of the RAND Europe studies quoted in this paper was quite large, around 600 to 1,100 respondents in each study. Thus, the willingness to pay values were statistically reliable. Additionally, a key feature of these set of stated choice experiments was that environmental attributes were evaluated alongside more "tangible attributes" which helped respondents relate to the alternative presented with real life choices.

[11] In these studies, we have only examined people's willingness to pay (WTP), but not their willingness to accept (WTA). WTP generally differs from willingness to accept. The difference is the reference position: WTP assumes that the environment will be improved, WTA asks how much damage the current state does (how much more income people would have to have to be as well off with today's pollution as they would be with less pollution but today's income). The relevant point is that the reference position itself, which influences factors (e.g. risk aversion and the applicability of the precautionary principle) depends on what is known about the carbon reduction schemes (e.g. how and by how much carbon is offset) and by the credibility and salience of improvements.